Scratch work of Author

NOTES

Begin

In[∘]:=
```
Print["CopyRight (C) 2022, Patrick L. Nash, under the General Public License."]
```

CopyRight (C) 2022, Patrick L. Nash, under the General Public License.

```
Print["Please  cite  this  work,  and this web page, if you use it"]
```

In[∘]:=
```
Print["For simplicity, metric  g_αβ=  g_αβ(x0,x1,x2,x3,x4,x5,x6,x7)= g_αβ(x0,x4) = diag{
   g_00(x0),g_11(x0,x4),g_11(x0,x4),g_11(x0,x4),-1, g_77(x0,x4),g_77(x0,x4),g_77(x0,x4) },"]
```

For simplicity, metric $g_{\alpha\beta}=$ $g_{\alpha\beta}(x0,x1,x2,x3,x4,x5,x6,x7)=$ $g_{\alpha\beta}(x0,x4)$ = diag{ $g_{00}(x0)$,$g_{11}(x0,x4)$,$g_{11}(x0,x4)$,$g_{11}(x0,x4)$,-1, $g_{77}(x0,x4)$,$g_{77}(x0,x4)$,$g_{77}(x0,x4)$ },

In[∘]:=
```
Print["where g_77(x0,x4) = g_11(x0,-x4) "]
```

where $g_{77}(x0,x4)$ = $g_{11}(x0,-x4)$

In[∘]:=
```
Unprotect[dir];
```

In[∘]:=
```
dir = FileNameJoin[Drop[FileNameSplit[NotebookFileName[]], -1]];
Protect[dir];
If[$Failed == SetDirectory[dir], {CreateDirectory[dir], SetDirectory[dir]}];
```

In[∘]:=
```
names = FileNameSplit[NotebookFileName[]]
```

Out[∘]=

{C:, Users, nsh, Documents, 8-dim, 2025-11-04, 2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3.nb}

In[∘]:=
```
name = StringReplace[names[[-1]], "nb" → "mx"]
```

Out[∘]=

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3.mx

In[∘]:=
```
header = StringReplace[names[[-1]], ".nb" → "-"]
```

Out[∘]=

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-

In[∘]:=
```
DIM8 = 8;
```

In[∘]:=
```
Protect[DIM8, M, K, H]
```

Out[∘]=

{DIM8, M, K, H}

Coordinates :

$$\left\{\underbrace{\text{hidden space}}, \underbrace{\text{3 - space}}, \underbrace{\text{time}} \underbrace{\text{superluminal deflating time}}\right\}$$

$$\{x0, \overbrace{x1, x2, x3}, x4, \overbrace{x5, x6, x7}\} :$$

In[∘]:=
```
X = {x0, x1, x2, x3, x4, x5, x6, x7};
Protect[X];
Protect[x0, x1, x2, x3, x4, x5, x6, x7];
```

In[∘]:=
```
sX0 = And @@ Thread[X > 0]
```

Out[∘]=
```
x0 > 0 && x1 > 0 && x2 > 0 && x3 > 0 && x4 > 0 && x5 > 0 && x6 > 0 && x7 > 0
```

In[∘]:=
```
ssX = H > 0 && sX0 && 6 H x0 > 0 && 2 la[x4] > 0 && Cot[6 H x0] > 0 && Sin[6 H x0] > 0
```

Out[∘]=
```
H > 0 && x0 > 0 && x1 > 0 && x2 > 0 && x3 > 0 && x4 > 0 && x5 > 0 && x6 > 0 &&
 x7 > 0 && 6 H x0[] > 0 && 2 la[x4[]] > 0 && Cot[6 H x0[]] > 0 && Sin[6 H x0[]] > 0
```

For Maple_2025 :

In[∘]:=
```
sreplaceZ = Z[#] → ToExpression["Z" <> ToString[#]] & /@ Range[0, 15]
```

Out[∘]=
```
{Z[0] → Z0, Z[1] → Z1, Z[2] → Z2, Z[3] → Z3, Z[4] → Z4, Z[5] → Z5, Z[6] → Z6, Z[7] → Z7, Z[8] → Z8,
 Z[9] → Z9, Z[10] → Z10, Z[11] → Z11, Z[12] → Z12, Z[13] → Z13, Z[14] → Z14, Z[15] → Z15}
```

In[∘]:=
```
sreplacenZ = nZ[#] → ToExpression["nZ" <> ToString[#]] & /@ Range[0, 15]
```

Out[∘]=
```
{nZ[0] → nZ0, nZ[1] → nZ1, nZ[2] → nZ2, nZ[3] → nZ3, nZ[4] → nZ4,
 nZ[5] → nZ5, nZ[6] → nZ6, nZ[7] → nZ7, nZ[8] → nZ8, nZ[9] → nZ9, nZ[10] → nZ10,
 nZ[11] → nZ11, nZ[12] → nZ12, nZ[13] → nZ13, nZ[14] → nZ14, nZ[15] → nZ15}
```

hacks (a.k.a., lies):

In[∘]:=
```
constraintTrig = Sin[6 * H * x0] > 0 && Cos[6 * H * x0] > 0 && Csc[6 * H * x0] > 0 &&
  Sec[6 * H * x0] > 0 && Tan[6 * H * x0] > 0 && Cot[6 * H * x0] > 0 && Sin[z] > 0 && Sqrt[Sin[z]] > 0 &&
  Sin[z]^(3/2) > 0 && Sin[z]^(1/2) > 0 && Sin[z]^(-3/2) > 0 && Sin[z]^(-1/2) > 0 && Cot[z] > 0 && Sqrt[Cot[z]] > 0 &&
  Cot[z]^(3/2) > 0 && Cot[z]^(1/2) > 0 && Tan[z] > 0 && Sec[z] > 0 && Sqrt[Csc[z]] > 0 && Csc[z] > 0
```

Out[∘]=

$$\mathrm{Sin}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Cos}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Csc}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Sec}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Tan}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Cot}[6\,H\,x0] > 0 \;\&\&\; \mathrm{Sin}[z] > 0 \;\&\&\; \sqrt{\mathrm{Sin}[z]} > 0 \;\&\&\; \mathrm{Sin}[z]^{3/2} > 0 \;\&\&\; \sqrt{\mathrm{Sin}[z]} > 0 \;\&\&\; \frac{1}{\mathrm{Sin}[z]^{3/2}} > 0 \;\&\&\; \frac{1}{\sqrt{\mathrm{Sin}[z]}} > 0 \;\&\&\; \mathrm{Cot}[z] > 0 \;\&\&\; \sqrt{\mathrm{Cot}[z]} > 0 \;\&\&\; \mathrm{Cot}[z]^{3/2} > 0 \;\&\&\; \sqrt{\mathrm{Cot}[z]} > 0 \;\&\&\; \mathrm{Tan}[z] > 0 \;\&\&\; \mathrm{Sec}[z] > 0 \;\&\&\; \sqrt{\mathrm{Csc}[z]} > 0 \;\&\&\; \mathrm{Csc}[z] > 0$$

more hacks (damn lies):

In[∘]:=

$$(*\&\&K^2-M^2>0\&\&\sqrt{K^2-M^2}>0\&\&e^{2\,H\,\sqrt{K^2-M^2}\,x4}>0\&\&2\,H\,\sqrt{K^2-M^2}\,x4>0\&\&\;2\,H\,\sqrt{1-M^2}\,x4>0\&\&\sqrt{1-M^2}>0\&\&e^{2\,H\,\sqrt{1-M^2}\,x4}>0\&\&2\,H\,\sqrt{1-M^2}\,x4>0*)$$

In[ ]:=
```
constraintX =
 x0 > 0 && x4 > 0 && H > 0 && 6 * H * x0 > 0 && 3 * H * x4 > 0 && a4[x4] > 0 && A4[t] > 0 && Q > 0 &&
  z > 0 && t > 0 && M > 0 && K > 0 && e^(-2 a4[H x4]) > 0 && e^(-a4[H x4]) > 0 && e^(2 a4[H x4]) > 0 && e^(a4[H x4]) > 0
```

Out[ ]=

$$x0 > 0 \,\&\&\, x4 > 0 \,\&\&\, H > 0 \,\&\&\, 6\,H\,x0 > 0 \,\&\&\, 3\,H\,x4 > 0 \,\&\&\, a4[x4] > 0 \,\&\&\, A4[t] > 0 \,\&\&\, Q > 0 \,\&\&\, z > 0 \,\&\&\, t > 0 \,\&\&\, M > 0 \,\&\&\, K > 0 \,\&\&\, e^{-2\,a4[H\,x4]} > 0 \,\&\&\, e^{-a4[H\,x4]} > 0 \,\&\&\, e^{2\,a4[H\,x4]} > 0 \,\&\&\, e^{a4[H\,x4]} > 0$$

statistics :

In[ ]:=
```
constraintVars = constraintX && constraintTrig
```

Out[ ]=

$$x0 > 0 \,\&\&\, x4 > 0 \,\&\&\, H > 0 \,\&\&\, 6\,H\,x0 > 0 \,\&\&\, 3\,H\,x4 > 0 \,\&\&\, a4[x4] > 0 \,\&\&\, A4[t] > 0 \,\&\&\, Q > 0 \,\&\&\, z > 0 \,\&\&\, t > 0 \,\&\&\, M > 0 \,\&\&\, K > 0 \,\&\&\, e^{-2\,a4[H\,x4]} > 0 \,\&\&\, e^{-a4[H\,x4]} > 0 \,\&\&\, e^{2\,a4[H\,x4]} > 0 \,\&\&\, e^{a4[H\,x4]} > 0 \,\&\&\, Sin[6\,H\,x0] > 0 \,\&\&\, Cos[6\,H\,x0] > 0 \,\&\&\, Csc[6\,H\,x0] > 0 \,\&\&\, Sec[6\,H\,x0] > 0 \,\&\&\, Tan[6\,H\,x0] > 0 \,\&\&\, Cot[6\,H\,x0] > 0 \,\&\&\, Sin[z] > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, Sin[z]^{3/2} > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, \frac{1}{Sin[z]^{3/2}} > 0 \,\&\&\, \frac{1}{\sqrt{Sin[z]}} > 0 \,\&\&\, Cot[z] > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Cot[z]^{3/2} > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Tan[z] > 0 \,\&\&\, Sec[z] > 0 \,\&\&\, \sqrt{Csc[z]} > 0 \,\&\&\, Csc[z] > 0$$

In[ ]:=
```
subsDefects =
 {Sqrt[e^(2 a4[H x4])] -> e^(a4[H x4]), Sqrt[e^(-2 a4[H x4])] -> e^(-a4[H x4]), Sqrt[e^(2 a4[H x4]) Sin[6 H x4]^(1/3)] -> e^(a4[H x4]) Sin[6 H x4]^(1/6),
  1/Sqrt[e^(2 a4[H x4]) Sin[6 H x4]^(1/3)] -> 1/(e^(a4[H x4]) Sin[6 H x4]^(1/6)),
  1/Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/6)] -> 1/(e^(a4[H x4]) Sin[6 H x0]^(1/6)),
  1/Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/6)] -> 1/(e^(-a4[H x4]) Sin[6 H x0]^(1/6)), Sqrt[e^(2 a4[H x4])] Sin[6 H x0]^(1/6) ->
  e^(a4[H x4]) Sin[6 H x0]^(1/6), Sqrt[e^(-2 a4[H x4])] Sin[6 H x0]^(1/6) -> e^(-a4[H x4]) Sin[6 H x0]^(1/6)}
```

Out[ ]=

$$\left\{\sqrt{e^{2\,a4[H\,x4]}} \to e^{a4[H\,x4]},\ \sqrt{e^{-2\,a4[H\,x4]}} \to e^{-a4[H\,x4]},\ \sqrt{e^{2\,a4[H\,x4]}\,Sin[6\,H\,x4]^{1/3}} \to e^{a4[H\,x4]}\,Sin[6\,H\,x4]^{1/6},\ \frac{1}{\sqrt{e^{2\,a4[H\,x4]}\,Sin[6\,H\,x4]^{1/3}}} \to \frac{e^{-a4[H\,x4]}}{Sin[6\,H\,x4]^{1/6}},\ \frac{1}{\sqrt{e^{2\,a4[H\,x4]}\,Sin[6\,H\,x0]^{1/6}}} \to \frac{e^{-a4[H\,x4]}}{Sin[6\,H\,x0]^{1/6}},\ \frac{1}{\sqrt{e^{-2\,a4[H\,x4]}\,Sin[6\,H\,x0]^{1/6}}} \to \frac{e^{a4[H\,x4]}}{Sin[6\,H\,x0]^{1/6}},\ \sqrt{e^{2\,a4[H\,x4]}}\,Sin[6\,H\,x0]^{1/6} \to e^{a4[H\,x4]}\,Sin[6\,H\,x0]^{1/6},\ \sqrt{e^{-2\,a4[H\,x4]}}\,Sin[6\,H\,x0]^{1/6} \to e^{-a4[H\,x4]}\,Sin[6\,H\,x0]^{1/6}\right\}$$

future coordinate transformation :

In[ ]:=
```
6 H x0 == z && H x4 == t
szt = Solve[%, {z, t}][[1]]
sx0x4 = Solve[%%, {x0, x4}][[1]]
Protect[sx0x4, szt];
```

Out[ ]=

$6\,H\,x0 == z\ \&\&\ H\,x4 == t$

Out[ ]=

$\{z \to 6\,H\,x0,\ t \to H\,x4\}$

Out[ ]=

$\left\{x0 \to \frac{z}{6\,H},\ x4 \to \frac{t}{H}\right\}$

In[ ]:=
```
sx0x4
```

Out[ ]=

$\left\{x0 \to \frac{z}{6\,H},\ x4 \to \frac{t}{H}\right\}$

In[ ]:=
```
(*sa4={a4→((A4[3 H #2])&)}*)
```

In[ ]:=
```
Protect[sx0x4, szt]
```

Out[ ]=

$\{\}$

SO (4, 4) Minkowski Lorentz metric $\eta 4488$: 4 + 4 spacetime;
8 × 8 dimensional :

In[ ]:=
```
(η4488 = ArrayFlatten[{{IdentityMatrix[4], 0}, {0, -IdentityMatrix[4]}}]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

SO (4, 4) Spinor Lorentz metric σ;
τ^A are analogous to the Dirac gamma matrices :
all true :

$$\text{Table}\left[\left\{A, B, \text{FullSimplify}\left[\frac{1}{2}\left(\tau[A].\bar{\tau}[B] + \tau[B].\bar{\tau}[A]\right) == \eta 4488[[A+1, B+1]] * \text{ID8}\right]\right\}, \{A, 0, 7\}, \{B, 0, 7\}\right]$$

Type - 1 and type - 2 employ σ (the ususal notational abuse),
since $\sigma == \sigma^{-1}$: 4 + 4 spacetime,
8 × 8 dimensional and 16 × 16 dimensional :

indices. We define the reduced Brauer-Weyl generators $\{\bar{\tau}^{A'}, \tau^{A'}\}$ of the generators of the two real 8×8 inequivalent irreducible representations of $\overline{SO(4,4)}$ (see eqs. (2.6) and (2.7)) by demanding that the tau matrices satisfy (the tilde denotes transpose)

$$\tilde{\bar{\tau}}^{A'} \sigma = \sigma \bar{\tau}^{A'} \tag{2.3}$$

and

$$\tau^{A'} \bar{\tau}^{B'} + \tau^{B'} \bar{\tau}^{A'} = 2IG^{A'B'} = \bar{\tau}^{A'} \tau^{B'} + \bar{\tau}^{B'} \tau^{A'}, \tag{2.4}$$

where I denotes the 8×8 unit matrix. Denoting the matrix elements of $\tau^{A'}$ by ${\tau^{A'a}}_b$, we may write eq. (3) as

$${\bar{\tau}^{A'}}_{ab} = {\tau^{A'}}_{ba}, \tag{2.5}$$

$$t^A = \begin{pmatrix} 0 & \bar{\tau}^A \\ \tau^A & 0 \end{pmatrix}.$$

$$t^A t^B - t^B t^A = \begin{pmatrix} \bar{\tau}^A \tau^B - \bar{\tau}^B \tau^A & 0 \\ 0 & \tau^A \bar{\tau}^B - \tau^B \bar{\tau}^A \end{pmatrix} = 4 \begin{pmatrix} {D_{(1)}}^{AB} & 0 \\ 0 & {D_{(2)}}^{AB} \end{pmatrix}$$

$$4{D_{(1)}}^{AB} = \bar{\tau}^A \tau^B - \bar{\tau}^B \tau^A$$

$$4{D_{(2)}}^{AB} = \tau^A \bar{\tau}^B - \tau^B \bar{\tau}^A.$$

Let $g \in \overline{SO(4,4)}$ and $L \in SO(4,4)$. The canonical 2-1 homomorphism $\overline{SO(4,4)} \to SO(4,4)$ is given by

$$8L^{A'}{}_{B'}(g) = \operatorname{tr} \widetilde{D}^{(2)}(g)\, \tau^{A'} D^{(1)}(g)\, \bar{\tau}_{B'} . \tag{2.8}$$

As usual tr denotes the trace. Under the action of $\overline{SO(4,4)}$

$$\widetilde{D}^{(1)} \sigma = \sigma D^{(1)-1} , \tag{2.9}$$

$$\sigma^{-1} \widetilde{D}^{(2)} = D^{(2)-1} \sigma^{-1} , \tag{2.10}$$

$$L^{A'}{}_{C'} G_{A'B'} L^{B'}{}_{D'} = G_{C'D'} , \tag{2.11}$$

$$L^{A'}{}_{B'} \tau^{B'} = \widetilde{D}^{(2)} \tau^{A'} D^{(1)} , \tag{2.12}$$

$$L^{A'}{}_{B'} \bar{\tau}^{B'} = D^{(1)-1} \bar{\tau}^{A'} \widetilde{D}^{(2)-1} . \tag{2.13}$$

In[ ]:=
```
(σ = ArrayFlatten[{{ConstantArray[0, {4, 4}], IdentityMatrix[4]},
    {IdentityMatrix[4], ConstantArray[0, {4, 4}]}}]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

below :

In[ ]:=
```
σ16 == ArrayFlatten[{{-σ, 0}, {0, σ}}]
```

below :

In[ ]:=
```
Table[T16^A[A1] = ArrayFlatten[{{0, τ̄[A1]}, {τ[A1], 0}}],
  {A1, 0, 7}];
```

below :

In[ ]:=
```
σ16.T16^A[#] == -Transpose[σ16.T16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

{True, True, True, True, True, True, True, True}

below :

In[ ]:=
```
Table[{{A1, B1}, FullSimplify[
```

```
ExpandAll[1/2 (T16^A[A1].T16^A[B1] + T16^A[B1].T16^A[A1]) ==
    η4488[[A1 + 1, B1 + 1]] * ID16]]},
  {A1, 0, 7}, {B1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

defs; some Symbols; metric

?todo: NEED DefScalarFunction[#]; & /@ (f16[#]&/@Range[0,15]), and allow xact to compute?

Introduce the wave function, Ψ16, for a Universe:

In[ ]:=
```
Ψ16 = f16[#][x0, x4] & /@ Range[0, 15]
```

Out[ ]=
```
{f16[0][x0, x4], f16[1][x0, x4], f16[2][x0, x4], f16[3][x0, x4],
 f16[4][x0, x4], f16[5][x0, x4], f16[6][x0, x4], f16[7][x0, x4],
 f16[8][x0, x4], f16[9][x0, x4], f16[10][x0, x4], f16[11][x0, x4],
 f16[12][x0, x4], f16[13][x0, x4], f16[14][x0, x4], f16[15][x0, x4]}
```

In[ ]:=
```
(*Ψnew16=F16[#][x0,x4]&/@Range[0,15]*)
```

In[ ]:=

```
Clear[sf16Aa];
sfψ16Aa = f16[#] → ToExpression[
    "((Z[" <> ToString[#] <> "][6*H*#1,H*#2] 1/(Sin[6*H*#1]^(1/2))&)"] & /@ Range[0, 15]
```

Out[ ]=

$$\left\{f16[0] \to \left(\frac{Z[0][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[1] \to \left(\frac{Z[1][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\right.$$

$$f16[2] \to \left(\frac{Z[2][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[3] \to \left(\frac{Z[3][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$f16[4] \to \left(\frac{Z[4][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[5] \to \left(\frac{Z[5][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$f16[6] \to \left(\frac{Z[6][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[7] \to \left(\frac{Z[7][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$f16[8] \to \left(\frac{Z[8][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[9] \to \left(\frac{Z[9][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$f16[10] \to \left(\frac{Z[10][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[11] \to \left(\frac{Z[11][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$f16[12] \to \left(\frac{Z[12][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[13] \to \left(\frac{Z[13][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),$$

$$\left. f16[14] \to \left(\frac{Z[14][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right),\ f16[15] \to \left(\frac{Z[15][6\,H\,\#1,\ H\,\#2]}{\sqrt{\mathrm{Sin}[6\,H\,\#1]}}\ \&\right)\right\}$$

In[ ]:=
```
Clear[snewfψ16Aa];
snewfψ16Aa = f16[#] → ToExpression[
    "((nZ[" <> ToString[#] <> "][6*H*#1,H*#2] 1/(Sin[6*H*#1]^(1/2))&)"] & /@ Range[0, 15]
```

Out[ ]=

$$\left\{f16[0] \to \left(\frac{nZ[0][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[1] \to \left(\frac{nZ[1][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\right.$$
$$f16[2] \to \left(\frac{nZ[2][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[3] \to \left(\frac{nZ[3][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$f16[4] \to \left(\frac{nZ[4][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[5] \to \left(\frac{nZ[5][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$f16[6] \to \left(\frac{nZ[6][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[7] \to \left(\frac{nZ[7][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$f16[8] \to \left(\frac{nZ[8][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[9] \to \left(\frac{nZ[9][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$f16[10] \to \left(\frac{nZ[10][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[11] \to \left(\frac{nZ[11][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$f16[12] \to \left(\frac{nZ[12][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[13] \to \left(\frac{nZ[13][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),$$
$$\left.f16[14] \to \left(\frac{nZ[14][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right),\ f16[15] \to \left(\frac{nZ[15][6\,H\,\#1,\ H\,\#2]}{\sqrt{Sin[6\,H\,\#1]}}\ \&\right)\right\}$$

0 (4, 4) related :

In[ ]:=
```
Needs["Notation`"]
```

In[ ]:=
```
Symbolize[τ̄]
```

During evaluation of In[ ]:=

"" Symbolize:
"The Symbolize boxes \!\(*OverscriptBox[\"τ\", \"_\"]\) do not have an embedded TemplateBox with tag NotationTemplateTag. The Symbolize statement \!\(*RowBox[{\"Symbolize\", \"[\", OverscriptBox[\"τ\", \"_\"], \"]\"}]\) may not have been entered using the palette, or the embedded TemplateBox may have been deleted. The embedded TemplateBox ensures correct parsing and retention of proper styling and grouping information."

Out[ ]=

$Failed

In[ ]:=
```
Symbolize[newτ̄]
```

During evaluation of In[ ]:=

"" Symbolize:
"The Symbolize boxes \!\(*OverscriptBox[\"newτ\", \"_\"]\) do not have an embedded TemplateBox with tag NotationTemplateTag. The Symbolize statement \!\(*RowBox[{\"Symbolize\", \"[\", OverscriptBox[\"newτ\", \"_\"], \"]\"}]\) may not have been entered using the palette, or the embedded TemplateBox may have been deleted. The embedded TemplateBox ensures correct parsing and retention of proper styling and grouping information."

Out[ ]=

$Failed

In[ ]:= Symbolize[$T16^{A}$]

In[ ]:= Symbolize[$T16^{\alpha}$]

In[ ]:= Symbolize[$newT16^{A}$]

In[ ]:= Symbolize[$newT16^{\alpha}$]

NEED DefScalarFunction[#]; & /@ Flatten[Universe]

In[ ]:= Universe = ToExpression["U" <> ToString[#]] & /@ Range[0, 7]

In[ ]:= Symbolize[$\mathcal{F}^{A}_{a}$]

In[ ]:= Symbolize[$\mathcal{F}^{a}_{A}$]

In[ ]:= Symbolize[$gtrye^{(A)}_{\alpha}$]

In[ ]:= Symbolize[$gtrye^{\alpha}_{(A)}$]

SPACETIME METRIC

In[ ]:= (*einsteinMetric=Array[g[#1-1,#2-1]&,{8,8}]*)

SPACETIME METRIC:

In[ ]:=
```
g4488 = Array[g[#1 - 1][#2 - 1][x0, x4] &, {8, 8}];
```

SPACETIME METRIC values:

MatrixMetric44

6 H x0 == z && H x4 == t

$$\left\{\left\{a4''[t] \to 0,\ a4'[t] \to \frac{2}{3}(-1+M)\right\},\ \left\{a4''[t] \to 0,\ a4'[t] \to \frac{2(1+M)}{3}\right\}\right\}$$

In[ ]:= (*β3=Exp[2 H x4 $\sqrt{K^2-M^2}$];*)

(*β3=Exp[2 * a4[3*H*x4]];*)

$\beta 3$ = Exp[2 * a4[H * x4]](*/.{a4→(((K1*$\frac{2\ (1+M)}{3}$+K2*$\frac{2}{3}$ (-1+M))#)&)}*)

$\beta 1$ = Sin[6 * H * x0]$^{\frac{1}{3}}$;

$\beta 2$ = Cot[6 * H * x0]^{2};

Out[ ]=

$e^{2\,a4[H\,x4]}$

In[ ]:=
```
MatrixForm[MatrixMetric44 =
  {{β2, 0, 0, 0, 0, 0, 0, 0}, {0, β1 β3, 0, 0, 0, 0, 0, 0}, {0, 0, β1 β3, 0, 0, 0, 0, 0},
    {0, 0, 0, β1 β3, 0, 0, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0}, {0, 0, 0, 0, 0, -β1/β3, 0, 0}, {0, 0,
     0, 0, 0, 0, -β1/β3, 0}, {0, 0, 0, 0, 0, 0, 0, -β1/β3}} // FullSimplify[#, constraintVars] &]
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} \mathrm{Cot}[6\,H\,x0]^2 & 0 & 0 & 0 & 0 & \\ 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 & 0 & \\ 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 & \\ 0 & 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & \\ 0 & 0 & 0 & 0 & -1 & \\ 0 & 0 & 0 & 0 & 0 & -e^{-2\,a4[H\,x4]}\ \mathrm{S} \\ 0 & 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 0 & 0 & \end{pmatrix}$$

In[ ]:=
```
(*Clear[sf16Aa];
sfψ16Aa=f16[#]→ToExpression["((Z["<>ToString[#]<>"][6*H*#1,3*H*#2] 1/Sin[6*H*#1]^(1/2))&)"]&/@
  Range[0,15]*)
```

In[ ]:=
```
(*Clear[sf16Aa];
sfψ16Aa=
 f16[#]→ToExpression["((Z["<>ToString[#]<>"][6*H*#1,3*H*#2])&)"]&/@Range[0,15]*)
```

In[ ]:=
```
(*Clear[sf16Aa];
sfψ16Aa=f16[#]→ToExpression["((Z["<>ToString[#]<>"][6*H*#1,H*#2] 1/Sin[6*H*#1]^(1/2))&)"]&/@
  Range[0,15]*)
```

In[ ]:=
```
(*Inactivate[((q)&)]Evaluate[Activate[Evaluate[q]]]*)
```

In[ ]:=
```
Clear[makeSubstitution];
makeSubstitution[] := Module[{met, mat, t, f, p},
  met = Flatten[g4488][[All, 0]];
  mat = Flatten[MatrixMetric44];
  t = Thread[met → mat];
  f = Table[FullForm[t[[j]] /. {x0 → #1, x4 → #2}], {j, 1, Length[t]}];
  p = Table[Block[{s, r, q, expr}, q = f[[j]][[1]][[2]];
     expr = Inactivate[((q) &)];
     s = f[[j]][[1]][[1]] → expr;
     r = Activate[s // Evaluate] // Evaluate;
     r], {j, 1, Length[f]}];
  Return[p];
 ]
```

In[∘]:=
```
makeSubstitution[a_, b_] := Module[{t, f, p},
  t = Thread[a → b];
  f = Table[FullForm[t⟦j⟧ /. {x0 → #1, x4 → #2}], {j, 1, Length[t]}];
  p = Table[Block[{s, r, q, expr}, q = f⟦j⟧⟦1⟧⟦2⟧;
     expr = Inactivate[((q) &)];
     s = f⟦j⟧⟦1⟧⟦1⟧ → expr;
     r = Activate[s // Evaluate] // Evaluate;
     r], {j, 1, Length[f]}];
  Return[p];
 ]
```

In[∘]:=
```
ssgm4488 = makeSubstitution[]
```

Out[∘]=

$$\{g[0][0] \to (\mathrm{Cot}[6\,H\,\#1]^2\,\&),\ g[0][1] \to (0\,\&),\ g[0][2] \to (0\,\&),\ g[0][3] \to (0\,\&),$$
$$g[0][4] \to (0\,\&),\ g[0][5] \to (0\,\&),\ g[0][6] \to (0\,\&),\ g[0][7] \to (0\,\&),\ g[1][0] \to (0\,\&),$$
$$g[1][1] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[1][2] \to (0\,\&),\ g[1][3] \to (0\,\&),$$
$$g[1][4] \to (0\,\&),\ g[1][5] \to (0\,\&),\ g[1][6] \to (0\,\&),\ g[1][7] \to (0\,\&),\ g[2][0] \to (0\,\&),$$
$$g[2][1] \to (0\,\&),\ g[2][2] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[2][3] \to (0\,\&),\ g[2][4] \to (0\,\&),$$
$$g[2][5] \to (0\,\&),\ g[2][6] \to (0\,\&),\ g[2][7] \to (0\,\&),\ g[3][0] \to (0\,\&),\ g[3][1] \to (0\,\&),$$
$$g[3][2] \to (0\,\&),\ g[3][3] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[3][4] \to (0\,\&),\ g[3][5] \to (0\,\&),$$
$$g[3][6] \to (0\,\&),\ g[3][7] \to (0\,\&),\ g[4][0] \to (0\,\&),\ g[4][1] \to (0\,\&),\ g[4][2] \to (0\,\&),$$
$$g[4][3] \to (0\,\&),\ g[4][4] \to (-1\,\&),\ g[4][5] \to (0\,\&),\ g[4][6] \to (0\,\&),\ g[4][7] \to (0\,\&),$$
$$g[5][0] \to (0\,\&),\ g[5][1] \to (0\,\&),\ g[5][2] \to (0\,\&),\ g[5][3] \to (0\,\&),\ g[5][4] \to (0\,\&),$$
$$g[5][5] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[5][6] \to (0\,\&),\ g[5][7] \to (0\,\&),$$
$$g[6][0] \to (0\,\&),\ g[6][1] \to (0\,\&),\ g[6][2] \to (0\,\&),\ g[6][3] \to (0\,\&),\ g[6][4] \to (0\,\&),$$
$$g[6][5] \to (0\,\&),\ g[6][6] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[6][7] \to (0\,\&),$$
$$g[7][0] \to (0\,\&),\ g[7][1] \to (0\,\&),\ g[7][2] \to (0\,\&),\ g[7][3] \to (0\,\&),\ g[7][4] \to (0\,\&),$$
$$g[7][5] \to (0\,\&),\ g[7][6] \to (0\,\&),\ g[7][7] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&)\}$$

In[∘]:= $\mathrm{Symbolize}\left[E_{\alpha}^{(A)}\right]$

In[∘]:= $\mathrm{Symbolize}\left[e_{\alpha}^{(A)}\right]$

In[∘]:= $e_{\alpha}^{(A)} = \mathrm{Array}\left[E_{\alpha}^{(A)}[\#1-1,\ \#2-1]\ \&,\ \{8,8\}\right]$

Out[∘]=

$$\{\{E_{\alpha}^{(A)}[0,0], E_{\alpha}^{(A)}[0,1], E_{\alpha}^{(A)}[0,2], E_{\alpha}^{(A)}[0,3], E_{\alpha}^{(A)}[0,4], E_{\alpha}^{(A)}[0,5], E_{\alpha}^{(A)}[0,6], E_{\alpha}^{(A)}[0,7]\},$$
$$\{E_{\alpha}^{(A)}[1,0], E_{\alpha}^{(A)}[1,1], E_{\alpha}^{(A)}[1,2], E_{\alpha}^{(A)}[1,3], E_{\alpha}^{(A)}[1,4], E_{\alpha}^{(A)}[1,5], E_{\alpha}^{(A)}[1,6], E_{\alpha}^{(A)}[1,7]\},$$
$$\{E_{\alpha}^{(A)}[2,0], E_{\alpha}^{(A)}[2,1], E_{\alpha}^{(A)}[2,2], E_{\alpha}^{(A)}[2,3], E_{\alpha}^{(A)}[2,4], E_{\alpha}^{(A)}[2,5], E_{\alpha}^{(A)}[2,6], E_{\alpha}^{(A)}[2,7]\},$$
$$\{E_{\alpha}^{(A)}[3,0], E_{\alpha}^{(A)}[3,1], E_{\alpha}^{(A)}[3,2], E_{\alpha}^{(A)}[3,3], E_{\alpha}^{(A)}[3,4], E_{\alpha}^{(A)}[3,5], E_{\alpha}^{(A)}[3,6], E_{\alpha}^{(A)}[3,7]\},$$
$$\{E_{\alpha}^{(A)}[4,0], E_{\alpha}^{(A)}[4,1], E_{\alpha}^{(A)}[4,2], E_{\alpha}^{(A)}[4,3], E_{\alpha}^{(A)}[4,4], E_{\alpha}^{(A)}[4,5], E_{\alpha}^{(A)}[4,6], E_{\alpha}^{(A)}[4,7]\},$$
$$\{E_{\alpha}^{(A)}[5,0], E_{\alpha}^{(A)}[5,1], E_{\alpha}^{(A)}[5,2], E_{\alpha}^{(A)}[5,3], E_{\alpha}^{(A)}[5,4], E_{\alpha}^{(A)}[5,5], E_{\alpha}^{(A)}[5,6], E_{\alpha}^{(A)}[5,7]\},$$
$$\{E_{\alpha}^{(A)}[6,0], E_{\alpha}^{(A)}[6,1], E_{\alpha}^{(A)}[6,2], E_{\alpha}^{(A)}[6,3], E_{\alpha}^{(A)}[6,4], E_{\alpha}^{(A)}[6,5], E_{\alpha}^{(A)}[6,6], E_{\alpha}^{(A)}[6,7]\},$$
$$\{E_{\alpha}^{(A)}[7,0], E_{\alpha}^{(A)}[7,1], E_{\alpha}^{(A)}[7,2], E_{\alpha}^{(A)}[7,3], E_{\alpha}^{(A)}[7,4], E_{\alpha}^{(A)}[7,5], E_{\alpha}^{(A)}[7,6], E_{\alpha}^{(A)}[7,7]\}\}$$

In[∘]:= $(*\mathrm{Symbolize}\left[se_{\alpha}^{(A)}\right]*)$

In[∘]:= $\mathrm{Symbolize}\left[sge_{\alpha}^{(A)}\right]$

In[∘]:= $\mathrm{Symbolize}\left[sgtrye_{\alpha}^{(A)}\right]$

```
In[•]:= Symbolize[E^α_(A)]
In[•]:= Symbolize[sge^α_(A)]
In[•]:= Symbolize[sgtrye^α_(A)]
In[•]:= Symbolize[e^α_(A)]
In[•]:= e^α_(A) = Array[E^α_(A)[#1 - 1, #2 - 1] &, {8, 8}]
Out[•]=
{{E^α_(A)[0, 0], E^α_(A)[0, 1], E^α_(A)[0, 2], E^α_(A)[0, 3], E^α_(A)[0, 4], E^α_(A)[0, 5], E^α_(A)[0, 6], E^α_(A)[0, 7]},
 {E^α_(A)[1, 0], E^α_(A)[1, 1], E^α_(A)[1, 2], E^α_(A)[1, 3], E^α_(A)[1, 4], E^α_(A)[1, 5], E^α_(A)[1, 6], E^α_(A)[1, 7]},
 {E^α_(A)[2, 0], E^α_(A)[2, 1], E^α_(A)[2, 2], E^α_(A)[2, 3], E^α_(A)[2, 4], E^α_(A)[2, 5], E^α_(A)[2, 6], E^α_(A)[2, 7]},
 {E^α_(A)[3, 0], E^α_(A)[3, 1], E^α_(A)[3, 2], E^α_(A)[3, 3], E^α_(A)[3, 4], E^α_(A)[3, 5], E^α_(A)[3, 6], E^α_(A)[3, 7]},
 {E^α_(A)[4, 0], E^α_(A)[4, 1], E^α_(A)[4, 2], E^α_(A)[4, 3], E^α_(A)[4, 4], E^α_(A)[4, 5], E^α_(A)[4, 6], E^α_(A)[4, 7]},
 {E^α_(A)[5, 0], E^α_(A)[5, 1], E^α_(A)[5, 2], E^α_(A)[5, 3], E^α_(A)[5, 4], E^α_(A)[5, 5], E^α_(A)[5, 6], E^α_(A)[5, 7]},
 {E^α_(A)[6, 0], E^α_(A)[6, 1], E^α_(A)[6, 2], E^α_(A)[6, 3], E^α_(A)[6, 4], E^α_(A)[6, 5], E^α_(A)[6, 6], E^α_(A)[6, 7]},
 {E^α_(A)[7, 0], E^α_(A)[7, 1], E^α_(A)[7, 2], E^α_(A)[7, 3], E^α_(A)[7, 4], E^α_(A)[7, 5], E^α_(A)[7, 6], E^α_(A)[7, 7]}}
In[•]:= (*gtrye^(A)_α = (e^(A)_α /.sgtrye^(A)_α)*)
In[•]:= (*gtrye^α_(A) = (e^α_(A) /.sgtrye^α_(A))*)
In[•]:= (*Symbolize[Γ^κ_α β]*)
In[•]:= (*preSpinConnection=Array[Γ^κ_α β[###]&,{8,8,8}];*)
In[•]:= (*Symbolize[ E^A_a ]*)
In[•]:= (*Symbolize[ E^a_A ]*)
In[•]:= (* F̄^A_a F̄^a_A *)
In[•]:= (*Do[ F̄^A_a =E^A_a[h]=Table[(u[[h]].σ.(τ̄[B])),{B,1,8}],{h,1,Length[u]}];
        Do[E^a_A[h]=FullSimplify[Inverse[E^A_a[h]]],{h,1,Length[u]}];
        Table[ F̄^a_A =E^a_A[h]== (u[[h]].σ.u[[h]])
            Transpose[Table[FullSimplify[ExpandAll[ η8[[B,B]]τ[B].u[[h]] ]],
              {B,1,8}]],{h,1,Length[u]}]*)
In[•]:= (*Table[FullSimplify[ExpandAll[Transpose[E^A_a[h]].η8.E^A_a[h]]]-
          (u[[h]].σ.u[[h]])σ== Zero,{h,1,Length[u]}]*)
In[•]:= (*iη88=FullSimplify[Inverse[η8]];*)
In[•]:= (*Clear[ω^(a)_μ (b)];*)Clear[ω]; Symbolize[ω^(a)_μ (b)]
In[•]:= ω = Array[ω^(a)_μ (b)[###] &, {8, 8, 8}];
        Protect[ω]
Out[•]=
{ω}
```

constants

In[ ]:=
```
similarityTransformation = {{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0,
    1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0},
   {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1}};
```

← ERROR : similarityTransformation has 1 st index that transforms as $\frac{\partial}{\partial \Psi}$, not as Ψs

In[ ]:=
```
(* similarityTransformation has 1st index that transforms as ∂/∂Ψ , not as Ψ *)
```

similarityTransformation has 1 st index that transforms as $\frac{\partial}{\partial \Psi}$, not as Ψ :

In[ ]:=
```
similarityTransformation = Transpose[similarityTransformation]
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1}}
```

In[ ]:=
```
(*ArrayFlatten[{{IdentityMatrix[4],0},{0,-IdentityMatrix[4]}}]*)
```

In[ ]:=
```
ID4 = IdentityMatrix[4];
ID8 = IdentityMatrix[8];
```

In[ ]:=
```
η4488 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

In[∘]:=
```
η4488[[#, #]] & /@ Range[8]
```
Out[∘]=
```
{1, 1, 1, 1, -1, -1, -1, -1}
```
In[∘]:=
```
Zero4 = ConstantArray[0, {4, 4}]; Zero8 = ConstantArray[0, {8, 8}];
mid = ExpandAll[-1 * ID4];
ϵ3 = Array[Signature[{##}] &, {3, 3, 3}]
ϵ4 = Array[Signature[{##}] &, {4, 4, 4, 4}];
MId = ExpandAll[-1 * ID8];
simp = {Zero4 → 0, ID4 → 1, mid → -1};
Simp = {Zero8 → ZERO, ID8 → ONE, MId → MONE};
```
Out[∘]=
```
{{{0, 0, 0}, {0, 0, 1}, {0, -1, 0}},
 {{0, 0, -1}, {0, 0, 0}, {1, 0, 0}}, {{0, 1, 0}, {-1, 0, 0}, {0, 0, 0}}}
```
In[∘]:=
```
Zero16 = ConstantArray[0, {16, 16}];
G16 = ArrayFlatten[{{η8, 0}, {0, -η8}}];
Id16 = IdentityMatrix[16]; MId16 = ExpandAll[-1 * Id16];
Simp16 = {Zero16 → ZERO16, Id16 → ONE16, MId16 → MONE16};
```
In[∘]:=
```
ZERO16 = ConstantArray[0, {16, 16}];
G16 = ArrayFlatten[{{η4488, 0}, {0, -η4488}}];
ID16 = IdentityMatrix[16]; MId16 = ExpandAll[-1 * ID16];
Simp16 = {ZERO16 → ZERO16, ID16 → ONE16, MId16 → MONE16};
```
In[∘]:=
```
Transpose[similarityTransformation].similarityTransformation == ID16
```
Out[∘]=
```
True
```
In[∘]:=
```
ωs = Flatten[
  Table[ToExpression["ω" <> ToString[A1] <> ToString[B1]], {A1, 1, 7}, {B1, A1 + 1, 8}]]
Length[ωs]
```
Out[∘]=
```
{ω12, ω13, ω14, ω15, ω16, ω17, ω18, ω23, ω24, ω25, ω26, ω27, ω28,
 ω34, ω35, ω36, ω37, ω38, ω45, ω46, ω47, ω48, ω56, ω57, ω58, ω67, ω68, ω78}
```
Out[∘]=
```
28
```
In[∘]:=
```
σ.σ - ID8 == Zero8
Tr[σ] == 0
```
Out[∘]=
```
True
```
Out[∘]=
```
True
```

some function definitions :

```
In[•]:= eextract[a_] := Extract[a, {#}] & /@ Range[0, Length[a]]
In[•]:= Clear[imes]
In[•]:= imes[a_] := {a}
In[•]:= imes[a_, b_] := {a, b}
In[•]:= imes[a_, b_, c_] := {a, b, c}
In[•]:= imes[a_, b_, c_, d_] := {a, b, c, d}
In[•]:= imes[a_, b_, c_, d_, f_] := {a, b, c, d, f}
In[•]:= imes[a_, b_, c_, d_, f_, h_] := {a, b, c, d, f, h}
In[•]:= imes[a_, b_, c_, d_, f_, h_, j_] := {a, b, c, d, f, h, j}
In[•]:= times[a__] := Flatten[{Flatten[#] & /@ a}]
In[•]:= (*times[a_,b_,c_,d_]:={a,b}*)
In[•]:= (*imes[a_,b_,c_,d_][0]:={a,d}*)
In[•]:= (*imes[a_,b_][0]^:={a,b}*)
In[•]:= iid[a_, b_] := a
In[•]:= iid[a_, b_, c_] := {a, b}
In[•]:= iid[a_List] := a[[1]]
In[•]:= qid[a__] := a
In[•]:= Clear[der]; der[a__] [c_][b__] := c
In[•]:= Clear[der3]; der3[a__] [c_][b__] := {c, a, b}
In[•]:= (*der[a_, b_] [c_]:= c*)
In[•]:= (*derz[a_, b_] := a*)
In[•]:= (*dert[a_, b_] := b*)
```

In[∘]:=
```
(*derivative[a__] [c_]:= FullForm[c]/.{Derivative→der}*)
```

In[∘]:=
```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
FullForm[#] & /@ %
(*ToString[#]&/@%*)
% /. {Derivative → der}
```

Out[∘]=

$\{Z[0][z, t], Z[0]^{(1,0)}[z, t], Z[0]^{(0,1)}[z, t]\}$

Out[∘]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[∘]=
```
{Z[0][z, t], Z[0], Z[0]}
```

In[∘]:=
```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
% * (Prime[#] & /@ Range[Length[%]])
Plus @@ %
FullForm[%] (* #]&/@%*)
% /. {Plus → qid, Times → qid, Derivative → der}
List[%]
Partition[%, 2]
eextract[#] & /@ %
(*eextract[#]&/@%*)
(*#__List[[0]]&/@%*)
#[[2]] & /@ %
#[[3]] & /@ %%
```

Out[∘]=

$\{Z[0][z, t], Z[0]^{(1,0)}[z, t], Z[0]^{(0,1)}[z, t]\}$

Out[∘]=

$\{2\, Z[0][z, t], 3\, Z[0]^{(1,0)}[z, t], 5\, Z[0]^{(0,1)}[z, t]\}$

Out[∘]=

$2\, Z[0][z, t] + 5\, Z[0]^{(0,1)}[z, t] + 3\, Z[0]^{(1,0)}[z, t]$

Out[∘]//FullForm=
```
Plus[Times[2, Z[0][z, t]], Times[5, Derivative[0, 1][Z[0]][z, t]],
 Times[3, Derivative[1, 0][Z[0]][z, t]]]
```

Out[∘]=
```
Sequence[2, Z[0][z, t], 5, Z[0], 3, Z[0]]
```

Out[∘]=
```
{2, Z[0][z, t], 5, Z[0], 3, Z[0]}
```

Out[∘]=
```
{{2, Z[0][z, t]}, {5, Z[0]}, {3, Z[0]}}
```

Out[∘]=
```
{{List, 2, Z[0][z, t]}, {List, 5, Z[0]}, {List, 3, Z[0]}}
```

Out[∘]=
```
{2, 5, 3}
```

Out[∘]=
```
{Z[0][z, t], Z[0], Z[0]}
```

Sequence[Subscript[expr, 1], Subscript[expr, 2], …]
represents a sequence of arguments to be spliced automatically into any function .

In[ ]:=
```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
FullForm[#] & /@ %
(*ToString[#]&/@%*)
% /. {Derivative → der3}
```

Out[ ]=
$\{Z[0][z, t], Z[0]^{(1,0)}[z, t], Z[0]^{(0,1)}[z, t]\}$

Out[ ]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[ ]=
```
{Z[0][z, t], List[Z[0], 1, 0, z, t], List[Z[0], 0, 1, z, t]}
```

In[ ]:=
```
helpf[x__] := Length[{x}]
```

In[ ]:=
```
{helpf[x, y, z], helpf[]}
```

Out[ ]=
```
{3, helpf[]}
```

In[ ]:=
```
f[##] & @@ X
```

Out[ ]=
```
f[x0, x1, x2, x3, x4, x5, x6, x7]
```

In[ ]:=
```
StringExtract["a--bbb--ccc--dddd", "--" → 3]
```

Out[ ]=
```
ccc
```

In[ ]:=
```
StringExtract["a bbb  cccc aa   d", -1]
```

Out[ ]=
```
d
```

In[ ]:=
```
StringRiffle[{{"a", "b", "c"}, {"d", "e", "f"}}, "\n", "\t"]
```

Out[ ]=
```
a    b    c
d    e    f
```

In[ ]:=
```
{"", "z, t"}
```

Out[ ]=
```
{, z, t}
```

```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
FullForm[#] & /@ %
ToString[#] & /@ %
StringSplit[#, "]"] & /@ %
StringExtract[#, "[" → All] & /@ %
StringExtract[#,
  "\!\(\*StyleBox[\"
     \",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*StyleBox[\"{\",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*
     StyleBox[\",\",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*StyleBox[\"
     \",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*StyleBox[\"z\",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*
     StyleBox[\",\",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*StyleBox[\"
     \",ShowStringCharacters->True,NumberMarks->True]\)\!\(\*StyleBox[\"t\",ShowStringCharacters->True,NumberMarks->True]\)" →
   All] & /@ %
InputForm[TextString[#]] & /@ %
```

In[∘]:=
```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
FullForm[#] & /@ %
ToString[#] & /@ %
StringSplit[#, "]"] & /@ %
StringExtract[#, "[" → All] & /@ %
(*StringExtract[#," {, z, t"→All]&/@%*)
InputForm[TextString[#]] & /@ %
```

Out[∘]=
```
{Z[0][z, t], Z[0]^(1,0)[z, t], Z[0]^(0,1)[z, t]}
```

Out[∘]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[∘]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[∘]=
```
{{Z[0, [z, t}, {Derivative[1, 0, [Z[0, , [z, t}, {Derivative[0, 1, [Z[0, , [z, t}}
```

Out[∘]=
```
{{{Z, 0}, {, z, t}}, {{Derivative, 1, 0}, {, Z, 0}, {}, {, z, t}},
 {{Derivative, 0, 1}, {, Z, 0}, {}, {, z, t}}}
```

Out[∘]=
```
{"{{Z, 0}, {, z, t}}", "{{Derivative, 1, 0}, {, Z, 0}, {}, {, z, t}}",
 "{{Derivative, 0, 1}, {, Z, 0}, {}, {, z, t}}"}
```

In[∘]:=
```
{Z[0][z, t], D[Z[0][z, t], z], D[Z[0][z, t], t]}
FullForm[#] & /@ %
ToString[#] & /@ %
(*InputForm[TextString[#]]&/@%*)
StringExtract[#, "[" → All] & /@ %
StringExtract[#, "]" → All] & /@ %%
StringExtract[#, "[" → 1] & /@ %%%
StringExtract[#, "]" → 1] & /@ %%%%
StringExtract[#, "Z[" → 1] & /@ %%%%%
```

Out[∘]=
```
{Z[0][z, t], Z[0]^(1,0)[z, t], Z[0]^(0,1)[z, t]}
```

Out[∘]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[∘]=
```
{Z[0][z, t], Derivative[1, 0][Z[0]][z, t], Derivative[0, 1][Z[0]][z, t]}
```

Out[∘]=
```
{{Z, 0], z, t]}, {Derivative, 1, 0], Z, 0]], z, t]}, {Derivative, 0, 1], Z, 0]], z, t]}}
```

Out[∘]=
```
{{Z[0, [z, t, }, {Derivative[1, 0, [Z[0, , [z, t, }, {Derivative[0, 1, [Z[0, , [z, t, }}
```

Out[∘]=
```
{Z, Derivative, Derivative}
```

Out[∘]=
```
{Z[0, Derivative[1, 0, Derivative[0, 1}
```

Out[∘]=
```
{, Derivative[1, 0][, Derivative[0, 1][}
```

In[∘]:=
```
(*TemplateApply[StringTemplate["Z `[` then `b`"],
 <|"a"→1234,"b"→5678|>]*)
```

In[∘]:=
```
skelx[x_, matQ_ : True] := Module[{t = {666}},
  If[matQ == True, t = Block[{r},
     r = x;
     Table[Block[{q}, q = SameQ[0, r⟦j, i⟧];
       If[True == q, Style[0, Blue], Style[Length[r⟦j, i⟧], Red]]],
      {j, 1, Length[r]}, {i, 1, Length[r⟦-1⟧]}]]];
  If[matQ == False, t = Block[{r},
     r = x;
     Table[Block[{q}, q = SameQ[0, r⟦j⟧];
       If[True == q, Style[0, {RGBColor → {0, 1 / 3, 0}, Bold}], Style[Length[r⟦j⟧], Red]]],
      {j, 1, Length[r]}]]];
  MatrixForm[t, TableAlignments → Left]]
```

In[∘]:=
```
makeSym[size_, fn_] :=
 Module[{rtmp}, rtmp = Table[fn[i, j], {i, 1, size}, {j, 1, i}];
  MapThread[Join, {rtmp, Rest /@ Flatten[rtmp, {{2}, {1}}]}]]
```

In[∘]:=
```
makeAntiSym[size_, fn_] :=
 Module[{rtmp}, rtmp = Table[If[i == j, 0, fn[i, j]], {i, 1, size}, {j, 1, i}];
  MapThread[Join, {rtmp, Rest /@ Flatten[-rtmp, {{2}, {1}}]}]]
```

In[∘]:=
```
Block[{MX}, MX = makeAntiSym[8, Subscript[ωω, ##] &]]
```

Out[∘]=

$$\{\{0, -\omega\omega_{2,1}, -\omega\omega_{3,1}, -\omega\omega_{4,1}, -\omega\omega_{5,1}, -\omega\omega_{6,1}, -\omega\omega_{7,1}, -\omega\omega_{8,1}\},$$
$$\{\omega\omega_{2,1}, 0, -\omega\omega_{3,2}, -\omega\omega_{4,2}, -\omega\omega_{5,2}, -\omega\omega_{6,2}, -\omega\omega_{7,2}, -\omega\omega_{8,2}\},$$
$$\{\omega\omega_{3,1}, \omega\omega_{3,2}, 0, -\omega\omega_{4,3}, -\omega\omega_{5,3}, -\omega\omega_{6,3}, -\omega\omega_{7,3}, -\omega\omega_{8,3}\},$$
$$\{\omega\omega_{4,1}, \omega\omega_{4,2}, \omega\omega_{4,3}, 0, -\omega\omega_{5,4}, -\omega\omega_{6,4}, -\omega\omega_{7,4}, -\omega\omega_{8,4}\},$$
$$\{\omega\omega_{5,1}, \omega\omega_{5,2}, \omega\omega_{5,3}, \omega\omega_{5,4}, 0, -\omega\omega_{6,5}, -\omega\omega_{7,5}, -\omega\omega_{8,5}\},$$
$$\{\omega\omega_{6,1}, \omega\omega_{6,2}, \omega\omega_{6,3}, \omega\omega_{6,4}, \omega\omega_{6,5}, 0, -\omega\omega_{7,6}, -\omega\omega_{8,6}\},$$
$$\{\omega\omega_{7,1}, \omega\omega_{7,2}, \omega\omega_{7,3}, \omega\omega_{7,4}, \omega\omega_{7,5}, \omega\omega_{7,6}, 0, -\omega\omega_{8,7}\},$$
$$\{\omega\omega_{8,1}, \omega\omega_{8,2}, \omega\omega_{8,3}, \omega\omega_{8,4}, \omega\omega_{8,5}, \omega\omega_{8,6}, \omega\omega_{8,7}, 0\}\}$$

$$\Gamma_{\mu\alpha\beta} = \frac{1}{2}\left(\frac{\partial g_{\mu\alpha}}{\partial x^\beta} + \frac{\partial g_{\mu\beta}}{\partial x^\alpha} - \frac{\partial g_{\alpha\beta}}{\partial x^\mu}\right),$$

$$\Gamma^\mu{}_{\alpha\beta} = g^{\mu\nu}\Gamma_{\nu\alpha\beta},$$

$$R^\mu{}_{\nu\alpha\beta} = \frac{\partial \Gamma^\mu{}_{\nu\beta}}{\partial x^\alpha} - \frac{\partial \Gamma^\mu{}_{\nu\alpha}}{\partial x^\beta} + \Gamma^\mu{}_{\rho\alpha}\Gamma^\rho{}_{\nu\beta} - \Gamma^\mu{}_{\rho\beta}\Gamma^\rho{}_{\nu\alpha}.$$

$$R_{\mu\nu} = R^\alpha{}_{\mu\alpha\nu}, \qquad R = g^{\mu\nu}R_{\mu\nu},$$

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R$$

In[ ]:=
```
(*Christoffel, Einstein tensor, ...*)
Clear[rt];
rt[g_, ass_ : {}] := Module[{t, ΓΓ, RicciΓ, RieΓ, RS, G, ginv},
  Print[Now];
  t = AbsoluteTiming[
    ginv = FullSimplify[Inverse[g], ass];
    ΓΓ = FullSimplify[Table[(1 / 2) * Sum[(ginv[[i, s]]) *
          (D[g[[s, j]], X[[k]] ] + D[g[[s, k]], X[[j]] ] - D[g[[j, k]], X[[s]] ]), {s, 1, DIM8}],
       {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}] , ass];
    RicciΓ = ParallelTable[FullSimplify[D[ΓΓ[[μ, ν, β]], X[[α]] ] - D[ΓΓ[[μ, ν, α]], X[[β]] ] +
        Sum[ΓΓ[[μ, s, α]] × ΓΓ[[s, ν, β]] - ΓΓ[[μ, s, β]] × ΓΓ[[s, ν, α]], {s, 1, DIM8}], ass],
      {μ, 1, DIM8}, {ν, 1, DIM8}, {α, 1, DIM8}, {β, 1, DIM8}] ;
    RieΓ = ParallelTable[ FullSimplify[Sum[ RicciΓ[[α, μ, α, ν]], {α, 1, DIM8}], ass],
      {μ, 1, DIM8}, {ν, 1, DIM8}] ;
    RS = FullSimplify[Tr[ ginv.RieΓ] , ass];
    G = ParallelTable[FullSimplify[RieΓ[[α]] - 1/2 g[[α]] RS, ass], {α, 1, Length[RieΓ]}];];
  Print[t];
  Print[Now];
  Return[{ginv, ΓΓ, RicciΓ, RieΓ, RS, G}]]
```

If ‘paste’ Maple MathML to ToExpression[MathMLForm[]] fails, then try to edit this :

In[ ]:=
```
Clear[mapleztStringToMathematica];
mapleztStringToMathematica[input_String, toExpression_ : False, debug_ : False] :=
 Module[{prepare, post, custom, use = input, save = input, linenumber = 0},
  (*use=ToString[InputForm[TextString[input]]];*) (*Print[use];*)
  prepare[in_String] := Module[{s = in}, linenumber++;
    s = in;
    (*If[s==ToString[InputForm[TextString[s]]],
      (*##&[]*)Print[s],Print[ToUpperCase[s]]];*)
    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),z,z)" →
        "D[Z[" <> ToString[j] <> "][z,t],{z,2}]"], {j, 0, 15}];
    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),z,t)" →
        "D[D[Z[" <> ToString[j] <> "][z,t],z],t]"], {j, 0, 15}];
    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),t,z)" →
        "D[D[Z[" <> ToString[j] <> "][z,t],t],z]"], {j, 0, 15}];
    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),t,t)" →
        "D[Z[" <> ToString[j] <> "][z,t],{t,2}]"], {j, 0, 15}];

    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),t)" →
        "D[Z[" <> ToString[j] <> "][z,t],t]"], {j, 0, 15}];
    Do[s = StringReplace[s, "diff(Z" <> ToString[j] <> "(z,t),z)" →
        "D[Z[" <> ToString[j] <> "][z,t],z]"], {j, 0, 15}];
```

```
    s = StringReplace[s, "tan(z)" → "Tan[z]"];
    s = StringReplace[s, "cot(z)" → "Cot[z]"];
    s = StringReplace[s, "sin(z)" → "Sin[z]"];
    s = StringReplace[s, "cos(z)" → "Cos[z]"];
    s = StringReplace[s, "sec(z)" → "Sec[z]"];
    s = StringReplace[s, "csc(z)" → "Csc[z]"];

    s = StringReplace[s, "=" → "->"];

    (*Do[s=StringReplace[s,"Z"<>ToString[j]<>"(z,t)"→"Z["<>ToString[j]<>"[z,t]"],
      {j,0,15}];*)
    (*s=StringReplace[s,"diff(a4(t),t)"→"D[a4[t],t]"];*)
    (*s=StringReplace[s,"exp(-2*a4(t))"→"Exp[-2a4[t]]"];*)
    (*s=StringReplace[s,"a4(t))"→"a4[t]"];*)

    Return[s];
   ];
  post[in_String] := Module[{s = in}, linenumber++;
    s = in;
    s = StringReplace[s, "a4(t))" → "a4[t]"];
    Do[s = StringReplace[s, "Z" <> ToString[j] <> "(z,t)" → "Z[" <> ToString[j] <> "][z,t]"],
     {j, 0, 15}];
    Return[s];
   ];
  custom[in_String] := Module[{s = in}, linenumber++;
    s = in;

    s = StringReplace[s, "diff(a4(t),t)" → "D[a4[t],t]"];
    s = StringReplace[s, "exp(-2*a4(t))" → "Exp[-2a4[t]]"];

    Return[s];
   ];
  use = prepare[use];
  use = custom[use];
  Return[post[use]];
  (*If[toExpression,Return[ToExpression[s/.{z→#1,t→#2}],##&[]];*)
 ]
```

Mathematica Lexer and Parser for Maple - like Syntax Supports : Basic arithmetic, function calls, lists {}, equations =, and specific Maple keywords .

In[ ]:=
```
(*---LEXER---*)(*Helper:Check if character is a digit*)
IsDigit[char_] := StringMatchQ[char, RegularExpression["\\d"]];

(*Helper:Check if character is a letter*)
IsAlpha[char_] := StringMatchQ[char, RegularExpression["[a-zA-Z_]"]];

(*Helper:Check if character is whitespace*)
IsSpace[char_] := StringMatchQ[char, RegularExpression["\\s"]];

(*Main Lexer Function*)
GetTokens[str_String] :=
  Module[{chars, len, i, char, tokens = {}, token, numStr, idStr}, chars = Characters[str];
   len = Length[chars];
   i = 1;
   While[i ≤ len, char = chars⟦i⟧;
    Which[(*Skip Whitespace*)IsSpace[char], i++, (*Numbers*)IsDigit[char], numStr = char;
     i++;
     While[i ≤ len && IsDigit[chars⟦i⟧], numStr = numStr <> chars⟦i⟧;
      i++;];
     AppendTo[tokens, {"NUMBER", ToExpression[numStr]}],
     (*Identifiers and Keywords*)IsAlpha[char], idStr = char;
     i++;
     While[i ≤ len && (IsAlpha[chars⟦i⟧] || IsDigit[chars⟦i⟧]), idStr = idStr <> chars⟦i⟧;
      i++;];
     (*Check for specific keywords if needed,
     otherwise IDENTIFIER*)AppendTo[tokens, {"IDENTIFIER", idStr}],
     (*Operators and Punctuation*)char == "+", AppendTo[tokens, {"PLUS", "+"}];
     i++, char == "-", AppendTo[tokens, {"MINUS", "-"}];
     i++, char == "*", AppendTo[tokens, {"STAR", "*"}];
     i++, char == "/", AppendTo[tokens, {"SLASH", "/"}];
     i++, char == "^", AppendTo[tokens, {"CARET", "^"}];
     i++, char == "(", AppendTo[tokens, {"LPAREN", "("}];
     i++, char == ")", AppendTo[tokens, {"RPAREN", ")"}];
     i++, char == "{", AppendTo[tokens, {"LBRACE", "{"}];
     i++, char == "}", AppendTo[tokens, {"RBRACE", "}"}];
     i++, char == "=", AppendTo[tokens, {"EQUALS", "="}];
     i++, char == ",", AppendTo[tokens, {"COMMA", ","}];
     i++, char == "$", AppendTo[tokens, {"DOLLAR", "$"}];
     i++, (*Ellipsis... or Dot.*)char == ".", If[i + 2 ≤ len &&
       chars⟦i + 1⟧ == "." && chars⟦i + 2⟧ == ".", AppendTo[tokens, {"ELLIPSIS", "..."}];
      i += 3, AppendTo[tokens, {"DOT", "."}];
      i++], True, Print["Unknown character: ", char];
     i++];];
   AppendTo[tokens, {"EOF", "EOF"}];
   tokens];
```

In[ ]:=
```
(*---PARSER---*)(*Grammar:Expression→
 Equation Equation→AddExp["=" AddExp] AddExp→MulExp {("+"|"-") MulExp} MulExp→
```

```
     PowerExp {("*"|"/") PowerExp} PowerExp→Primary["^" PowerExp] (Right associative)
        Primary→NUMBER|IDENTIFIER|"(" Expression ")"|IDENTIFIER "(" ArgList ")"|
         "{" ArgList "}" ArgList→Expression {"," Expression}|Empty*)
ParseTokens[tokens_List] := Module[{pos = 1, currentToken, eat, peek, parseExpression,
    parseEquation, parseAddExp, parseMulExp, parsePowerExp, parseUnaryExp,
    parsePrimary, parseArgs, parseList}, currentToken := tokens[[pos]];
   peek[] := tokens[[pos]];
   eat[type_] := If[currentToken[[1]] == type, pos++;
     True, Print["Error: Expected ", type, " but found ", currentToken[[1]]];
     False];
   (*Entry point*)parseExpression[] := parseEquation[];
   (*Equation:a=b*)parseEquation[] := Module[{left, right}, left = parseAddExp[];
     If[currentToken[[1]] == "EQUALS", eat["EQUALS"];
      right = parseAddExp[];
      {"Equation", left, right}, left]];
   parseAddExp[] := Module[{node, right, op}, node = parseMulExp[];
     While[MemberQ[{"PLUS", "MINUS"}, currentToken[[1]]], op = currentToken[[2]];
      eat[currentToken[[1]]];
      right = parseMulExp[];
      node = {"BinaryOp", op, node, right};];
     node];
   parseMulExp[] := Module[{node, right, op}, node = parsePowerExp[];
     While[True, If[MemberQ[{"STAR", "SLASH"}, currentToken[[1]]], op = currentToken[[2]];
       eat[currentToken[[1]]];
       right = parsePowerExp[];
       node = {"BinaryOp", op, node, right}, (*Implicit Multiplication*)
       If[MemberQ[{"IDENTIFIER", "NUMBER", "LPAREN", "LBRACE", "ELLIPSIS"},
         currentToken[[1]]], right = parsePowerExp[];
        node = {"BinaryOp", "*", node, right},
        Break[] (*Not an operator or start of expression*)]]];
     node];
   parsePowerExp[] := Module[{node, right}, node = parseUnaryExp[];
     If[currentToken[[1]] == "CARET", eat["CARET"];
      right = parsePowerExp[];
      (*Right associative recursion*){"BinaryOp", "^", node, right}, node]];
   parseUnaryExp[] := Module[{op, node},
     If[MemberQ[{"PLUS", "MINUS"}, currentToken[[1]]], op = currentToken[[2]];
      eat[currentToken[[1]]];
      node = parseUnaryExp[];
      {"UnaryOp", op, node}, parsePrimary[]]];
   parsePrimary[] := Module[{token, node, name, args}, token = currentToken;
     Switch[token[[1]], "NUMBER", eat["NUMBER"];
      {"Number", token[[2]]}, "IDENTIFIER", eat["IDENTIFIER"];
      name = token[[2]];
      (*Check if it's a function call:IDENTIFIER followed by LPAREN*)
      If[currentToken[[1]] == "LPAREN", eat["LPAREN"];
       args = parseArgs[];
```

```
        eat["RPAREN"];
        {"Call", name, args}, {"Identifier", name}], "LPAREN", eat["LPAREN"];
      node = parseExpression[];
      eat["RPAREN"];
      node, "LBRACE", parseList[], "ELLIPSIS", eat["ELLIPSIS"];
      {"Identifier", "..."}, "EOF", Print["Error: Unexpected EOF in Primary"];
      {"Error", "EOF"}, (*Do NOT eat EOF*)
      _, Print["Error: Unexpected token in Primary: ", token];
      eat[token[[1]]];
      (*Advance to avoid infinite loop*){"Error", token}]];
  (*Parse List:{a,b,c}*)parseList[] := Module[{elements}, eat["LBRACE"];
    elements = parseArgs[];
    eat["RBRACE"];
    {"List", elements}];
  (*Parse Argument List:expr,expr,...*)parseArgs[] := Module[{args = {}, arg},
    If[currentToken[[1]] ≠ "RPAREN" && currentToken[[1]] ≠ "RBRACE", arg = parseExpression[];
     AppendTo[args, arg];
     While[currentToken[[1]] == "COMMA", eat["COMMA"];
      arg = parseExpression[];
      AppendTo[args, arg];];];
    args];
  parseExpression[]];
```

In[ ]:=

```
(*---CONVERTER---*)(*Map Maple function names to Mathematica function names*)
MapleToMathematicaFunction[funcName_String] :=
  Switch[funcName, "diff", "D", "int", "Integrate", "Int", "Integrate", "DESol",
   "DSolve", "exp", "Exp", "log", "Log", "sqrt", "Sqrt", "tan", "Tan", "sin",
   "Sin", "cos", "Cos", "cot", "Cot", "sec", "Sec", "csc", "Csc", "csch", "Csch",
   "tanh", "Tanh", "sinh", "Sinh", "cosh", "Cosh", "coth", "Coth", "sech", "Sech",
   "det", "Det", "transpose", "Transpose", "sphericalbessel", "SphericalBesselJ",
   "lambertw", "ProductLog", "gamma", "Gamma", "airy", "AiryAi", "besselJ",
   "BesselJ", "besselY", "BesselY", "hypergeometricU", "HypergeometricU", "zeta",
   "Zeta", "erf", "Erf", "erfc", "Erfc", _, funcName (*Default:keep same name*)];

(*Helper:Process a single AST node-core conversion logic*)
ProcessASTNode[nodeType_, nodeData_, childResults_] :=
  Module[{funcName, cleanFuncName, mathFunc, argsStr},
   Switch[nodeType, "Number", ToString[nodeData], "Identifier",
    (*Handle special identifiers like _Y→Y*)If[StringLength[nodeData] > 0 &&
      StringTake[nodeData, 1] == "_", StringDrop[nodeData, 1], nodeData], "BinaryOp",
    "(" <> childResults[[1]] <> " " <> nodeData <> " " <> childResults[[2]] <> ")",
    "UnaryOp", nodeData <> "(" <> childResults[[1]] <> ")", "Equation",
    childResults[[1]] <> " == " <> childResults[[2]], "List",
    "{" <> StringRiffle[childResults, ", "] <> "}", "Call", funcName = nodeData;
    (*Handle special identifiers like _Y→Y for function names too*)
    cleanFuncName = If[StringLength[funcName] > 0 && StringTake[funcName, 1] == "_",
      StringDrop[funcName, 1], funcName];
    mathFunc = MapleToMathematicaFunction[cleanFuncName];
```

```
    argsStr = StringRiffle[childResults, ", "];
    mathFunc <> "[" <> argsStr <> "]", _, "Error"]];

(*Convert AST to Mathematica String-Non-
 recursive iterative version using post-order traversal*)
ToMathematicaString[ast_] := Module[{stack, outputStack, currentItem,
    node, nodeType, children, childCount, childResults, i, result, nodeData},
   (*Use two stacks:one for traversal,one for results*)stack = {{ast, False}};
   (*{node,visited}*)outputStack = {};
   (*Post-order traversal:process children before parents*)
   While[Length[stack] > 0, currentItem = Last[stack];
    node = currentItem[[1]];
    nodeType = node[[1]];
    If[currentItem[[2]], (*Node already visited,process it*)stack = Most[stack];
     (*Determine children and extract data*)
     {children, nodeData} = Switch[nodeType, "Number", {{}, node[[2]]},
       "Identifier", {{}, node[[2]]}, "BinaryOp", {{node[[3]], node[[4]]}, node[[2]]},
       "UnaryOp", {{node[[3]]}, node[[2]]}, "Equation", {{node[[2]], node[[3]]}, ""},
       "List", {node[[2]], ""}, "Call", {node[[3]], node[[2]]}, _, {{}, ""}];
     (*Pop child results from output stack*)childCount = Length[children];
     childResults = {};
     If[childCount > 0, Do[PrependTo[childResults, Last[outputStack]];
        outputStack = Most[outputStack];, {i, 1, childCount}];];
     (*Process this node*)result = ProcessASTNode[nodeType, nodeData, childResults];
     AppendTo[outputStack, result];, (*Node not visited,
     mark as visited and push children*)stack[[Length[stack]]] = {node, True};
     (*Push children onto stack in reverse order (so they process left-to-right)*)
     children = Switch[nodeType, "Number", {}, "Identifier", {},
       "BinaryOp", {node[[3]], node[[4]]}, "UnaryOp", {node[[3]]}, "Equation",
       {node[[2]], node[[3]]}, "List", node[[2]], "Call", node[[3]], _, {}];
     Do[AppendTo[stack, {children[[i]], False}];, {i, Length[children], 1, -1}];];];
   (*Return the final result*)If[Length[outputStack] > 0, Last[outputStack], "Error"]];

(*---MAIN WRAPPER---*)
ConvertMapleToMathematica[inputStr_String] :=
  Module[{tokens, ast}, tokens = GetTokens[inputStr];
   ast = ParseTokens[tokens];
   ToMathematicaString[ast]];
```

In[ ]:=
```
sta = "{nZ10(z, t) = (c2C7*sin(C2Q1*t) + c2C8*cos(C2Q1*t))*(c2C5*sin(z)^(sqrt(-C2Q1^2
    + M^2)/6) + c2C6*sin(z)^(-sqrt(-C2Q1^2 + M^2)/6)), nZ11(z, t) =
    (c2C3*sin(C2Q1*t) + c2C4*cos(C2Q1*t))*(c2C1*sin(z)^(sqrt(-C2Q1^2
    + M^2)/6) + c2C2*sin(z)^(-sqrt(-C2Q1^2 + M^2)/6)), nZ8(z, t) =
    (((-C2Q1*c2C2*c2C3 + M*c2C6*c2C8)*cos(C2Q1*t) + sin(C2Q1*t)*(C2Q1*c2C2*c2C4
    + M*c2C6*c2C7))*sin(z)^(-sqrt(-C2Q1^2 + M^2)/6) + ((C2Q1*c2C1*c2C3
    - M*c2C5*c2C8)*cos(C2Q1*t) - sin(C2Q1*t)*(C2Q1*c2C1*c2C4 +
    M*c2C5*c2C7))*sin(z)^(sqrt(-C2Q1^2 + M^2)/6) + (-cos(M*t)*c2C10 +
    sin(M*t)*c2C9)*sqrt(-C2Q1^2 + M^2))/sqrt(-C2Q1^2 + M^2), nZ9(z, t) =
    (((C2Q1*c2C6*c2C7 + M*c2C2*c2C4)*cos(C2Q1*t) + sin(C2Q1*t)*(-C2Q1*c2C6*c2C8
    + M*c2C2*c2C3))*sin(z)^(-sqrt(-C2Q1^2 + M^2)/3) + sqrt(-C2Q1^2 +
    M^2)*(cos(M*t)*c2C9 + sin(M*t)*c2C10)*sin(z)^(-sqrt(-C2Q1^2 + M^2)/6) +
    (-C2Q1*c2C5*c2C7 - M*c2C1*c2C4)*cos(C2Q1*t) - sin(C2Q1*t)*(-C2Q1*c2C5*c2C8
    + M*c2C1*c2C3))*sin(z)^(sqrt(-C2Q1^2 + M^2)/6)/sqrt(-C2Q1^2 + M^2)}";
```

In[ ]:=
```
ConvertMapleToMathematica[sta]
```

Out[ ]=
```
{nZ10[z, t] == (((c2C7 * Sin[(C2Q1 * t)]) + (c2C8 * Cos[(C2Q1 * t)])) * ((c2C5 * (Sin[z]
  ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6))) + (c2C6 * (Sin[z] ^ (-(Sqrt[((-(C2Q1)
  ^ 2) + (M ^ 2))]) / 6))))), nZ11[z, t] == (((c2C3 * Sin[(C2Q1 * t)]) + (c2C4 *
  Cos[(C2Q1 * t)])) * ((c2C1 * (Sin[z] ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6)))
  + (c2C2 * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) / 6))))), nZ8[z, t] ==
  (((((((((-(C2Q1) * c2C2) * c2C3) + ((M * c2C6) * c2C8)) * Cos[(C2Q1 * t)]) +
  (Sin[(C2Q1 * t)] * (((C2Q1 * c2C2) * c2C4) + ((M * c2C6) * c2C7)))) * (Sin[z] ^
  (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) / 6))) + ((((((C2Q1 * c2C1) * c2C3) - ((M *
  c2C5) * c2C8)) * Cos[(C2Q1 * t)]) - (Sin[(C2Q1 * t)] * (((C2Q1 * c2C1) * c2C4)
  + ((M * c2C5) * c2C7)))) * (Sin[z] ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6)))) +
  (((-(Cos[(M * t)]) * c2C10) + (Sin[(M * t)] * c2C9)) * Sqrt[((-(C2Q1) ^ 2) + (M ^
  2))])) / Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]), nZ9[z, t] == ((((((((((C2Q1 * c2C6) *
  c2C7) + ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1)
  * c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) +
  (M ^ 2))]) / 3))) + ((Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] * ((Cos[(M * t)] * c2C9)
  + (Sin[(M * t)] * c2C10))) * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) /
  6)))) + ((((-(C2Q1) * c2C5) * c2C7) - ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)])) -
  (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3)))) * (Sin[z]
  ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6))) / Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])}
```

In[ ]:=
```
sti =
  "{nZ10(z,t)=(c2C7*sin(C2Q1*t)+c2C8*cos(C2Q1*t))*(c2C5*sin(z)^(1/6*sqrt(-C2Q1^2+M^2))+
    c2C6*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2))),nZ11(z,t)=(c2C3*sin(C2Q1*t)+c2C4*cos(C2Q1*t)
    )*(c2C1*sin(z)^(1/6*sqrt(-C2Q1^2+M^2))+c2C2*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2))),nZ8(z
    ,t)=1/6*(6*sqrt(-C2Q1^2+M^2)*c2C6*(c2C7*sin(C2Q1*t)+c2C8*cos(C2Q1*t))*sin(z)^(-1/6
    *sqrt(-C2Q1^2+M^2))-6*sqrt(-C2Q1^2+M^2)*c2C5*(c2C7*sin(C2Q1*t)+c2C8*cos(C2Q1*t))*
    sin(z)^(1/6*sqrt(-C2Q1^2+M^2))+(-6*M*c2C10-Int(-cos(M*t)*((-C2Q1^2+M^2)*Int(-cos(z
    )*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*c2C8+M*c2C2*
    c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2)-1)+((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)
    +sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3))*sin(z)^(1/6*sqrt(-C2Q1^2+M^2)-1)),z)-6
    *sqrt(-C2Q1^2+M^2)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*
    c2C6*c2C8+M*c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2))-sin(z)^(1/6*sqrt(-C2Q1^2+M
    ^2))*((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1
    *c2C3)))),t))*cos(M*t)+(6*M*c2C9-Int(-sin(M*t)*((-C2Q1^2+M^2)*Int(-cos(z)*(((C2Q1*
    c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*c2C8+M*c2C2*c2C3))*sin(
    z)^(-1/6*sqrt(-C2Q1^2+M^2)-1)+((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t
    )*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3))*sin(z)^(1/6*sqrt(-C2Q1^2+M^2)-1)),z)-6*sqrt(-C2Q1
    ^2+M^2)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*c2C8+M*
    c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2))-sin(z)^(1/6*sqrt(-C2Q1^2+M^2))*((C2Q1*
    c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3)))),t)
    )*sin(M*t)-C2Q1*Int(-cos(z)*(((-C2Q1*c2C6*c2C8+M*c2C2*c2C3)*cos(C2Q1*t)-sin(C2Q1*t
    )*(C2Q1*c2C6*c2C7+M*c2C2*c2C4))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2)-1)+((-C2Q1*c2C5*
    c2C8+M*c2C1*c2C3)*cos(C2Q1*t)-sin(C2Q1*t)*(C2Q1*c2C5*c2C7+M*c2C1*c2C4))*sin(z)^(1/
    6*sqrt(-C2Q1^2+M^2)-1)),z))/M,nZ9(z,t)=1/6*((6*M*c2C9-Int(-sin(M*t)*((-C2Q1^2+M^2)
    *Int(-cos(z)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*
    c2C8+M*c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2)-1)+((C2Q1*c2C5*c2C7+M*c2C1*c2C4)
    *cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3))*sin(z)^(1/6*sqrt(-C2Q1^2+M
    ^2)-1)),z)-6*sqrt(-C2Q1^2+M^2)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1
    *t)*(-C2Q1*c2C6*c2C8+M*c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2))-sin(z)^(1/6*
    sqrt(-C2Q1^2+M^2))*((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*
    c2C5*c2C8+M*c2C1*c2C3)))),t))*cos(M*t)+(6*M*c2C10+Int(-cos(M*t)*((-C2Q1^2+M^2)*Int(-cc
    *c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2)-1)+((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(
    C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3))*sin(z)^(1/6*sqrt(-C2Q1^2+M^2)-1
    )),z)-6*sqrt(-C2Q1^2+M^2)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q
     2Q1^2+M^2))*((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8
    +M*c2C1*c2C3)))),t))*sin(M*t)+M*Int(-cos(z)*(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(
    C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*c2C8+M*c2C2*c2C3))*sin(z)^(-1/6*sqrt(-C2Q1^2+M^2)-
    1)+((C2Q1*c2C5*c2C7+M*c2C1*c2C4)*cos(C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*
    c2C3))*sin(z)^(1/6*sqrt(-C2Q1^2+M^2)-1)),z))/M}";
```

In[ ]:=
```
ConvertMapleToMathematica[sti]
```

Out[ ]=
```
{nZ10[z, t] == (((c2C7 * Sin[(C2Q1 * t)]) + (c2C8 * Cos[(C2Q1 * t)])) * ((c2C5 * (Sin[z]
  ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]))) + (c2C6 * (Sin[z] ^ ((-(1) / 6)
  * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])))), nZ11[z, t] == (((c2C3 * Sin[(C2Q1 * t)])
  + (c2C4 * Cos[(C2Q1 * t)])) * ((c2C1 * (Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^
  2) + (M ^ 2))]))) + (c2C2 * (Sin[z] ^ ((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^
  2))])))), nZ8[z, t] == (((1 / 6) * ((((((((6 * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])
```

```
* c2C6) * ((c2C7 * Sin[(C2Q1 * t)]) + (c2C8 * Cos[(C2Q1 * t)]))) * (Sin[z] ^
((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]))) - ((((6 * Sqrt[((-(C2Q1) ^ 2)
+ (M ^ 2))]) * c2C5) * ((c2C7 * Sin[(C2Q1 * t)]) + (c2C8 * Cos[(C2Q1 * t)]))) *
(Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]))))) + ((((-(6) * M) * c2C10) -
Integrate[(-(Cos[(M * t)]) * ((((-(C2Q1) ^ 2) + (M ^ 2)) * Integrate[(-(Cos[z]) *
(((((((C2Q1 * c2C6) * c2C7) + ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1
* t)] * (((-(C2Q1) * c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ (((-(1)
/ 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))) + ((((((C2Q1 * c2C5) * c2C7) +
((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5)
* c2C8) + ((M * c2C1) * c2C3)))) * (Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) +
(M ^ 2))]) - 1))))), z]) - ((6 * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) * (((((((C2Q1
* c2C6) * c2C7) + ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] *
(((-(C2Q1) * c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ ((-(1) / 6) *
Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])))) - ((Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) +
(M ^ 2))])) * (((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)])
+ (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3))))))))),
t]) * Cos[(M * t)])) + ((((6 * M) * c2C9) - Integrate[(-(Sin[(M * t)]) *
((((-(C2Q1) ^ 2) + (M ^ 2)) * Integrate[(-(Cos[z]) * (((((((C2Q1 * c2C6) * c2C7)
+ ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) *
c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ (((-(1) / 6) * Sqrt[((-(C2Q1)
^ 2) + (M ^ 2))]) - 1))) + ((((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) *
Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1)
* c2C3)))) * (Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))))),
z]) - ((6 * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) * (((((((C2Q1 * c2C6) * c2C7) +
((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C6)
* c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ ((-(1) / 6) * Sqrt[((-(C2Q1) ^
2) + (M ^ 2))])))) - ((Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])) *
(((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1
* t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3)))))))), t]) * Sin[(M
* t)])) - (C2Q1 * Integrate[(-(Cos[z]) * (((((((-(C2Q1) * c2C6) * c2C8) + ((M *
c2C2) * c2C3)) * Cos[(C2Q1 * t)]) - (Sin[(C2Q1 * t)] * (((C2Q1 * c2C6) * c2C7)
+ ((M * c2C2) * c2C4)))) * (Sin[z] ^ (((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^
2))]) - 1))) + ((((((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3)) * Cos[(C2Q1
* t)]) - (Sin[(C2Q1 * t)] * (((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)))) *
(Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))))), z]))) / M),
nZ9[z, t] == (((1 / 6) * ((((((6 * M) * c2C9) - Integrate[(-(Sin[(M * t)]) *
((((-(C2Q1) ^ 2) + (M ^ 2)) * Integrate[(-(Cos[z]) * (((((((C2Q1 * c2C6) * c2C7)
+ ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) *
c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ (((-(1) / 6) * Sqrt[((-(C2Q1)
^ 2) + (M ^ 2))]) - 1))) + ((((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) *
Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1)
* c2C3)))) * (Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))))),
z]) - ((6 * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) * (((((((C2Q1 * c2C6) * c2C7) +
((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C6)
* c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ ((-(1) / 6) * Sqrt[((-(C2Q1) ^
2) + (M ^ 2))])))) - ((Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])) *
(((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1
```

```
* t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3))))))))), t]) * Cos[(M
* t)]) + ((((6 * M) * c2C10) + Integrate[(-(Cos[(M * t)]) * ((((-(C2Q1) ^ 2)
+ (M ^ 2)) * Integrate[(-(Cos[z]) * (((((((C2Q1 * c2C6) * c2C7) + ((M * c2C2)
* c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C6) * c2C8) +
((M * c2C2) * c2C3)))) * (Sin[z] ^ (((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^
2))]) - 1))) + ((((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 *
t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3))))
* (Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))))), z]) - ((6 *
Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) * (((((((C2Q1 * c2C6) * c2C7) + ((M * c2C2)
* c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C6) * c2C8) +
((M * c2C2) * c2C3)))) * (Sin[z] ^ ((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^
2))])))) - ((Sin[z] ^ ((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]))) * (((((C2Q1
* c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)]
* (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3))))))))), t]) * Sin[(M *
t)])) + (M * Integrate[(-(Cos[z]) * (((((((C2Q1 * c2C6) * c2C7) + ((M * c2C2)
* c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C6) * c2C8) +
((M * c2C2) * c2C3)))) * (Sin[z] ^ (((-(1) / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^
2))]) - 1))) + ((((((C2Q1 * c2C5) * c2C7) + ((M * c2C1) * c2C4)) * Cos[(C2Q1 *
t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3))))
* (Sin[z] ^ (((1 / 6) * Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) - 1))))), z])))) / M)}
```

gtry and Γ and ...

In[∘]:=
```
gtry = MatrixMetric44
```

Out[∘]=

$$\{\{\mathrm{Cot}[6\,H\,x0]^2, 0, 0, 0, 0, 0, 0, 0\}, \{0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0, 0\}, \{0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0\}, \{0, 0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0\}, \{0, 0, 0, 0, -1, 0, 0, 0\}, \{0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0\}, \{0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0\}, \{0, 0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}$$

In[∘]:=
```
Protect[gtry]
```

Out[∘]=

{gtry}

In[∘]:=
```
Unprotect[ginv, Γ, RicciΓ, RieΓ, RS, EinsteinG]
```

Out[∘]=

{}

In[∘]:=
```
result = {ginv, Γ, RicciΓ, RieΓ, RS, EinsteinG} = rt[gtry];
```

Tue 9 Dec 2025 05:52:36 GMT−8

{4.66973, Null}

Tue 9 Dec 2025 05:52:41 GMT−8

In[∘]:=
```
Protect[ginv, Γ, RicciΓ, RieΓ, RS, EinsteinG]
```

Out[∘]=

{ginv, Γ, RicciΓ, RieΓ, RS, EinsteinG}

verify $g_{\mu\nu|\alpha} = 0$:

In[∘]:=
```
Simplify[Table[D[gtry⟦j, k⟧, X⟦i⟧] -
    Sum[gtry⟦k, s⟧ × Γ⟦s, i, j⟧, {s, 1, DIM8}] - Sum[gtry⟦j, s⟧ × Γ⟦s, i, k⟧, {s, 1, DIM8}],
   {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}]] // Flatten // Union
```

Out[∘]=
```
{0}
```

In[∘]:=
```
Table[g[j][k] →
   If[j == k, ToExpression["((g[" <> ToString[j] <> "][" <> ToString[k] <> "][#1,#2])&)"],
    (0 &)], {j, 0, 7}, {k, 0, 7}];
sg = % // Flatten
```

Out[∘]=
```
{g[0][0] → (g[0][0][#1, #2] &), g[0][1] → (0 &), g[0][2] → (0 &),
 g[0][3] → (0 &), g[0][4] → (0 &), g[0][5] → (0 &), g[0][6] → (0 &),
 g[0][7] → (0 &), g[1][0] → (0 &), g[1][1] → (g[1][1][#1, #2] &), g[1][2] → (0 &),
 g[1][3] → (0 &), g[1][4] → (0 &), g[1][5] → (0 &), g[1][6] → (0 &),
 g[1][7] → (0 &), g[2][0] → (0 &), g[2][1] → (0 &), g[2][2] → (g[2][2][#1, #2] &),
 g[2][3] → (0 &), g[2][4] → (0 &), g[2][5] → (0 &), g[2][6] → (0 &), g[2][7] → (0 &),
 g[3][0] → (0 &), g[3][1] → (0 &), g[3][2] → (0 &), g[3][3] → (g[3][3][#1, #2] &),
 g[3][4] → (0 &), g[3][5] → (0 &), g[3][6] → (0 &), g[3][7] → (0 &), g[4][0] → (0 &),
 g[4][1] → (0 &), g[4][2] → (0 &), g[4][3] → (0 &), g[4][4] → (g[4][4][#1, #2] &),
 g[4][5] → (0 &), g[4][6] → (0 &), g[4][7] → (0 &), g[5][0] → (0 &), g[5][1] → (0 &),
 g[5][2] → (0 &), g[5][3] → (0 &), g[5][4] → (0 &), g[5][5] → (g[5][5][#1, #2] &),
 g[5][6] → (0 &), g[5][7] → (0 &), g[6][0] → (0 &), g[6][1] → (0 &), g[6][2] → (0 &),
 g[6][3] → (0 &), g[6][4] → (0 &), g[6][5] → (0 &), g[6][6] → (g[6][6][#1, #2] &),
 g[6][7] → (0 &), g[7][0] → (0 &), g[7][1] → (0 &), g[7][2] → (0 &), g[7][3] → (0 &),
 g[7][4] → (0 &), g[7][5] → (0 &), g[7][6] → (0 &), g[7][7] → (g[7][7][#1, #2] &)}
```

In[∘]:=
```
g[7][7][x0, x4] /. ssgm4488
% /. sx0x4
```

Out[∘]=

$$-e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}$$

Out[∘]=

$$-e^{-2\,a4[t]}\,\mathrm{Sin}[z]^{1/3}$$

In[∘]:=
```
MatrixMetric44
```

Out[∘]=

$$\{\{\mathrm{Cot}[6\,H\,x0]^2, 0, 0, 0, 0, 0, 0, 0\}, \{0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0, 0\},$$
$$\{0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0\}, \{0, 0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0\},$$
$$\{0, 0, 0, 0, -1, 0, 0, 0\}, \{0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0\},$$
$$\{0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0\}, \{0, 0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}$$

In[ ]:=
```
ssgm4488[x0, x4] /. sx0x4
```

Out[ ]=

$$\{g[0][0] \to (\mathrm{Cot}[6\,H\,\#1]^2\,\&),\ g[0][1] \to (0\,\&),\ g[0][2] \to (0\,\&),\ g[0][3] \to (0\,\&),$$
$$g[0][4] \to (0\,\&),\ g[0][5] \to (0\,\&),\ g[0][6] \to (0\,\&),\ g[0][7] \to (0\,\&),\ g[1][0] \to (0\,\&),$$
$$g[1][1] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[1][2] \to (0\,\&),\ g[1][3] \to (0\,\&),$$
$$g[1][4] \to (0\,\&),\ g[1][5] \to (0\,\&),\ g[1][6] \to (0\,\&),\ g[1][7] \to (0\,\&),\ g[2][0] \to (0\,\&),$$
$$g[2][1] \to (0\,\&),\ g[2][2] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[2][3] \to (0\,\&),\ g[2][4] \to (0\,\&),$$
$$g[2][5] \to (0\,\&),\ g[2][6] \to (0\,\&),\ g[2][7] \to (0\,\&),\ g[3][0] \to (0\,\&),\ g[3][1] \to (0\,\&),$$
$$g[3][2] \to (0\,\&),\ g[3][3] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[3][4] \to (0\,\&),\ g[3][5] \to (0\,\&),$$
$$g[3][6] \to (0\,\&),\ g[3][7] \to (0\,\&),\ g[4][0] \to (0\,\&),\ g[4][1] \to (0\,\&),\ g[4][2] \to (0\,\&),$$
$$g[4][3] \to (0\,\&),\ g[4][4] \to (-1\,\&),\ g[4][5] \to (0\,\&),\ g[4][6] \to (0\,\&),\ g[4][7] \to (0\,\&),$$
$$g[5][0] \to (0\,\&),\ g[5][1] \to (0\,\&),\ g[5][2] \to (0\,\&),\ g[5][3] \to (0\,\&),\ g[5][4] \to (0\,\&),$$
$$g[5][5] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[5][6] \to (0\,\&),\ g[5][7] \to (0\,\&),$$
$$g[6][0] \to (0\,\&),\ g[6][1] \to (0\,\&),\ g[6][2] \to (0\,\&),\ g[6][3] \to (0\,\&),\ g[6][4] \to (0\,\&),$$
$$g[6][5] \to (0\,\&),\ g[6][6] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[6][7] \to (0\,\&),$$
$$g[7][0] \to (0\,\&),\ g[7][1] \to (0\,\&),\ g[7][2] \to (0\,\&),\ g[7][3] \to (0\,\&),\ g[7][4] \to (0\,\&),$$
$$g[7][5] \to (0\,\&),\ g[7][6] \to (0\,\&),\ g[7][7] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&)\}\left[\frac{z}{6\,H},\ \frac{t}{H}\right]$$

In[ ]:=
```
(*ssgGzt={G[0][0]→((Cot[#1]^2)&),G[0][1]→((0)&),G[0][2]→((0)&),
  G[0][3]→((0)&),G[0][4]→((0)&),G[0][5]→((0)&),G[0][6]→((0)&),G[0][7]→((0)&),
  G[1][0]→((0)&),G[1][1]→((e^(2*A4[#2]) Sin[#1]^(1/3))&),G[1][2]→((0)&),G[1][3]→((0)&),
  G[1][4]→((0)&),G[1][5]→((0)&),G[1][6]→((0)&),G[1][7]→((0)&),G[2][0]→((0)&),
  G[2][1]→((0)&),G[2][2]→((e^(2*A4[#2]) Sin[#1]^(1/3))&),G[2][3]→((0)&),G[2][4]→((0)&),
  G[2][5]→((0)&),G[2][6]→((0)&),G[2][7]→((0)&),G[3][0]→((0)&),G[3][1]→((0)&),
  G[3][2]→((0)&),G[3][3]→((e^(2*A4[#2]) Sin[#1]^(1/3))&),G[3][4]→((0)&),G[3][5]→((0)&),
  G[3][6]→((0)&),G[3][7]→((0)&),G[4][0]→((0)&),G[4][1]→((0)&),G[4][2]→((0)&),
  G[4][3]→((0)&),G[4][4]→((-1)&),G[4][5]→((0)&),G[4][6]→((0)&),G[4][7]→((0)&),
  G[5][0]→((0)&),G[5][1]→((0)&),G[5][2]→((0)&),G[5][3]→((0)&),G[5][4]→((0)&),
  G[5][5]→((-e^(-2*A4[#2]) Sin[#1]^(1/3))&),G[5][6]→((0)&),G[5][7]→((0)&),
  G[6][0]→((0)&),G[6][1]→((0)&),G[6][2]→((0)&),G[6][3]→((0)&),G[6][4]→((0)&),
  G[6][5]→((0)&),G[6][6]→((-e^(-2*A4[#2]) Sin[#1]^(1/3))&),G[6][7]→((0)&),
  G[7][0]→((0)&),G[7][1]→((0)&),G[7][2]→((0)&),G[7][3]→((0)&),G[7][4]→((0)&),
  G[7][5]→((0)&),G[7][6]→((0)&),G[7][7]→((-e^(-2*A4[#2]) Sin[#1]^(1/3))&)}*)
```

In[ ]:=
```
(*G[#][#][z,t]/.ssgGzt&/@Range[0,7]*)
```

In[ ]:=
```
detgg = Det[g4488 /. sg] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$g[0][0][x0, x4] \times g[1][1][x0, x4] \times g[2][2][x0, x4] \times g[3][3][x0, x4] \times g[4][4][x0, x4] \times g[5][5][x0, x4] \times g[6][6][x0, x4] \times g[7][7][x0, x4]$$

In[ ]:=
```
g4488 /. sg // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} g[0][0][x0, x4] & 0 & 0 & 0 & 0 & 0 \\ 0 & g[1][1][x0, x4] & 0 & 0 & 0 & 0 \\ 0 & 0 & g[2][2][x0, x4] & 0 & 0 & 0 \\ 0 & 0 & 0 & g[3][3][x0, x4] & 0 & 0 \\ 0 & 0 & 0 & 0 & g[4][4][x0, x4] & 0 \\ 0 & 0 & 0 & 0 & 0 & g[5][5][x0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
MatrixMetric44.η4488
(*eAa=*)FullSimplify[√%, constraintVars]
```

Out[ ]=

$$\{\{\mathrm{Cot}[6\,H\,x0]^2, 0, 0, 0, 0, 0, 0, 0\}, \{0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0, 0\}, \{0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0\}, \{0, 0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0\}, \{0, 0, 0, 0, 1, 0, 0, 0\}, \{0, 0, 0, 0, 0, e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0\}, \{0, 0, 0, 0, 0, 0, e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0\}, \{0, 0, 0, 0, 0, 0, 0, e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}$$

Out[ ]=

$$\{\{\mathrm{Cot}[6\,H\,x0], 0, 0, 0, 0, 0, 0, 0\}, \{0, \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}, 0, 0, 0, 0, 0, 0\}, \{0, 0, \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}, 0, 0, 0, 0, 0\}, \{0, 0, 0, \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}, 0, 0, 0, 0\}, \{0, 0, 0, 0, 1, 0, 0, 0\}, \{0, 0, 0, 0, 0, \sqrt{e^{-2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}, 0, 0\}, \{0, 0, 0, 0, 0, 0, \sqrt{e^{-2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}, 0\}, \{0, 0, 0, 0, 0, 0, 0, \sqrt{e^{-2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6}\}\}$$

eAa

In[ ]:=
```
g4488.η4488 /. sg
(eAa = FullSimplify[√%, constraintVars]) // MatrixForm
```

Out[ ]=

$$\{\{g[0][0][x0, x4], 0, 0, 0, 0, 0, 0, 0\}, \{0, g[1][1][x0, x4], 0, 0, 0, 0, 0, 0\}, \{0, 0, g[2][2][x0, x4], 0, 0, 0, 0, 0\}, \{0, 0, 0, g[3][3][x0, x4], 0, 0, 0, 0\}, \{0, 0, 0, 0, -g[4][4][x0, x4], 0, 0, 0\}, \{0, 0, 0, 0, 0, -g[5][5][x0, x4], 0, 0\}, \{0, 0, 0, 0, 0, 0, -g[6][6][x0, x4], 0\}, \{0, 0, 0, 0, 0, 0, 0, -g[7][7][x0, x4]\}\}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} \sqrt{g[0][0][x0, x4]} & 0 & 0 & 0 & 0 \\ 0 & \sqrt{g[1][1][x0, x4]} & 0 & 0 & 0 \\ 0 & 0 & \sqrt{g[2][2][x0, x4]} & 0 & 0 \\ 0 & 0 & 0 & \sqrt{g[3][3][x0, x4]} & 0 \\ 0 & 0 & 0 & 0 & \sqrt{-g[4][4][x0, x4]} \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
eAa
ssgm4488
(eAa04 = %% /. % // FullSimplify[#, constraintVars] &) // MatrixForm
```

Out[ ]=

$$\{\{\sqrt{g[0][0][x0, x4]}, 0, 0, 0, 0, 0, 0, 0\}, \{0, \sqrt{g[1][1][x0, x4]}, 0, 0, 0, 0, 0, 0\}, \{0, 0, \sqrt{g[2][2][x0, x4]}, 0, 0, 0, 0, 0\}, \{0, 0, 0, \sqrt{g[3][3][x0, x4]}, 0, 0, 0, 0\}, \{0, 0, 0, 0, \sqrt{-g[4][4][x0, x4]}, 0, 0, 0\}, \{0, 0, 0, 0, 0, \sqrt{-g[5][5][x0, x4]}, 0, 0\}, \{0, 0, 0, 0, 0, 0, \sqrt{-g[6][6][x0, x4]}, 0\}, \{0, 0, 0, 0, 0, 0, 0, \sqrt{-g[7][7][x0, x4]}\}\}$$

Out[ ]=

$$\{g[0][0] \to (\mathrm{Cot}[6\,H\,\#1]^2\,\&),\ g[0][1] \to (0\,\&),\ g[0][2] \to (0\,\&),\ g[0][3] \to (0\,\&),$$
$$g[0][4] \to (0\,\&),\ g[0][5] \to (0\,\&),\ g[0][6] \to (0\,\&),\ g[0][7] \to (0\,\&),\ g[1][0] \to (0\,\&),$$
$$g[1][1] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[1][2] \to (0\,\&),\ g[1][3] \to (0\,\&),$$
$$g[1][4] \to (0\,\&),\ g[1][5] \to (0\,\&),\ g[1][6] \to (0\,\&),\ g[1][7] \to (0\,\&),\ g[2][0] \to (0\,\&),$$
$$g[2][1] \to (0\,\&),\ g[2][2] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[2][3] \to (0\,\&),\ g[2][4] \to (0\,\&),$$
$$g[2][5] \to (0\,\&),\ g[2][6] \to (0\,\&),\ g[2][7] \to (0\,\&),\ g[3][0] \to (0\,\&),\ g[3][1] \to (0\,\&),$$
$$g[3][2] \to (0\,\&),\ g[3][3] \to (e^{2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[3][4] \to (0\,\&),\ g[3][5] \to (0\,\&),$$
$$g[3][6] \to (0\,\&),\ g[3][7] \to (0\,\&),\ g[4][0] \to (0\,\&),\ g[4][1] \to (0\,\&),\ g[4][2] \to (0\,\&),$$
$$g[4][3] \to (0\,\&),\ g[4][4] \to (-1\,\&),\ g[4][5] \to (0\,\&),\ g[4][6] \to (0\,\&),\ g[4][7] \to (0\,\&),$$
$$g[5][0] \to (0\,\&),\ g[5][1] \to (0\,\&),\ g[5][2] \to (0\,\&),\ g[5][3] \to (0\,\&),\ g[5][4] \to (0\,\&),$$
$$g[5][5] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[5][6] \to (0\,\&),\ g[5][7] \to (0\,\&),$$
$$g[6][0] \to (0\,\&),\ g[6][1] \to (0\,\&),\ g[6][2] \to (0\,\&),\ g[6][3] \to (0\,\&),\ g[6][4] \to (0\,\&),$$
$$g[6][5] \to (0\,\&),\ g[6][6] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&),\ g[6][7] \to (0\,\&),$$
$$g[7][0] \to (0\,\&),\ g[7][1] \to (0\,\&),\ g[7][2] \to (0\,\&),\ g[7][3] \to (0\,\&),\ g[7][4] \to (0\,\&),$$
$$g[7][5] \to (0\,\&),\ g[7][6] \to (0\,\&),\ g[7][7] \to (-e^{-2\,a4[H\,\#2]}\,\mathrm{Sin}[6\,H\,\#1]^{1/3}\,\&)\}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} \mathrm{Cot}[6\,H\,x0] & 0 & 0 & 0 & 0 \\ 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 & 0 & 0 \\ 0 & 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 & 0 \\ 0 & 0 & 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad \sqrt{e^{-2\,a4}}$$

OCTAD $e_{\alpha}^{(A)}$ ← Lorentz, ← spacetime :

- $e_{\alpha}^{(A)} = e_{\alpha}^{(A)} = eAa$

In[∘]:=
```
(sge_α^(A) = Thread[Flatten[e_α^(A)] → Flatten[eAa]]) (*//Column*)
```

Out[∘]=

$$\{E_{\alpha}^{(A)}[0,0] \to \sqrt{g[0][0][x0,x4]},\ E_{\alpha}^{(A)}[0,1] \to 0,\ E_{\alpha}^{(A)}[0,2] \to 0,\ E_{\alpha}^{(A)}[0,3] \to 0,\ E_{\alpha}^{(A)}[0,4] \to 0,$$
$$E_{\alpha}^{(A)}[0,5] \to 0,\ E_{\alpha}^{(A)}[0,6] \to 0,\ E_{\alpha}^{(A)}[0,7] \to 0,\ E_{\alpha}^{(A)}[1,0] \to 0,\ E_{\alpha}^{(A)}[1,1] \to \sqrt{g[1][1][x0,x4]},$$
$$E_{\alpha}^{(A)}[1,2] \to 0,\ E_{\alpha}^{(A)}[1,3] \to 0,\ E_{\alpha}^{(A)}[1,4] \to 0,\ E_{\alpha}^{(A)}[1,5] \to 0,\ E_{\alpha}^{(A)}[1,6] \to 0,\ E_{\alpha}^{(A)}[1,7] \to 0,$$
$$E_{\alpha}^{(A)}[2,0] \to 0,\ E_{\alpha}^{(A)}[2,1] \to 0,\ E_{\alpha}^{(A)}[2,2] \to \sqrt{g[2][2][x0,x4]},\ E_{\alpha}^{(A)}[2,3] \to 0,\ E_{\alpha}^{(A)}[2,4] \to 0,$$
$$E_{\alpha}^{(A)}[2,5] \to 0,\ E_{\alpha}^{(A)}[2,6] \to 0,\ E_{\alpha}^{(A)}[2,7] \to 0,\ E_{\alpha}^{(A)}[3,0] \to 0,\ E_{\alpha}^{(A)}[3,1] \to 0,\ E_{\alpha}^{(A)}[3,2] \to 0,$$
$$E_{\alpha}^{(A)}[3,3] \to \sqrt{g[3][3][x0,x4]},\ E_{\alpha}^{(A)}[3,4] \to 0,\ E_{\alpha}^{(A)}[3,5] \to 0,\ E_{\alpha}^{(A)}[3,6] \to 0,\ E_{\alpha}^{(A)}[3,7] \to 0,$$
$$E_{\alpha}^{(A)}[4,0] \to 0,\ E_{\alpha}^{(A)}[4,1] \to 0,\ E_{\alpha}^{(A)}[4,2] \to 0,\ E_{\alpha}^{(A)}[4,3] \to 0,\ E_{\alpha}^{(A)}[4,4] \to \sqrt{-g[4][4][x0,x4]},$$
$$E_{\alpha}^{(A)}[4,5] \to 0,\ E_{\alpha}^{(A)}[4,6] \to 0,\ E_{\alpha}^{(A)}[4,7] \to 0,\ E_{\alpha}^{(A)}[5,0] \to 0,\ E_{\alpha}^{(A)}[5,1] \to 0,\ E_{\alpha}^{(A)}[5,2] \to 0,$$
$$E_{\alpha}^{(A)}[5,3] \to 0,\ E_{\alpha}^{(A)}[5,4] \to 0,\ E_{\alpha}^{(A)}[5,5] \to \sqrt{-g[5][5][x0,x4]},\ E_{\alpha}^{(A)}[5,6] \to 0,\ E_{\alpha}^{(A)}[5,7] \to 0,$$
$$E_{\alpha}^{(A)}[6,0] \to 0,\ E_{\alpha}^{(A)}[6,1] \to 0,\ E_{\alpha}^{(A)}[6,2] \to 0,\ E_{\alpha}^{(A)}[6,3] \to 0,\ E_{\alpha}^{(A)}[6,4] \to 0,\ E_{\alpha}^{(A)}[6,5] \to 0,$$
$$E_{\alpha}^{(A)}[6,6] \to \sqrt{-g[6][6][x0,x4]},\ E_{\alpha}^{(A)}[6,7] \to 0,\ E_{\alpha}^{(A)}[7,0] \to 0,\ E_{\alpha}^{(A)}[7,1] \to 0,\ E_{\alpha}^{(A)}[7,2] \to 0,$$
$$E_{\alpha}^{(A)}[7,3] \to 0,\ E_{\alpha}^{(A)}[7,4] \to 0,\ E_{\alpha}^{(A)}[7,5] \to 0,\ E_{\alpha}^{(A)}[7,6] \to 0,\ E_{\alpha}^{(A)}[7,7] \to \sqrt{-g[7][7][x0,x4]}\}$$

In[∘]:=
```
(*Symbolize[sge_α^(A)]*)
```

In[∘]:=
```
(*Symbolize[sgtrye_α^(A)]*)
```

In[∘]:=
```
(sgtrye_α^(A) = Thread[Flatten[e_α^(A)] → Flatten[eAa04]]) (*//Column*)
```

Out[∘]=

$$\{E_{\alpha}^{(A)}[0,0] \to \mathrm{Cot}[6\,H\,x0],\ E_{\alpha}^{(A)}[0,1] \to 0,\ E_{\alpha}^{(A)}[0,2] \to 0,\ E_{\alpha}^{(A)}[0,3] \to 0,$$
$$E_{\alpha}^{(A)}[0,4] \to 0,\ E_{\alpha}^{(A)}[0,5] \to 0,\ E_{\alpha}^{(A)}[0,6] \to 0,\ E_{\alpha}^{(A)}[0,7] \to 0,\ E_{\alpha}^{(A)}[1,0] \to 0,$$
$$E_{\alpha}^{(A)}[1,1] \to \sqrt{e^{2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6},\ E_{\alpha}^{(A)}[1,2] \to 0,\ E_{\alpha}^{(A)}[1,3] \to 0,\ E_{\alpha}^{(A)}[1,4] \to 0,$$
$$E_{\alpha}^{(A)}[1,5] \to 0,\ E_{\alpha}^{(A)}[1,6] \to 0,\ E_{\alpha}^{(A)}[1,7] \to 0,\ E_{\alpha}^{(A)}[2,0] \to 0,\ E_{\alpha}^{(A)}[2,1] \to 0,$$
$$E_{\alpha}^{(A)}[2,2] \to \sqrt{e^{2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6},\ E_{\alpha}^{(A)}[2,3] \to 0,\ E_{\alpha}^{(A)}[2,4] \to 0,\ E_{\alpha}^{(A)}[2,5] \to 0,$$
$$E_{\alpha}^{(A)}[2,6] \to 0,\ E_{\alpha}^{(A)}[2,7] \to 0,\ E_{\alpha}^{(A)}[3,0] \to 0,\ E_{\alpha}^{(A)}[3,1] \to 0,\ E_{\alpha}^{(A)}[3,2] \to 0,$$
$$E_{\alpha}^{(A)}[3,3] \to \sqrt{e^{2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6},\ E_{\alpha}^{(A)}[3,4] \to 0,\ E_{\alpha}^{(A)}[3,5] \to 0,\ E_{\alpha}^{(A)}[3,6] \to 0,$$
$$E_{\alpha}^{(A)}[3,7] \to 0,\ E_{\alpha}^{(A)}[4,0] \to 0,\ E_{\alpha}^{(A)}[4,1] \to 0,\ E_{\alpha}^{(A)}[4,2] \to 0,\ E_{\alpha}^{(A)}[4,3] \to 0,$$
$$E_{\alpha}^{(A)}[4,4] \to 1,\ E_{\alpha}^{(A)}[4,5] \to 0,\ E_{\alpha}^{(A)}[4,6] \to 0,\ E_{\alpha}^{(A)}[4,7] \to 0,\ E_{\alpha}^{(A)}[5,0] \to 0,\ E_{\alpha}^{(A)}[5,1] \to 0,$$
$$E_{\alpha}^{(A)}[5,2] \to 0,\ E_{\alpha}^{(A)}[5,3] \to 0,\ E_{\alpha}^{(A)}[5,4] \to 0,\ E_{\alpha}^{(A)}[5,5] \to \sqrt{e^{-2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6},$$
$$E_{\alpha}^{(A)}[5,6] \to 0,\ E_{\alpha}^{(A)}[5,7] \to 0,\ E_{\alpha}^{(A)}[6,0] \to 0,\ E_{\alpha}^{(A)}[6,1] \to 0,\ E_{\alpha}^{(A)}[6,2] \to 0,$$
$$E_{\alpha}^{(A)}[6,3] \to 0,\ E_{\alpha}^{(A)}[6,4] \to 0,\ E_{\alpha}^{(A)}[6,5] \to 0,\ E_{\alpha}^{(A)}[6,6] \to \sqrt{e^{-2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6},$$
$$E_{\alpha}^{(A)}[6,7] \to 0,\ E_{\alpha}^{(A)}[7,0] \to 0,\ E_{\alpha}^{(A)}[7,1] \to 0,\ E_{\alpha}^{(A)}[7,2] \to 0,\ E_{\alpha}^{(A)}[7,3] \to 0,$$
$$E_{\alpha}^{(A)}[7,4] \to 0,\ E_{\alpha}^{(A)}[7,5] \to 0,\ E_{\alpha}^{(A)}[7,6] \to 0,\ E_{\alpha}^{(A)}[7,7] \to \sqrt{e^{-2\,a4[H\,x4]}}\ \mathrm{Sin}[6\,H\,x0]^{1/6}\}$$

In[ ]:=
```
(sgtrye^α_(A) = Thread[Flatten[e^α_(A)] → Flatten[Inverse[e^(A)_α /. sgtrye^(A)_α]]]) (*//Column*)
```

Out[ ]=

$$\left\{E^{\alpha}_{(A)}[0,0]\to \text{Tan}[6\,H\,x0],\ E^{\alpha}_{(A)}[0,1]\to 0,\ E^{\alpha}_{(A)}[0,2]\to 0,\ E^{\alpha}_{(A)}[0,3]\to 0,\right.$$
$$E^{\alpha}_{(A)}[0,4]\to 0,\ E^{\alpha}_{(A)}[0,5]\to 0,\ E^{\alpha}_{(A)}[0,6]\to 0,\ E^{\alpha}_{(A)}[0,7]\to 0,\ E^{\alpha}_{(A)}[1,0]\to 0,$$
$$E^{\alpha}_{(A)}[1,1]\to \frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},\ E^{\alpha}_{(A)}[1,2]\to 0,\ E^{\alpha}_{(A)}[1,3]\to 0,\ E^{\alpha}_{(A)}[1,4]\to 0,$$
$$E^{\alpha}_{(A)}[1,5]\to 0,\ E^{\alpha}_{(A)}[1,6]\to 0,\ E^{\alpha}_{(A)}[1,7]\to 0,\ E^{\alpha}_{(A)}[2,0]\to 0,\ E^{\alpha}_{(A)}[2,1]\to 0,$$
$$E^{\alpha}_{(A)}[2,2]\to \frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},\ E^{\alpha}_{(A)}[2,3]\to 0,\ E^{\alpha}_{(A)}[2,4]\to 0,\ E^{\alpha}_{(A)}[2,5]\to 0,$$
$$E^{\alpha}_{(A)}[2,6]\to 0,\ E^{\alpha}_{(A)}[2,7]\to 0,\ E^{\alpha}_{(A)}[3,0]\to 0,\ E^{\alpha}_{(A)}[3,1]\to 0,\ E^{\alpha}_{(A)}[3,2]\to 0,$$
$$E^{\alpha}_{(A)}[3,3]\to \frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},\ E^{\alpha}_{(A)}[3,4]\to 0,\ E^{\alpha}_{(A)}[3,5]\to 0,\ E^{\alpha}_{(A)}[3,6]\to 0,$$
$$E^{\alpha}_{(A)}[3,7]\to 0,\ E^{\alpha}_{(A)}[4,0]\to 0,\ E^{\alpha}_{(A)}[4,1]\to 0,\ E^{\alpha}_{(A)}[4,2]\to 0,\ E^{\alpha}_{(A)}[4,3]\to 0,$$
$$E^{\alpha}_{(A)}[4,4]\to 1,\ E^{\alpha}_{(A)}[4,5]\to 0,\ E^{\alpha}_{(A)}[4,6]\to 0,\ E^{\alpha}_{(A)}[4,7]\to 0,\ E^{\alpha}_{(A)}[5,0]\to 0,\ E^{\alpha}_{(A)}[5,1]\to 0,$$
$$E^{\alpha}_{(A)}[5,2]\to 0,\ E^{\alpha}_{(A)}[5,3]\to 0,\ E^{\alpha}_{(A)}[5,4]\to 0,\ E^{\alpha}_{(A)}[5,5]\to \frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},$$
$$E^{\alpha}_{(A)}[5,6]\to 0,\ E^{\alpha}_{(A)}[5,7]\to 0,\ E^{\alpha}_{(A)}[6,0]\to 0,\ E^{\alpha}_{(A)}[6,1]\to 0,\ E^{\alpha}_{(A)}[6,2]\to 0,$$
$$E^{\alpha}_{(A)}[6,3]\to 0,\ E^{\alpha}_{(A)}[6,4]\to 0,\ E^{\alpha}_{(A)}[6,5]\to 0,\ E^{\alpha}_{(A)}[6,6]\to \frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},$$
$$E^{\alpha}_{(A)}[6,7]\to 0,\ E^{\alpha}_{(A)}[7,0]\to 0,\ E^{\alpha}_{(A)}[7,1]\to 0,\ E^{\alpha}_{(A)}[7,2]\to 0,\ E^{\alpha}_{(A)}[7,3]\to 0,$$
$$\left.E^{\alpha}_{(A)}[7,4]\to 0,\ E^{\alpha}_{(A)}[7,5]\to 0,\ E^{\alpha}_{(A)}[7,6]\to 0,\ E^{\alpha}_{(A)}[7,7]\to \frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}}\right\}$$

In[ ]:=
```
gtrye^(A)_α = (e^(A)_α /. sgtrye^(A)_α) /. subsDefects
```

Out[ ]=

$$\{\{\text{Cot}[6\,H\,x0],0,0,0,0,0,0,0\},\{0,e^{a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0,0\},$$
$$\{0,0,e^{a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0\},\{0,0,0,e^{a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6},0,0,0,0\},$$
$$\{0,0,0,0,1,0,0,0\},\{0,0,0,0,0,e^{-a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6},0,0\},$$
$$\{0,0,0,0,0,0,e^{-a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6},0\},\{0,0,0,0,0,0,0,e^{-a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/6}\}\}$$

In[ ]:=
```
gtrye^α_(A) = (e^α_(A) /. sgtrye^α_(A)) /. subsDefects
```

Out[ ]=

$$\left\{\{\text{Tan}[6\,H\,x0],0,0,0,0,0,0,0\},\left\{0,\frac{e^{-a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0,0,0\right\},\right.$$
$$\left\{0,0,\frac{e^{-a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0,0\right\},\left\{0,0,0,\frac{e^{-a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0\right\},$$
$$\{0,0,0,0,1,0,0,0\},\left\{0,0,0,0,0,\frac{e^{a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}},0,0\right\},$$
$$\left.\left\{0,0,0,0,0,0,\frac{e^{a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}},0\right\},\left\{0,0,0,0,0,0,0,\frac{e^{a4[H\,x4]}}{\text{Sin}[6\,H\,x0]^{1/6}}\right\}\right\}$$

In[ ]:=
```
e_α^(A)
% /. sgtrye_α^(A) // MatrixForm
```

Out[ ]=

$$\{\{E_\alpha^{(A)}[0,0], E_\alpha^{(A)}[0,1], E_\alpha^{(A)}[0,2], E_\alpha^{(A)}[0,3], E_\alpha^{(A)}[0,4], E_\alpha^{(A)}[0,5], E_\alpha^{(A)}[0,6], E_\alpha^{(A)}[0,7]\},$$
$$\{E_\alpha^{(A)}[1,0], E_\alpha^{(A)}[1,1], E_\alpha^{(A)}[1,2], E_\alpha^{(A)}[1,3], E_\alpha^{(A)}[1,4], E_\alpha^{(A)}[1,5], E_\alpha^{(A)}[1,6], E_\alpha^{(A)}[1,7]\},$$
$$\{E_\alpha^{(A)}[2,0], E_\alpha^{(A)}[2,1], E_\alpha^{(A)}[2,2], E_\alpha^{(A)}[2,3], E_\alpha^{(A)}[2,4], E_\alpha^{(A)}[2,5], E_\alpha^{(A)}[2,6], E_\alpha^{(A)}[2,7]\},$$
$$\{E_\alpha^{(A)}[3,0], E_\alpha^{(A)}[3,1], E_\alpha^{(A)}[3,2], E_\alpha^{(A)}[3,3], E_\alpha^{(A)}[3,4], E_\alpha^{(A)}[3,5], E_\alpha^{(A)}[3,6], E_\alpha^{(A)}[3,7]\},$$
$$\{E_\alpha^{(A)}[4,0], E_\alpha^{(A)}[4,1], E_\alpha^{(A)}[4,2], E_\alpha^{(A)}[4,3], E_\alpha^{(A)}[4,4], E_\alpha^{(A)}[4,5], E_\alpha^{(A)}[4,6], E_\alpha^{(A)}[4,7]\},$$
$$\{E_\alpha^{(A)}[5,0], E_\alpha^{(A)}[5,1], E_\alpha^{(A)}[5,2], E_\alpha^{(A)}[5,3], E_\alpha^{(A)}[5,4], E_\alpha^{(A)}[5,5], E_\alpha^{(A)}[5,6], E_\alpha^{(A)}[5,7]\},$$
$$\{E_\alpha^{(A)}[6,0], E_\alpha^{(A)}[6,1], E_\alpha^{(A)}[6,2], E_\alpha^{(A)}[6,3], E_\alpha^{(A)}[6,4], E_\alpha^{(A)}[6,5], E_\alpha^{(A)}[6,6], E_\alpha^{(A)}[6,7]\},$$
$$\{E_\alpha^{(A)}[7,0], E_\alpha^{(A)}[7,1], E_\alpha^{(A)}[7,2], E_\alpha^{(A)}[7,3], E_\alpha^{(A)}[7,4], E_\alpha^{(A)}[7,5], E_\alpha^{(A)}[7,6], E_\alpha^{(A)}[7,7]\}\}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} \mathrm{Cot}[6\,H\,x0] & 0 & 0 & 0 & 0 & \\ 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 & 0 & 0 & \\ 0 & 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 & 0 & \\ 0 & 0 & 0 & \sqrt{e^{2\,a4[H\,x4]}}\,\mathrm{Sin}[6\,H\,x0]^{1/6} & 0 & \\ 0 & 0 & 0 & 0 & 1 & \\ 0 & 0 & 0 & 0 & 0 & \sqrt{e^{-2\,a4}} \\ 0 & 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 0 & 0 & \end{pmatrix}$$

In[ ]:=
```
eηe = FullSimplify[Transpose[e_α^(A)].η4488.e_α^(A), constraintVars];
% /. sge_α^(A)
%% /. sgtrye_α^(A)
% == gtry // FullSimplify[#, constraintVars] &
```

Out[ ]=

```
{{g[0][0][x0, x4], 0, 0, 0, 0, 0, 0, 0}, {0, g[1][1][x0, x4], 0, 0, 0, 0, 0, 0},
 {0, 0, g[2][2][x0, x4], 0, 0, 0, 0, 0}, {0, 0, 0, g[3][3][x0, x4], 0, 0, 0, 0},
 {0, 0, 0, 0, g[4][4][x0, x4], 0, 0, 0}, {0, 0, 0, 0, 0, g[5][5][x0, x4], 0, 0},
 {0, 0, 0, 0, 0, 0, g[6][6][x0, x4], 0}, {0, 0, 0, 0, 0, 0, 0, g[7][7][x0, x4]}}
```

Out[ ]=

$$\{\{\mathrm{Cot}[6\,H\,x0]^2, 0, 0, 0, 0, 0, 0, 0\}, \{0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0, 0\},$$
$$\{0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0\}, \{0, 0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0\},$$
$$\{0, 0, 0, 0, -1, 0, 0, 0\}, \{0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0\},$$
$$\{0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0\}, \{0, 0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}$$

Out[ ]=

True

In[ ]:=
```
gtry
```

Out[ ]=

$$\{\{\mathrm{Cot}[6\,H\,x0]^2, 0, 0, 0, 0, 0, 0, 0\}, \{0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0, 0\},$$
$$\{0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0, 0\}, \{0, 0, 0, e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0, 0, 0\},$$
$$\{0, 0, 0, 0, -1, 0, 0, 0\}, \{0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0, 0\},$$
$$\{0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}, 0\}, \{0, 0, 0, 0, 0, 0, 0, -e^{-2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}$$

In[ ]:=
```
(*FullSimplify[Transpose[e_α^(A)].η4488.e_α^(A),constraintVars]-MatrixMetric44*)
```

In[ ]:=
```
ssgm4488
```

Out[ ]=
```
{g[0][0] → (Cot[6 H #1]^2 &), g[0][1] → (0 &), g[0][2] → (0 &), g[0][3] → (0 &),
 g[0][4] → (0 &), g[0][5] → (0 &), g[0][6] → (0 &), g[0][7] → (0 &), g[1][0] → (0 &),
 g[1][1] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[1][2] → (0 &), g[1][3] → (0 &),
 g[1][4] → (0 &), g[1][5] → (0 &), g[1][6] → (0 &), g[1][7] → (0 &), g[2][0] → (0 &),
 g[2][1] → (0 &), g[2][2] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[2][3] → (0 &), g[2][4] → (0 &),
 g[2][5] → (0 &), g[2][6] → (0 &), g[2][7] → (0 &), g[3][0] → (0 &), g[3][1] → (0 &),
 g[3][2] → (0 &), g[3][3] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[3][4] → (0 &), g[3][5] → (0 &),
 g[3][6] → (0 &), g[3][7] → (0 &), g[4][0] → (0 &), g[4][1] → (0 &), g[4][2] → (0 &),
 g[4][3] → (0 &), g[4][4] → (-1 &), g[4][5] → (0 &), g[4][6] → (0 &), g[4][7] → (0 &),
 g[5][0] → (0 &), g[5][1] → (0 &), g[5][2] → (0 &), g[5][3] → (0 &), g[5][4] → (0 &),
 g[5][5] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[5][6] → (0 &), g[5][7] → (0 &),
 g[6][0] → (0 &), g[6][1] → (0 &), g[6][2] → (0 &), g[6][3] → (0 &), g[6][4] → (0 &),
 g[6][5] → (0 &), g[6][6] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[6][7] → (0 &),
 g[7][0] → (0 &), g[7][1] → (0 &), g[7][2] → (0 &), g[7][3] → (0 &), g[7][4] → (0 &),
 g[7][5] → (0 &), g[7][6] → (0 &), g[7][7] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &)}
```

In[ ]:=
```
MatrixMetric44 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} \mathrm{Cot}[6\,H\,x0]^2 & 0 & 0 & 0 & 0 \\ 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 & 0 \\ 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 \\ 0 & 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 \\ 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad -e^{-2\,a4[H\,x4]}\,S$$

In[ ]:=
```
e_α^(A)
```

Out[ ]=
```
{{E_α^(A)[0, 0], E_α^(A)[0, 1], E_α^(A)[0, 2], E_α^(A)[0, 3], E_α^(A)[0, 4], E_α^(A)[0, 5], E_α^(A)[0, 6], E_α^(A)[0, 7]},
 {E_α^(A)[1, 0], E_α^(A)[1, 1], E_α^(A)[1, 2], E_α^(A)[1, 3], E_α^(A)[1, 4], E_α^(A)[1, 5], E_α^(A)[1, 6], E_α^(A)[1, 7]},
 {E_α^(A)[2, 0], E_α^(A)[2, 1], E_α^(A)[2, 2], E_α^(A)[2, 3], E_α^(A)[2, 4], E_α^(A)[2, 5], E_α^(A)[2, 6], E_α^(A)[2, 7]},
 {E_α^(A)[3, 0], E_α^(A)[3, 1], E_α^(A)[3, 2], E_α^(A)[3, 3], E_α^(A)[3, 4], E_α^(A)[3, 5], E_α^(A)[3, 6], E_α^(A)[3, 7]},
 {E_α^(A)[4, 0], E_α^(A)[4, 1], E_α^(A)[4, 2], E_α^(A)[4, 3], E_α^(A)[4, 4], E_α^(A)[4, 5], E_α^(A)[4, 6], E_α^(A)[4, 7]},
 {E_α^(A)[5, 0], E_α^(A)[5, 1], E_α^(A)[5, 2], E_α^(A)[5, 3], E_α^(A)[5, 4], E_α^(A)[5, 5], E_α^(A)[5, 6], E_α^(A)[5, 7]},
 {E_α^(A)[6, 0], E_α^(A)[6, 1], E_α^(A)[6, 2], E_α^(A)[6, 3], E_α^(A)[6, 4], E_α^(A)[6, 5], E_α^(A)[6, 6], E_α^(A)[6, 7]},
 {E_α^(A)[7, 0], E_α^(A)[7, 1], E_α^(A)[7, 2], E_α^(A)[7, 3], E_α^(A)[7, 4], E_α^(A)[7, 5], E_α^(A)[7, 6], E_α^(A)[7, 7]}}
```

In[ ]:=
```
Block[{s, r}, s = FullSimplify[e_α^(A) /. sgtrye_α^(A), constraintVars];
 r = FullSimplify[Transpose[s].η4488.s, constraintVars] - MatrixMetric44;
 FullSimplify[r, constraintVars]]
```

Out[ ]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

In[ ]:=
```
(*(e_α^(A) =eAa)//MatrixForm*)
```

In[ ]:=
```
(*e_α^(A)
 Inverse[%]*)
```

In[ ]:=
```
(*(e^α_(A) =Inverse[e_α^(A) /.sge_Subsuperscript_α_and_LeftParenthesis_A_RightParenthesis])//
 MatrixForm*)
```

In[ ]:= $e^{\alpha}_{(A)}$

Out[ ]=

$$\begin{aligned}
&\{\{E^{\alpha}_{(A)}[0,0], E^{\alpha}_{(A)}[0,1], E^{\alpha}_{(A)}[0,2], E^{\alpha}_{(A)}[0,3], E^{\alpha}_{(A)}[0,4], E^{\alpha}_{(A)}[0,5], E^{\alpha}_{(A)}[0,6], E^{\alpha}_{(A)}[0,7]\},\\
&\{E^{\alpha}_{(A)}[1,0], E^{\alpha}_{(A)}[1,1], E^{\alpha}_{(A)}[1,2], E^{\alpha}_{(A)}[1,3], E^{\alpha}_{(A)}[1,4], E^{\alpha}_{(A)}[1,5], E^{\alpha}_{(A)}[1,6], E^{\alpha}_{(A)}[1,7]\},\\
&\{E^{\alpha}_{(A)}[2,0], E^{\alpha}_{(A)}[2,1], E^{\alpha}_{(A)}[2,2], E^{\alpha}_{(A)}[2,3], E^{\alpha}_{(A)}[2,4], E^{\alpha}_{(A)}[2,5], E^{\alpha}_{(A)}[2,6], E^{\alpha}_{(A)}[2,7]\},\\
&\{E^{\alpha}_{(A)}[3,0], E^{\alpha}_{(A)}[3,1], E^{\alpha}_{(A)}[3,2], E^{\alpha}_{(A)}[3,3], E^{\alpha}_{(A)}[3,4], E^{\alpha}_{(A)}[3,5], E^{\alpha}_{(A)}[3,6], E^{\alpha}_{(A)}[3,7]\},\\
&\{E^{\alpha}_{(A)}[4,0], E^{\alpha}_{(A)}[4,1], E^{\alpha}_{(A)}[4,2], E^{\alpha}_{(A)}[4,3], E^{\alpha}_{(A)}[4,4], E^{\alpha}_{(A)}[4,5], E^{\alpha}_{(A)}[4,6], E^{\alpha}_{(A)}[4,7]\},\\
&\{E^{\alpha}_{(A)}[5,0], E^{\alpha}_{(A)}[5,1], E^{\alpha}_{(A)}[5,2], E^{\alpha}_{(A)}[5,3], E^{\alpha}_{(A)}[5,4], E^{\alpha}_{(A)}[5,5], E^{\alpha}_{(A)}[5,6], E^{\alpha}_{(A)}[5,7]\},\\
&\{E^{\alpha}_{(A)}[6,0], E^{\alpha}_{(A)}[6,1], E^{\alpha}_{(A)}[6,2], E^{\alpha}_{(A)}[6,3], E^{\alpha}_{(A)}[6,4], E^{\alpha}_{(A)}[6,5], E^{\alpha}_{(A)}[6,6], E^{\alpha}_{(A)}[6,7]\},\\
&\{E^{\alpha}_{(A)}[7,0], E^{\alpha}_{(A)}[7,1], E^{\alpha}_{(A)}[7,2], E^{\alpha}_{(A)}[7,3], E^{\alpha}_{(A)}[7,4], E^{\alpha}_{(A)}[7,5], E^{\alpha}_{(A)}[7,6], E^{\alpha}_{(A)}[7,7]\}\}
\end{aligned}$$

In[ ]:=
```
(sge^α_(A) = Thread[Flatten[e^α_(A)] → Flatten[Inverse[e_α^(A) /. sge_α^(A)]]])(*//Column*)
```

Out[ ]=

$$\begin{aligned}
&\{E^{\alpha}_{(A)}[0,0] \to \frac{1}{\sqrt{g[0][0][x0,x4]}}, E^{\alpha}_{(A)}[0,1] \to 0, E^{\alpha}_{(A)}[0,2] \to 0, E^{\alpha}_{(A)}[0,3] \to 0, E^{\alpha}_{(A)}[0,4] \to 0,\\
&E^{\alpha}_{(A)}[0,5] \to 0, E^{\alpha}_{(A)}[0,6] \to 0, E^{\alpha}_{(A)}[0,7] \to 0, E^{\alpha}_{(A)}[1,0] \to 0, E^{\alpha}_{(A)}[1,1] \to \frac{1}{\sqrt{g[1][1][x0,x4]}},\\
&E^{\alpha}_{(A)}[1,2] \to 0, E^{\alpha}_{(A)}[1,3] \to 0, E^{\alpha}_{(A)}[1,4] \to 0, E^{\alpha}_{(A)}[1,5] \to 0, E^{\alpha}_{(A)}[1,6] \to 0, E^{\alpha}_{(A)}[1,7] \to 0,\\
&E^{\alpha}_{(A)}[2,0] \to 0, E^{\alpha}_{(A)}[2,1] \to 0, E^{\alpha}_{(A)}[2,2] \to \frac{1}{\sqrt{g[2][2][x0,x4]}}, E^{\alpha}_{(A)}[2,3] \to 0, E^{\alpha}_{(A)}[2,4] \to 0,\\
&E^{\alpha}_{(A)}[2,5] \to 0, E^{\alpha}_{(A)}[2,6] \to 0, E^{\alpha}_{(A)}[2,7] \to 0, E^{\alpha}_{(A)}[3,0] \to 0, E^{\alpha}_{(A)}[3,1] \to 0, E^{\alpha}_{(A)}[3,2] \to 0,\\
&E^{\alpha}_{(A)}[3,3] \to \frac{1}{\sqrt{g[3][3][x0,x4]}}, E^{\alpha}_{(A)}[3,4] \to 0, E^{\alpha}_{(A)}[3,5] \to 0, E^{\alpha}_{(A)}[3,6] \to 0, E^{\alpha}_{(A)}[3,7] \to 0,\\
&E^{\alpha}_{(A)}[4,0] \to 0, E^{\alpha}_{(A)}[4,1] \to 0, E^{\alpha}_{(A)}[4,2] \to 0, E^{\alpha}_{(A)}[4,3] \to 0, E^{\alpha}_{(A)}[4,4] \to \frac{1}{\sqrt{-g[4][4][x0,x4]}},\\
&E^{\alpha}_{(A)}[4,5] \to 0, E^{\alpha}_{(A)}[4,6] \to 0, E^{\alpha}_{(A)}[4,7] \to 0, E^{\alpha}_{(A)}[5,0] \to 0, E^{\alpha}_{(A)}[5,1] \to 0, E^{\alpha}_{(A)}[5,2] \to 0,\\
&E^{\alpha}_{(A)}[5,3] \to 0, E^{\alpha}_{(A)}[5,4] \to 0, E^{\alpha}_{(A)}[5,5] \to \frac{1}{\sqrt{-g[5][5][x0,x4]}}, E^{\alpha}_{(A)}[5,6] \to 0, E^{\alpha}_{(A)}[5,7] \to 0,\\
&E^{\alpha}_{(A)}[6,0] \to 0, E^{\alpha}_{(A)}[6,1] \to 0, E^{\alpha}_{(A)}[6,2] \to 0, E^{\alpha}_{(A)}[6,3] \to 0, E^{\alpha}_{(A)}[6,4] \to 0, E^{\alpha}_{(A)}[6,5] \to 0,\\
&E^{\alpha}_{(A)}[6,6] \to \frac{1}{\sqrt{-g[6][6][x0,x4]}}, E^{\alpha}_{(A)}[6,7] \to 0, E^{\alpha}_{(A)}[7,0] \to 0, E^{\alpha}_{(A)}[7,1] \to 0, E^{\alpha}_{(A)}[7,2] \to 0,\\
&E^{\alpha}_{(A)}[7,3] \to 0, E^{\alpha}_{(A)}[7,4] \to 0, E^{\alpha}_{(A)}[7,5] \to 0, E^{\alpha}_{(A)}[7,6] \to 0, E^{\alpha}_{(A)}[7,7] \to \frac{1}{\sqrt{-g[7][7][x0,x4]}}\}
\end{aligned}$$

In[ ]:=
```
(*Symbolize[sge^α_(A)]*)
```

In[∘]:=
```
(*Symbolize[sgtrye^α_(A)]*)
```

In[∘]:=
```
(*%/.sge^(A)_α
 %%/.sgtrye^(A)_α*)
```

In[∘]:=
```
(*FullSimplify[Transpose[e^(A)_α].η4488.e^(A)_α,constraintVars]-MatrixMetric44*)
```

For Spin (4, 4); τ tau; T16; OCTAD : Nash; Introduce the wave function, Ψ16, for this Universe::

O(4,4); evalues, evecs of σ

In[∘]:=
```
{evalues, evecs} = Eigensystem[σ]
```

Out[∘]=
```
{{-1, -1, -1, -1, 1, 1, 1, 1}, {{0, 0, 0, -1, 0, 0, 0, 1}, {0, 0, -1, 0, 0, 0, 1, 0},
  {0, -1, 0, 0, 0, 1, 0, 0}, {-1, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 1},
  {0, 0, 1, 0, 0, 0, 1, 0}, {0, 1, 0, 0, 0, 1, 0, 0}, {1, 0, 0, 0, 1, 0, 0, 0}}}
```

In[∘]:=
```
(u = ExpandAll[1/√2 evecs]) // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & -\frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} \\ 0 & 0 & -\frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 \\ 0 & -\frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 \\ -\frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} \\ 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 \\ 0 & \frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 \\ \frac{1}{\sqrt{2}} & 0 & 0 & 0 & \frac{1}{\sqrt{2}} & 0 & 0 & 0 \end{pmatrix}$$

In[∘]:=
```
Table[u[[h]].σ.u[[h]], {h, 1, Length[u]}]
```

Out[∘]=
```
{-1, -1, -1, -1, 1, 1, 1, 1}
```

In[∘]:=
```
Table[(Transpose[u][[h]]).σ.u[[h]], {h, 1, Length[u]}]
```

Out[∘]=
```
{-1, -1, -1, -1, 1, 1, 1, 1}
```

In[∘]:=
```
Table[(Transpose[u][[A]]) == -σ.u[[A]], {A, 1, 4}]
Table[(Transpose[u][[A]]) == σ.u[[A]], {A, 5, Length[u]}]
```

Out[∘]=
```
{True, True, True, True}
```

Out[∘]=
```
{True, True, True, True}
```

```
Ax = ((KroneckerProduct[dX, X] - KroneckerProduct[X, dX])/2).σ;
```

```
Au = (KroneckerProduct[dU, U] - KroneckerProduct[U, dU])/2 .σ;
```

$$\text{Lsquared} = \dot{x}^A \dot{x}_A = dX.\sigma.dX + X.\sigma.X\left(\frac{dU.\sigma.dU}{U.\sigma.U} - \left(\frac{U.\sigma.dU}{U.\sigma.U}\right)^2\right) + \frac{2}{U.\sigma.U}\,\mathrm{Tr}\left[\bar{\tau}^A.Ax.\tau_A.Au\right]$$

```
Timing[Simplify[ExpandAll[dY.η8.dY - Lsquared]]]
{10.733, 0}
```

```
In[•]:= FullSimplify[Sqrt[Flatten[MatrixMetric44.η4488]], constraintVars]
Out[•]=
{Cot[6 H x0], 0, 0, 0, 0, 0, 0, 0, 0, Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/6)], 0, 0, 0, 0, 0, 0, 0, 0,
 Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/6)], 0, 0, 0, 0, 0, 0, 0, 0, Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/6)], 0, 0, 0,
 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/6)], 0, 0, 0, 0, 0, 0,
 0, 0, Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/6)], 0, 0, 0, 0, 0, 0, 0, 0, Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/6)]}
```

SO(4), γ; M8, {0, 1, 2, 3, 4, 5, 6, 7}, {+,+,+,+,-,-,-,-}, {x0, x1, x2, x3, x4, x5, x6, x7}

```
In[•]:= Qa[h_, p_, q_] := Signature[{h, p, q, 4}];
Qb[h_, p_, q_] := ID4[[p, 4]] * ID4[[q, h]] - ID4[[p, h]] * ID4[[q, 4]];
SelfDualAntiSymmetric[h_, p_, q_] := Qa[h, p, q] - Qb[h, p, q] ;
AntiSelfDualAntiSymmetric[h_, p_, q_] := (Qa[h, p, q] + Qb[h, p, q] );
In[•]:= Qa[1, 2, 3]
Out[•]=
1
In[•]:= ϵ4[[1, 2, 3, 4]]
Out[•]=
1
In[•]:= Do[s4by4[h] = Table[Table[SelfDualAntiSymmetric[h, p, q], {q, 4}], {p, 4}],
 {h, 1, 3} ]
In[•]:= Do[
 t4by4[h] = Table[Table[AntiSelfDualAntiSymmetric[h, p, q], {q, 4}], {p, 4}],
 {h, 1, 3} ]
In[•]:= (*Protect[{s4by4[1],s4by4[2],s4by4[3],t4by4[1],t4by4[2],t4by4[3]}]*)
In[•]:= Protect[s4by4, t4by4]
Out[•]=
{s4by4, t4by4}
```

In[ ]:=
```
{s4by4[#] // MatrixForm, MatrixForm[t4by4[#]]} & /@ Range[3]
```

Out[ ]=

$$\left\{\left\{\begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}\right\},\right.$$

$$\left.\left\{\begin{pmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}\right\}, \left\{\begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \end{pmatrix}\right\}\right\}$$

In[ ]:=
```
Table[{{J, K}, MatrixForm[s4by4[J].t4by4[K]]}, {J, 1, 3}, {K, 1, 3}]
```

Out[ ]=

$$\left\{\left\{\left\{\{1, 1\}, \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}, \left\{\{1, 2\}, \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}\right\}, \left\{\{1, 3\}, \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}\right\}\right\},\right.$$

$$\left\{\left\{\{2, 1\}, \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & -1 & 0 \end{pmatrix}\right\}, \left\{\{2, 2\}, \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}, \left\{\{2, 3\}, \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}\right\}\right\},$$

$$\left.\left\{\left\{\{3, 1\}, \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}\right\}, \left\{\{3, 2\}, \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix}\right\}, \left\{\{3, 3\}, \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}\right\}\right\}$$

In[ ]:=
```
Do[st[J, K] = s4by4[J].t4by4[K], {J, 1, 3}, {K, 1, 3}]
```

In[ ]:=
```
Table[{{J, K}, MatrixForm[st[J, K]]}, {J, 1, 3}, {K, 1, 3}]
```

Out[ ]=

$$\left\{\left\{\left\{\{1, 1\}, \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}, \left\{\{1, 2\}, \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}\right\}, \left\{\{1, 3\}, \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}\right\}\right\},\right.$$

$$\left\{\left\{\{2, 1\}, \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & -1 & 0 \end{pmatrix}\right\}, \left\{\{2, 2\}, \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}, \left\{\{2, 3\}, \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}\right\}\right\},$$

$$\left.\left\{\left\{\{3, 1\}, \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}\right\}, \left\{\{3, 2\}, \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix}\right\}, \left\{\{3, 3\}, \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\right\}\right\}\right\}$$

In[ ]:=
```
Protect[st]
```

Out[ ]=

{st}

In[ ]:=
```
Table[{{J, K}, MatrixForm[st[J, K] - Transpose[st[J, K]]]}, {J, 1, 3}, {K, 1, 3}]
```

Out[ ]=

$$\left\{\left\{\left\{\{1,1\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{1,2\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{1,3\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\}\right\},\right.$$

$$\left\{\left\{\{2,1\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{2,2\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{2,3\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\}\right\},$$

$$\left.\left\{\left\{\{3,1\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{3,2\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\},\left\{\{3,3\},\begin{pmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{pmatrix}\right\}\right\}\right\}$$

In[ ]:=
```
Permutations[Range[3], 2]
```

Out[ ]=
```
{{}, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 1}, {2, 3}, {3, 1}, {3, 2}}
```

In[ ]:=
```
KroneckerProduct[Range[3], Range[3]]
```

Out[ ]=
```
{{1, 2, 3}, {2, 4, 6}, {3, 6, 9}}
```

In[ ]:=
```
Table[{J, K}, {J, 1, 3}, {K, 1, 3}]
st[##] & /@ %
st[##] & @@ %%
```

Out[ ]=
```
{{{1, 1}, {1, 2}, {1, 3}}, {{2, 1}, {2, 2}, {2, 3}}, {{3, 1}, {3, 2}, {3, 3}}}
```

Out[ ]=
```
{st[{{1, 1}, {1, 2}, {1, 3}}], st[{{2, 1}, {2, 2}, {2, 3}}], st[{{3, 1}, {3, 2}, {3, 3}}]}
```

Out[ ]=
```
st[{{1, 1}, {1, 2}, {1, 3}}, {{2, 1}, {2, 2}, {2, 3}}, {{3, 1}, {3, 2}, {3, 3}}]
```

In[ ]:=
```
Flatten[{s4by4[#] & /@ Range[3], t4by4[#] & /@ Range[3],
  Flatten[Table[st[J, K], {J, 1, 3}, {K, 1, 3}], 1], {ID4}}, 1]
Length[%]
```

Out[ ]=
```
{{{0, 0, 0, 1}, {0, 0, 1, 0}, {0, -1, 0, 0}, {-1, 0, 0, 0}},
 {{0, 0, -1, 0}, {0, 0, 0, 1}, {1, 0, 0, 0}, {0, -1, 0, 0}},
 {{0, 1, 0, 0}, {-1, 0, 0, 0}, {0, 0, 0, 1}, {0, 0, -1, 0}},
 {{0, 0, 0, -1}, {0, 0, 1, 0}, {0, -1, 0, 0}, {1, 0, 0, 0}},
 {{0, 0, -1, 0}, {0, 0, 0, -1}, {1, 0, 0, 0}, {0, 1, 0, 0}},
 {{0, 1, 0, 0}, {-1, 0, 0, 0}, {0, 0, 0, -1}, {0, 0, 1, 0}},
 {{1, 0, 0, 0}, {0, -1, 0, 0}, {0, 0, -1, 0}, {0, 0, 0, 1}},
 {{0, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, 1}, {0, 0, 1, 0}},
 {{0, 0, 1, 0}, {0, 0, 0, -1}, {1, 0, 0, 0}, {0, -1, 0, 0}},
 {{0, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, -1}, {0, 0, -1, 0}},
 {{-1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, -1, 0}, {0, 0, 0, 1}},
 {{0, 0, 0, 1}, {0, 0, 1, 0}, {0, 1, 0, 0}, {1, 0, 0, 0}},
 {{0, 0, 1, 0}, {0, 0, 0, 1}, {1, 0, 0, 0}, {0, 1, 0, 0}},
 {{0, 0, 0, -1}, {0, 0, 1, 0}, {0, 1, 0, 0}, {-1, 0, 0, 0}},
 {{-1, 0, 0, 0}, {0, -1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}},
 {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}}}
```

Out[ ]=
```
16
```

In[ ]:=
```
Unprotect[γ];
γ = Flatten[{s4by4[#] & /@ Range[3], t4by4[#] & /@ Range[3],
   Flatten[Table[st[J, K], {J, 1, 3}, {K, 1, 3}], 1], {ID4}}, 1]
```

Out[ ]=
```
{{{0, 0, 0, 1}, {0, 0, 1, 0}, {0, -1, 0, 0}, {-1, 0, 0, 0}},
 {{0, 0, -1, 0}, {0, 0, 0, 1}, {1, 0, 0, 0}, {0, -1, 0, 0}},
 {{0, 1, 0, 0}, {-1, 0, 0, 0}, {0, 0, 0, 1}, {0, 0, -1, 0}},
 {{0, 0, 0, -1}, {0, 0, 1, 0}, {0, -1, 0, 0}, {1, 0, 0, 0}},
 {{0, 0, -1, 0}, {0, 0, 0, -1}, {1, 0, 0, 0}, {0, 1, 0, 0}},
 {{0, 1, 0, 0}, {-1, 0, 0, 0}, {0, 0, 0, -1}, {0, 0, 1, 0}},
 {{1, 0, 0, 0}, {0, -1, 0, 0}, {0, 0, -1, 0}, {0, 0, 0, 1}},
 {{0, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, 1}, {0, 0, 1, 0}},
 {{0, 0, 1, 0}, {0, 0, 0, -1}, {1, 0, 0, 0}, {0, -1, 0, 0}},
 {{0, 1, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, -1}, {0, 0, -1, 0}},
 {{-1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, -1, 0}, {0, 0, 0, 1}},
 {{0, 0, 0, 1}, {0, 0, 1, 0}, {0, 1, 0, 0}, {1, 0, 0, 0}},
 {{0, 0, 1, 0}, {0, 0, 0, 1}, {1, 0, 0, 0}, {0, 1, 0, 0}},
 {{0, 0, 0, -1}, {0, 0, 1, 0}, {0, 1, 0, 0}, {-1, 0, 0, 0}},
 {{-1, 0, 0, 0}, {0, -1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}},
 {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}}}
```

In[ ]:=
```
Length[γ]
```

Out[ ]=
```
16
```

In[ ]:=
```
Protect[γ]
```
Out[ ]=
```
{γ}
```
In[ ]:=
```
γ[[1]]
```
Out[ ]=
```
{{0, 0, 0, 1}, {0, 0, 1, 0}, {0, -1, 0, 0}, {-1, 0, 0, 0}}
```
In[ ]:=
```
γ[[-1]]
```
Out[ ]=
```
{{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}}
```

Self Dual Anti-Symmetric

In[ ]:=
$$\text{Table}\left[\left(\frac{1}{2}\sum_{j1=1}^{4}\left(\sum_{j2=1}^{4}\epsilon 4[[p,q,j1,j2]]\times s4by4[h][[j1,j2]]\right)\right)-s4by4[h][[p,q]],\ \{h,1,3\},\ \{q,4\},\ \{p,4\}\right]$$

Out[ ]=
```
{{{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}},
 {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}},
 {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}}}
```

Anti SelfDual Anti-Symmetric

In[ ]:=
$$\text{Table}\left[\left(\frac{1}{2}\sum_{j1=1}^{4}\left(\sum_{j2=1}^{4}\epsilon 4[[p,q,j1,j2]]\times t4by4[h][[j1,j2]]\right)\right)+t4by4[h][[p,q]],\ \{h,1,3\},\ \{q,4\},\ \{p,4\}\right]$$

Out[ ]=
```
{{{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}},
 {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}},
 {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}}}
```

SO(4,4), Spin(4,4) = $\overline{\text{SO}(4,4)}$, τ ; if using xact: M8, {0, 1, 2, 3, 4, 5, 6, 7}, {+,+,+,+,-,-,-,-}, {x0, x1, x2, x3, x4, x5, x6, x7}

In[ ]:=
```
τ̄ === τ̄
```
Out[ ]=
```
False
```
In[ ]:=
```
τ̄
Head[%]
```
Out[ ]=
```
τ̄
```
Out[ ]=
```
OverBar
```

In[ ]:=
```
τ̄
Head[%]
```

Out[ ]=
```
τ̄
```

Out[ ]=
```
ParsedBoxWrapper
```

In[ ]:=
```
τ̄
Head[%]
```

Out[ ]=
```
τ̄
```

Out[ ]=
```
OverBar
```

In[ ]:=
```
Symbol
```

Out[ ]=
```
Symbol
```

In[ ]:=
```
τ̄ === τ̄
```

Out[ ]=
```
True
```

In[ ]:=
```
τ̄ === τ̄
```

Out[ ]=
```
False
```

In[ ]:=
```
η4488 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

In[ ]:=
```
η4488 == DiagonalMatrix[RotateRight[evalues, 4]]
```

Out[ ]=
```
True
```

In[ ]:=
```
DiagonalMatrix[RotateRight[evalues, 3]] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

these also yield correct reps:

```
ζ[0] = ID8;
Table[ζ[7 - h] = ArrayFlatten[{{0, -t4by4[h]}, {t4by4[h], 0}}], {h, 1, 3} ];
Table[ζ[h] = ArrayFlatten[{{0, s4by4[h]}, {s4by4[h], 0}}], {h, 1, 3} ];
(ζ[7] = ζ[1].ζ[2].ζ[3].ζ[4].ζ[5].ζ[6]) // MatrixForm
```

```
ζ[0] = ID8;
Table[ζ[h] = ArrayFlatten[{{0, t4by4[h]}, {t4by4[h], 0}}], {h, 1, 3} ];
Table[ζ[7 - h] = ArrayFlatten[{{0, -s4by4[h]}, {s4by4[h], 0}}], {h, 1, 3} ];
(ζ[7] = ζ[1].ζ[2].ζ[3].ζ[4].ζ[5].ζ[6]) // MatrixForm
```

```
ζ[0] = ID8;
Table[ζ[h] = ArrayFlatten[{{0, t4by4[h]}, {t4by4[h], 0}}], {h, 1, 3} ];
Table[ζ[7 - h] = ArrayFlatten[{{0, s4by4[h]}, {-s4by4[h], 0}}], {h, 1, 3} ];
(ζ[7] = ζ[1].ζ[2].ζ[3].ζ[4].ζ[5].ζ[6]) // MatrixForm
```

In[ ]:=
```
ζ[0] = ID8;
Table[
  ζ[7 - h] = ArrayFlatten[{{0, t4by4[h]}, {-t4by4[h], 0}}], {h, 1, 3} ];
Table[ζ[h] = ArrayFlatten[{{0, s4by4[h]}, {s4by4[h], 0}}], {h, 1, 3} ];
(ζ[7] = ζ[1].ζ[2].ζ[3].ζ[4].ζ[5].ζ[6]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
σ == ζ[1].ζ[2].ζ[3]
```

Out[ ]=
```
True
```

In[ ]:=
```
Table[{A, B, FullSimplify[
    ExpandAll[1/2 (ζ[A].ζ[B] + ζ[B].ζ[A]) == -η4488[[A + 1, B + 1]] * ID8]]},
  {A, 1, 7}, {B, 1, 7}]
```

Out[ ]=
```
{{{1, 1, True}, {1, 2, True}, {1, 3, True}, {1, 4, True},
  {1, 5, True}, {1, 6, True}, {1, 7, True}}, {{2, 1, True}, {2, 2, True},
  {2, 3, True}, {2, 4, True}, {2, 5, True}, {2, 6, True}, {2, 7, True}},
 {{3, 1, True}, {3, 2, True}, {3, 3, True}, {3, 4, True}, {3, 5, True}, {3, 6, True},
  {3, 7, True}}, {{4, 1, True}, {4, 2, True}, {4, 3, True}, {4, 4, True},
  {4, 5, True}, {4, 6, True}, {4, 7, True}}, {{5, 1, True}, {5, 2, True},
  {5, 3, True}, {5, 4, True}, {5, 5, True}, {5, 6, True}, {5, 7, True}},
 {{6, 1, True}, {6, 2, True}, {6, 3, True}, {6, 4, True}, {6, 5, True},
  {6, 6, True}, {6, 7, True}}, {{7, 1, True}, {7, 2, True},
  {7, 3, True}, {7, 4, True}, {7, 5, True}, {7, 6, True}, {7, 7, True}}}
```

In[ ]:=
```
η4488 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

In[ ]:=
```
Table[{A, -η4488[[A + 1, A + 1]] * ξ[A] == Transpose[ξ[A]]} , {A, 1, 7}]
```

Out[ ]=
```
{{1, True}, {2, True}, {3, True}, {4, True}, {5, True}, {6, True}, {7, True}}
```

In[ ]:=
```
(σ == ξ[1].ξ[2].ξ[3])
```

Out[ ]=
```
True
```

In[ ]:=
```
σ.ξ[1].ξ[2].ξ[3] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
τ[0] = ID8;
Do[
 {τ[A] = FullSimplify[ExpandAll[(ξ[A])]]} ,
 {A, 1, 7}]
(*Do[
 {τ[A] = FullSimplify[ExpandAll[-(σ.ξ[1].
        ξ[2].ξ[3].ξ[A])]]} , {A, 1, 7}]*)
```

In[ ]:=
```
(σ == τ[1].τ[2].τ[3])
```

Out[ ]=
```
True
```

In[ ]:=
```
(*Symbolize[τ̄]*)
```

In[ ]:=
```
τ̄[0] = ID8;
Do[{τ̄[A] = FullSimplify[ExpandAll[
      (σ.Transpose[τ[A]].σ)]]} , {A, 1, 7}]
```

In[ ]:=
```
σ.τ̄[#] == Transpose[σ.τ[#]] & /@ Range[0, 7]
```

Out[ ]=
```
{True, True, True, True, True, True, True, True}
```

In[ ]:=
```
Table[{A, B, FullSimplify[
    ExpandAll[1/2 (τ[A].τ̄[B] + τ[B].τ̄[A]) == η4488[[A + 1, B + 1]] * ID8]]},
  {A, 0, 7}, {B, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
\begin{pmatrix}0\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}0\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}1\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}1\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}2\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}2\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}3\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}3\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}4\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}4\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}5\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}5\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}6\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}6\\7\\\text{True}\end{pmatrix}\\
\begin{pmatrix}7\\0\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\1\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\2\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\3\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\4\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\5\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\6\\\text{True}\end{pmatrix} & \begin{pmatrix}7\\7\\\text{True}\end{pmatrix}
\end{pmatrix}$$

In[ ]:=
```
τ[7] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
-1 & 0 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & -1 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & -1 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}$$

In[ ]:=
```
(Ω = σ.τ[7]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
Ω == τ[4].τ[5].τ[6]
```

Out[ ]=

True

In[ ]:=
```
τ[5].τ[6].τ[7] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \end{pmatrix}$$

In[ ]:=
```
(σΩ = σ.Ω) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
Inverse[σΩ] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
τ[1].τ[2].τ[3].τ[4].τ[5].τ[6].τ[7] == τ[0] == ID8
```

Out[ ]=

True

In[ ]:=
```
(σ == τ[1].τ[2].τ[3])
```

Out[ ]=

True

In[ ]:=
```
(σ == τ[4].τ[5].τ[6].τ[7])
```
Out[ ]=
```
True
```
In[ ]:=
```
τ[1].τ[2].τ[3].τ[#] == -Transpose[τ[1].τ[2].τ[3].τ[#]] & /@ Range[0, 7]
```
Out[ ]=
```
{False, True, True, True, True, True, True, True}
```
In[ ]:=
```
σ.τ̄[#] == Transpose[σ.τ[#]] & /@ Range[0, 7]
```
Out[ ]=
```
{True, True, True, True, True, True, True, True}
```
In[ ]:=
```
τ[5].τ[6].τ[7].τ̄[#] == Transpose[τ[5].τ[6].τ[7].τ[#]] & /@
 Range[0, 7]
```
Out[ ]=
```
{False, True, True, True, False, True, True, True}
```
In[ ]:=
```
τ[4].τ[#] == Transpose[τ[4].τ[#]] & /@ Range[0, 7]
```
Out[ ]=
```
{True, True, True, True, True, False, False, False}
```
In[ ]:=
```
τ[4].τ̄[#] == Transpose[τ[4].τ[#]] & /@ Range[0, 7]
```
Out[ ]=
```
{True, False, False, False, False, True, True, True}
```
In[ ]:=
```
τ[4].τ[#] == Transpose[τ[4].τ[#]] & /@ Range[0, 7]
```
Out[ ]=
```
{True, True, True, True, True, False, False, False}
```

$$t^A = \begin{pmatrix} 0 & \bar{\tau}^A \\ \tau^A & 0 \end{pmatrix}.$$; O (4, 4) : SAB ;

covariantDiffMatrix = $T16^A[5].T16^A[6].T16^A[7]$

$$S = \begin{pmatrix} a & b \\ c & d \end{pmatrix};$$

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} . \begin{pmatrix} 0 & \bar{\tau}^A \\ \tau^A & 0 \end{pmatrix} . \begin{pmatrix} \tilde{a} & \tilde{c} \\ \tilde{b} & \tilde{d} \end{pmatrix} = \begin{pmatrix} b.\tau^A & a.\bar{\tau}^A \\ d.\tau^A & c.\bar{\tau}^A \end{pmatrix} . \begin{pmatrix} \tilde{a} & \tilde{c} \\ \tilde{b} & \tilde{d} \end{pmatrix}$$

$$= \begin{pmatrix} b.\tau^A.\tilde{a} + a.\bar{\tau}^A.\tilde{b} & b.\tau^A.\tilde{c} + a.\bar{\tau}^A.\tilde{d} \\ d.\tau^A.\tilde{a} + c.\bar{\tau}^A.\tilde{b} & d.\tau^A.\tilde{c} + c.\bar{\tau}^A.\tilde{d} \end{pmatrix}$$

In[ ]:=
```
similarityTransformation // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}$$

In[ ]:=
```
blocks = Partition[similarityTransformation, {8, 8}];
```

In[ ]:=
```
(*To access the individual blocks:*)
block11 = blocks[[1, 1]] (*Top-left block*)
block12 = blocks[[1, 2]] (*Top-right block*)
block21 = blocks[[2, 1]] (*Bottom-left block*)
block22 = blocks[[2, 2]] (*Bottom-right block*)
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

Out[ ]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {1, 0, 0, 0, 0, 0, 0, 0},
 {0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0}}
```

Out[ ]=
```
{{0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

Out[ ]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0},
 {0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 1}}
```

In[ ]:=
```
ArrayFlatten[{{blocks[[1, 1]], blocks[[1, 2]]}, {blocks[[2, 1]], blocks[[2, 2]]}}] ===
 similarityTransformation
```

Out[ ]=
```
True
```

In[ ]:=

$$\begin{pmatrix} \text{blocks}[[1,1]] & \text{blocks}[[1,2]] \\ \text{blocks}[[2,1]] & \text{blocks}[[2,2]] \end{pmatrix} . \begin{pmatrix} & \overline{\tau}^{A} \\ 0 & \\ \tau^{A} & 0 \end{pmatrix} . \begin{pmatrix} \tilde{\text{blocks}}[[1,1]] & \tilde{\text{blocks}}[[2,1]] \\ \tilde{\text{blocks}}[[1,2]] & \tilde{\text{blocks}}[[2,2]] \end{pmatrix} =$$

$$\begin{pmatrix} \text{blocks}[[1,2]].\tau^{A} & \text{blocks}[[1,1]].\overline{\tau}^{A} \\ \text{blocks}[[2,2]].\tau^{A} & \text{blocks}[[2,1]].\overline{\tau}^{A} \end{pmatrix} . \begin{pmatrix} \tilde{\text{blocks}}[[1,1]] & \tilde{\text{blocks}}[[2,1]] \\ \tilde{\text{blocks}}[[1,2]] & \tilde{\text{blocks}}[[2,2]] \end{pmatrix}$$

$$= \begin{pmatrix} \text{blocks}[[1,2]].\tau^{A}.\tilde{\text{blocks}}[[1,1]] + \text{blocks}[[1,1]].\overline{\tau}^{A}.\tilde{\text{blocks}}[[1,2]] & \text{blocks}[[1,2]] \\ \text{blocks}[[2,2]].\tau^{A}.\tilde{\text{blocks}}[[1,1]] + \text{blocks}[[2,1]].\overline{\tau}^{A}.\tilde{\text{blocks}}[[1,2]] & \text{blocks}[[2,\ldots \end{pmatrix}$$

In[∘]:=
```
Table[
 newT16^A[A1] === ArrayFlatten[{{blocks⟦1, 2⟧.τ[A1].Transpose[blocks⟦1, 1⟧] + blocks⟦1, 1⟧.
       τ̄[A1].Transpose[blocks⟦1, 2⟧], blocks⟦1, 2⟧.τ[A1].Transpose[blocks⟦2, 1⟧] +
      blocks⟦1, 1⟧.τ̄[A1].Transpose[blocks⟦2, 2⟧]},
    {blocks⟦2, 2⟧.τ[A1].Transpose[blocks⟦1, 1⟧] + blocks⟦2, 1⟧.τ̄[A1].
       Transpose[blocks⟦1, 2⟧], blocks⟦2, 2⟧.τ[A1].Transpose[blocks⟦2, 1⟧] +
      blocks⟦2, 1⟧.τ̄[A1].Transpose[blocks⟦2, 2⟧]}}], {A1, 0, 7}]
```

Out[∘]=
```
{False, False, False, False, False, False, False, False}
```

In[∘]:=
```
MatrixForm[newT16^A[#]] & /@ Range[0, 8]
```

Out[∘]=
```
{newT16^A[0], newT16^A[1], newT16^A[2], newT16^A[3],
 newT16^A[4], newT16^A[5], newT16^A[6], newT16^A[7], newT16^A[8]}
```

In[∘]:=
```
(*Example 16x16 matrix*)(*matrix=Table[RandomInteger[{1,100}],{16},{16}];*)

(*Partition the matrix into 8x8 blocks*)
(*blocks=Partition[matrix,{8,8}];*)

(*The result is a 2x2 list of 8x8 matrices*)
(*blocks*)
```

In[∘]:=
```
(*TakeList[similarityTransformation,{8,8}]*)
```

In[∘]:=
```
blocks = TakeList[similarityTransformation, {8, 8}, {8, 8}]
ArrayFlatten[%] === similarityTransformation
```

Out[∘]=
```
{{{{1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0}, {0,
0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {1, 0, 0,
0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0,
0, 0}}}, {{{0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1,
0}, {0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0}, {0, 0,
0, 0, 0, 0, 0, 1}}}}
```

Out[∘]=
```
True
```

In[∘]:=
```
Length[blocks]
```

Out[∘]=
```
2
```

In[∘]:=
```
(*similarityTransformation==ArrayFlatten[{{Take[],Take[]},{Take[],Take[]}}]*)
```

Take [*list*, seq_1, seq_2]

gives a nested list in which elements specified by seq_i are taken at level i in *list*.

effectively extracts a submatrix from *list*.

In[ ]:=
```
Take[]
```

Take: Take called with 0 arguments; 1 or more arguments are expected.

Out[ ]=
```
Take[]
```

Need these in order to define the Lagrangian for the "universe," later :

In[ ]:=
```
(σ16 = T16^A[0].T16^A[1].T16^A[2].T16^A[3]) // MatrixForm
```

Out[ ]//MatrixForm=

$$T16^A[0].T16^A[1].T16^A[2].T16^A[3]$$

In[ ]:=
```
Table[T16^A[A1] = ArrayFlatten[{{0, τ̄[A1]}, {τ[A1], 0}}],
  {A1, 0, 7}];
```

In[ ]:=
```
(T16^A[8] = T16^A[0].T16^A[1].T16^A[2].T16^A[3].T16^A[4].T16^A[5].T16^A[6].T16^A[7]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
Table[newT16^A[A1] = similarityTransformation. T16^A[A1].
    Transpose[similarityTransformation], {A1, 0, 8}];
```

In[ ]:=
```
(newσ16 = similarityTransformation. σ16.Transpose[similarityTransformation]) //
 MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
σ16 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
T16^A[0].T16^A[1].T16^A[2].T16^A[3].T16^A[#] ==
   -Transpose[T16^A[0].T16^A[1].T16^A[2].T16^A[3].T16^A[#]] & /@ Range[0, 8]
```

Out[ ]=
```
{True, True, True, True, True, True, True, True, False}
```

In[ ]:=
```
T16^A[4].T16^A[5].T16^A[6].T16^A[7].T16^A[#] ==
   Transpose[T16^A[4].T16^A[5].T16^A[6].T16^A[7].T16^A[#]] & /@ Range[0, 8]
```

Out[ ]=
```
{True, True, True, True, True, True, True, True, True}
```

In[ ]:=
```
T16^A[8] == σ16.T16^A[4].T16^A[5].T16^A[6].T16^A[7]
```

Out[ ]=
```
True
```

In[ ]:=
```
T16^A[#] == Transpose[T16^A[#]] & /@ Range[0, 8]
```

Out[ ]=
```
{True, True, True, True, False, False, False, False, True}
```

In[ ]:=
```
T16^A[#] == -Transpose[T16^A[#]] & /@ Range[0, 8]
```

Out[ ]=
```
{False, False, False, False, True, True, True, True, False}
```

In[ ]:=
```
σ16.T16^A[#] == -Transpose[σ16.T16^A[#]] & /@ Range[0, 7]
```

Out[ ]=
```
{True, True, True, True, True, True, True, True}
```

In[ ]:=
```
(covariantDiffMatrix = T16^A[5].T16^A[6].T16^A[7]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
σ16.covariantDiffMatrix == Transpose[σ16.covariantDiffMatrix]
```

Out[ ]=
```
True
```

In[ ]:=
```
ID16 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
(σ16(*=T16^A[0].T16^A[1].T16^A[2].T16^A[3]*)) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
σ16 == ArrayFlatten[{{-σ, 0}, {0, σ}}]
```

Out[ ]=

True

later, after defining $e^{\alpha}_{(A)}$:

In[ ]:=
```
(*Table[T16^α[α1-1]=
   Sum[(e^α_(A)[[α1,A1]]) T16^A[A1-1],{A1,1,8}],{α1,1,8}];*)
```

In[ ]:=
```
(*(T16^α[8]=T16^α[0].T16^α[1].T16^α[2].T16^α[3].T16^α[4].T16^α[5].T16^α[6].T16^α[7])//
 MatrixForm*)
```

In[ ]:=
```
(*eLpairs*)
```

In[ ]:=
```
(*Ω16a=Array[0&,{16,16}];
 {1+#[[1]],1+#[[2]]}&/@eLpairs
 (Ω16a[[#[[1]],#[[2]]]]=1)&/@%*)
```

In[ ]:=
```
(*Ω16a//MatrixForm*)
```

In[ ]:=
```
(*(Ω16=σ16.(Ω16a+Transpose[Ω16a]))//MatrixForm*)
```

In[ ]:=
```
T16^A[0].T16^A[4] // MatrixForm
T16^A[0].T16^A[4].σ16
(Ω16 = %) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Out[ ]=

```
{{0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0}}
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{pmatrix}$$

In[ ]:=
```
Det[Ω16]
```

Out[ ]=

1

In[ ]:=
```
σ16.Ω16 // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
σ16.T16^A[#] == -Transpose[σ16.T16^A[#]] & /@
 Range[0, 7]
```

Out[ ]=

{True, True, True, True, True, True, True, True}

In[ ]:=
```
σ16.T16^A[#] == -Transpose[σ16.T16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

{True, True, True, True, True, True, True, True}

In[ ]:=
```
σ16.T16^A[#] == -Transpose[σ16.T16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

{True, True, True, True, True, True, True, True}

In[ ]:=
```
σ16.newT16^A[#] == -Transpose[σ16.newT16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

{False, False, False, True, False, True, True, False}

In[ ]:=
```
newσ16.newT16^A[#] == -Transpose[newσ16.newT16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

{True, True, True, True, True, True, True, True}

In[ ]:=
```
Table[{{A1, B1}, FullSimplify[
    ExpandAll[1/2 (T16^A[A1].T16^A[B1] + T16^A[B1].T16^A[A1]) ==
      η4488[[A1 + 1, B1 + 1]] * ID16]]},
  {A1, 0, 7}, {B1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

In[ ]:=
```
Table[{{A1, B1}, FullSimplify[ExpandAll[
      1/2 (newT16^A[A1].newT16^A[B1] + newT16^A[B1].newT16^A[A1]) ==
       η4488[[A1 + 1, B1 + 1]] * ID16]]},
  {A1, 0, 7}, {B1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

In[ ]:=
```
Ψ16upper = Take[Ψ16, 8]
Ψ16lower = Take[Ψ16, -8]
Ψ16 == Flatten[{Ψ16upper, Ψ16lower}]
```

Out[ ]=
```
{f16[0][x0, x4], f16[1][x0, x4], f16[2][x0, x4], f16[3][x0, x4],
 f16[4][x0, x4], f16[5][x0, x4], f16[6][x0, x4], f16[7][x0, x4]}
```

Out[ ]=
```
{f16[8][x0, x4], f16[9][x0, x4], f16[10][x0, x4], f16[11][x0, x4],
 f16[12][x0, x4], f16[13][x0, x4], f16[14][x0, x4], f16[15][x0, x4]}
```

Out[ ]=
```
True
```

$$t^A = \begin{pmatrix} 0 & \overline{\tau}^A \\ \tau^A & 0 \end{pmatrix}.$$

```
Table[T16^A[A1] = ArrayFlatten[{{0, τ̄[A1]}, {τ[A1], 0}}],
  {A1, 0, 7}]
σ16 == ArrayFlatten[{{-σ, 0}, {0, σ}}]
```

$$\begin{pmatrix} 0 & \overline{\tau}[A1] \\ \tau[A1] & 0 \end{pmatrix} \begin{pmatrix} \Psi16upper \\ \Psi16lower \end{pmatrix} = \begin{pmatrix} \overline{\tau}[A1].\Psi16lower \\ \tau[A1].\Psi16upper \end{pmatrix}$$

$$\sigma16.\begin{pmatrix} 0 & \overline{\tau}[A1] \\ \tau[A1] & 0 \end{pmatrix} \begin{pmatrix} \Psi16upper \\ \Psi16lower \end{pmatrix} = \begin{pmatrix} -\sigma\,\overline{\tau}[A1].\Psi16lower \\ \sigma\,\tau[A1].\Psi16upper \end{pmatrix}$$

$$\Psi16.\sigma16.\begin{pmatrix} 0 & \overline{\tau}[A1] \\ \tau[A1] & 0 \end{pmatrix}.\Psi16 = \begin{pmatrix} -\Psi16upper.\sigma\,\overline{\tau}[A1].\Psi16lower \\ \Psi16lower.\sigma\,\tau[A1]\,\Psi16upper \end{pmatrix}$$

In[ ]:=
```
(*σ16.T16^A[#]&/@Range[0,7]*)
```

In[ ]:=
```
(*
(T16^A[8]=FullSimplify[
    T16^A[0].T16^A[1].T16^A[2].T16^A[3].T16^A[4].T16^A[5].T16^A[6].T16^A[7]])//MatrixForm*)
```

In[ ]:=
```
η4488
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0},
 {0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, 0, 0, -1, 0}, {0, 0, 0, 0, 0, 0, 0, -1}}
```

In[ ]:=
```
η99 = DiagonalMatrix[{1, 1, 1, 1, -1, -1, -1, -1, 1}]
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0, 0}, {0, 0, 0, 0, 0, -1, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, -1, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 1}}
```

In[ ]:=
```
(*Table[{A1,B1,
   FullSimplify[ExpandAll[1/2 ( T16^A[A1].T16^A[B1]+T16^A[B1].T16^A[A1]) == η99[[A1,B1]]*ID16]]},
  {A1,0, 8},{B1,0, 8}]//MatrixForm*)
```

In[ ]:=
```
(*Table[1/4 (T16^A[A1].T16^A[B1]+T16^A[B1].T16^A[A1]), {A1, 8},{B1,8}]*)
```

In[ ]:=
```
(P_L = 1/2 (ID16 - T16^A[8])) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
(P_R = 1/2 (ID16 + T16^A[8])) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
{ID16 == P_L + P_R, P_L.P_L == P_L, P_L.P_R == P_R.P_L == ZERO16}
```

Out[ ]=

```
{True, True, True}
```

```
SAB = Table[
    1/4 (T16^A[A1].T16^A[B1] - T16^A[B1].T16^A[A1]), {A1, 0, 7}, {B1, 0, 7}];
```

In[∘]:=
```
SAB = Table[1/4 (T16^A[A1].T16^A[B1] - T16^A[B1].T16^A[A1]),
    {A1, 0, 7}, {B1, 0, 7}];
```

In[∘]:=
```
ParallelTable[FullSimplify[σ16.SAB⟦A1, B1⟧ == -Transpose[σ16.SAB⟦A1, B1⟧]],
   {A1, 1, 8}, {B1, 1, 8}] // Flatten // Union
```

Out[∘]=
```
{True}
```

In[∘]:=
```
ParallelTable[FullSimplify[SAB⟦A1, B1⟧.SAB⟦A2, B2⟧ - SAB⟦A2, B2⟧.SAB⟦A1, B1⟧ ==
      -(η4488⟦A1, A2⟧ × SAB⟦B1, B2⟧ - η4488⟦A1, B2⟧ × SAB⟦B1, A2⟧ -
         η4488⟦B1, A2⟧ × SAB⟦A1, B2⟧ + η4488⟦B1, B2⟧ × SAB⟦A1, A2⟧)],
   {A1, 1, 7}, {B1, A1 + 1, 8}, {A2, 1, 7}, {B2, A2 + 1, 8}] // Flatten // Union
```

Out[∘]=
```
{True}
```

In[∘]:=
```
ParallelTable[FullSimplify[SAB⟦A1, B1⟧.T16^A[B2 - 1] - T16^A[B2 - 1].SAB⟦A1, B1⟧ ==
      (-η4488⟦B2, A1⟧ T16^A[B1 - 1] + η4488⟦B2, B1⟧ T16^A[A1 - 1])],
   {A1, 1, 8}, {B1, 1, 8}, {B2, 1, 8}] // Flatten // Union
```

Out[∘]=
```
{True}
```

In[∘]:=
```
(*ParallelTable[{{A1,B1},FullSimplify[σ16.SAB⟦A1,B1⟧==-Transpose[σ16.SAB⟦A1,B1⟧]]},
 {A1,1, 8},{B1,1,8}]*)
```

In[∘]:=
```
(*ParallelTable[{{A1,B1,A2,B2},
  FullSimplify[SAB⟦A1,B1⟧.SAB⟦A2,B2⟧ -SAB⟦A2,B2⟧.SAB⟦A1,B1⟧==-(η4488⟦A1,A2⟧SAB⟦B1,B2⟧-
       η4488⟦A1,B2⟧SAB⟦B1,A2⟧-η4488⟦B1,A2⟧SAB⟦A1,B2⟧+η4488⟦B1,B2⟧SAB⟦A1,A2⟧)]},
 {A1,1, 7},{B1,A1+1,8},{A2,1, 7},{B2,A2+1,8}]*)
```

In[∘]:=
```
(*ParallelTable[{{A1,B1,B2},FullSimplify[SAB⟦A1,B1⟧.T16^A[B2-1] -T16^A[B2-1].SAB⟦A1,B1⟧==
    (-η4488⟦B2,A1⟧T16^A[B1-1]+η4488⟦B2,B1⟧T16^A[A1-1])]}, {A1,1, 8},{B1,1,8},{B2,1,8}]*)
```

In[∘]:=
```
Do[sAB[A1][B1] = 1/4 (T16^A[A1].T16^A[B1] - T16^A[B1].T16^A[A1]),
   {A1, 0, 7}, {B1, 0, 7}];
```

In[ ]:=
```
sAB[-1 + 1][-1 + 2] == SAB⟦1, 2⟧
```

Out[ ]=

True

In[ ]:=
```
σ16.SAB⟦1, 2⟧ // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0
\end{pmatrix}$$

In[ ]:=
```
σ16.sAB[1][2] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

The commutation relations for the generators J_{ab} of the $\mathfrak{so}(3,3)$ Lie algebra (using the physics convention where generators are Hermitian) are given by the formula:

$$[J_{ab}, J_{cd}] = i(\eta_{ac}J_{bd} - \eta_{ad}J_{bc} - \eta_{bc}J_{ad} + \eta_{bd}J_{ac})$$

where:

- The indices a, b, c, d range from 1 to 6.
- η_{ab} is the **metric tensor** with signature $(+,+,+,-,-,-)$ (or the reverse, depending on the convention). A common choice is a diagonal matrix $\eta = \mathbf{diag}(1,1,1,-1,-1,-1)$.
- J_{ab} are the **generators** of the algebra, which are antisymmetric, $J_{ab} = -J_{ba}$.
- The terms on the right-hand side involve Kronecker deltas weighted by the metric, ensuring the resulting generator is also an element of the algebra and satisfies the required antisymmetry and Jacobi identity properties.

The final answer is $[\mathbf{J_{ab}}, \mathbf{J_{cd}}] = \mathbf{i}(\boldsymbol{\eta}_{\mathbf{ac}}\mathbf{J_{bd}} - \boldsymbol{\eta}_{\mathbf{ad}}\mathbf{J_{bc}} - \boldsymbol{\eta}_{\mathbf{bc}}\mathbf{J_{ad}} + \boldsymbol{\eta}_{\mathbf{bd}}\mathbf{J_{ac}})$.

Step 1: Define the generators and metric

The **so(4,4)** Lie algebra has 28 generators, which can be denoted as $J_{\mu\nu}$ where the indices μ, ν range from 0 to 7, and $J_{\mu\nu} = -J_{\nu\mu}$. The Lie algebra is defined in an 8-dimensional real vector space equipped with a metric $\eta_{\mu\nu}$ with signature (4, 4).

- **Generators:** $J_{\mu\nu}$ with $\mu, \nu \in \{0, 1, \ldots, 7\}$
- **Metric tensor:** $\eta_{\mu\nu} = \mathrm{diag}(-1,-1,-1,-1,+1,+1,+1,+1)$ (or the opposite sign convention)

Step 2: State the general commutation relation

The commutation relations for the generators of the **so(p,q)** Lie algebra are a generalization of the **so(n)** algebra relations, incorporating the metric tensor $\eta_{\mu\nu}$.

Answer:

The commutation relations for the generators $J_{\mu\nu}$ of the **so(4,4)** Lie algebra are:

$$[J_{\mu\nu}, J_{\rho\sigma}] = \eta_{\mu\rho}J_{\nu\sigma} - \eta_{\mu\sigma}J_{\nu\rho} - \eta_{\nu\rho}J_{\mu\sigma} + \eta_{\nu\sigma}J_{\mu\rho}$$

where $\eta_{\mu\nu}$ is the metric tensor with a (4,4) signature (four plus signs and four minus signs, or vice versa).

(Note: In some physics conventions, an extra factor of i or $i\hbar$ is included depending on whether the generators are defined as Hermitian or not).

what are the commutation relation for the generators of so(4,4)?

The commutation relations for the generators $J_{\mu\nu}$ of the $so(4,4)$ Lie algebra, where $\mu, \nu \in \{0, 1, \ldots, 7\}$ and $J_{\mu\nu} = -J_{\nu\mu}$, are the standard relations for orthogonal Lie algebras, given by a generalization of the angular momentum commutation relations:

$$[J_{\mu\nu}, J_{\rho\sigma}] = i(\eta_{\mu\rho}J_{\nu\sigma} - \eta_{\mu\sigma}J_{\nu\rho} - \eta_{\nu\rho}J_{\mu\sigma} + \eta_{\nu\sigma}J_{\mu\rho})$$

where $\eta_{\mu\nu}$ is the flat metric of 8-dimensional Minkowski space with signature (4,4) (or some other convention, the structure constants are the same as for $so(8)$ in an appropriate basis), which is a diagonal matrix with four positive and four negative entries (e.g., $\eta = \mathrm{diag}(+1, +1, +1, +1, -1, -1, -1, -1)$).

↳ **Why is the metric signature significant for $so(4,4)$ commutation relations?**

Why is the metric signature significant for $so(4,4)$ commutation relations?

The metric signature is significant for the $so(p, q)$ commutation relations because the metric tensor $\eta_{\mu\nu}$ acts as the **structure constants** of the Lie algebra, defining its specific algebraic structure and physical properties (if applicable).

Here is a detailed explanation of its significance:

- **Definition of the Algebra:** The commutation relation for the generators $J_{\mu\nu}$ of any orthogonal Lie algebra $so(p, q)$ is given by:
  $[J_{\mu\nu}, J_{\rho\sigma}] = i(\eta_{\mu\rho}J_{\nu\sigma} - \eta_{\mu\sigma}J_{\nu\rho} - \eta_{\nu\rho}J_{\mu\sigma} + \eta_{\nu\sigma}J_{\mu\rho})$
  The values of the structure constants depend directly on the components of the metric $\eta_{\mu\nu}$. This means that the specific algebraic properties of $so(4,4)$ are distinct from $so(8)$ (which has a (8,0) signature, i.e., a Euclidean metric), even though they operate in the same 8-dimensional vector space.

- **Physical Interpretation:** In physics, the metric signature determines the nature of spacetime. A mixed signature (like (4,4) or the more common (1,3) Minkowski signature) implies a causal structure, distinguishing between timelike and spacelike dimensions.
  - Generators associated with rotations in spacelike dimensions (positive $\eta_{\mu\nu}$ entries) typically lead to compact symmetry groups (like $SO(4)$ or $SO(8)$).

In[ ]:=
```
η4488
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0},
 {0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, 0, 0, -1, 0}, {0, 0, 0, 0, 0, 0, 0, -1}}
```

orthogonal Lie algebra $so(p,q)$ is given by:

$$[J_{\mu\nu}, J_{\rho\sigma}] = i(\eta_{\mu\rho}J_{\nu\sigma} - \eta_{\mu\sigma}J_{\nu\rho} - \eta_{\nu\rho}J_{\mu\sigma} + \eta_{\nu\sigma}J_{\mu\rho})$$

In[ ]:=
```
SAB⟦6, 2⟧.SAB⟦6, 7⟧ - SAB⟦6, 7⟧.SAB⟦6, 2⟧ == η4488⟦6, 6⟧ × SAB⟦7, 2⟧
```

Out[ ]=
```
True
```

In[ ]:=
```
{{6, 2, 6, 7}, False}
```

Out[ ]=
```
{{6, 2, 6, 7}, False}
```

In[ ]:=
```
SAB⟦1, 2⟧.SAB⟦1, 3⟧ - SAB⟦1, 3⟧.SAB⟦1, 2⟧ == η4488⟦1, 1⟧ × SAB⟦2, 3⟧
```

Out[ ]=
```
False
```

In[ ]:=
```
sAB[0][0]
```

Out[ ]=
```
{{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}}
```

In[ ]:=
```
sAB[0][1]
```

Out[ ]=

$$\left\{\left\{0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0\right\},\left\{0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0\right\},\right.$$
$$\left\{0,0,0,0,0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0\right\},\left\{0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2}\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0\right\},\left\{0,0,0,0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0,0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0,0,0,0,0\right\},$$
$$\left.\left\{0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0\right\},\left\{0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0\right\}\right\}$$

In[ ]:=
```
Table[Transpose[T16^A[8].sAB[A1][B1]] == T16^A[8].sAB[A1][B1], {A1, 0, 7}, {B1, 0, 7}]
```

Out[ ]=

```
{{True, False, False, False, True, True, True, True},
 {False, True, False, False, True, True, True, True},
 {False, False, True, False, True, True, True, True},
 {False, False, False, True, True, True, True, True},
 {True, True, True, True, True, False, False, False},
 {True, True, True, True, False, True, False, False},
 {True, True, True, True, False, False, True, False},
 {True, True, True, True, False, False, False, True}}
```

In[ ]:=
```
Table[Transpose[T16^A[7].sAB[A1][B1]] == T16^A[7].sAB[A1][B1], {A1, 0, 7}, {B1, 0, 7}]
```

Out[ ]=

```
{{True, True, True, True, False, False, False, True},
 {True, True, True, True, False, False, False, True},
 {True, True, True, True, False, False, False, True},
 {True, True, True, True, False, False, False, True},
 {False, False, False, False, True, True, True, False},
 {False, False, False, False, True, True, True, False},
 {False, False, False, False, True, True, True, False},
 {True, True, True, True, False, False, False, True}}
```

In[∘]:=
```
Table[Transpose[σ16.sAB[A1][B1]] == σ16.sAB[A1][B1], {A1, 0, 7}, {B1, 0, 7}]
```

Out[∘]=
```
{{True, False, False, False, False, False, False, False},
 {False, True, False, False, False, False, False, False},
 {False, False, True, False, False, False, False, False},
 {False, False, False, True, False, False, False, False},
 {False, False, False, False, True, False, False, False},
 {False, False, False, False, False, True, False, False},
 {False, False, False, False, False, False, True, False},
 {False, False, False, False, False, False, False, True}}
```

In[∘]:=
```
Table[Transpose[σ16.SAB⟦A1, B1⟧] == σ16.SAB⟦A1, B1⟧, {A1, 1, 8}, {B1, 1, 8}]
```

Out[∘]=
```
{{True, False, False, False, False, False, False, False},
 {False, True, False, False, False, False, False, False},
 {False, False, True, False, False, False, False, False},
 {False, False, False, True, False, False, False, False},
 {False, False, False, False, True, False, False, False},
 {False, False, False, False, False, True, False, False},
 {False, False, False, False, False, False, True, False},
 {False, False, False, False, False, False, False, True}}
```

In[∘]:=
```
SAB⟦1, 2⟧⟦1⟧
```

Out[∘]=

$$\left\{0, 0, 0, 0, 0, 0, 0, \frac{1}{2}, 0, 0, 0, 0, 0, 0, 0, 0\right\}$$

In[∘]:=
```
SAB⟦1, 2⟧⟦2⟧
```

Out[∘]=

$$\left\{0, 0, 0, 0, 0, 0, \frac{1}{2}, 0, 0, 0, 0, 0, 0, 0, 0, 0\right\}$$

$$t^A = \begin{pmatrix} 0 & \bar{\tau}^A \\ \tau^A & 0 \end{pmatrix}.$$

In[∘]:=
```
SAB1 = Table[Take[SAB⟦A1, B1⟧⟦C1⟧, 8], {A1, 8}, {B1, 8}, {C1, 1, 8}];
```

In[∘]:=
```
SAB2 = Table[Take[SAB⟦A1, B1⟧⟦C1⟧, -8], {A1, 8}, {B1, 8}, {C1, 9, 16}];
```

In[∘]:=
```
SAB⟦1, 2⟧ == ArrayFlatten[{{SAB1⟦1, 2⟧, 0}, {0, SAB2⟦1, 2⟧}}]
```

Out[∘]=
```
True
```

In[∘]:=
```
(*Table[
 SAB⟦A1,B1⟧== ArrayFlatten[{{SAB1⟦A1,B1⟧,0},{0,SAB2⟦A1,B1⟧}}],
 {A1,0, 7},{B1,0,7}]*)
```

$$4D_{(1)}{}^{AB} = \bar{\tau}^A \tau^B - \bar{\tau}^B \tau^A$$

$$4D_{(2)}{}^{AB} = \tau^A \bar{\tau}^B - \tau^B \bar{\tau}^A .$$

Let $g \in \overline{SO(4,4)}$ and $L \in SO(4,4)$. The canonical 2-1 homomorphism $\overline{SO(4,4)} \to SO(4,4)$ is given by

$$8L^{A'}{}_{B'}(g) = \operatorname{tr} \widetilde{D}^{(2)}(g)\, \tau^{A'} D^{(1)}(g)\, \bar{\tau}_{B'} . \tag{2.8}$$

As usual tr denotes the trace. Under the action of $\overline{SO(4,4)}$

$$\widetilde{D}^{(1)} \sigma = \sigma D^{(1)-1} , \tag{2.9}$$

$$\sigma^{-1} \widetilde{D}^{(2)} = D^{(2)-1} \sigma^{-1} , \tag{2.10}$$

$$L^{A'}{}_{C'} G_{A'B'} L^{B'}{}_{D'} = G_{C'D'} , \tag{2.11}$$

$$L^{A'}{}_{B'} \tau^{B'} = \widetilde{D}^{(2)} \tau^{A'} D^{(1)} , \tag{2.12}$$

$$L^{A'}{}_{B'} \bar{\tau}^{B'} = D^{(1)-1} \bar{\tau}^{A'} \widetilde{D}^{(2)-1} . \tag{2.13}$$

In[ ]:=
```
SAB2[[1, 2]]
```

Out[ ]=

$$\left\{\left\{0, 0, 0, 0, 0, 0, 0, -\frac{1}{2}\right\}, \left\{0, 0, 0, 0, 0, 0, -\frac{1}{2}, 0\right\}, \left\{0, 0, 0, 0, 0, \frac{1}{2}, 0, 0\right\}, \left\{0, 0, 0, 0, \frac{1}{2}, 0, 0, 0\right\}, \left\{0, 0, 0, -\frac{1}{2}, 0, 0, 0, 0\right\}, \left\{0, 0, -\frac{1}{2}, 0, 0, 0, 0, 0\right\}, \left\{0, \frac{1}{2}, 0, 0, 0, 0, 0, 0\right\}, \left\{\frac{1}{2}, 0, 0, 0, 0, 0, 0, 0\right\}\right\}$$

In[ ]:=
```
τ[0]
```

Out[ ]=

```
{{1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0},
 {0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 1}}
```

In[ ]:=
```
(*Block[{b,A,F_a^(μ),F^a_(μ),ψ,Ψ},
 b=Array[A,{8}];
 ψ[1]=Array[Ψ[1],{8}];
 ψ[2]=Array[Ψ[2],{8}];
 F_a^(μ)=Table[(1/Sqrt[ψ[1].σ.ψ[1]] ψ[1].σ.(τ̄[μL])),{μL,1,8}];
 F^a_(μ)= Transpose[Table[(1/Sqrt[ψ[1].σ.ψ[1]] η4488[[μL,μL]]τ[μL].ψ[1]),{μL,1,8}]];
 b===FullSimplify[F_a^(μ).ψ[2]/.Thread[ψ[2]→F^a_(μ).b]]]*)
```

In[ ]:=
```
(*Block[{b,A,B,q,F^a_(μ),ψ,φ,Ψ},
 b=Array[A,{8}];
 ψ[1]=Array[Ψ[1],{8}];
 φ[1]=Array[Ψ[2],{8}];
 q=ParallelTable[FullSimplify[
    (1/Sqrt[ψ[1].σ.ψ[1]] ψ[1].σ.1/2 (τ̄[A1].τ[B1]-τ̄[B1].τ[A1]).φ[1])],{A1,1,8},{B1,1,8}];
 B=FullSimplify[(1/Sqrt[ψ[1].σ.ψ[1]] ParallelSum[η4488[[μL,μL]]τ[μL]b[[μL]],{μL,1,8}].ψ[1])];
 FullSimplify[q/.Thread[φ[1]→B]]]*)
```

In[ ]:=
```
(*Block[{b,A,B,q,F^a_(μ),ψ,φ,Ψ},
 b=Array[A,{8}];
 ψ[1]=Array[Ψ[1],{8}];
 φ[1]=Array[Ψ[2],{8}];
 q=ParallelTable[FullSimplify[(ψ[1].σ.(τ̄[A1].τ[B1]).φ[1])],{A1,1,8},{B1,1,8}];
 B=FullSimplify[( ParallelSum[η4488[[μL,μL]]τ[μL]b[[μL]],{μL,1,8}].ψ[1])];
 FullSimplify[1/Sqrt[ψ[1].σ.ψ[1]] q/.Thread[φ[1]→B]]]*)
```

$T16^{\alpha}$

In[ ]:= ssgm4488

Out[ ]=

```
{g[0][0] → (Cot[6 H #1]^2 &), g[0][1] → (0 &), g[0][2] → (0 &), g[0][3] → (0 &),
 g[0][4] → (0 &), g[0][5] → (0 &), g[0][6] → (0 &), g[0][7] → (0 &), g[1][0] → (0 &),
 g[1][1] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[1][2] → (0 &), g[1][3] → (0 &),
 g[1][4] → (0 &), g[1][5] → (0 &), g[1][6] → (0 &), g[1][7] → (0 &), g[2][0] → (0 &),
 g[2][1] → (0 &), g[2][2] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[2][3] → (0 &), g[2][4] → (0 &),
 g[2][5] → (0 &), g[2][6] → (0 &), g[2][7] → (0 &), g[3][0] → (0 &), g[3][1] → (0 &),
 g[3][2] → (0 &), g[3][3] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[3][4] → (0 &), g[3][5] → (0 &),
 g[3][6] → (0 &), g[3][7] → (0 &), g[4][0] → (0 &), g[4][1] → (0 &), g[4][2] → (0 &),
 g[4][3] → (0 &), g[4][4] → (-1 &), g[4][5] → (0 &), g[4][6] → (0 &), g[4][7] → (0 &),
 g[5][0] → (0 &), g[5][1] → (0 &), g[5][2] → (0 &), g[5][3] → (0 &), g[5][4] → (0 &),
 g[5][5] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[5][6] → (0 &), g[5][7] → (0 &),
 g[6][0] → (0 &), g[6][1] → (0 &), g[6][2] → (0 &), g[6][3] → (0 &), g[6][4] → (0 &),
 g[6][5] → (0 &), g[6][6] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[6][7] → (0 &),
 g[7][0] → (0 &), g[7][1] → (0 &), g[7][2] → (0 &), g[7][3] → (0 &), g[7][4] → (0 &),
 g[7][5] → (0 &), g[7][6] → (0 &), g[7][7] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &)}
```

In[ ]:= $e^{\alpha}_{(A)}$ /. $sge^{\alpha}_{(A)}$

Out[ ]=

$$\left\{\left\{\frac{1}{\sqrt{g[0][0][x0, x4]}}, 0, 0, 0, 0, 0, 0, 0\right\}, \left\{0, \frac{1}{\sqrt{g[1][1][x0, x4]}}, 0, 0, 0, 0, 0, 0\right\}, \left\{0, 0, \frac{1}{\sqrt{g[2][2][x0, x4]}}, 0, 0, 0, 0, 0\right\}, \left\{0, 0, 0, \frac{1}{\sqrt{g[3][3][x0, x4]}}, 0, 0, 0, 0\right\}, \left\{0, 0, 0, 0, \frac{1}{\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\right\}, \left\{0, 0, 0, 0, 0, \frac{1}{\sqrt{-g[5][5][x0, x4]}}, 0, 0\right\}, \left\{0, 0, 0, 0, 0, 0, \frac{1}{\sqrt{-g[6][6][x0, x4]}}, 0\right\}, \left\{0, 0, 0, 0, 0, 0, 0, \frac{1}{\sqrt{-g[7][7][x0, x4]}}\right\}\right\}$$

In[ ]:=

```
Table[T16^α[α1 - 1] =
   Sum[((e^α_(A) /. sge^α_(A))[[α1, A1]]) T16^A[A1 - 1], {A1, 1, 8}],
  {α1, 1, 8}];(*/.ssgm4488*)
```

In[ ]:=

```
(T16^α[8] = T16^α[0].T16^α[1].T16^α[2].T16^α[3].T16^α[4].T16^α[5].T16^α[6].T16^α[7]);
```

In[ ]:=

```
Table[newT16^α[A1] = similarityTransformation. T16^α[A1].
    Transpose[similarityTransformation], {A1, 0, 8} ];
```

In[ ]:=

```
(*T16^α[8]==T16^A[8]*Sec[6 H x0]*)
```

CHECK

Table[T16$^{\alpha}$[α1 - 1] = Sum[(e$^{\alpha}_{(A)}$[[α1, A1]]) T16^{A}[A1 - 1], {A1, 1, 8}], {α1, 1, 8}]; and ● ● ● :

In[ ]:=
```
(*Table[T16^α[α1-1]=
   Sum[(e^α_(A)[[α1,A1]]) T16^A[A1-1],{A1,1,8}],{α1,1,8}];*)
```

In[ ]:=
```
(*(T16^α[8]=T16^α[0].T16^α[1].T16^α[2].T16^α[3].T16^α[4].T16^α[5].T16^α[6].T16^α[7])//
 MatrixForm*)
```

In[ ]:=
```
Table[{{A1, B1}, FullSimplify[
    ExpandAll[1/2 (T16^A[A1].T16^A[B1] + T16^A[B1].T16^A[A1]) ==
      η4488[[A1 + 1, B1 + 1]] * ID16]]},
  {A1, 0, 7}, {B1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

In[ ]:=
```
Table[{{α1, β1}, FullSimplify[
    1/2 FullSimplify[((T16^α[α1].T16^α[β1] + T16^α[β1].T16^α[α1]) /.
        ssgm4488), constraintVars] ==
     Inverse[MatrixMetric44][[α1 + 1, β1 + 1]] * ID16]},
  {α1, 0, 7}, {β1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

In[ ]:=
```
Table[{{α1, β1}, FullSimplify[
    1/2 FullSimplify[((newT16^α[α1].newT16^α[β1] + newT16^α[β1].
          newT16^α[α1]) /. ssgm4488), constraintVars] ==
     Inverse[MatrixMetric44][[α1 + 1, β1 + 1]] * ID16]},
  {α1, 0, 7}, {β1, 0, 7}] // MatrixForm
```

Out[ ]//MatrixForm=

{0, 0} True	{0, 1} True	{0, 2} True	{0, 3} True	{0, 4} True	{0, 5} True	{0, 6} True	{0, 7} True
{1, 0} True	{1, 1} True	{1, 2} True	{1, 3} True	{1, 4} True	{1, 5} True	{1, 6} True	{1, 7} True
{2, 0} True	{2, 1} True	{2, 2} True	{2, 3} True	{2, 4} True	{2, 5} True	{2, 6} True	{2, 7} True
{3, 0} True	{3, 1} True	{3, 2} True	{3, 3} True	{3, 4} True	{3, 5} True	{3, 6} True	{3, 7} True
{4, 0} True	{4, 1} True	{4, 2} True	{4, 3} True	{4, 4} True	{4, 5} True	{4, 6} True	{4, 7} True
{5, 0} True	{5, 1} True	{5, 2} True	{5, 3} True	{5, 4} True	{5, 5} True	{5, 6} True	{5, 7} True
{6, 0} True	{6, 1} True	{6, 2} True	{6, 3} True	{6, 4} True	{6, 5} True	{6, 6} True	{6, 7} True
{7, 0} True	{7, 1} True	{7, 2} True	{7, 3} True	{7, 4} True	{7, 5} True	{7, 6} True	{7, 7} True

In[ ]:=
```
MatrixMetric44 // MatrixForm
```

Out[ ]//MatrixForm=

$\text{Cot}[6\,H\,x0]^2$	0	0	0	0
0	$e^{2\,a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/3}$	0	0	0
0	0	$e^{2\,a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/3}$	0	0
0	0	0	$e^{2\,a4[H\,x4]}\,\text{Sin}[6\,H\,x0]^{1/3}$	0
0	0	0	0	-1
0	0	0	0	0 $-e^{-2\,a4[H\,x4]}$ S
0	0	0	0	0
0	0	0	0	0

In[ ]:=
```
(e^α_(A) /. sgtrye^α_(A)).MatrixMetric44.(e^α_(A) /. sgtrye^α_(A)) // MatrixForm
```

Out[ ]//MatrixForm=

1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	-1	0	0	0
0	0	0	0	0	-1	0	0
0	0	0	0	0	0	-1	0
0	0	0	0	0	0	0	-1

In[∘]:=
```
Transpose[(e_α^(A) /. sgtrye_α^(A))].η4488.(e_α^(A) /. sgtrye_α^(A)) - MatrixMetric44 //
  FullSimplify[#, constraintVars] &
```

Out[∘]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

In[∘]:=
```
Transpose[(e^α_(A) /. sgtrye^α_(A))].MatrixMetric44.(e^α_(A) /. sgtrye^α_(A)) - η4488 //
  (*Full*)Simplify[#, constraintVars] &
```

Out[∘]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

In[∘]:=
```
Inverse[(e^α_(A) /. sgtrye^α_(A))] == (e_α^(A) /. sgtrye_α^(A))
```

Out[∘]=
```
True
```

In[∘]:=
```
Block[{a, b, c, d, m}, m = {{a, b}, {c, d}}; Inverse[Transpose[m]] - Transpose[Inverse[m]]]
```

Out[∘]=
```
{{0, 0}, {0, 0}}
```

BELOW : LagrangianΨ16 =

$$\kappa \sqrt{\mathrm{Det}[g_{\mu\nu}]}\ \mathrm{Transpose}[\Psi 16].\sigma 16.T16^{A}[A1].\Psi 16_{|\alpha}\, g^{-1\ \alpha\beta}\, \eta_{A1\,B1}\, E^{B1}_{\beta} + \text{mass term}$$

In[∘]:=
```
e_α^(A) /. sgtrye_α^(A)
```

Out[∘]=
```
{{Cot[6 H x0], 0, 0, 0, 0, 0, 0, 0}, {0, Sqrt[ⅇ^(2 a4[H x4])] Sin[6 H x0]^(1/6), 0, 0, 0, 0, 0, 0},
 {0, 0, Sqrt[ⅇ^(2 a4[H x4])] Sin[6 H x0]^(1/6), 0, 0, 0, 0, 0}, {0, 0, 0, Sqrt[ⅇ^(2 a4[H x4])] Sin[6 H x0]^(1/6), 0, 0, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, Sqrt[ⅇ^(-2 a4[H x4])] Sin[6 H x0]^(1/6), 0, 0},
 {0, 0, 0, 0, 0, 0, Sqrt[ⅇ^(-2 a4[H x4])] Sin[6 H x0]^(1/6), 0},
 {0, 0, 0, 0, 0, 0, 0, Sqrt[ⅇ^(-2 a4[H x4])] Sin[6 H x0]^(1/6)}}
```

In[ ]:= $e^{\alpha}_{(A)}$ /. sgtrye$^{\alpha}_{(A)}$

Out[ ]=

$$\left\{\{\text{Tan}[6\,H\,x0],0,0,0,0,0,0,0\},\left\{0,\frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0,0,0\right\},\right.$$
$$\left\{0,0,\frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0,0\right\},\left\{0,0,0,\frac{1}{\sqrt{e^{2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},0,0,0,0\right\},$$
$$\{0,0,0,0,1,0,0,0\},\left\{0,0,0,0,0,\frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},0,0\right\},$$
$$\left\{0,0,0,0,0,0,\frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}},0\right\},$$
$$\left.\left\{0,0,0,0,0,0,0,\frac{1}{\sqrt{e^{-2\,a4[H\,x4]}}\,\text{Sin}[6\,H\,x0]^{1/6}}\right\}\right\}$$

In[ ]:= $e^{\alpha}_{(A)}$ /. sge$^{\alpha}_{(A)}$

Out[ ]=

$$\left\{\left\{\frac{1}{\sqrt{g[0][0][x0,x4]}},0,0,0,0,0,0,0\right\},\left\{0,\frac{1}{\sqrt{g[1][1][x0,x4]}},0,0,0,0,0,0\right\},\right.$$
$$\left\{0,0,\frac{1}{\sqrt{g[2][2][x0,x4]}},0,0,0,0,0\right\},\left\{0,0,0,\frac{1}{\sqrt{g[3][3][x0,x4]}},0,0,0,0\right\},$$
$$\left\{0,0,0,0,\frac{1}{\sqrt{-g[4][4][x0,x4]}},0,0,0\right\},\left\{0,0,0,0,0,\frac{1}{\sqrt{-g[5][5][x0,x4]}},0,0\right\},$$
$$\left\{0,0,0,0,0,0,\frac{1}{\sqrt{-g[6][6][x0,x4]}},0\right\},\left\{0,0,0,0,0,0,0,\frac{1}{\sqrt{-g[7][7][x0,x4]}}\right\}\right\}$$

In[ ]:=

```
Clear[con];
con[g_, ass_ : {}] := Module[{t, ΓΓ, ginv},
  ginv = FullSimplify[Inverse[g], ass];
  ΓΓ = FullSimplify[Table[(1 / 2) * Sum[(ginv⟦i, s⟧) *
        (D[g⟦s, j⟧, X⟦k⟧ ] + D[g⟦s, k⟧, X⟦j⟧ ] - D[g⟦j, k⟧, X⟦s⟧ ]), {s, 1, DIM8}],
     {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}] , ass];
  Return[{ginv, ΓΓ}]]
```

In[ ]:=
```
ssgm4488
```

Out[ ]=
```
{g[0][0] → (Cot[6 H #1]^2 &), g[0][1] → (0 &), g[0][2] → (0 &), g[0][3] → (0 &),
 g[0][4] → (0 &), g[0][5] → (0 &), g[0][6] → (0 &), g[0][7] → (0 &), g[1][0] → (0 &),
 g[1][1] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[1][2] → (0 &), g[1][3] → (0 &),
 g[1][4] → (0 &), g[1][5] → (0 &), g[1][6] → (0 &), g[1][7] → (0 &), g[2][0] → (0 &),
 g[2][1] → (0 &), g[2][2] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[2][3] → (0 &), g[2][4] → (0 &),
 g[2][5] → (0 &), g[2][6] → (0 &), g[2][7] → (0 &), g[3][0] → (0 &), g[3][1] → (0 &),
 g[3][2] → (0 &), g[3][3] → (e^(2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[3][4] → (0 &), g[3][5] → (0 &),
 g[3][6] → (0 &), g[3][7] → (0 &), g[4][0] → (0 &), g[4][1] → (0 &), g[4][2] → (0 &),
 g[4][3] → (0 &), g[4][4] → (-1 &), g[4][5] → (0 &), g[4][6] → (0 &), g[4][7] → (0 &),
 g[5][0] → (0 &), g[5][1] → (0 &), g[5][2] → (0 &), g[5][3] → (0 &), g[5][4] → (0 &),
 g[5][5] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[5][6] → (0 &), g[5][7] → (0 &),
 g[6][0] → (0 &), g[6][1] → (0 &), g[6][2] → (0 &), g[6][3] → (0 &), g[6][4] → (0 &),
 g[6][5] → (0 &), g[6][6] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &), g[6][7] → (0 &),
 g[7][0] → (0 &), g[7][1] → (0 &), g[7][2] → (0 &), g[7][3] → (0 &), g[7][4] → (0 &),
 g[7][5] → (0 &), g[7][6] → (0 &), g[7][7] → (-e^(-2 a4[H #2]) Sin[6 H #1]^(1/3) &)}
```

In[ ]:=
```
g4488
g4488 /. sg
```

Out[ ]=
```
{{g[0][0][x0, x4], g[0][1][x0, x4], g[0][2][x0, x4], g[0][3][x0, x4],
   g[0][4][x0, x4], g[0][5][x0, x4], g[0][6][x0, x4], g[0][7][x0, x4]},
 {g[1][0][x0, x4], g[1][1][x0, x4], g[1][2][x0, x4], g[1][3][x0, x4],
   g[1][4][x0, x4], g[1][5][x0, x4], g[1][6][x0, x4], g[1][7][x0, x4]},
 {g[2][0][x0, x4], g[2][1][x0, x4], g[2][2][x0, x4], g[2][3][x0, x4],
   g[2][4][x0, x4], g[2][5][x0, x4], g[2][6][x0, x4], g[2][7][x0, x4]},
 {g[3][0][x0, x4], g[3][1][x0, x4], g[3][2][x0, x4], g[3][3][x0, x4],
   g[3][4][x0, x4], g[3][5][x0, x4], g[3][6][x0, x4], g[3][7][x0, x4]},
 {g[4][0][x0, x4], g[4][1][x0, x4], g[4][2][x0, x4], g[4][3][x0, x4],
   g[4][4][x0, x4], g[4][5][x0, x4], g[4][6][x0, x4], g[4][7][x0, x4]},
 {g[5][0][x0, x4], g[5][1][x0, x4], g[5][2][x0, x4], g[5][3][x0, x4],
   g[5][4][x0, x4], g[5][5][x0, x4], g[5][6][x0, x4], g[5][7][x0, x4]},
 {g[6][0][x0, x4], g[6][1][x0, x4], g[6][2][x0, x4], g[6][3][x0, x4],
   g[6][4][x0, x4], g[6][5][x0, x4], g[6][6][x0, x4], g[6][7][x0, x4]},
 {g[7][0][x0, x4], g[7][1][x0, x4], g[7][2][x0, x4], g[7][3][x0, x4],
   g[7][4][x0, x4], g[7][5][x0, x4], g[7][6][x0, x4], g[7][7][x0, x4]}}
```

Out[ ]=
```
{{g[0][0][x0, x4], 0, 0, 0, 0, 0, 0, 0}, {0, g[1][1][x0, x4], 0, 0, 0, 0, 0, 0},
 {0, 0, g[2][2][x0, x4], 0, 0, 0, 0, 0}, {0, 0, 0, g[3][3][x0, x4], 0, 0, 0, 0},
 {0, 0, 0, 0, g[4][4][x0, x4], 0, 0, 0}, {0, 0, 0, 0, 0, g[5][5][x0, x4], 0, 0},
 {0, 0, 0, 0, 0, 0, g[6][6][x0, x4], 0}, {0, 0, 0, 0, 0, 0, 0, g[7][7][x0, x4]}}
```

In[ ]:=
```
MatrixForm[#] & /@ Block[{eAα, eαA, (*ginv,Γ,gg,*)colVecs, rowVecs, ab, ba, r},
  (*gg=g4488/.sg;*)
  (*{ginv,Γ}=con[gg];*)
  eαA = e^α_(A) /. sge^α_(A);
  eAα = e^(A)_α /. sge^(A)_α;
  rowVecs = Table[eAα[[b, All]], {b, 1, Length[eAα]}];
  colVecs = Table[eαA[[All, b]], {b, 1, Length[eαA]}];
  ab = rowVecs.colVecs // FullSimplify[#, constraintVars] &;
  ba = Transpose[colVecs].Transpose[rowVecs] // FullSimplify[#, constraintVars] &;
  (*r={{ab},{ba}};*)
  r = {ab, ba};
  r]
```

Out[ ]=

$$\left\{\begin{pmatrix} 1&0&0&0&0&0&0&0\\ 0&1&0&0&0&0&0&0\\ 0&0&1&0&0&0&0&0\\ 0&0&0&1&0&0&0&0\\ 0&0&0&0&1&0&0&0\\ 0&0&0&0&0&1&0&0\\ 0&0&0&0&0&0&1&0\\ 0&0&0&0&0&0&0&1 \end{pmatrix}, \begin{pmatrix} 1&0&0&0&0&0&0&0\\ 0&1&0&0&0&0&0&0\\ 0&0&1&0&0&0&0&0\\ 0&0&0&1&0&0&0&0\\ 0&0&0&0&1&0&0&0\\ 0&0&0&0&0&1&0&0\\ 0&0&0&0&0&0&1&0\\ 0&0&0&0&0&0&0&1 \end{pmatrix}\right\}$$

metric compatibility condition for the Octad

$$\nabla_\mu e^I_\nu = \partial_\mu e^I_\nu - \Gamma^\rho_{\mu\nu} e^I_\rho + \omega^I_{\mu J} e^J_\nu = 0$$

In[ ]:=
```
Clear[spinCoefficients];
spinCoefficients[eIν_] := Module[{eνI, w, r, s},
  If[Dimensions[eIν] ≠ {8, 8}, Return[{}]];
  If[Det[eIν] == 0, Return[{}]];
  eνI = FullSimplify[Inverse[eIν], constraintVars] /. subsDefects;
  w = Table[-Table[
      FullSimplify[Sum[D[eIν[[I1, ν1]], X[[μ1]]] * eνI[[ν1, Jprime]], {ν1, 1, Length[eνI]}] -
         Sum[  eIν[[I1, ρ]] * Γ[[ρ, μ1, ν1]] * eνI[[ν1, Jprime]], {ν1, 1, Length[eνI]},
          {ρ, 1, Length[X]}], constraintVars] /. subsDefects,
      {I1, 1, Length[eIν]}, {Jprime, 1, Length[eνI]}], {μ1, 1, Length[X]}];
  Assert[Dimensions[w] == {8, 8, 8}];
  Return[w];
 ]
```

In[ ]:=
```
spinCoeffs = spinCoefficients[gtrye_α^(A)]
```

Out[ ]=
```
{{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, -e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, 0, 0, 0}, {e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0,
   0, 0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, 0, -e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, 0, 0, -e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {e^(a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4],
   0, 0, 0}, {0, 0, 0, e^(a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0},
  {e^(-a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, -e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}},
 {{0, 0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6), 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {e^(-a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, -e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6)},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4]},
  {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
  {e^(-a4[H x4]) H Sin[6 H x0]^(1/6), 0, 0, 0, -e^(-a4[H x4]) H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0}}}
```

In[∘]:=
```
Table[
 ωμIJ[μ] = FullSimplify[-((D[gtrye_α^(A), X[[μ]]].gtrye^α_(A)) - (gtrye_α^(A).Γ[[All, μ, All]].gtrye^α_(A))),
    constraintVars] /. subsDefects, {μ, 1, Length[X]}]
```

Out[∘]=

$$\{\{\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0,0\},\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,$$
$$0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$$
$$0,0,0\},\{0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\}\}$$

In[∘]:= (*gtrye^α_(A).gtrye^(A)_α*)

In[∘]:= (*gtrye^(A)_α.gtrye^α_(A)*)

In[∘]:= (*gtrye^(A)_α*)

In[∘]:=
```
(*Γ
 Dimensions[%]*)
```

In[∘]:= (*Table[Γ[[All,μ,All]],{μ,1,Length[X]}]*)

```
In[•]:= (*Γ⟦All,5,All⟧*)
In[•]:= (*Γ⟦All,1,All⟧*)
In[•]:= (*spinCoeffs⟦1⟧*)
In[•]:= (*spinCoeffs⟦5⟧*)
In[•]:= (*{X⟦1⟧,X⟦5⟧}*)
In[•]:= (*spinCoeffs⟦1⟧⟦1⟧⟦1⟧*)
In[•]:= (*ωμIJ[1]⟦1⟧⟦1⟧*)
In[•]:= (*Block[{μ=1},FullSimplify[-((D[gtrye_α^(A),X⟦μ⟧].gtrye^α_(A))-(gtrye_α^(A).Γ⟦All,μ,All⟧.gtrye^α_(A))),
          constraintVars]/.subsDefects]
        Dimensions[%]*)
In[•]:= (*Block[{μ=1},FullSimplify[
          -((D[gtrye_α^(A),X⟦μ⟧].Transpose[gtrye^α_(A)])-(gtrye_α^(A).Γ⟦All,μ,All⟧.Transpose[gtrye^α_(A)])),
          constraintVars]/.subsDefects]*)
In[•]:= (*Block[{μ=1},
          FullSimplify[-((Sum[    D[gtrye_α^(A)⟦All,ν⟧,X⟦μ⟧]*gtrye^α_(A)⟦ν,All⟧    ,{ν,1,8}]  )-
              (gtrye_α^(A).Γ⟦All,μ,All⟧.gtrye^α_(A))),constraintVars]/.subsDefects]
        Dimensions[%]*)
In[•]:= (*Table[,{A1,1,8},{B1,1,8}]*)
In[•]:= (*Block[{μ=1},
          Table[FullSimplify[-((Sum[    D[gtrye_α^(A)⟦A1,ν⟧,X⟦μ⟧]*gtrye^α_(A)⟦ν,B1⟧    ,{ν,1,8}]  )-
                (Sum[    gtrye_α^(A)⟦A1,ρ⟧*Γ⟦ρ,μ,ν⟧*gtrye^α_(A)⟦ν,B1⟧    ,{ρ,1,8},{ν,1,8}]  )),
            constraintVars]/.subsDefects,{A1,1,8},{B1,1,8}]]
        Dimensions[%]*)
In[•]:= Table[ ( ωμIJ[μ] - spinCoeffs⟦μ⟧ ) /. subsDefects , {μ, 1, Length[X]}] // Flatten // Union
Out[•]=
{0}
```

- **Metric compatibility**: The tetrad formalism uses a tetrad (or vierbein) to connect the curved spacetime to a local flat, Lorentzian frame. The connection coefficients are defined to satisfy the metric compatibility condition for the tetrad, which is:
  - $\nabla_\mu e^a{}_\nu = 0$
  - Here, ∇_μ is the covariant derivative with respect to the connection $\Gamma^a{}_{b\nu}$, and $e^a{}_\nu$ is the tetrad component.

○ Metric compatibility : The tetrad formalism uses a tetrad (or vierbein) to connect the curved spacetime to a local flat, Lorentzian frame . The connection coefficients are defined to satisfy the metric compatibility condition for the tetrad, which is : ○ V
не "
v=0
• Here, Vu is the covariant derivative with respect to the connection F" bv, and ea v is
the tetrad component .

No it is not the torsionless condition which is:

$$T^I_{\mu\nu} = D^{\omega}_{[\mu} e^I_{\nu]} = \partial_{[\mu} e^I_{\nu]} + \omega^I_{[\mu J} e^J_{\nu]} = 0$$

This postulate says:

$$\nabla_\mu e^I_\nu = \partial_\mu e^I_\nu - \Gamma^\rho_{\mu\nu} e^I_\rho + \omega^I_{\mu J}\, e^J_\nu = 0$$

And is merely obtained by expressing a tensor in two different basis then putting the two components equals after returning in the natural basis, it is a sorte of "consistancy" condition.

I see the anticommutativity of the spin-connection not implying the metricity but resulting from it! By imposing $D^{\omega}_{\mu} \eta_{IJ} = 0$ (neverthless, after that it will IMPLY it)

So in the same spirit, I wonder if there is a way to obtain the "tetrad postulate" from a same requirement, say, the metricity of g for example (It will neverthless IMPLY it once written down)

I think that the confusion in almost all papers I read is the problem, recently I read a paper which pointed out these confusions (An Ambiguous Statement Called 'Tetrad Postulate' and the Correct Field Equations Satisfied by the Tetrad Fields arXiv:math-ph/0411085v12 6 Jan 2008) The author said that this postulate comes from the metricity condition but didn't show how (even if he was very rigourous in the mathematical demonstrations, too rigourous at my tast :-))

In[ ]:=
```
Block[{eAα, eαA, t, ginv, Γ, gg},
 gg = g4488 /. sg;
 {ginv, Γ} = con[gg];
 eαA = e^α_(A) /. sge^α_(A); eAα = e^(A)_α /. sge^(A)_α;
 t = Table[ Block[{v, V, contra, covari},
    V = eAα[[b, All]];
    v = eαA[[All, b]];
    contra = Table[D[v[[k]], X[[μ]] ] + Sum[ v[[i]] × Γ[[k, i, μ]], {i, 1, DIM8}], {k, 1, DIM8}];
    (*before ω terms*)
    covari = Table[D[V[[k]], X[[μ]] ] - Sum[ V[[i]] × Γ[[i, k, μ]], {i, 1, DIM8}], {k, 1, DIM8}];
    (*before ω terms*)
    {b - 1, X[[μ]], {{contra}, {covari}}}], {b, 1, Length[eαA]}, {μ, 1, DIM8}];
 t]
FullSimplify[# /. ssgm4488, constraintVars] & /@ %
```

Out[ ]=

$$\left\{\left\{\left\{0, x0, \left\{\left\{0, 0, 0, 0, -\frac{g[0][0]^{(0,1)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\; g[4][4][x0, x4]}, 0, 0, 0\right\}\right\}, \left\{\left\{0, 0, 0, 0, -\frac{g[0][0]^{(0,1)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x1, \left\{\left\{\left\{0, \frac{g[1][1]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[1][1][x0, x4]}, 0, 0, 0, 0, 0, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, \frac{g[1][1]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x2, \left\{\left\{\left\{0, 0, \frac{g[2][2]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[2][2][x0, x4]}, 0, 0, 0, 0, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, 0, \frac{g[2][2]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x3, \left\{\left\{\left\{0, 0, 0, \frac{g[3][3]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[3][3][x0, x4]}, 0, 0, 0, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, 0, 0, \frac{g[3][3]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x4, \left\{\left\{\left\{0, 0, 0, 0, \frac{g[4][4]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, 0, 0, 0, \frac{g[4][4]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x5, \left\{\left\{\left\{0, 0, 0, 0, 0, \frac{g[5][5]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[5][5][x0, x4]}, 0, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, 0, 0, 0, 0, \frac{g[5][5]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x6, \left\{\left\{\left\{0, 0, 0, 0, 0, 0, \frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[6][6][x0, x4]}, 0\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left\{\left\{0, 0, 0, 0, 0, 0, \frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0\right\}\right\}\right\}\right\},$$

$$\left\{0, x7, \left\{\left\{\left\{0, 0, 0, 0, 0, 0, 0, \frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\, g[7][7][x0, x4]}\right\}\right\},\right.\right.$$

$$\left.\left.\left.\left.\left\{\left\{0, 0, 0, 0, 0, 0, 0, \frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}\right\}\right\}\right\}\right\},$$

$$\left\{\{1, x0, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \left\{1, x1,\right.\right.$$

$$\left.\left\{\left\{\left\{-\frac{g[1][1]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\sqrt{g[1][1][x0, x4]}}, 0, 0, 0, -\frac{g[1][1]^{(0,1)}[x0, x4]}{2\sqrt{g[1][1][x0, x4]}\, g[4][4][x0, x4]},\right.\right.\right.\right.$$

$$\left.\left.\left.\left.\left.0, 0, 0\right\}\right\}, \left\{\left\{-\frac{g[1][1]^{(1,0)}[x0, x4]}{2\sqrt{g[1][1][x0, x4]}}, 0, 0, 0, -\frac{g[1][1]^{(0,1)}[x0, x4]}{2\sqrt{g[1][1][x0, x4]}}, 0, 0, 0\right\}\right\}\right\}\right\},$$

$$\{1, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{1, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{1, x4, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{1, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{1, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{1, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\},$$
$$\{\{2, x0, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{2, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{2, x2,$$
$$\{\{\{-\frac{g[2][2]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{g[2][2][x0, x4]}}, 0, 0, 0, -\frac{g[2][2]^{(0,1)}[x0, x4]}{2\, \sqrt{g[2][2][x0, x4]}\, g[4][4][x0, x4]},$$
$$0, 0, 0\}\}, \{\{-\frac{g[2][2]^{(1,0)}[x0, x4]}{2\, \sqrt{g[2][2][x0, x4]}}, 0, 0, 0, -\frac{g[2][2]^{(0,1)}[x0, x4]}{2\, \sqrt{g[2][2][x0, x4]}}, 0, 0, 0\}\}\}\},$$
$$\{2, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{2, x4, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{2, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{2, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{2, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\},$$
$$\{\{3, x0, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{3, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{3, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{3, x3,$$
$$\{\{\{-\frac{g[3][3]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{g[3][3][x0, x4]}}, 0, 0, 0, -\frac{g[3][3]^{(0,1)}[x0, x4]}{2\, \sqrt{g[3][3][x0, x4]}\, g[4][4][x0, x4]},$$
$$0, 0, 0\}\}, \{\{-\frac{g[3][3]^{(1,0)}[x0, x4]}{2\, \sqrt{g[3][3][x0, x4]}}, 0, 0, 0, -\frac{g[3][3]^{(0,1)}[x0, x4]}{2\, \sqrt{g[3][3][x0, x4]}}, 0, 0, 0\}\}\}\},$$
$$\{3, x4, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{3, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{3, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{3, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\},$$
$$\{\{4, x0, \{\{\{\frac{g[0][0]^{(0,1)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0,$$
$$\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, (-g[4][4][x0, x4])^{3/2}} + \frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\}\},$$
$$\{\{\frac{g[0][0]^{(0,1)}[x0, x4]\, \sqrt{-g[4][4][x0, x4]}}{2\, g[4][4][x0, x4]}, 0, 0, 0,$$
$$-\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}} - \frac{g[4][4]^{(1,0)}[x0, x4]\, \sqrt{-g[4][4][x0, x4]}}{2\, g[4][4][x0, x4]}, 0, 0, 0\}\}\}\},$$
$$\{4, x1, \{\{\{0, \frac{g[1][1]^{(0,1)}[x0, x4]}{2\, g[1][1][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, 0, 0, 0\}\},$$
$$\{\{0, \frac{g[1][1]^{(0,1)}[x0, x4]\, \sqrt{-g[4][4][x0, x4]}}{2\, g[4][4][x0, x4]}, 0, 0, 0, 0, 0, 0\}\}\}\},$$
$$\{4, x2, \{\{\{0, 0, \frac{g[2][2]^{(0,1)}[x0, x4]}{2\, g[2][2][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, 0, 0\}\},$$

$$\left\{\left\{0,\ 0,\ \frac{g[2][2]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0,\ 0,\ 0,\ 0,\ 0\right\}\right\}\right\},$$

$$\left\{4,\ x3,\ \left\{\left\{\left\{0,\ 0,\ 0,\ \frac{g[3][3]^{(0,1)}[x0,\ x4]}{2\,g[3][3][x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}},\ 0,\ 0,\ 0,\ 0\right\}\right\},\right.\right.$$

$$\left.\left.\left\{\left\{0,\ 0,\ 0,\ \frac{g[3][3]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0,\ 0,\ 0,\ 0\right\}\right\}\right\}\right\},$$

$$\left\{4,\ x4,\ \left\{\left\{\left\{-\frac{g[4][4]^{(1,0)}[x0,\ x4]}{2\,g[0][0][x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}},\ 0,\ 0,\ 0,\right.\right.\right.$$

$$\left.\left.\frac{g[4][4]^{(0,1)}[x0,\ x4]}{2\,(-g[4][4][x0,\ x4])^{3/2}}+\frac{g[4][4]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[4][4][x0,\ x4]}\ g[4][4][x0,\ x4]},\ 0,\ 0,\ 0\right\}\right\},$$

$$\left\{\left\{-\frac{g[4][4]^{(1,0)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0,\ 0,\ 0,\right.\right.$$

$$\left.\left.\left.\left.-\frac{g[4][4]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[4][4][x0,\ x4]}}-\frac{g[4][4]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0,\ 0,\ 0\right\}\right\}\right\}\right\},$$

$$\left\{4,\ x5,\ \left\{\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[5][5]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[4][4][x0,\ x4]}\ g[5][5][x0,\ x4]},\ 0,\ 0\right\}\right\},\right.\right.$$

$$\left.\left.\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[5][5]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0,\ 0\right\}\right\}\right\}\right\},$$

$$\left\{4,\ x6,\ \left\{\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[6][6]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[4][4][x0,\ x4]}\ g[6][6][x0,\ x4]},\ 0\right\}\right\},\right.\right.$$

$$\left.\left.\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[6][6]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]},\ 0\right\}\right\}\right\}\right\},$$

$$\left\{4,\ x7,\ \left\{\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[7][7]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[4][4][x0,\ x4]}\ g[7][7][x0,\ x4]}\right\}\right\},\right.\right.$$

$$\left.\left.\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[7][7]^{(0,1)}[x0,\ x4]\ \sqrt{-g[4][4][x0,\ x4]}}{2\,g[4][4][x0,\ x4]}\right\}\right\}\right\}\right\},\ \left\{\left\{5,\ x0,\right.\right.$$

$$\left\{\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[5][5]^{(1,0)}[x0,\ x4]}{2\,(-g[5][5][x0,\ x4])^{3/2}}+\frac{g[5][5]^{(1,0)}[x0,\ x4]}{2\,\sqrt{-g[5][5][x0,\ x4]}\ g[5][5][x0,\ x4]},\ 0,\ 0\right\}\right\},\right.$$

$$\left.\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ -\frac{g[5][5]^{(1,0)}[x0,\ x4]}{2\,\sqrt{-g[5][5][x0,\ x4]}}-\frac{g[5][5]^{(1,0)}[x0,\ x4]\ \sqrt{-g[5][5][x0,\ x4]}}{2\,g[5][5][x0,\ x4]},\right.\right.$$

$$\left.\left.\left.\left.0,\ 0\right\}\right\}\right\}\right\},\ \{5,\ x1,\ \{\{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\},\ \{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\}\}\},$$

$$\{5,\ x2,\ \{\{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\},\ \{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\}\}\},$$

$$\{5,\ x3,\ \{\{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\},\ \{\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}\}\}\},\ \left\{5,\ x4,\right.$$

$$\left\{\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ \frac{g[5][5]^{(0,1)}[x0,\ x4]}{2\,(-g[5][5][x0,\ x4])^{3/2}}+\frac{g[5][5]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[5][5][x0,\ x4]}\ g[5][5][x0,\ x4]},\ 0,\ 0\right\}\right\},\right.$$

$$\left\{\left\{0,\ 0,\ 0,\ 0,\ 0,\ -\frac{g[5][5]^{(0,1)}[x0,\ x4]}{2\,\sqrt{-g[5][5][x0,\ x4]}}-\frac{g[5][5]^{(0,1)}[x0,\ x4]\ \sqrt{-g[5][5][x0,\ x4]}}{2\,g[5][5][x0,\ x4]},\right.\right.$$

$$0, 0\}\}\}\}, \{5, x5, \{\{\{-\frac{g[5][5]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{-g[5][5][x0, x4]}},$$

$$0, 0, 0, -\frac{g[5][5]^{(0,1)}[x0, x4]}{2\, g[4][4][x0, x4]\, \sqrt{-g[5][5][x0, x4]}}, 0, 0, 0\}\},$$

$$\{\{-\frac{g[5][5]^{(1,0)}[x0, x4]\, \sqrt{-g[5][5][x0, x4]}}{2\, g[5][5][x0, x4]}, 0, 0, 0,$$

$$-\frac{g[5][5]^{(0,1)}[x0, x4]\, \sqrt{-g[5][5][x0, x4]}}{2\, g[5][5][x0, x4]}, 0, 0, 0\}\}\}\},$$

$$\{5, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{5, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\}, \{\{6, x0,$$

$$\{\{\{0, 0, 0, 0, 0, 0, \frac{g[6][6]^{(1,0)}[x0, x4]}{2\, (-g[6][6][x0, x4])^{3/2}} + \frac{g[6][6]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[6][6][x0, x4]}\, g[6][6][x0, x4]}, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[6][6][x0, x4]}} - \frac{g[6][6]^{(1,0)}[x0, x4]\, \sqrt{-g[6][6][x0, x4]}}{2\, g[6][6][x0, x4]},$$

$$0\}\}\}\}, \{6, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{6, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{6, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{6, x4,$$

$$\{\{\{0, 0, 0, 0, 0, 0, \frac{g[6][6]^{(0,1)}[x0, x4]}{2\, (-g[6][6][x0, x4])^{3/2}} + \frac{g[6][6]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[6][6][x0, x4]}\, g[6][6][x0, x4]}, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[6][6][x0, x4]}} - \frac{g[6][6]^{(0,1)}[x0, x4]\, \sqrt{-g[6][6][x0, x4]}}{2\, g[6][6][x0, x4]},$$

$$0\}\}\}\}, \{6, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{6, x6,$$

$$\{\{\{-\frac{g[6][6]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{-g[6][6][x0, x4]}}, 0, 0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4]}{2\, g[4][4][x0, x4]\, \sqrt{-g[6][6][x0, x4]}},$$

$$0, 0, 0\}\}, \{\{-\frac{g[6][6]^{(1,0)}[x0, x4]\, \sqrt{-g[6][6][x0, x4]}}{2\, g[6][6][x0, x4]}, 0,$$

$$0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4]\, \sqrt{-g[6][6][x0, x4]}}{2\, g[6][6][x0, x4]}, 0, 0, 0\}\}\}\},$$

$$\{6, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\}, \{\{7, x0,$$

$$\{\{\{0, 0, 0, 0, 0, 0, 0, \frac{g[7][7]^{(1,0)}[x0, x4]}{2\, (-g[7][7][x0, x4])^{3/2}} + \frac{g[7][7]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[7][7][x0, x4]}\, g[7][7][x0, x4]}\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0,$$

$$-\frac{g[7][7]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[7][7][x0, x4]}} - \frac{g[7][7]^{(1,0)}[x0, x4]\, \sqrt{-g[7][7][x0, x4]}}{2\, g[7][7][x0, x4]}\}\}\}\},$$

$$\{7, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{7, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{7, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{7, x4,$$

$$\left\{\left\{\left\{0,0,0,0,0,0,0,\frac{g[7][7]^{(0,1)}[x0,x4]}{2\,(-g[7][7][x0,x4])^{3/2}}+\frac{g[7][7]^{(0,1)}[x0,x4]}{2\sqrt{-g[7][7][x0,x4]}\;g[7][7][x0,x4]}\right\}\right\},\right.$$

$$\left\{\left\{0,0,0,0,0,0,0,\right.\right.$$

$$\left.\left.\left.-\frac{g[7][7]^{(0,1)}[x0,x4]}{2\sqrt{-g[7][7][x0,x4]}}-\frac{g[7][7]^{(0,1)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\,g[7][7][x0,x4]}\right\}\right\}\right\},$$

$$\{7,x5,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{7,x6,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},\left\{7,x7,\right.$$

$$\left\{\left\{\left\{-\frac{g[7][7]^{(1,0)}[x0,x4]}{2\,g[0][0][x0,x4]\sqrt{-g[7][7][x0,x4]}},0,0,0,-\frac{g[7][7]^{(0,1)}[x0,x4]}{2\,g[4][4][x0,x4]\sqrt{-g[7][7][x0,x4]}},\right.\right.\right.$$

$$\left.\left.0,0,0\right\}\right\},\left\{\left\{-\frac{g[7][7]^{(1,0)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\,g[7][7][x0,x4]},0,0,\right.\right.$$

$$\left.\left.\left.\left.0,-\frac{g[7][7]^{(0,1)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\,g[7][7][x0,x4]},0,0,0\right\}\right\}\right\}\right\}\right\}$$

Out[ ]=

$$\left\{\left\{\{0,x0,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},\right.\right.$$

$$\{0,x1,\{\{\{0,H,0,0,0,0,0,0\}\},\{\{0,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3},0,0,0,0,0,0\}\}\}\},$$

$$\{0,x2,\{\{\{0,0,H,0,0,0,0,0\}\},\{\{0,0,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3},0,0,0,0,0\}\}\}\},$$

$$\{0,x3,\{\{\{0,0,0,H,0,0,0,0\}\},\{\{0,0,0,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3},0,0,0,0\}\}\}\},$$

$$\{0,x4,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{0,x5,\{\{\{0,0,0,0,0,H,0,0\}\},\{\{0,0,0,0,0,-e^{-2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3},0,0\}\}\}\},$$

$$\{0,x6,\{\{\{0,0,0,0,0,0,H,0\}\},\{\{0,0,0,0,0,0,-e^{-2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3},0\}\}\}\},$$

$$\{0,x7,\{\{\{0,0,0,0,0,0,0,H\}\},\{\{0,0,0,0,0,0,0,-e^{-2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3}\}\}\}\}\},$$

$$\{\{1,x0,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x1,\{\{\{-\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sec}[6\,H\,x0]\,\mathrm{Sin}[6\,H\,x0]^{7/6},$$

$$0,0,0,\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\},$$

$$\{\{-\frac{\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Cos}[6\,H\,x0]}{\mathrm{Sin}[6\,H\,x0]^{5/6}},0,0,0,-\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\}\}\},$$

$$\{1,x2,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x3,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x4,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x5,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x6,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{1,x7,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\}\},$$

$$\{\{2,x0,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{2,x1,\{\{\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,0\}\}\}\},$$

$$\{2,x2,\{\{\{-\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sec}[6\,H\,x0]\,\mathrm{Sin}[6\,H\,x0]^{7/6},$$

$$0,0,0,\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\},$$

$$\{\{-\frac{\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Cos}[6\,H\,x0]}{\mathrm{Sin}[6\,H\,x0]^{5/6}},0,0,0,-\sqrt{e^{2\,a4[H\,x4]}}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\}\}\},$$

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{2, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{2, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{2, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{2, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{2, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
{{3, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x3, {{{-Sqrt[E^(2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6),
    0, 0, 0, Sqrt[E^(2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}},
  {{-Sqrt[E^(2 a4[H x4])] H Cos[6 H x0]/Sin[6 H x0]^(5/6), 0, 0, 0, -Sqrt[E^(2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}}},
{3, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{3, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
{{4, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{4, x1, {{{0, H a4'[H x4], 0, 0, 0, 0, 0, 0}},
  {{0, -E^(2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4], 0, 0, 0, 0, 0, 0}}}},
{4, x2, {{{0, 0, H a4'[H x4], 0, 0, 0, 0, 0}},
  {{0, 0, -E^(2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4], 0, 0, 0, 0, 0}}}},
{4, x3, {{{0, 0, 0, H a4'[H x4], 0, 0, 0, 0}},
  {{0, 0, 0, -E^(2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4], 0, 0, 0, 0}}}},
{4, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{4, x5, {{{0, 0, 0, 0, 0, -H a4'[H x4], 0, 0}},
  {{0, 0, 0, 0, 0, -E^(-2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4], 0, 0}}}},
{4, x6, {{{0, 0, 0, 0, 0, 0, -H a4'[H x4], 0}},
  {{0, 0, 0, 0, 0, 0, -E^(-2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4], 0}}}},
{4, x7, {{{0, 0, 0, 0, 0, 0, 0, -H a4'[H x4]}},
  {{0, 0, 0, 0, 0, 0, 0, -E^(-2 a4[H x4]) H Sin[6 H x0]^(1/3) a4'[H x4]}}}}},
{{5, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x5, {{{Sqrt[E^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6),
    0, 0, 0, Sqrt[E^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}},
  {{-Sqrt[E^(-2 a4[H x4])] H Cos[6 H x0]/Sin[6 H x0]^(5/6), 0, 0, 0, Sqrt[E^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}}},
{5, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
{5, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
```

```
{{6, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {6, x6, {{{Sqrt[e^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6),
      0, 0, 0, Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}},
    {{-Sqrt[e^(-2 a4[H x4])] H Cos[6 H x0]/Sin[6 H x0]^(5/6), 0, 0, 0, Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}}},
 {6, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
{{7, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
 {7, x7, {{{Sqrt[e^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6),
      0, 0, 0, Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}},
    {{-Sqrt[e^(-2 a4[H x4])] H Cos[6 H x0]/Sin[6 H x0]^(5/6), 0, 0, 0, Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}}}}
```

```
In[•]:= (*Block[{eAα,eαA,t,ginv,Γ,gg},
  gg=g4488/.sg;
  {ginv,Γ}=con[gg];
  eαA=e^α_(A)/.sge^α_(A);
  eAα=e^(A)_α/.sge^(A)_α;
  t=Table[ Block[{v,V,d},v=eαA[[All,b]];
     d=Table[D[v[[k]],X[[μ]] ]+Sum[ v[[i]] Γ[[k,i,μ]],{i,1,DIM8}],{k,1,DIM8}];
     {b-1,X[[μ]],d}],{b,1,Length[eαA]},{μ,1,DIM8}];t]
 FullSimplify[#/.ssgm4488,constraintVars]&/@%*)
```

```
In[•]:= (*Block[{eAα,eαA,t,ginv,Γ,gg},
  gg=g4488/.sg;
  {ginv,Γ}=con[gg];
  eαA=e^α_(A)/.sge^α_(A);
  eAα=e^(A)_α/.sge^(A)_α;
  t=Table[ Block[{v,V,d},v=eAα[[b,All]];
     d=Table[D[v[[k]],X[[μ]] ]-Sum[ v[[i]] Γ[[k,i,μ]],{i,1,DIM8}],{k,1,DIM8}];
     {b-1,X[[μ]],d}],{b,1,Length[eαA]},{μ,1,DIM8}];t]
 FullSimplify[#/.ssgm4488,constraintVars]&/@%*)
```

```
In[•]:= Symbolize[ω^(a)_μ (b)]
```

```
In[•]:= ω = Array[ω^(a)_μ (b)[###] &, {8, 8, 8}];
```

In[ ]:=
```
ω[[1]]
```

Out[ ]=

$$\{\{\omega^{(a)}_{\mu\,(b)}[1,1,1],\ \omega^{(a)}_{\mu\,(b)}[1,1,2],\ \omega^{(a)}_{\mu\,(b)}[1,1,3],\ \omega^{(a)}_{\mu\,(b)}[1,1,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,1,5],\ \omega^{(a)}_{\mu\,(b)}[1,1,6],\ \omega^{(a)}_{\mu\,(b)}[1,1,7],\ \omega^{(a)}_{\mu\,(b)}[1,1,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,2,1],\ \omega^{(a)}_{\mu\,(b)}[1,2,2],\ \omega^{(a)}_{\mu\,(b)}[1,2,3],\ \omega^{(a)}_{\mu\,(b)}[1,2,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,2,5],\ \omega^{(a)}_{\mu\,(b)}[1,2,6],\ \omega^{(a)}_{\mu\,(b)}[1,2,7],\ \omega^{(a)}_{\mu\,(b)}[1,2,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,3,1],\ \omega^{(a)}_{\mu\,(b)}[1,3,2],\ \omega^{(a)}_{\mu\,(b)}[1,3,3],\ \omega^{(a)}_{\mu\,(b)}[1,3,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,3,5],\ \omega^{(a)}_{\mu\,(b)}[1,3,6],\ \omega^{(a)}_{\mu\,(b)}[1,3,7],\ \omega^{(a)}_{\mu\,(b)}[1,3,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,4,1],\ \omega^{(a)}_{\mu\,(b)}[1,4,2],\ \omega^{(a)}_{\mu\,(b)}[1,4,3],\ \omega^{(a)}_{\mu\,(b)}[1,4,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,4,5],\ \omega^{(a)}_{\mu\,(b)}[1,4,6],\ \omega^{(a)}_{\mu\,(b)}[1,4,7],\ \omega^{(a)}_{\mu\,(b)}[1,4,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,5,1],\ \omega^{(a)}_{\mu\,(b)}[1,5,2],\ \omega^{(a)}_{\mu\,(b)}[1,5,3],\ \omega^{(a)}_{\mu\,(b)}[1,5,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,5,5],\ \omega^{(a)}_{\mu\,(b)}[1,5,6],\ \omega^{(a)}_{\mu\,(b)}[1,5,7],\ \omega^{(a)}_{\mu\,(b)}[1,5,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,6,1],\ \omega^{(a)}_{\mu\,(b)}[1,6,2],\ \omega^{(a)}_{\mu\,(b)}[1,6,3],\ \omega^{(a)}_{\mu\,(b)}[1,6,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,6,5],\ \omega^{(a)}_{\mu\,(b)}[1,6,6],\ \omega^{(a)}_{\mu\,(b)}[1,6,7],\ \omega^{(a)}_{\mu\,(b)}[1,6,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,7,1],\ \omega^{(a)}_{\mu\,(b)}[1,7,2],\ \omega^{(a)}_{\mu\,(b)}[1,7,3],\ \omega^{(a)}_{\mu\,(b)}[1,7,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,7,5],\ \omega^{(a)}_{\mu\,(b)}[1,7,6],\ \omega^{(a)}_{\mu\,(b)}[1,7,7],\ \omega^{(a)}_{\mu\,(b)}[1,7,8]\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,8,1],\ \omega^{(a)}_{\mu\,(b)}[1,8,2],\ \omega^{(a)}_{\mu\,(b)}[1,8,3],\ \omega^{(a)}_{\mu\,(b)}[1,8,4],$$
$$\omega^{(a)}_{\mu\,(b)}[1,8,5],\ \omega^{(a)}_{\mu\,(b)}[1,8,6],\ \omega^{(a)}_{\mu\,(b)}[1,8,7],\ \omega^{(a)}_{\mu\,(b)}[1,8,8]\}\}$$

In[ ]:=
```
sω = Block[{eAα, eαA, t, V, ginv, Γ, gg},
  gg = g4488 /. sg;
  {ginv, Γ} = con[gg];
  eαA = e^α_(A) /. sge^α_(A);
  eAα = e^(A)_α /. sge^(A)_α;
  Table[ω[[μ, a, b]] → Block[{v, d}, v = eαA[[All, b]];
     d = Sum[(D[v[[k]], X[[μ]] ] + Sum[ v[[i]] × Γ[[k, i, μ]], {i, 1, DIM8}]) * eAα[[a, k]], {k, 1, DIM8}];
     d], {μ, 1, DIM8}, {a, 1, Length[eαA]}, {b, 1, Length[eαA]}]]
```

Out[ ]=

$$\{\{\{\omega^{(a)}_{\mu\,(b)}[1,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,3]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,5]\to \frac{g[0][0]^{(0,1)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\ \sqrt{-g[4][4][x0,x4]}},$$
$$\omega^{(a)}_{\mu\,(b)}[1,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,8]\to 0\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[1,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[1,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[1,5,1]\to -\frac{g[0][0]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[4][4][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[1,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,5]\to \left(\frac{g[4][4]^{(1,0)}[x0,x4]}{2(-g[4][4][x0,x4])^{3/2}}+\frac{g[4][4]^{(1,0)}[x0,x4]}{2\sqrt{-g[4][4][x0,x4]}\,g[4][4][x0,x4]}\right)\sqrt{-g[4][4][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[1,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[1,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,6]\to \left(\frac{g[5][5]^{(1,0)}[x0,x4]}{2(-g[5][5][x0,x4])^{3/2}}+\frac{g[5][5]^{(1,0)}[x0,x4]}{2\sqrt{-g[5][5][x0,x4]}\,g[5][5][x0,x4]}\right)\sqrt{-g[5][5][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[1,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,8]\to 0\right\},\ \left\{\omega^{(a)}_{\mu\,(b)}[1,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,7]\to \left(\frac{g[6][6]^{(1,0)}[x0,x4]}{2(-g[6][6][x0,x4])^{3/2}}+\frac{g[6][6]^{(1,0)}[x0,x4]}{2\sqrt{-g[6][6][x0,x4]}\,g[6][6][x0,x4]}\right)\sqrt{-g[6][6][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[1,7,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[1,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,8]\to \left(\frac{g[7][7]^{(1,0)}[x0,x4]}{2(-g[7][7][x0,x4])^{3/2}}+\frac{g[7][7]^{(1,0)}[x0,x4]}{2\sqrt{-g[7][7][x0,x4]}\,g[7][7][x0,x4]}\right)\sqrt{-g[7][7][x0,x4]}\right\}\right\},$$

$$\left\{\left\{\omega^{(a)}_{\mu\,(b)}[2,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,2]\to -\frac{g[1][1]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{g[1][1][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[2,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[2,2,1]\to \frac{g[1][1]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{g[1][1][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[2,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,5]\to \frac{g[1][1]^{(0,1)}[x0,x4]}{2\sqrt{g[1][1][x0,x4]}\,\sqrt{-g[4][4][x0,x4]}},\right.$$

$$\omega^{(a)}_{\mu\,(b)}[2,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,2]\to -\frac{g[1][1]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[1][1][x0,x4]}\,g[4][4][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[2,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,5]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[2,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[2,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,8]\to 0\}\},$$

$$\{\{\omega^{(a)}_{\mu\,(b)}[3,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,2]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,1,3]\to -\frac{g[2][2]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{g[2][2][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[3,1,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,3,1]\to \frac{g[2][2]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{g[2][2][x0,x4]}},$$

$$\omega^{(a)}_{\mu\,(b)}[3,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,3,5]\to \frac{g[2][2]^{(0,1)}[x0,x4]}{2\sqrt{g[2][2][x0,x4]}\,\sqrt{-g[4][4][x0,x4]}},$$

$$\omega^{(a)}_{\mu\,(b)}[3,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,2]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,5,3] \to -\frac{g[2][2]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[2][2][x0,x4]}\,g[4][4][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[3,5,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,5,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,6,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,6,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,7,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,7,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[3,8,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[3,8,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,8] \to 0\}\},$$

$$\{\{\omega^{(a)}_{\mu\,(b)}[4,1,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,3] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,1,4] \to -\frac{g[3][3]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{g[3][3][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[4,1,5] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,1,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[4,2,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,2,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[4,3,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,3,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[4,4,1] \to \frac{g[3][3]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{g[3][3][x0,x4]}},$$

$$\omega^{(a)}_{\mu\,(b)}[4,4,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,4,5] \to \frac{g[3][3]^{(0,1)}[x0,x4]}{2\sqrt{g[3][3][x0,x4]}\sqrt{-g[4][4][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[4,4,6] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,4,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,8] \to 0\},\ \{\omega^{(a)}_{\mu\,(b)}[4,5,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,2] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,5,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,4] \to -\frac{g[3][3]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[3][3][x0,x4]}\,g[4][4][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[4,5,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[4,6,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,6,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,8] \to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[4,7,1] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,2] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,3] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,4] \to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[4,7,5] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,6] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,7] \to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,8] \to 0\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[4,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,4]\to 0,\right.$$
$$\left.\omega^{(a)}_{\mu\,(b)}[4,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,8]\to 0\right\}\Big\},$$

$$\Big\{\Big\{\omega^{(a)}_{\mu\,(b)}[5,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[5,1,5]\to -\frac{g[4][4]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\ \sqrt{-g[4][4][x0,x4]}},$$
$$\omega^{(a)}_{\mu\,(b)}[5,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,8]\to 0\Big\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,4]\to 0,\right.$$
$$\left.\omega^{(a)}_{\mu\,(b)}[5,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,4]\to 0,\right.$$
$$\left.\omega^{(a)}_{\mu\,(b)}[5,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,4]\to 0,\right.$$
$$\left.\omega^{(a)}_{\mu\,(b)}[5,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,5,1]\to \frac{g[4][4]^{(1,0)}[x0,x4]\ \sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\ g[4][4][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[5,5,2]\to 0,\right.$$
$$\omega^{(a)}_{\mu\,(b)}[5,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,5]\to$$
$$\left(\frac{g[4][4]^{(0,1)}[x0,x4]}{2\,(-g[4][4][x0,x4])^{3/2}}+\frac{g[4][4]^{(0,1)}[x0,x4]}{2\sqrt{-g[4][4][x0,x4]}\ g[4][4][x0,x4]}\right)\sqrt{-g[4][4][x0,x4]},$$
$$\left.\omega^{(a)}_{\mu\,(b)}[5,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,3]\to 0,\right.$$
$$\omega^{(a)}_{\mu\,(b)}[5,6,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,6]\to$$
$$\left(\frac{g[5][5]^{(0,1)}[x0,x4]}{2\,(-g[5][5][x0,x4])^{3/2}}+\frac{g[5][5]^{(0,1)}[x0,x4]}{2\sqrt{-g[5][5][x0,x4]}\ g[5][5][x0,x4]}\right)\sqrt{-g[5][5][x0,x4]},$$
$$\left.\omega^{(a)}_{\mu\,(b)}[5,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,8]\to 0\right\},\ \left\{\omega^{(a)}_{\mu\,(b)}[5,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,2]\to 0,\right.$$
$$\omega^{(a)}_{\mu\,(b)}[5,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,6]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[5,7,7]\to\left(\frac{g[6][6]^{(0,1)}[x0,x4]}{2\,(-g[6][6][x0,x4])^{3/2}}+\frac{g[6][6]^{(0,1)}[x0,x4]}{2\sqrt{-g[6][6][x0,x4]}\ g[6][6][x0,x4]}\right)$$
$$\left.\sqrt{-g[6][6][x0,x4]},\ \omega^{(a)}_{\mu\,(b)}[5,7,8]\to 0\right\},$$

$$\left\{\omega^{(a)}_{\mu\,(b)}[5,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,4]\to 0,\right.$$
$$\omega^{(a)}_{\mu\,(b)}[5,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,8]\to$$
$$\left(\frac{g[7][7]^{(0,1)}[x0,x4]}{2\,(-g[7][7][x0,x4])^{3/2}}+\frac{g[7][7]^{(0,1)}[x0,x4]}{2\sqrt{-g[7][7][x0,x4]}\ g[7][7][x0,x4]}\right)\sqrt{-g[7][7][x0,x4]}\Big\}\Big\},$$

$$\{\{\omega^{(a)}_{\mu\,(b)}[6,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,6]\to -\frac{g[5][5]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{-g[5][5][x0,x4]}},$$

$$\omega^{(a)}_{\mu\,(b)}[6,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,6]\to -\frac{g[5][5]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[5][5][x0,x4]}},$$

$$\omega^{(a)}_{\mu\,(b)}[6,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,6,1]\to \frac{g[5][5]^{(1,0)}[x0,x4]\sqrt{-g[5][5][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[5][5][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[6,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,6,5]\to \frac{g[5][5]^{(0,1)}[x0,x4]\sqrt{-g[5][5][x0,x4]}}{2\sqrt{-g[4][4][x0,x4]}\,g[5][5][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[6,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[6,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[6,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,8]\to 0\}\},$$

$$\{\{\omega^{(a)}_{\mu\,(b)}[7,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,3]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[7,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,6]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[7,1,7]\to -\frac{g[6][6]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{-g[6][6][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[7,1,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[7,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[7,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[7,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[7,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[7,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,3]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,6]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,5,7]\to -\frac{g[6][6]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[6][6][x0,x4]}},\ \omega^{(a)}_{\mu\,(b)}[7,5,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[7,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[7,7,1]\to \frac{g[6][6]^{(1,0)}[x0,x4]\sqrt{-g[6][6][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[6][6][x0,x4]},$$
$$\omega^{(a)}_{\mu\,(b)}[7,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,7,5]\to \frac{g[6][6]^{(0,1)}[x0,x4]\sqrt{-g[6][6][x0,x4]}}{2\sqrt{-g[4][4][x0,x4]}\,g[6][6][x0,x4]},$$
$$\omega^{(a)}_{\mu\,(b)}[7,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[7,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[7,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,8]\to 0\}\},$$
$$\{\{\omega^{(a)}_{\mu\,(b)}[8,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,7]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,1,8]\to -\frac{g[7][7]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{-g[7][7][x0,x4]}}\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[8,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[8,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[8,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[8,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[8,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,7]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,5,8] \to -\frac{g[7][7]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[7][7][x0,x4]}}\Big\},$$

$$\Big\{\omega^{(a)}_{\mu\,(b)}[8,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,8]\to 0\Big\},$$

$$\Big\{\omega^{(a)}_{\mu\,(b)}[8,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,8]\to 0\Big\},$$

$$\Big\{\omega^{(a)}_{\mu\,(b)}[8,8,1]\to \frac{g[7][7]^{(1,0)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[7][7][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[8,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,8,5]\to \frac{g[7][7]^{(0,1)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\sqrt{-g[4][4][x0,x4]}\,g[7][7][x0,x4]},$$

$$\omega^{(a)}_{\mu\,(b)}[8,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,8]\to 0\Big\}\Big\}\Big\}$$

In[ ]:=
```
(*sω=Block[{eAα,eαA,t,V,ginv,Γ,gg},
  gg=g4488/.sg;
  {ginv,Γ}=con[gg];
  eαA=e^α_(A) /.sge^α_(A);
  eAα=e^(A)_α /.sge^(A)_α;
  Table[ ω^(a)_μ (b) [μ,a,b]→Block[{v,d},v=eαA⟦All,b⟧;
     d=Sum[(D[v⟦k⟧,X⟦μ⟧ ]+Sum[ v⟦i⟧ Γ⟦k,i,μ⟧,{i,1,DIM8}])*eAα⟦a,k⟧,{k,1,DIM8}];
     d],{μ,1,DIM8},{a,1,Length[eαA]},{b,1,Length[eαA]}]]*)
```

In[ ]:=
```
sωf = Flatten[sω];
```

In[ ]:=
```
(*ω^(a)_μ (b)*)
ω;
ωmat = % /. sωf
Dimensions[%]
```

Out[ ]=

$$\Big\{\Big\{\Big\{0,0,0,0,\frac{g[0][0]^{(0,1)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\sqrt{-g[4][4][x0,x4]}},0,0,0\Big\},$$

$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$

$$\Big\{-\frac{g[0][0]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[4][4][x0,x4]},0,0,0,$$

$$\left(\frac{g[4][4]^{(1,0)}[x0,x4]}{2\,(-g[4][4][x0,x4])^{3/2}}+\frac{g[4][4]^{(1,0)}[x0,x4]}{2\sqrt{-g[4][4][x0,x4]}\,g[4][4][x0,x4]}\right)\sqrt{-g[4][4][x0,x4]},$$

$$0,0,0\Big\},\Big\{0,0,0,0,0,$$

$$\left(\frac{g[5][5]^{(1,0)}[x0,x4]}{2\,(-g[5][5][x0,x4])^{3/2}}+\frac{g[5][5]^{(1,0)}[x0,x4]}{2\sqrt{-g[5][5][x0,x4]}\,g[5][5][x0,x4]}\right)\sqrt{-g[5][5][x0,x4]},0,$$

$$0\Big\}, \Big\{0, 0, 0, 0, 0, 0, \left(\frac{g[6][6]^{(1,0)}[x0, x4]}{2\,(-g[6][6][x0, x4])^{3/2}} + \frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}\;g[6][6][x0, x4]}\right)$$

$$\sqrt{-g[6][6][x0, x4]}, 0\Big\}, \Big\{0, 0, 0, 0, 0, 0, 0,$$

$$\left(\frac{g[7][7]^{(1,0)}[x0, x4]}{2\,(-g[7][7][x0, x4])^{3/2}} + \frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}\;g[7][7][x0, x4]}\right)\sqrt{-g[7][7][x0, x4]}\Big\}\Big\},$$

$$\Big\{\Big\{0, -\frac{g[1][1]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[1][1][x0, x4]}}, 0, 0, 0, 0, 0, 0\Big\},$$

$$\Big\{\frac{g[1][1]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[1][1][x0, x4]}}, 0, 0, 0,$$

$$\frac{g[1][1]^{(0,1)}[x0, x4]}{2\sqrt{g[1][1][x0, x4]}\;\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\Big\}, \{0, 0, 0, 0, 0, 0, 0, 0\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \Big\{0, -\frac{g[1][1]^{(0,1)}[x0, x4]\;\sqrt{-g[4][4][x0, x4]}}{2\sqrt{g[1][1][x0, x4]}\;g[4][4][x0, x4]}, 0, 0, 0, 0, 0, 0\Big\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}\Big\},$$

$$\Big\{\Big\{0, 0, -\frac{g[2][2]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[2][2][x0, x4]}}, 0, 0, 0, 0, 0\Big\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \Big\{\frac{g[2][2]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[2][2][x0, x4]}}, 0, 0, 0,$$

$$\frac{g[2][2]^{(0,1)}[x0, x4]}{2\sqrt{g[2][2][x0, x4]}\;\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\Big\}, \{0, 0, 0, 0, 0, 0, 0, 0\},$$

$$\Big\{0, 0, -\frac{g[2][2]^{(0,1)}[x0, x4]\;\sqrt{-g[4][4][x0, x4]}}{2\sqrt{g[2][2][x0, x4]}\;g[4][4][x0, x4]}, 0, 0, 0, 0, 0\Big\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}\Big\},$$

$$\Big\{\Big\{0, 0, 0, -\frac{g[3][3]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[3][3][x0, x4]}}, 0, 0, 0, 0\Big\}, \{0, 0, 0, 0, 0, 0, 0, 0\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \Big\{\frac{g[3][3]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{g[3][3][x0, x4]}},$$

$$0, 0, 0, \frac{g[3][3]^{(0,1)}[x0, x4]}{2\sqrt{g[3][3][x0, x4]}\;\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\Big\},$$

$$\Big\{0, 0, 0, -\frac{g[3][3]^{(0,1)}[x0, x4]\;\sqrt{-g[4][4][x0, x4]}}{2\sqrt{g[3][3][x0, x4]}\;g[4][4][x0, x4]}, 0, 0, 0, 0\Big\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}\Big\},$$

$$\Big\{\Big\{0, 0, 0, 0, -\frac{g[4][4]^{(1,0)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\Big\},$$

$$\{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\}, \{0, 0, 0, 0, 0, 0, 0, 0\},$$

$$\left\{\frac{g[4][4]^{(1,0)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[4][4][x0,x4]},0,0,0,\right.$$
$$\left(\frac{g[4][4]^{(0,1)}[x0,x4]}{2(-g[4][4][x0,x4])^{3/2}}+\frac{g[4][4]^{(0,1)}[x0,x4]}{2\sqrt{-g[4][4][x0,x4]}\,g[4][4][x0,x4]}\right)\sqrt{-g[4][4][x0,x4]},0,$$
$$\left.0,0\right\},\left\{0,0,0,0,0,\left(\frac{g[5][5]^{(0,1)}[x0,x4]}{2(-g[5][5][x0,x4])^{3/2}}+\frac{g[5][5]^{(0,1)}[x0,x4]}{2\sqrt{-g[5][5][x0,x4]}\,g[5][5][x0,x4]}\right)\right.$$
$$\left.\sqrt{-g[5][5][x0,x4]},0,0\right\},\left\{0,0,0,0,0,0,\right.$$
$$\left(\frac{g[6][6]^{(0,1)}[x0,x4]}{2(-g[6][6][x0,x4])^{3/2}}+\frac{g[6][6]^{(0,1)}[x0,x4]}{2\sqrt{-g[6][6][x0,x4]}\,g[6][6][x0,x4]}\right)\sqrt{-g[6][6][x0,x4]},0\Big\},$$
$$\left\{0,0,0,0,0,0,0,\left(\frac{g[7][7]^{(0,1)}[x0,x4]}{2(-g[7][7][x0,x4])^{3/2}}+\frac{g[7][7]^{(0,1)}[x0,x4]}{2\sqrt{-g[7][7][x0,x4]}\,g[7][7][x0,x4]}\right)\right.$$
$$\left.\sqrt{-g[7][7][x0,x4]}\right\}\Big\},\left\{\left\{0,0,0,0,0,-\frac{g[5][5]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{-g[5][5][x0,x4]}},0,0\right\},\right.$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\left\{0,0,0,0,0,-\frac{g[5][5]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[5][5][x0,x4]}},0,0\right\},$$
$$\left\{\frac{g[5][5]^{(1,0)}[x0,x4]\sqrt{-g[5][5][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[5][5][x0,x4]},0,0,0,\frac{g[5][5]^{(0,1)}[x0,x4]\sqrt{-g[5][5][x0,x4]}}{2\sqrt{-g[4][4][x0,x4]}\,g[5][5][x0,x4]},\right.$$
$$\left.0,0,0\right\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\Big\},$$
$$\left\{\left\{0,0,0,0,0,0,-\frac{g[6][6]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{-g[6][6][x0,x4]}},0\right\},\right.$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\left\{0,0,0,0,0,0,-\frac{g[6][6]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[6][6][x0,x4]}},0\right\},$$
$$\{0,0,0,0,0,0,0,0\},\left\{\frac{g[6][6]^{(1,0)}[x0,x4]\sqrt{-g[6][6][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[6][6][x0,x4]},0,0,0,\right.$$
$$\left.\frac{g[6][6]^{(0,1)}[x0,x4]\sqrt{-g[6][6][x0,x4]}}{2\sqrt{-g[4][4][x0,x4]}\,g[6][6][x0,x4]},0,0,0\right\},\{0,0,0,0,0,0,0,0\}\Big\},$$
$$\left\{\left\{0,0,0,0,0,0,0,-\frac{g[7][7]^{(1,0)}[x0,x4]}{2\sqrt{g[0][0][x0,x4]}\,\sqrt{-g[7][7][x0,x4]}}\right\},\right.$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\left\{0,0,0,0,0,0,0,-\frac{g[7][7]^{(0,1)}[x0,x4]\sqrt{-g[4][4][x0,x4]}}{2\,g[4][4][x0,x4]\sqrt{-g[7][7][x0,x4]}}\right\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\left\{\frac{g[7][7]^{(1,0)}[x0,x4]\sqrt{-g[7][7][x0,x4]}}{2\sqrt{g[0][0][x0,x4]}\,g[7][7][x0,x4]},\right.$$

$$0, 0, 0, \frac{g[7][7]^{(0,1)}[x0, x4]\sqrt{-g[7][7][x0, x4]}}{2\sqrt{-g[4][4][x0, x4]}\, g[7][7][x0, x4]}, 0, 0, 0\}\}\}$$

Out[ ]=

```
{8, 8, 8}
```

In[ ]:=

```
sωgtry = Block[{eAα, eαA, t, V},
  eαA = e^α_(A) /. sgtrye^α_(A);
  eAα = e^(A)_α /. sgtrye^(A)_α;
  Table[(*V=eAα[[a,All]];*) ω^(a)_μ(b) [μ, a, b] → Block[{v, d}, v = eαA[[All, b]];
     d = Sum[(D[v[[k]], X[[μ]] ] + Sum[ v[[i]] × Γ[[k, i, μ]], {i, 1, DIM8}]) * eAα[[a, k]], {k, 1, DIM8}];
     FullSimplify[d, constraintVars] /. {Sqrt[e^(2 a4[H x4])] → e^(a4[H x4]), Sqrt[e^(-2 a4[H x4])] → e^(-a4[H x4])}],
   {μ, 1, DIM8}, {a, 1, Length[eAα]}, {b, 1, Length[eαA]}]]
```

Out[ ]=

$$\{\{\{\omega^{(a)}_{\mu\,(b)}[1,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,1,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,2,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,3,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,4,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,5,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,6,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,7,8]\to 0\},$$
$$\{\omega^{(a)}_{\mu\,(b)}[1,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,4]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[1,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[1,8,8]\to 0\}\},$$
$$\{\{\omega^{(a)}_{\mu\,(b)}[2,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,2]\to -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[2,1,3]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[2,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,1,7]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[2,1,8]\to 0\},\ \{\omega^{(a)}_{\mu\,(b)}[2,2,1]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[2,2,2]\to 0,$$
$$\omega^{(a)}_{\mu\,(b)}[2,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,5]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$$

$\omega^{(a)}_{\mu\,(b)}[2,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,4,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,2]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[2,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,5]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,5,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[2,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[2,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[2,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[3,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,3]\to -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},$

$\omega^{(a)}_{\mu\,(b)}[3,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,1,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,3,1]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[3,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,3,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,5]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[3,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,4,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,3]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[3,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,5,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[3,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[3,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[3,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[4,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,1,4]\to -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[4,1,5]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,1,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,4,1]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[4,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,4,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,5]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ \omega^{(a)}_{\mu\,(b)}[4,4,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,4,8]\to 0\},\ \{\omega^{(a)}_{\mu\,(b)}[4,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,2]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,4]\to e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[4,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,5,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[4,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[4,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[4,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[5,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,1,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,4,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,5,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[5,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[5,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[5,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[6,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,6]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},$

$\omega^{(a)}_{\mu\,(b)}[6,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,1,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,4,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,5,6]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ \omega^{(a)}_{\mu\,(b)}[6,5,7]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,5,8]\to 0\},\ \{\omega^{(a)}_{\mu\,(b)}[6,6,1]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[6,6,2]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,5]\to -e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[6,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[6,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[6,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[6,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[7,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,1,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,1,7]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[7,1,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,4,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,5,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,5,7]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ \omega^{(a)}_{\mu\,(b)}[7,5,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,6,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,7,1]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[7,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,7,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,5]\to -e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$

$\omega^{(a)}_{\mu\,(b)}[7,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,7,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[7,8,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[7,8,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[7,8,8]\to 0\}\},$

$\{\{\omega^{(a)}_{\mu\,(b)}[8,1,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,3]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[8,1,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,6]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[8,1,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,1,8]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\},$

$\{\omega^{(a)}_{\mu\,(b)}[8,2,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[8,2,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,2,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[8,3,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,4]\to 0,$

$\omega^{(a)}_{\mu\,(b)}[8,3,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,3,8]\to 0\},$

$\{\omega^{(a)}_{\mu\,(b)}[8,4,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,4]\to 0,$

$$\omega^{(a)}_{\mu\,(b)}[8,4,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,4,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[8,5,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,3]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,5,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,6]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,5,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,5,8]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[8,6,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,6,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,6,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[8,7,1]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,3]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,4]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,7,5]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,7,8]\to 0\},$$

$$\{\omega^{(a)}_{\mu\,(b)}[8,8,1]\to e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ \omega^{(a)}_{\mu\,(b)}[8,8,2]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,3]\to 0,$$

$$\omega^{(a)}_{\mu\,(b)}[8,8,4]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,5]\to -e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$$

$$\omega^{(a)}_{\mu\,(b)}[8,8,6]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,7]\to 0,\ \omega^{(a)}_{\mu\,(b)}[8,8,8]\to 0\}\}\}$$

In[ ]:=
```
sωfgtry = Flatten[sωgtry];
```

In[ ]:=

```
(*ω_μ^(a)_(b)*)
ω;
ωω = % /. sωfgtry // FullSimplify[#, constraintVars] &
Dimensions[%]
```

Out[ ]=

$$\{\{\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0,0\},\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,$$
$$0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,-e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],$$
$$0,0,0\},\{0,0,0,e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\}\},$$
$$\{\{0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\},$$
$$\{0,0,0,0,0,0,0,0\}\},\{\{0,0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{0,0,0,0,0,0,0,e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]\},$$
$$\{0,0,0,0,0,0,0,0\},\{0,0,0,0,0,0,0,0\},$$
$$\{e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6},0,0,0,-e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],0,0,0\}\}\}$$

Out[ ]=

$$\{8,8,8\}$$

In[∘]:=
```
g4488 /. sg
% /. ssgm4488
```

Out[∘]=
```
{{g[0][0][x0, x4], 0, 0, 0, 0, 0, 0, 0}, {0, g[1][1][x0, x4], 0, 0, 0, 0, 0, 0},
 {0, 0, g[2][2][x0, x4], 0, 0, 0, 0, 0}, {0, 0, 0, g[3][3][x0, x4], 0, 0, 0, 0},
 {0, 0, 0, 0, g[4][4][x0, x4], 0, 0, 0}, {0, 0, 0, 0, 0, g[5][5][x0, x4], 0, 0},
 {0, 0, 0, 0, 0, 0, g[6][6][x0, x4], 0}, {0, 0, 0, 0, 0, 0, 0, g[7][7][x0, x4]}}
```

Out[∘]=
```
{{Cot[6 H x0]^2, 0, 0, 0, 0, 0, 0, 0}, {0, e^(2 a4[H x4]) Sin[6 H x0]^(1/3), 0, 0, 0, 0, 0, 0},
 {0, 0, e^(2 a4[H x4]) Sin[6 H x0]^(1/3), 0, 0, 0, 0, 0}, {0, 0, 0, e^(2 a4[H x4]) Sin[6 H x0]^(1/3), 0, 0, 0, 0},
 {0, 0, 0, 0, -1, 0, 0, 0}, {0, 0, 0, 0, 0, -e^(-2 a4[H x4]) Sin[6 H x0]^(1/3), 0, 0},
 {0, 0, 0, 0, 0, 0, -e^(-2 a4[H x4]) Sin[6 H x0]^(1/3), 0}, {0, 0, 0, 0, 0, 0, 0, -e^(-2 a4[H x4]) Sin[6 H x0]^(1/3)}}
```

check metric compatibility condition for the Octad

In[∘]:=
```
Block[{eAα, eαA, t, ginv, Γ, gg(*,ωω*)},
 (*ωω=ω_μ^(a)_(b) /.sωf;*)
 gg = g4488 /. sg /. ssgm4488;
 {ginv, Γ} = con[gg];
 eαA = e^α_(A) /. sge^α_(A); eAα = e^(A)_α /. sge^(A)_α;
 t = Table[ Block[{v, V, contra, covari},
    V = eAα[[b, All]];
    v = eαA[[All, b]];
    contra =
     Table[D[v[[k]], X[[μ]] ] + Sum[ v[[i]] × Γ[[k, i, μ]], {i, 1, DIM8}], {k, 1, DIM8}];
    (*no ω terms*)
    covari = Table[D[V[[k]], X[[μ]] ] - Sum[ V[[i]] × Γ[[i, k, μ]], {i, 1, DIM8}] +
        Sum[ eAα[[J, All]][[k]] × ωmat[[μ, b, J]], {J, 1, DIM8}] //
       FullSimplify[#, constraintVars && e^(2 a4[H x4]) > 0 && e^(a4[H x4]) > 0 &&
          e^(-2 a4[H x4]) > 0 && e^(-a4[H x4]) > 0] &, {k, 1, DIM8}]; (*ω terms*)
    (*{b-1,X[[μ]],{{contra},{covari}}}],{b,1,Length[eαA]},{μ,1,DIM8}];*)
    {b - 1, X[[μ]], covari}], {b, 1, Length[eαA]}, {μ, 1, DIM8}];
 t]
FullSimplify[# /. ssgm4488,
   constraintVars && e^(2 a4[H x4]) > 0 && e^(a4[H x4]) > 0 && e^(-2 a4[H x4]) > 0 && e^(-a4[H x4]) > 0] & /@ %
```

Out[∘]=

$$\left\{\left\{\left\{0, x0, \left\{\frac{g[0][0]^{(1,0)}[x0, x4] + 24\, H\, \mathrm{Csc}[12\, H\, x0]\, g[0][0][x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0, \frac{g[0][0]^{(0,1)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}}, 0, 0, 0\right\}\right\}, \left\{0, x1, \left\{0, \frac{-g[1][1]^{(1,0)}[x0, x4] + 2\, e^{2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\sqrt{g[0][0][x0, x4]}},\right.\right.\right.$$

$$0, 0, 0, 0, 0, 0\}\}, \{0, x2, \{0, 0,$$

$$\frac{-g[2][2]^{(1,0)}[x0, x4] + 2\, e^{2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}},$$

$$0, 0, 0, 0, 0\}\}, \{0, x3, \{0, 0, 0,$$

$$\frac{-g[3][3]^{(1,0)}[x0, x4] + 2\, e^{2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}},$$

$$0, 0, 0, 0\}\},$$

$$\{0, x4, \{\frac{g[0][0]^{(0,1)}[x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}}, 0, 0, 0, -\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}}, 0, 0, 0\}\},$$

$$\{0, x5, \{0, 0, 0, 0, 0,$$

$$\frac{-g[5][5]^{(1,0)}[x0, x4] - 2\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}},$$

$$0, 0\}\}, \{0, x6, \{0, 0, 0, 0, 0, 0,$$

$$\frac{-g[6][6]^{(1,0)}[x0, x4] - 2\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}},$$

$$0\}\}, \{0, x7, \{0, 0, 0, 0, 0, 0, 0,$$

$$\frac{-g[7][7]^{(1,0)}[x0, x4] - 2\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sec}[6\, H\, x0]\, \mathrm{Sin}[6\, H\, x0]^{4/3}\, g[0][0][x0, x4]}{2\, \sqrt{g[0][0][x0, x4]}}\}\}\},$$

$$\{\{1, x0, \{0, \frac{g[1][1]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[1][1][x0, x4]}{2\, \sqrt{g[1][1][x0, x4]}},$$

$$0, 0, 0, 0, 0, 0\}\},$$

$$\{1, x1, \{\frac{g[1][1]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[1][1][x0, x4]}{2\, \sqrt{g[1][1][x0, x4]}}, 0, 0,$$

$$0, \frac{g[1][1]^{(0,1)}[x0, x4] - 6\, H\, a4'[H\, x4]\, g[1][1][x0, x4]}{2\, \sqrt{g[1][1][x0, x4]}}, 0, 0, 0\}\},$$

$$\{1, x2, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{1, x3, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{1, x4, \{0, \frac{g[1][1]^{(0,1)}[x0, x4] - 6\, H\, a4'[H\, x4]\, g[1][1][x0, x4]}{2\, \sqrt{g[1][1][x0, x4]}}, 0, 0, 0, 0, 0, 0\}\},$$

$$\{1, x5, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{1, x6, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{1, x7, \{0, 0, 0, 0, 0, 0, 0, 0\}\}\},$$

$$\{\{2, x0, \{0, 0, \frac{g[2][2]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[2][2][x0, x4]}{2\, \sqrt{g[2][2][x0, x4]}},$$

$$0, 0, 0, 0, 0\}\}, \{2, x1, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\left\{2, x2, \left\{\frac{g[2][2]^{(1,0)}[x0, x4] - 2\,H\,\mathrm{Cot}[6\,H\,x0]\,g[2][2][x0, x4]}{2\sqrt{g[2][2][x0, x4]}}, 0, 0,\right.\right.$$

$$\left.\left.0, \frac{g[2][2]^{(0,1)}[x0, x4] - 6\,H\,a4'[H\,x4]\,g[2][2][x0, x4]}{2\sqrt{g[2][2][x0, x4]}}, 0, 0, 0\right\}\right\},$$

$$\{2, x3, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\left\{2, x4, \left\{0, 0, \frac{g[2][2]^{(0,1)}[x0, x4] - 6\,H\,a4'[H\,x4]\,g[2][2][x0, x4]}{2\sqrt{g[2][2][x0, x4]}}, 0, 0, 0, 0, 0\right\}\right\},$$

$$\{2, x5, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{2, x6, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{2, x7, \{0, 0, 0, 0, 0, 0, 0, 0\}\}\}, \{\{3, x0,$$

$$\left\{0, 0, 0, \frac{g[3][3]^{(1,0)}[x0, x4] - 2\,H\,\mathrm{Cot}[6\,H\,x0]\,g[3][3][x0, x4]}{2\sqrt{g[3][3][x0, x4]}}, 0, 0, 0, 0\right\}\right\},$$

$$\{3, x1, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{3, x2, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\left\{3, x3, \left\{\frac{g[3][3]^{(1,0)}[x0, x4] - 2\,H\,\mathrm{Cot}[6\,H\,x0]\,g[3][3][x0, x4]}{2\sqrt{g[3][3][x0, x4]}}, 0, 0,\right.\right.$$

$$\left.\left.0, \frac{g[3][3]^{(0,1)}[x0, x4] - 6\,H\,a4'[H\,x4]\,g[3][3][x0, x4]}{2\sqrt{g[3][3][x0, x4]}}, 0, 0, 0\right\}\right\},$$

$$\left\{3, x4, \left\{0, 0, 0, \frac{g[3][3]^{(0,1)}[x0, x4] - 6\,H\,a4'[H\,x4]\,g[3][3][x0, x4]}{2\sqrt{g[3][3][x0, x4]}}, 0, 0, 0, 0\right\}\right\},$$

$$\{3, x5, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{3, x6, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{3, x7, \{0, 0, 0, 0, 0, 0, 0, 0\}\}\},$$

$$\left\{\left\{4, x0, \left\{\frac{g[0][0]^{(0,1)}[x0, x4]}{2\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, -\frac{g[4][4]^{(1,0)}[x0, x4]}{2\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\right\}\right\}, \left\{4,\right.\right.$$

$$x1, \left\{0, \frac{g[1][1]^{(0,1)}[x0, x4] + 6\,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3}\,a4'[H\,x4]\,g[4][4][x0, x4]}{2\sqrt{-g[4][4][x0, x4]}},\right.$$

$$\left.0, 0, 0, 0, 0, 0\right\}\right\}, \left\{4, x2,\right.$$

$$\left\{0, 0, \frac{g[2][2]^{(0,1)}[x0, x4] + 6\,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3}\,a4'[H\,x4]\,g[4][4][x0, x4]}{2\sqrt{-g[4][4][x0, x4]}},\right.$$

$$\left.0, 0, 0, 0, 0\right\}\right\}, \left\{4, x3, \left\{0, 0, 0,\right.\right.$$

$$\frac{g[3][3]^{(0,1)}[x0, x4] + 6\,e^{2\,a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/3}\,a4'[H\,x4]\,g[4][4][x0, x4]}{2\sqrt{-g[4][4][x0, x4]}},$$

$$\left.0, 0, 0, 0\right\}\right\},$$

$$\left\{4, x4, \left\{-\frac{g[4][4]^{(1,0)}[x0, x4]}{2\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, -\frac{g[4][4]^{(0,1)}[x0, x4]}{2\sqrt{-g[4][4][x0, x4]}}, 0, 0, 0\right\}\right\}, \left\{4,\right.$$

$$x5, \left\{0, 0, 0, 0, 0, \frac{1}{2}\left(-6\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sin}[6\, H\, x0]^{1/3}\, a4'[H\, x4] - \frac{g[5][5]^{(0,1)}[x0, x4]}{g[4][4][x0, x4]}\right)\right.$$
$$\left.\sqrt{-g[4][4][x0, x4]}, 0, 0\right\}\Big\}, \Big\{4, x6,$$
$$\left\{0, 0, 0, 0, 0, 0, \frac{1}{2}\left(-6\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sin}[6\, H\, x0]^{1/3}\, a4'[H\, x4] - \frac{g[6][6]^{(0,1)}[x0, x4]}{g[4][4][x0, x4]}\right)\right.$$
$$\left.\sqrt{-g[4][4][x0, x4]}, 0\right\}\Big\}, \Big\{4, x7, \Big\{0, 0, 0, 0, 0, 0, 0,$$
$$\frac{1}{2}\left(-6\, e^{-2\, a4[H\, x4]}\, H\, \mathrm{Sin}[6\, H\, x0]^{1/3}\, a4'[H\, x4] - \frac{g[7][7]^{(0,1)}[x0, x4]}{g[4][4][x0, x4]}\right)$$
$$\left.\sqrt{-g[4][4][x0, x4]}\right\}\Big\}\Big\}, \Big\{\Big\{5, x0,$$
$$\left\{0, 0, 0, 0, 0, -\frac{g[5][5]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[5][5][x0, x4]}{2\sqrt{-g[5][5][x0, x4]}}, 0, 0\right\}\Big\},$$
$$\{5, x1, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{5, x2, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$
$$\{5, x3, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$
$$\left\{5, x4, \left\{0, 0, 0, 0, 0, -\frac{g[5][5]^{(0,1)}[x0, x4] + 6\, H\, a4'[H\, x4]\, g[5][5][x0, x4]}{2\sqrt{-g[5][5][x0, x4]}}, 0, 0\right\}\right\},$$
$$\Big\{5, x5, \Big\{-\frac{g[5][5]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[5][5][x0, x4]}{2\sqrt{-g[5][5][x0, x4]}}, 0, 0,$$
$$0, -\frac{g[5][5]^{(0,1)}[x0, x4] + 6\, H\, a4'[H\, x4]\, g[5][5][x0, x4]}{2\sqrt{-g[5][5][x0, x4]}}, 0, 0, 0\Big\}\Big\},$$
$$\{5, x6, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{5, x7, \{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}, \Big\{\Big\{6, x0,$$
$$\left\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[6][6][x0, x4]}{2\sqrt{-g[6][6][x0, x4]}}, 0\right\}\Big\},$$
$$\{6, x1, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{6, x2, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$
$$\{6, x3, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$
$$\left\{6, x4, \left\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4] + 6\, H\, a4'[H\, x4]\, g[6][6][x0, x4]}{2\sqrt{-g[6][6][x0, x4]}}, 0\right\}\right\},$$
$$\{6, x5, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$
$$\Big\{6, x6, \Big\{-\frac{g[6][6]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[6][6][x0, x4]}{2\sqrt{-g[6][6][x0, x4]}}, 0, 0,$$
$$0, -\frac{g[6][6]^{(0,1)}[x0, x4] + 6\, H\, a4'[H\, x4]\, g[6][6][x0, x4]}{2\sqrt{-g[6][6][x0, x4]}}, 0, 0, 0\Big\}\Big\},$$
$$\{6, x7, \{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}, \Big\{\Big\{7, x0,$$
$$\left\{0, 0, 0, 0, 0, 0, 0, -\frac{g[7][7]^{(1,0)}[x0, x4] - 2\, H\, \mathrm{Cot}[6\, H\, x0]\, g[7][7][x0, x4]}{2\sqrt{-g[7][7][x0, x4]}}\right\}\Big\},$$
$$\{7, x1, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{7, x2, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{7, x3, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\left\{7, x4, \left\{0, 0, 0, 0, 0, 0, 0, -\frac{g[7][7]^{(0,1)}[x0, x4] + 6\,H\,a4'[H\,x4]\,g[7][7][x0, x4]}{2\sqrt{-g[7][7][x0, x4]}}\right\}\right\},$$

$$\{7, x5, \{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{7, x6, \{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\left\{7, x7, \left\{-\frac{g[7][7]^{(1,0)}[x0, x4] - 2\,H\,\mathrm{Cot}[6\,H\,x0]\,g[7][7][x0, x4]}{2\sqrt{-g[7][7][x0, x4]}}, 0, 0,\right.\right.$$

$$\left.\left.\left. 0, -\frac{g[7][7]^{(0,1)}[x0, x4] + 6\,H\,a4'[H\,x4]\,g[7][7][x0, x4]}{2\sqrt{-g[7][7][x0, x4]}}, 0, 0, 0\right\}\right\}\right\}$$

Out[•]=

{{{0, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {0, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{1, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {1, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{2, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {2, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{3, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {3, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{4, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {4, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{5, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {5, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{6, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {6, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}, {{7, x0, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x1, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x2, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x3, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x4, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x5, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x6, {0, 0, 0, 0, 0, 0, 0, 0}}, {7, x7, {0, 0, 0, 0, 0, 0, 0, 0}}}}}

In[•]:=

```
Block[{eAα, eαA, t, ginv, Γ, gg(*,ωω*)},
 (*ωω=ω_μ^(a)_(b) /.sωf;*)
 gg = g4488 /. sg;
 {ginv, Γ} = con[gg];
 eαA = e^α_(A) /. sge^α_(A); eAα = e^(A)_α /. sge^(A)_α;
 t = Table[ Block[{v, V, contra, covari},
    V = eAα[[b, All]];
    v = eαA[[All, b]];
    contra =
     Table[D[v[[k]], X[[μ]] ] + Sum[ v[[i]] × Γ[[k, i, μ]], {i, 1, DIM8}], {k, 1, DIM8}];
    (*no ω terms*)
    covari = Table[D[V[[k]], X[[μ]] ] - Sum[ V[[i]] × Γ[[i, k, μ]], {i, 1, DIM8}] +
       Sum[ eAα[[J, All]][[k]] × ωmat[[μ, b, J]], {J, 1, DIM8}],
      {k, 1, DIM8}]; (*ω terms*)
    {b - 1, X[[μ]], {{contra}, {covari}}}], {b, 1, Length[eαA]}, {μ, 1, DIM8}];
 t]
FullSimplify[# /. ssgm4488,
   constraintVars && e^(2 a4[H x4]) > 0 && e^(a4[H x4]) > 0 && e^(-2 a4[H x4]) > 0 && e^(-a4[H x4]) > 0] & /@ %
```

Out[•]=

$$\left\{\left\{\left\{0, x0, \left\{\left\{\left\{0, 0, 0, 0, -\frac{g[0][0]^{(0,1)}[x0, x4]}{2\sqrt{g[0][0][x0, x4]}\;g[4][4][x0, x4]}, 0, 0, 0\right\}\right\},\right.\right.\right.\right.$$

```
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x1, {{{0, g[1][1]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[1][1][x0, x4]), 0, 0, 0, 0, 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x2, {{{0, 0, g[2][2]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[2][2][x0, x4]), 0, 0, 0, 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x3, {{{0, 0, 0, g[3][3]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[3][3][x0, x4]), 0, 0, 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x4, {{{0, 0, 0, 0, g[4][4]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[4][4][x0, x4]), 0, 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x5, {{{0, 0, 0, 0, 0, g[5][5]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[5][5][x0, x4]), 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x6, {{{0, 0, 0, 0, 0, 0, g[6][6]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[6][6][x0, x4]), 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {0, x7, {{{0, 0, 0, 0, 0, 0, 0, g[7][7]^(1,0)[x0, x4] / (2 Sqrt[g[0][0][x0, x4]] g[7][7][x0, x4])}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{1, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x1, {{{- g[1][1]^(1,0)[x0, x4] / (2 g[0][0][x0, x4] Sqrt[g[1][1][x0, x4]]), 0, 0, 0,
      - g[1][1]^(0,1)[x0, x4] / (2 Sqrt[g[1][1][x0, x4]] g[4][4][x0, x4]), 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {1, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{2, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
```

$$\{2, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\Big\{2, x2, \Big\{\Big\{\Big\{-\frac{g[2][2]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{g[2][2][x0, x4]}}, 0, 0, 0,$$

$$-\frac{g[2][2]^{(0,1)}[x0, x4]}{2\, \sqrt{g[2][2][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\Big\}\Big\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}\Big\},$$

$$\{2, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{2, x4, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{2, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{2, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{2, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\Big\},$$

$$\Big\{\{3, x0, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{3, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{3, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\Big\{3, x3, \Big\{\Big\{\Big\{-\frac{g[3][3]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{g[3][3][x0, x4]}}, 0, 0, 0,$$

$$-\frac{g[3][3]^{(0,1)}[x0, x4]}{2\, \sqrt{g[3][3][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\Big\}\Big\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}\Big\},$$

$$\{3, x4, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{3, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{3, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{3, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\Big\},$$

$$\Big\{\Big\{4, x0, \Big\{\Big\{\Big\{\frac{g[0][0]^{(0,1)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0,$$

$$\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, (-g[4][4][x0, x4])^{3/2}} + \frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\Big\}\Big\},$$

$$\Big\{\Big\{0, 0, 0, 0, -\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}} - \frac{g[4][4]^{(1,0)}[x0, x4]\, \sqrt{-g[4][4][x0, x4]}}{2\, g[4][4][x0, x4]} -$$

$$\left(\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, (-g[4][4][x0, x4])^{3/2}} + \frac{g[4][4]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[4][4][x0, x4]}\right)$$

$$g[4][4][x0, x4], 0, 0, 0\Big\}\Big\}\Big\}\Big\},$$

$$\Big\{4, x1, \Big\{\Big\{\Big\{0, \frac{g[1][1]^{(0,1)}[x0, x4]}{2\, g[1][1][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, 0, 0, 0\Big\}\Big\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}\Big\},$$

$$\Big\{4, x2, \Big\{\Big\{\Big\{0, 0, \frac{g[2][2]^{(0,1)}[x0, x4]}{2\, g[2][2][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, 0, 0\Big\}\Big\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{4, x3, \{\{\{0, 0, 0, \frac{g[3][3]^{(0,1)}[x0, x4]}{2\, g[3][3][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{4, x4, \{\{\{-\frac{g[4][4]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\, \sqrt{-g[4][4][x0, x4]}}, 0, 0, 0,$$

$$\frac{g[4][4]^{(0,1)}[x0, x4]}{2\, (-g[4][4][x0, x4])^{3/2}} + \frac{g[4][4]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[4][4][x0, x4]}, 0, 0, 0\}\},$$

$$\{\{0, 0, 0, 0, -\frac{g[4][4]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}} - \frac{g[4][4]^{(0,1)}[x0, x4]\, \sqrt{-g[4][4][x0, x4]}}{2\, g[4][4][x0, x4]} -$$

$$\left(\frac{g[4][4]^{(0,1)}[x0, x4]}{2\, (-g[4][4][x0, x4])^{3/2}} + \frac{g[4][4]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[4][4][x0, x4]}\right)$$

$$g[4][4][x0, x4], 0, 0, 0\}\}\}\},$$

$$\{4, x5, \{\{\{0, 0, 0, 0, 0, \frac{g[5][5]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[5][5][x0, x4]}, 0, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{4, x6, \{\{\{0, 0, 0, 0, 0, 0, \frac{g[6][6]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[6][6][x0, x4]}, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{4, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, \frac{g[7][7]^{(0,1)}[x0, x4]}{2\, \sqrt{-g[4][4][x0, x4]}\, g[7][7][x0, x4]}\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{\{5, x0,$$

$$\{\{\{0, 0, 0, 0, 0, \frac{g[5][5]^{(1,0)}[x0, x4]}{2\, (-g[5][5][x0, x4])^{3/2}} + \frac{g[5][5]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[5][5][x0, x4]}\, g[5][5][x0, x4]},$$

$$0, 0\}\}, \{\{0, 0, 0, 0, 0, -\frac{g[5][5]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[5][5][x0, x4]}} -$$

$$\frac{g[5][5]^{(1,0)}[x0, x4]\, \sqrt{-g[5][5][x0, x4]}}{2\, g[5][5][x0, x4]} - \left(\frac{g[5][5]^{(1,0)}[x0, x4]}{2\, (-g[5][5][x0, x4])^{3/2}} +\right.$$

$$\left.\frac{g[5][5]^{(1,0)}[x0, x4]}{2\, \sqrt{-g[5][5][x0, x4]}\, g[5][5][x0, x4]}\right) g[5][5][x0, x4], 0, 0\}\}\}\},$$

$$\{5, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{5, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{5, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}, \{5, x4,$$

$$\left\{\left\{\left\{0, 0, 0, 0, 0, \frac{g[5][5]^{(0,1)}[x0, x4]}{2\,(-g[5][5][x0, x4])^{3/2}} + \frac{g[5][5]^{(0,1)}[x0, x4]}{2\sqrt{-g[5][5][x0, x4]}\; g[5][5][x0, x4]},\right.\right.\right.$$

$$\left.\left.\left.0, 0\right\}\right\}, \left\{\left\{0, 0, 0, 0, 0, -\frac{g[5][5]^{(0,1)}[x0, x4]}{2\sqrt{-g[5][5][x0, x4]}} - \right.\right.\right.$$

$$\frac{g[5][5]^{(0,1)}[x0, x4]\sqrt{-g[5][5][x0, x4]}}{2\,g[5][5][x0, x4]} - \left(\frac{g[5][5]^{(0,1)}[x0, x4]}{2\,(-g[5][5][x0, x4])^{3/2}} + \right.$$

$$\left.\left.\left.\left.\frac{g[5][5]^{(0,1)}[x0, x4]}{2\sqrt{-g[5][5][x0, x4]}\; g[5][5][x0, x4]}\right) g[5][5][x0, x4], 0, 0\right\}\right\}\right\},$$

$$\left\{5, x5, \left\{\left\{\left\{-\frac{g[5][5]^{(1,0)}[x0, x4]}{2\,g[0][0][x0, x4]\sqrt{-g[5][5][x0, x4]}}, 0, 0, 0,\right.\right.\right.\right.$$

$$\left.\left.\left.-\frac{g[5][5]^{(0,1)}[x0, x4]}{2\,g[4][4][x0, x4]\sqrt{-g[5][5][x0, x4]}}, 0, 0, 0\right\}\right\},$$

$$\left.\left.\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\right\}\right\}, \{5, x6,$$

$$\{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{5, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\right\},$$

$$\left\{\left\{6, x0, \left\{\left\{\left\{0, 0, 0, 0, 0, 0,\right.\right.\right.\right.\right.$$

$$\left.\left.\frac{g[6][6]^{(1,0)}[x0, x4]}{2\,(-g[6][6][x0, x4])^{3/2}} + \frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}\; g[6][6][x0, x4]}, 0\right\}\right\},$$

$$\left.\left\{\left\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}} - \right.\right.\right.$$

$$\frac{g[6][6]^{(1,0)}[x0, x4]\sqrt{-g[6][6][x0, x4]}}{2\,g[6][6][x0, x4]} - \left(\frac{g[6][6]^{(1,0)}[x0, x4]}{2\,(-g[6][6][x0, x4])^{3/2}} + \right.$$

$$\left.\left.\left.\left.\frac{g[6][6]^{(1,0)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}\; g[6][6][x0, x4]}\right) g[6][6][x0, x4], 0\right\}\right\}\right\},$$

$$\{6, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{6, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{6, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\left\{6, x4, \left\{\left\{\left\{0, 0, 0, 0, 0, 0,\right.\right.\right.\right.$$

$$\left.\left.\frac{g[6][6]^{(0,1)}[x0, x4]}{2\,(-g[6][6][x0, x4])^{3/2}} + \frac{g[6][6]^{(0,1)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}\; g[6][6][x0, x4]}, 0\right\}\right\},$$

$$\left.\left\{\left\{0, 0, 0, 0, 0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}} - \right.\right.\right.$$

$$\frac{g[6][6]^{(0,1)}[x0, x4]\sqrt{-g[6][6][x0, x4]}}{2\,g[6][6][x0, x4]} - \left(\frac{g[6][6]^{(0,1)}[x0, x4]}{2\,(-g[6][6][x0, x4])^{3/2}} + \right.$$

$$\frac{g[6][6]^{(0,1)}[x0, x4]}{2\sqrt{-g[6][6][x0, x4]}\, g[6][6][x0, x4]}\Bigg) g[6][6][x0, x4], 0\Big\}\Big\}\Big\}\Big\},$$

$$\{6, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\Big\{6, x6, \Big\{\Big\{\Big\{-\frac{g[6][6]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\sqrt{-g[6][6][x0, x4]}}, 0,$$

$$0, 0, -\frac{g[6][6]^{(0,1)}[x0, x4]}{2\, g[4][4][x0, x4]\sqrt{-g[6][6][x0, x4]}}, 0, 0, 0\Big\}\Big\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\Big\}\Big\}, \{6, x7, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\},$$

$$\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\}\Big\}, \Big\{\Big\{7, x0, \Big\{\Big\{\Big\{0, 0, 0, 0, 0, 0, 0,$$

$$\frac{g[7][7]^{(1,0)}[x0, x4]}{2\,(-g[7][7][x0, x4])^{3/2}} + \frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}\, g[7][7][x0, x4]}\Big\}\Big\},$$

$$\Big\{\Big\{0, 0, 0, 0, 0, 0, 0, -\frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}} -$$

$$\frac{g[7][7]^{(1,0)}[x0, x4]\sqrt{-g[7][7][x0, x4]}}{2\, g[7][7][x0, x4]} - \Bigg(\frac{g[7][7]^{(1,0)}[x0, x4]}{2\,(-g[7][7][x0, x4])^{3/2}} +$$

$$\frac{g[7][7]^{(1,0)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}\, g[7][7][x0, x4]}\Bigg) g[7][7][x0, x4]\Big\}\Big\}\Big\}\Big\},$$

$$\{7, x1, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{7, x2, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{7, x3, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\Big\{7, x4, \Big\{\Big\{\Big\{0, 0, 0, 0, 0, 0, 0,$$

$$\frac{g[7][7]^{(0,1)}[x0, x4]}{2\,(-g[7][7][x0, x4])^{3/2}} + \frac{g[7][7]^{(0,1)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}\, g[7][7][x0, x4]}\Big\}\Big\},$$

$$\Big\{\Big\{0, 0, 0, 0, 0, 0, 0, -\frac{g[7][7]^{(0,1)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}} -$$

$$\frac{g[7][7]^{(0,1)}[x0, x4]\sqrt{-g[7][7][x0, x4]}}{2\, g[7][7][x0, x4]} - \Bigg(\frac{g[7][7]^{(0,1)}[x0, x4]}{2\,(-g[7][7][x0, x4])^{3/2}} +$$

$$\frac{g[7][7]^{(0,1)}[x0, x4]}{2\sqrt{-g[7][7][x0, x4]}\, g[7][7][x0, x4]}\Bigg) g[7][7][x0, x4]\Big\}\Big\}\Big\}\Big\},$$

$$\{7, x5, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\{7, x6, \{\{\{0, 0, 0, 0, 0, 0, 0, 0\}\}, \{\{0, 0, 0, 0, 0, 0, 0, 0\}\}\}\},$$

$$\Big\{7, x7, \Big\{\Big\{\Big\{-\frac{g[7][7]^{(1,0)}[x0, x4]}{2\, g[0][0][x0, x4]\sqrt{-g[7][7][x0, x4]}}, 0,$$

```
      0, 0, -(g[7][7]^(0,1)[x0, x4])/(2 g[4][4][x0, x4] Sqrt[-g[7][7][x0, x4]]), 0, 0, 0}},
    {{0, 0, 0, 0, 0, 0, 0, 0}}}}}}
```

Out[ ]=

```
{{{0, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x1, {{{0, H, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x2, {{{0, 0, H, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x3, {{{0, 0, 0, H, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x5, {{{0, 0, 0, 0, 0, H, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x6, {{{0, 0, 0, 0, 0, 0, H, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {0, x7, {{{0, 0, 0, 0, 0, 0, 0, H}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}}},
 {{1, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x1, {{{-Sqrt[e^(2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
       3 Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {1, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}}},
 {{2, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x2, {{{-Sqrt[e^(2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
       3 Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {2, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}}},
 {{3, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {3, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {3, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {3, x3, {{{-Sqrt[e^(2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
       3 Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) a4'[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {3, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {3, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
```

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  {3, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {3, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{4, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x1, {{{0, 3 H a4′[H x4], 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x2, {{{0, 0, 3 H a4′[H x4], 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x3, {{{0, 0, 0, 3 H a4′[H x4], 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x5, {{{0, 0, 0, 0, 0, -3 H a4′[H x4], 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x6, {{{0, 0, 0, 0, 0, 0, -3 H a4′[H x4], 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {4, x7, {{{0, 0, 0, 0, 0, 0, 0, -3 H a4′[H x4]}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{5, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x5, {{{Sqrt[e^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
      3 Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
  {5, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {5, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{6, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x6, {{{Sqrt[e^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
      3 Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {6, x7, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}},
 {{7, x0, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x1, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x2, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x3, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x4, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x5, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x6, {{{0, 0, 0, 0, 0, 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}},
  {7, x7, {{{Sqrt[e^(-2 a4[H x4])] H Sec[6 H x0] Sin[6 H x0]^(7/6), 0, 0, 0,
      3 Sqrt[e^(-2 a4[H x4])] H Sin[6 H x0]^(1/6) a4′[H x4], 0, 0, 0}}, {{0, 0, 0, 0, 0, 0, 0, 0}}}}}}
```

In[∘]:=
```
(*ωΨ=
 Table[Sum[ExpandAll[(ω^(a)_μ(b)[μ,a,b]/.sωf)Simplify[(Transpose[Ψ16].σ16.SAB[[a,b]].Ψ16)]],
   {a,1,8},{b,1,8}],{μ,1,8}]*)
```

In[∘]:=
```
(*ωΨ=Table[Sum[ExpandAll[(ωmat[[μ,a,b]])Simplify[(Transpose[Ψ16].σ16.SAB[[a,b]].Ψ16)]],
   {a,1,8},{b,1,8}],{μ,1,8}]*)
```

In[∘]:=
```
(*jωΨ=ParallelTable[{j,base16[[j,2]],Table[
    {X[[μ]],Simplify[(Transpose[Ψ16].σ16.(ZZZ0 *T16^α[0]+T16^α[4]* ZZZ4 ).base16[[j,1]].(Sum[
          ωmat[[μ,a,b]]SAB[[a,b]],{a,1,8},{b,1,8}])Ψ16)]},{μ,1,8}]},{j,1,Length[base16]}]*)
```

In[∘]:=
```
(*jωΨ=ParallelTable[{j,base16[[j,2]],Table[Sum[ExpandAll[(ω^(a)_μ(b)[μ,a,b]/.sωf)Simplify[
        (Transpose[Ψ16].σ16.(ZZZ0 *T16^α[0]+T16^α[4]* ZZZ4 ).base16[[j,1]].SAB[[a,b]].Ψ16)]],
     {a,1,8},{b,1,8}],{μ,1,8}]},{j,1,Length[base16]}]*)
```

In[∘]:=
```
(*jωΨ[[92]]*)
```

In[∘]:=
```
(*jωΨ[[92]]/.ssgm4488//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
SAB[[1]][[2]]
```

Out[∘]=

$$\left\{\left\{0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0\right\},\left\{0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0\right\},\right.$$
$$\left\{0,0,0,0,0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0\right\},\left\{0,0,\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{-\frac{1}{2},0,0,0,0,0,0,0,0,0,0,0,0,0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2}\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0\right\},\left\{0,0,0,0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0,0,0,0\right\},$$
$$\left\{0,0,0,0,0,0,0,0,0,0,-\frac{1}{2},0,0,0,0,0\right\},$$
$$\left.\left\{0,0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0\right\},\left\{0,0,0,0,0,0,0,0,\frac{1}{2},0,0,0,0,0,0,0\right\}\right\}$$

In[∘]:=
```
(ω^(a)_μ(b)[8, 8, 1] /. Flatten[sωgtry])
```

Out[∘]=

$$e^{-a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}$$

In[ ]:=
```
SAB[[1, 2]].Ψ16
```

Out[ ]=

$$\left\{\frac{1}{2}\,\text{f16}[7][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[6][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[5][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[4][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[3][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[2][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[1][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[0][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[15][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[14][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[13][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[12][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[11][\text{x0}, \text{x4}], -\frac{1}{2}\,\text{f16}[10][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[9][\text{x0}, \text{x4}], \frac{1}{2}\,\text{f16}[8][\text{x0}, \text{x4}]\right\}$$

In[ ]:=
```
T16^A[0]
```

Out[ ]=

```
{{0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1},
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0}}
```

In[ ]:=

$$\text{SAB} = \text{Table}\left[\frac{1}{4}\left(\text{T16}^{A}[\text{A1}].\text{T16}^{A}[\text{B1}] - \text{T16}^{A}[\text{B1}].\text{T16}^{A}[\text{A1}]\right), \{\text{A1}, 0, 7\}, \{\text{B1}, 0, 7\}\right];$$

In[ ]:=
```
Ψ16
```

Out[ ]=

```
{f16[0][x0, x4], f16[1][x0, x4], f16[2][x0, x4], f16[3][x0, x4],
 f16[4][x0, x4], f16[5][x0, x4], f16[6][x0, x4], f16[7][x0, x4],
 f16[8][x0, x4], f16[9][x0, x4], f16[10][x0, x4], f16[11][x0, x4],
 f16[12][x0, x4], f16[13][x0, x4], f16[14][x0, x4], f16[15][x0, x4]}
```

In[∘]:=
```
Sum[ExpandAll[(ω^(a)_μ (b) [4, a, b] /. sωfgtry) Simplify[(SAB⟦a, b⟧)]], {a, 1, 8}, {b, 1, 8}].
  Ψ16 // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[5][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[4][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[7][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[6][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[1][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[0][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[3][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[2][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[13][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[12][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[15][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[14][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[9][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[8][x0,x4] \\ e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[11][x0,x4] \\ -e^{a4[H\,x4]}\,H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,f16[10][x0,x4] \end{pmatrix}$$

In[∘]:=
```
(*Table[Block[{eAα,eαA,t,V},eαA=e^α_(A) /.sgtrye^α_(A);
  eAα=e^(A)_α /.sgtrye^(A)_α;
  V=eAα⟦a,All⟧;
  t=Table[Block[{v,d},v=eαA⟦All,b⟧;
     d=D[v⟦k⟧,X⟦j⟧ ]+Sum[ v⟦i⟧ Γ⟦k,i,j⟧,{i,1,DIM8}];
     d.V],{k,1,DIM8}];
  t],{j,1,DIM8},{a,1,Length[eαA]},{b,1,Length[eαA]}]*)
```

In[∘]:=
```
Clear[rt];
rt[g_, ass_ : {}] := Module[{t, Γ, RicciΓ, RieΓ, RS, G, ginv},
  Print[Now];
  t = AbsoluteTiming[
    ginv = FullSimplify[Inverse[g], ass];
    Γ = FullSimplify[Table[(1 / 2) * Sum[(ginv⟦i, s⟧) *
          (D[g⟦s, j⟧, X⟦k⟧ ] + D[g⟦s, k⟧, X⟦j⟧ ] - D[g⟦j, k⟧, X⟦s⟧ ]), {s, 1, DIM8}],
       {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}] , ass];
    RicciΓ = ParallelTable[FullSimplify[D[Γ⟦μ, ν, β⟧, X⟦α⟧ ] - D[Γ⟦μ, ν, α⟧, X⟦β⟧ ] +
         Sum[Γ⟦μ, s, α⟧ × Γ⟦s, ν, β⟧ - Γ⟦μ, s, β⟧ × Γ⟦s, ν, α⟧, {s, 1, DIM8}], ass],
      {μ, 1, DIM8}, {ν, 1, DIM8}, {α, 1, DIM8}, {β, 1, DIM8}] ;
    RieΓ = ParallelTable[ FullSimplify[Sum[ RicciΓ⟦α, μ, α, ν⟧, {α, 1, DIM8}], ass],
      {μ, 1, DIM8}, {ν, 1, DIM8}] ;
    RS = FullSimplify[Tr[ ginv.RieΓ] , ass];
    G = ParallelTable[FullSimplify[RieΓ⟦α⟧ - 1/2 g⟦α⟧ RS, ass], {α, 1, Length[RieΓ]}];];
  Print[t];
  Print[Now];
  Return[{ginv, Γ, RicciΓ, RieΓ, RS, G}]]
```

verify $g_{\mu\nu|\alpha} = 0$:

In[∘]:=
```
Simplify[Table[D[gtry[[j, k]], X[[i]] ] -
     Sum[ gtry[[k, s]] × Γ[[s, i, j]], {s, 1, DIM8}] - Sum[ gtry[[j, s]] × Γ[[s, i, k]], {s, 1, DIM8}],
    {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}] ] // Flatten // Union
```

Out[∘]=

{0}

- **CHECK**

In[∘]:=
```
MatrixMetric44 // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} \mathrm{Cot}[6\,H\,x0]^2 & 0 & 0 & 0 & 0 \\ 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 & 0 \\ 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 & 0 \\ 0 & 0 & 0 & e^{2\,a4[H\,x4]}\,\mathrm{Sin}[6\,H\,x0]^{1/3} & 0 \\ 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad -e^{-2\,a4[H\,x4]}\,S$$

In[∘]:=
```
(e^α_(A).MatrixMetric44.e^α_(A) /. sgtrye^α_(A)) // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}$$

In[∘]:=
```
Transpose[e^(A)_α].η4488.e^(A)_α - MatrixMetric44 /. sgtrye^(A)_α // FullSimplify[#, constraintVars] &
```

Out[∘]=

{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}

In[∘]:=
```
Transpose[e^α_(A)].MatrixMetric44.e^α_(A) - η4488 /. sgtrye^α_(A) // FullSimplify[#, constraintVars] &
```

Out[∘]=

{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}

In[∘]:=
```
Inverse[e^α_(A) /. sgtrye^α_(A)] == e^(A)_α /. sgtrye^(A)_α // FullSimplify[#, constraintVars] &
```

Out[∘]=

True

In[∘]:=
```
Block[{a, b, c, d, m}, m = {{a, b}, {c, d}}; Inverse[Transpose[m]] - Transpose[Inverse[m]]]
```

Out[∘]=

{{0, 0}, {0, 0}}

In[∘]:=
```
(*Inverse[Transpose[e^α_(A)].MatrixMetric44.e^α_(A)]==
  e^(A)_α.Inverse[MatrixMetric44].Transpose[e^(A)_α]//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
(*e^(A)_α.Inverse[MatrixMetric44].Transpose[e^(A)_α]//FullSimplify[#,constraintVars]&
   %-Inverse[η4488]//Union[Flatten[#]]&*)
```

In[∘]:=
```
(*Transpose[e^(A)_α]==e^(A)_α//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
(*(FullSimplify[e^(A)_α.Inverse[MatrixMetric44].Transpose[e^(A)_α] -Inverse[η4488] ,
    constraintVars]//Union[Flatten[#]]&)//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
(*(FullSimplify[Transpose[e^(A)_α].Inverse[MatrixMetric44].e^(A)_α,constraintVars]-
    Inverse[η4488]//Union[Flatten[#]]&)//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
(*(FullSimplify[Transpose[e^(A)_α].ginv.e^(A)_α,constraintVars]-Inverse[η4488]//
   Union[Flatten[#]]&)//FullSimplify[#,constraintVars]&*)
```

In[∘]:=
```
(E^α_(A) = Table[Sum[e^(A)_α [[A1, α1]] ginv[[α1, β1]] × η4488[[A1, B1]] /. sgtrye^(A)_α ,
      {α1, 1, 8}, {A1, 1, 8}], {β1, 1, 8}, {B1, 1, 8}] //
    FullSimplify[#, constraintVars] &) // Column
```

Out[∘]=

$$\{\mathrm{Tan}[6\,H\,x0],\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\}$$

$$\left\{0,\ \frac{e^{-a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{0,\ 0,\ \frac{e^{-a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}},\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{0,\ 0,\ 0,\ \frac{e^{-a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}},\ 0,\ 0,\ 0,\ 0\right\}$$

$$\{0,\ 0,\ 0,\ 0,\ 1,\ 0,\ 0,\ 0\}$$

$$\left\{0,\ 0,\ 0,\ 0,\ 0,\ \frac{e^{a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}},\ 0,\ 0\right\}$$

$$\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{e^{a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}},\ 0\right\}$$

$$\left\{0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ \frac{e^{a4[x4]}}{\mathrm{Sin}[6\,H\,x0]^{1/6}}\right\}$$

$$\mathrm{Lagrangian}\Psi 16 = \kappa\sqrt{\mathrm{Det}[g_{\mu\nu}]}\ \mathrm{Transpose}[\Psi 16].\sigma 16.\mathrm{T16}^{A}[A1].\Psi 16_{,\alpha}\, g^{-1\ \alpha\beta}\ \eta_{A1\,B1}\ E^{B1}_{\beta} + \mathrm{mass\ term}$$

In[ ]:=
```
ass = constraintVars
```

Out[ ]=

$$x0 > 0 \,\&\&\, x4 > 0 \,\&\&\, H > 0 \,\&\&\, 6\,H\,x0 > 0 \,\&\&\, 3\,H\,x4 > 0 \,\&\&\, a4[x4] > 0 \,\&\&\, A4[t] > 0 \,\&\&\, Q > 0 \,\&\&\, z > 0 \,\&\&\, t > 0 \,\&\&\, M > 0 \,\&\&\, K > 0 \,\&\&\, e^{-2\,a4[H\,x4]} > 0 \,\&\&\, e^{-a4[H\,x4]} > 0 \,\&\&\, e^{2\,a4[H\,x4]} > 0 \,\&\&\, e^{a4[H\,x4]} > 0 \,\&\&\, Sin[6\,H\,x0] > 0 \,\&\&\, Cos[6\,H\,x0] > 0 \,\&\&\, Csc[6\,H\,x0] > 0 \,\&\&\, Sec[6\,H\,x0] > 0 \,\&\&\, Tan[6\,H\,x0] > 0 \,\&\&\, Cot[6\,H\,x0] > 0 \,\&\&\, Sin[z] > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, Sin[z]^{3/2} > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, \frac{1}{Sin[z]^{3/2}} > 0 \,\&\&\, \frac{1}{\sqrt{Sin[z]}} > 0 \,\&\&\, Cot[z] > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Cot[z]^{3/2} > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Tan[z] > 0 \,\&\&\, Sec[z] > 0 \,\&\&\, \sqrt{Csc[z]} > 0 \,\&\&\, Csc[z] > 0$$

In[ ]:=

$$\mathbf{x0 > 0 \,\&\&\, x4 > 0 \,\&\&\, H > 0 \,\&\&\, 6\,H\,x0 > 0 \,\&\&\, H\,x4 > 0 \,\&\&\, a4[x4] > 0 \,\&\&\, A4[t] > 0 \,\&\&\, Q > 0 \,\&\&\, z > 0 \,\&\&\, t > 0 \,\&\&\, M > 0 \,\&\&\, K > 0 \,\&\&\, e^{-2\,a4[H\,x4]} > 0 \,\&\&\, e^{-a4[H\,x4]} > 0 \,\&\&\, e^{2\,a4[H\,x4]} > 0 \,\&\&\, e^{a4[H\,x4]} > 0 \,\&\&\, Sin[6\,H\,x0] > 0 \,\&\&\, Cos[6\,H\,x0] > 0 \,\&\&\, Csc[6\,H\,x0] > 0 \,\&\&\, Sec[6\,H\,x0] > 0 \,\&\&\, Tan[6\,H\,x0] > 0 \,\&\&\, Cot[6\,H\,x0] > 0 \,\&\&\, Sin[z] > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, Sin[z]^{3/2} > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, \frac{1}{Sin[z]^{3/2}} > 0 \,\&\&\, \frac{1}{\sqrt{Sin[z]}} > 0 \,\&\&\, Cot[z] > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Cot[z]^{3/2} > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Tan[z] > 0 \,\&\&\, Sec[z] > 0 \,\&\&\, \sqrt{Csc[z]} > 0 \,\&\&\, Csc[z] > 0}$$

Out[ ]=

$$x0 > 0 \,\&\&\, x4 > 0 \,\&\&\, H > 0 \,\&\&\, 6\,H\,x0 > 0 \,\&\&\, H\,x4 > 0 \,\&\&\, a4[x4] > 0 \,\&\&\, A4[t] > 0 \,\&\&\, Q > 0 \,\&\&\, z > 0 \,\&\&\, t > 0 \,\&\&\, M > 0 \,\&\&\, K > 0 \,\&\&\, e^{-2\,a4[H\,x4]} > 0 \,\&\&\, e^{-a4[H\,x4]} > 0 \,\&\&\, e^{2\,a4[H\,x4]} > 0 \,\&\&\, e^{a4[H\,x4]} > 0 \,\&\&\, Sin[6\,H\,x0] > 0 \,\&\&\, Cos[6\,H\,x0] > 0 \,\&\&\, Csc[6\,H\,x0] > 0 \,\&\&\, Sec[6\,H\,x0] > 0 \,\&\&\, Tan[6\,H\,x0] > 0 \,\&\&\, Cot[6\,H\,x0] > 0 \,\&\&\, Sin[z] > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, Sin[z]^{3/2} > 0 \,\&\&\, \sqrt{Sin[z]} > 0 \,\&\&\, \frac{1}{Sin[z]^{3/2}} > 0 \,\&\&\, \frac{1}{\sqrt{Sin[z]}} > 0 \,\&\&\, Cot[z] > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Cot[z]^{3/2} > 0 \,\&\&\, \sqrt{Cot[z]} > 0 \,\&\&\, Tan[z] > 0 \,\&\&\, Sec[z] > 0 \,\&\&\, \sqrt{Csc[z]} > 0 \,\&\&\, Csc[z] > 0$$

In[ ]:=
```
ginv == FullSimplify[Inverse[gtry], ass]
```

Out[ ]=

True

In[ ]:=
```
ginv === Transpose[ginv]
```

Out[ ]=

True

verify metric covariant derivative again:

In[ ]:=
```
Simplify[Table[D[gtry[[j, k]], X[[i]] ] -
     Sum[ gtry[[k, s]] × Γ[[s, i, j]], {s, 1, DIM8}] - Sum[ gtry[[j, s]] × Γ[[s, i, k]], {s, 1, DIM8}],
    {i, 1, DIM8}, {j, 1, DIM8}, {k, 1, DIM8}] ] // Flatten // Union
```

Out[ ]=

{0}

In[ ]:=
```
RS
```

Out[ ]=

$$6\,H^2\left(-7 + a4'[H\,x4]^2\right)$$

In[ ]:=
```
EinsteinG
skelx[%]
```

Out[ ]=

$$\{\{-3 H^2 \mathrm{Cot}[6 H x0]^2 (-5 + a4'[H x4]^2), 0, 0, 0, 0, 0, 0, 0\},$$
$$\{0, -e^{2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 - a4''[H x4]), 0, 0, 0, 0, 0, 0\},$$
$$\{0, 0, -e^{2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 - a4''[H x4]), 0, 0, 0, 0, 0\},$$
$$\{0, 0, 0, -e^{2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 - a4''[H x4]), 0, 0, 0, 0\},$$
$$\{0, 0, 0, 0, -3 H^2 (7 + a4'[H x4]^2), 0, 0, 0\},$$
$$\{0, 0, 0, 0, 0, e^{-2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 + a4''[H x4]), 0, 0\},$$
$$\{0, 0, 0, 0, 0, 0, e^{-2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 + a4''[H x4]), 0\},$$
$$\{0, 0, 0, 0, 0, 0, 0, e^{-2 a4[H x4]} H^2 \mathrm{Sin}[6 H x0]^{1/3} (-15 + 3 a4'[H x4]^2 + a4''[H x4])\}\}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} 4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 4 \end{pmatrix}$$

```
Union[Table[
  Sum[τ[A].bas64[[k, 1]].σ.τ̄[A] × η8[[A, A]], {A, 1, 8}] - ID8 Tr[bas64[[k, 1]].σ] +
   4 eg[[k]] (bas64[[k, 1]] - Transpose[bas64[[k, 1]]])/2 .σ, {k, 1, 64}]]
```

{{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}}

BASIS of 16 × 16 matrices :

In[ ]:=
```
16 * 16
```

Out[ ]=

256

In[ ]:=
```
2^8
```

Out[ ]=

256

In[ ]:=
```
Sum[Binomial[8, p], {p, 0, 8}]
```

Out[ ]=

256

In[ ]:=
```
Id16 == ID16 == Dot @@ (T16^A[#] & /@ Range[0, 8])
```

Out[ ]=

True

In[ ]:=
```
Clear[t160]; t160 = {{Id16, {Range[0, 8]}}}; Length[t160]
Clear[t16A];
t16A = {};
Do[AppendTo[t16A, {T16^A[j], {j}}], {j, 0, 7}];
Length[t16A]
Clear[t16AB];
t16AB = {};
Do[AppendTo[t16AB, {T16^A[j].T16^A[k], {j, k}}], {j, 0, 6}, {k, j + 1, 7}];
Length[t16AB]
Clear[t16ABC];
t16ABC = {};
Do[AppendTo[t16ABC, {T16^A[j].T16^A[k].T16^A[h], {j, k, h}}],
 {j, 0, 5}, {k, j + 1, 6}, {h, k + 1, 7}];
Length[t16ABC]
Clear[t16ABCD];
t16ABCD = {};
Do[AppendTo[t16ABCD, {T16^A[j].T16^A[k].T16^A[h].T16^A[i], {j, k, h, i}}],
 {j, 0, 4}, {k, j + 1, 5}, {h, k + 1, 6}, {i, h + 1, 7}];
Length[t16ABCD]
Clear[t16ABCDE];
t16ABCDE = {};
Do[AppendTo[t16ABCDE, {T16^A[j].T16^A[k].T16^A[h].T16^A[i].T16^A[l], {j, k, h, i, l}}],
 {j, 0, 3}, {k, j + 1, 4}, {h, k + 1, 5}, {i, h + 1, 6}, {l, i + 1, 7}];
Length[t16ABCDE]
Clear[t16ABCDEF];
t16ABCDEF = {};
Do[AppendTo[t16ABCDEF, {T16^A[j].T16^A[k].T16^A[h].T16^A[i].T16^A[l].T16^A[q], {j, k, h, i, l,
    q}}], {j, 0, 2}, {k, j + 1, 3}, {h, k + 1, 4}, {i, h + 1, 5}, {l, i + 1, 6}, {q, l + 1, 7}];
Length[t16ABCDEF]
Clear[t16ABCDEFG];
t16ABCDEFG = {};
Do[AppendTo[t16ABCDEFG,
  {T16^A[j].T16^A[k].T16^A[h].T16^A[i].T16^A[l].T16^A[q].T16^A[r], {j, k, h, i, l, q, r}}],
 {j, 0, 1}, {k, j + 1, 2}, {h, k + 1, 3}, {i, h + 1, 4}, {l, i + 1, 5}, {q, l + 1, 6}, {r, q + 1, 7}];
Length[t16ABCDEFG]
Clear[t16ABCDEFGH];
t16ABCDEFGH = {};
Do[AppendTo[t16ABCDEFGH, {T16^A[j].T16^A[k].T16^A[h].T16^A[i].T16^A[l].
    T16^A[q].T16^A[r].T16^A[s], {j, k, h, i, l, q, r, s}}], {j, 0, 1}, {k, j + 1, 1},
 {h, k + 1, 2}, {i, h + 1, 3}, {l, i + 1, 4}, {q, l + 1, 5}, {r, q + 1, 6}, {s, r + 1, 7}];
Length[t16ABCDEFGH]
% + %% + %%% + %%%% + %%%%% + %%%%%% + %%%%%%% + %%%%%%%% + %%%%%%%%%
```

Out[ ]=
```
1
```

Out[•]=
8

Out[•]=
28

Out[•]=
56

Out[•]=
70

Out[•]=
56

Out[•]=
28

Out[•]=
8

Out[•]=
1

Out[•]=
256

In[•]:=
```
(*base16=Flatten[
  {t160,t16A,t16AB,t16ABC,t16ABCD,t16ABCDE,t16ABCDEF,t16ABCDEFG,t16ABCDEFGH},1];
Length[base16]*)
```

In[•]:=
```
base16 = Flatten[
  {t16A, t16AB, t16ABC, t16ABCD, t16ABCDE, t16ABCDEF, t16ABCDEFG, t16ABCDEFGH, t160}, 1];
Length[base16]
```

Out[•]=
256

In[•]:=
```
Length[Union[base16[[All, 1]]]]
```

Out[•]=
256

In[•]:=
```
Tr[#.# / 16] & /@ base16[[All, 1]] // Flatten // Union
```

Out[•]=
{-1, 1}

In[•]:=
```
positiveTrMM = Select[base16, Tr[#[[1]].#[[1]]] > 0 & → "Index"]
```

Out[•]=
{1, 2, 3, 4, 12, 13, 14, 15, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 59, 60, 61, 62, 63, 64, 65, 66, 73, 74, 75, 76, 89, 90, 91, 92, 93, 102, 103, 104, 105, 106, 107, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 148, 149, 150, 151, 152, 153, 162, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 183, 184, 185, 186, 187, 188, 197, 198, 199, 200, 201, 202, 203, 212, 217, 218, 225, 226, 227, 228, 229, 230, 231, 232, 234, 235, 236, 237, 240, 241, 242, 243, 247, 248, 249, 250, 255, 256}

In[ ]:=
```
negativeTrMM = Select[base16, Tr[#[[1]].#[[1]]] < 0 & → "Index"]
```

Out[ ]=
```
{5, 6, 7, 8, 9, 10, 11, 16, 17, 22, 31, 32, 33, 34, 35, 36, 37, 38, 43, 52, 53, 54, 55, 56, 57, 58,
 67, 68, 69, 70, 71, 72, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 94, 95, 96, 97,
 98, 99, 100, 101, 108, 109, 110, 111, 124, 125, 126, 127, 128, 129, 130, 131, 144, 145,
 146, 147, 154, 155, 156, 157, 158, 159, 160, 161, 163, 164, 165, 166, 179, 180, 181, 182,
 189, 190, 191, 192, 193, 194, 195, 196, 204, 205, 206, 207, 208, 209, 210, 211, 213, 214,
 215, 216, 219, 220, 221, 222, 223, 224, 233, 238, 239, 244, 245, 246, 251, 252, 253, 254}
```

In[ ]:=
```
{Length[positiveTrMM], Length[negativeTrMM]}
```

Out[ ]=
```
{136, 120}
```

In[ ]:=
```
dups = Block[{s}, s = base16[[All, 1]]; Select[s, MemberQ[s, -#] &]]; Length[dups]
```

Out[ ]=
```
0
```

In[ ]:=
```
dups = Select[base16, MemberQ[base16[[All, 1]], -#[[1]]] &]; Length[dups]
```

Out[ ]=
```
0
```

In[ ]:=
```
BASE16 = use16 = Complement[base16, dups]; Length[use16]
```

Out[ ]=
```
256
```

In[ ]:=
```
(*(T16^A[8]=T16^A[0].T16^A[1].T16^A[2].T16^A[3].T16^A[4].T16^A[5].T16^A[6].T16^A[7])//MatrixForm*)
```

In[ ]:=
```
MatrixForm[T16^A[#]] & /@ Range[0, 7]
```

Out[ ]=

$$\left\{\begin{pmatrix} 0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1\\ 1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0 \end{pmatrix}, \begin{pmatrix} 0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1\\ 0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\ 0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\ -1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0 \end{pmatrix},$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix},$$

$$\left.\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\
-1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}\right\}$$

```
In[ ]:= (*BASE16[[-1]]*)

In[ ]:= (*BASE16[[-2]]
        %[[1]]==BASE16[[-1]][[1]]*)
```

In[ ]:=
```
16 * (16 + 1) / 2
16 * (16 - 1) / 2
% + %%
```

Out[ ]=
```
136
```

Out[ ]=
```
120
```

Out[ ]=
```
256
```

In[ ]:=
```
Clear[symm16];
symm16 = {};
Do[If[base16⟦k, 1⟧ == Transpose[base16⟦k, 1⟧],
  AppendTo[symm16, {base16⟦k, 1⟧, {{k}, base16⟦k, 2⟧}}] ], {k, 1, Length[base16]}];
Length[symm16]
symm16⟦%⟧
```

Out[ ]=
```
136
```

Out[ ]=
```
{{{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1}}, {{256}, {{0, 1, 2, 3, 4, 5, 6, 7, 8}}}}
```

In[ ]:=
```
dupssymm16 = Select[symm16, MemberQ[symm16⟦All, 1⟧, -#⟦1⟧] &]; Length[dupssymm16]
```

Out[ ]=
```
0
```

In[ ]:=
```
#[[2]] & /@ symm16
```

Out[ ]=
```
{{{1}, {0}}, {{2}, {1}}, {{3}, {2}}, {{4}, {3}}, {{12}, {0, 4}}, {{13}, {0, 5}},
 {{14}, {0, 6}}, {{15}, {0, 7}}, {{18}, {1, 4}}, {{19}, {1, 5}}, {{20}, {1, 6}},
 {{21}, {1, 7}}, {{23}, {2, 4}}, {{24}, {2, 5}}, {{25}, {2, 6}}, {{26}, {2, 7}},
 {{27}, {3, 4}}, {{28}, {3, 5}}, {{29}, {3, 6}}, {{30}, {3, 7}}, {{39}, {0, 1, 4}},
 {{40}, {0, 1, 5}}, {{41}, {0, 1, 6}}, {{42}, {0, 1, 7}}, {{44}, {0, 2, 4}}, {{45}, {0, 2, 5}},
 {{46}, {0, 2, 6}}, {{47}, {0, 2, 7}}, {{48}, {0, 3, 4}}, {{49}, {0, 3, 5}}, {{50}, {0, 3, 6}},
 {{51}, {0, 3, 7}}, {{59}, {1, 2, 4}}, {{60}, {1, 2, 5}}, {{61}, {1, 2, 6}}, {{62}, {1, 2, 7}},
 {{63}, {1, 3, 4}}, {{64}, {1, 3, 5}}, {{65}, {1, 3, 6}}, {{66}, {1, 3, 7}}, {{73}, {2, 3, 4}},
 {{74}, {2, 3, 5}}, {{75}, {2, 3, 6}}, {{76}, {2, 3, 7}}, {{89}, {4, 5, 6}}, {{90}, {4, 5, 7}},
 {{91}, {4, 6, 7}}, {{92}, {5, 6, 7}}, {{93}, {0, 1, 2, 3}}, {{102}, {0, 1, 4, 5}},
 {{103}, {0, 1, 4, 6}}, {{104}, {0, 1, 4, 7}}, {{105}, {0, 1, 5, 6}}, {{106}, {0, 1, 5, 7}},
 {{107}, {0, 1, 6, 7}}, {{112}, {0, 2, 4, 5}}, {{113}, {0, 2, 4, 6}}, {{114}, {0, 2, 4, 7}},
 {{115}, {0, 2, 5, 6}}, {{116}, {0, 2, 5, 7}}, {{117}, {0, 2, 6, 7}}, {{118}, {0, 3, 4, 5}},
 {{119}, {0, 3, 4, 6}}, {{120}, {0, 3, 4, 7}}, {{121}, {0, 3, 5, 6}}, {{122}, {0, 3, 5, 7}},
 {{123}, {0, 3, 6, 7}}, {{132}, {1, 2, 4, 5}}, {{133}, {1, 2, 4, 6}}, {{134}, {1, 2, 4, 7}},
 {{135}, {1, 2, 5, 6}}, {{136}, {1, 2, 5, 7}}, {{137}, {1, 2, 6, 7}}, {{138}, {1, 3, 4, 5}},
 {{139}, {1, 3, 4, 6}}, {{140}, {1, 3, 4, 7}}, {{141}, {1, 3, 5, 6}}, {{142}, {1, 3, 5, 7}},
 {{143}, {1, 3, 6, 7}}, {{148}, {2, 3, 4, 5}}, {{149}, {2, 3, 4, 6}}, {{150}, {2, 3, 4, 7}},
 {{151}, {2, 3, 5, 6}}, {{152}, {2, 3, 5, 7}}, {{153}, {2, 3, 6, 7}}, {{162}, {4, 5, 6, 7}},
 {{167}, {0, 1, 2, 4, 5}}, {{168}, {0, 1, 2, 4, 6}}, {{169}, {0, 1, 2, 4, 7}},
 {{170}, {0, 1, 2, 5, 6}}, {{171}, {0, 1, 2, 5, 7}}, {{172}, {0, 1, 2, 6, 7}},
 {{173}, {0, 1, 3, 4, 5}}, {{174}, {0, 1, 3, 4, 6}}, {{175}, {0, 1, 3, 4, 7}},
 {{176}, {0, 1, 3, 5, 6}}, {{177}, {0, 1, 3, 5, 7}}, {{178}, {0, 1, 3, 6, 7}},
 {{183}, {0, 2, 3, 4, 5}}, {{184}, {0, 2, 3, 4, 6}}, {{185}, {0, 2, 3, 4, 7}},
 {{186}, {0, 2, 3, 5, 6}}, {{187}, {0, 2, 3, 5, 7}}, {{188}, {0, 2, 3, 6, 7}},
 {{197}, {0, 4, 5, 6, 7}}, {{198}, {1, 2, 3, 4, 5}}, {{199}, {1, 2, 3, 4, 6}},
 {{200}, {1, 2, 3, 4, 7}}, {{201}, {1, 2, 3, 5, 6}}, {{202}, {1, 2, 3, 5, 7}},
 {{203}, {1, 2, 3, 6, 7}}, {{212}, {1, 4, 5, 6, 7}}, {{217}, {2, 4, 5, 6, 7}},
 {{218}, {3, 4, 5, 6, 7}}, {{225}, {0, 1, 2, 4, 5, 6}}, {{226}, {0, 1, 2, 4, 5, 7}},
 {{227}, {0, 1, 2, 4, 6, 7}}, {{228}, {0, 1, 2, 5, 6, 7}}, {{229}, {0, 1, 3, 4, 5, 6}},
 {{230}, {0, 1, 3, 4, 5, 7}}, {{231}, {0, 1, 3, 4, 6, 7}}, {{232}, {0, 1, 3, 5, 6, 7}},
 {{234}, {0, 2, 3, 4, 5, 6}}, {{235}, {0, 2, 3, 4, 5, 7}}, {{236}, {0, 2, 3, 4, 6, 7}},
 {{237}, {0, 2, 3, 5, 6, 7}}, {{240}, {1, 2, 3, 4, 5, 6}}, {{241}, {1, 2, 3, 4, 5, 7}},
 {{242}, {1, 2, 3, 4, 6, 7}}, {{243}, {1, 2, 3, 5, 6, 7}}, {{247}, {0, 1, 2, 3, 4, 5, 6}},
 {{248}, {0, 1, 2, 3, 4, 5, 7}}, {{249}, {0, 1, 2, 3, 4, 6, 7}}, {{250}, {0, 1, 2, 3, 5, 6, 7}},
 {{255}, {0, 1, 2, 3, 4, 5, 6, 7}}, {{256}, {{0, 1, 2, 3, 4, 5, 6, 7, 8}}}}
```

In[ ]:=
```
σ16 == T16^A[0].T16^A[1].T16^A[2].T16^A[3]
```

Out[ ]=
```
True
```

In[ ]:=
```
σ16 == base16[[93]][[1]]
```

Out[ ]=
```
True
```

In[∘]:=
```
Select[symm16, #[[2]][[1]][[1]] == 93 & → "Index"]
```
Out[∘]=
```
{49}
```
In[∘]:=
```
σ16 == symm16[[49]][[1]]
```
Out[∘]=
```
True
```
In[∘]:=
```
symm16[[134]]
```
Out[∘]=
```
{{{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
  {0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}}, {{250}, {0, 1, 2, 3, 5, 6, 7}}}
```
In[∘]:=
```
Select[symm16, #[[2]][[1]][[1]] == 250 & → "Index"]
```
Out[∘]=
```
{134}
```
In[∘]:=
```
T16_Superscript_A
```
Out[∘]=
$T16^A$

In[∘]:=
$\sigma 16.T16^A[5].T16^A[6].T16^A[7] == symm16[[134]][[1]]$

Out[∘]=
```
True
```
In[∘]:=
$T16^A[8] == base16[[255]][[1]]$

Out[∘]=
```
True
```
In[∘]:=
```
Select[symm16, #[[2]][[1]][[1]] == 255 & → "Index"]
```
Out[∘]=
```
{135}
```

- **similarly :**

In[∘]:=
```
coupled1 = {4, 5, 0, 9, 9, 12, 4, 5, 1, 8, 8, 13} // Union
```
Out[∘]=
```
{0, 1, 4, 5, 8, 9, 12, 13}
```
In[∘]:=
```
coupled2 = Complement[Range[0, 15], coupled1]
```
Out[∘]=
```
{2, 3, 6, 7, 10, 11, 14, 15}
```

In[ ]:=
```
coupled = {coupled1, coupled2}
```

Out[ ]=
```
{{0, 1, 4, 5, 8, 9, 12, 13}, {2, 3, 6, 7, 10, 11, 14, 15}}
```

In[ ]:=
```
Block[{m, vars, eqs, eqs1, eqs2, s, Φ16},
 Φ16 = f[#] & /@ Range[16];
 m = Array[qb[#1, #2] &, {16, 16}];
 vars = Flatten[m];
 eqs1 = And @@ Thread[m.Φ16 == Flatten[{Φ16⟦# + 1⟧ & /@ coupled1, Φ16⟦# + 1⟧ & /@ coupled2}]];
 eqs2 = And @@ Thread[m.Transpose[m] == Flatten[ID16]];
 eqs = eqs1 && eqs2;
 s = Solve[eqs, vars] // FullSimplify;
 s
]
```

Out[ ]=
```
{}
```

In[ ]:=
```
linTrans = Block[{m, b, vars, eqs, eqs1, eqs2, s, Φ16, t},
  Φ16 = f[#] & /@ Range[16];
  m = Array[qb[#1, #2] &, {16, 16}];
  b = Flatten[{Φ16⟦# + 1⟧ & /@ coupled1, Φ16⟦# + 1⟧ & /@ coupled2}];
  t = Table[Block[{sv, eq, d}, d = D[ m⟦j⟧.b, Φ16⟦j⟧];
     sv = Flatten[{d → 1, Thread[Complement[m⟦j⟧, {d}] → 0]}];
     (*Print[{m⟦j⟧.b},{Φ16⟦j⟧},{sv}];*)
     (*eq=Thread[m⟦j⟧.b==Φ16⟦j⟧];
     sv=Solve[eq,Flatten[m⟦j⟧]]//FullSimplify;
     sv*)(*{v.b,Φ16⟦j⟧}*)sv], {j, 1, 16}];
  (*
  vars=Flatten[m];
  eqs1=And@@Thread[m.Φ16==Flatten[{Φ16⟦#+1⟧&/@coupled1,Φ16⟦#+1⟧&/@coupled2}]];
  eqs2=And@@Thread[m.Transpose[m]==Flatten[ID16]];
  eqs=eqs1&&eqs2;
  s=Solve[eqs,vars]//FullSimplify;*)
  m /. Flatten[t]
 ]
```

Out[ ]=
```
{{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0},
 {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
 {0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1}}
```

In[ ]:=
```
linTrans // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
linTrans.Transpose[linTrans] // FullSimplify // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
linTrans.Ψ16 // Column
Union[%[[1]]]
```

Out[ ]=
```
f16[0][x0, x4]
f16[1][x0, x4]
f16[8][x0, x4]
f16[9][x0, x4]
f16[2][x0, x4]
f16[3][x0, x4]
f16[10][x0, x4]
f16[11][x0, x4]
f16[4][x0, x4]
f16[5][x0, x4]
f16[12][x0, x4]
f16[13][x0, x4]
f16[6][x0, x4]
f16[7][x0, x4]
f16[14][x0, x4]
f16[15][x0, x4]
```

Out[ ]=
```
{f16[0][x0, x4], f16[1][x0, x4], f16[2][x0, x4], f16[3][x0, x4],
 f16[4][x0, x4], f16[5][x0, x4], f16[6][x0, x4], f16[7][x0, x4],
 f16[8][x0, x4], f16[9][x0, x4], f16[10][x0, x4], f16[11][x0, x4],
 f16[12][x0, x4], f16[13][x0, x4], f16[14][x0, x4], f16[15][x0, x4]}
```

In[ ]:=
```
positiveTrMM = Select[base16, Tr[#[[1]] . #[[1]]] > 0 & -> "Index"]
```

Out[ ]=

{1, 2, 3, 4, 12, 13, 14, 15, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 59, 60, 61, 62, 63, 64, 65, 66, 73, 74, 75, 76, 89, 90, 91, 92, 93, 102, 103, 104, 105, 106, 107, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 148, 149, 150, 151, 152, 153, 162, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 183, 184, 185, 186, 187, 188, 197, 198, 199, 200, 201, 202, 203, 212, 217, 218, 225, 226, 227, 228, 229, 230, 231, 232, 234, 235, 236, 237, 240, 241, 242, 243, 247, 248, 249, 250, 255, 256}

In[ ]:=
```
negativeTrMM = Select[base16, Tr[#[[1]] . #[[1]]] < 0 & -> "Index"]
```

Out[ ]=

{5, 6, 7, 8, 9, 10, 11, 16, 17, 22, 31, 32, 33, 34, 35, 36, 37, 38, 43, 52, 53, 54, 55, 56, 57, 58, 67, 68, 69, 70, 71, 72, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 94, 95, 96, 97, 98, 99, 100, 101, 108, 109, 110, 111, 124, 125, 126, 127, 128, 129, 130, 131, 144, 145, 146, 147, 154, 155, 156, 157, 158, 159, 160, 161, 163, 164, 165, 166, 179, 180, 181, 182, 189, 190, 191, 192, 193, 194, 195, 196, 204, 205, 206, 207, 208, 209, 210, 211, 213, 214, 215, 216, 219, 220, 221, 222, 223, 224, 233, 238, 239, 244, 245, 246, 251, 252, 253, 254}

In[ ]:=
```
{Length[positiveTrMM], Length[negativeTrMM]}
```

Out[ ]=

{136, 120}

In[ ]:=
```
positiveTrMM = Select[base16, Tr[#[[1]].#[[1]]] > 0 & → "Index"]
```

Out[ ]=
```
{1, 2, 3, 4, 12, 13, 14, 15, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 39, 40, 41, 42, 44,
 45, 46, 47, 48, 49, 50, 51, 59, 60, 61, 62, 63, 64, 65, 66, 73, 74, 75, 76, 89, 90, 91,
 92, 93, 102, 103, 104, 105, 106, 107, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121,
 122, 123, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 148, 149, 150, 151,
 152, 153, 162, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 183, 184, 185,
 186, 187, 188, 197, 198, 199, 200, 201, 202, 203, 212, 217, 218, 225, 226, 227, 228, 229,
 230, 231, 232, 234, 235, 236, 237, 240, 241, 242, 243, 247, 248, 249, 250, 255, 256}
```

In[ ]:=
```
negativeTrMM = Select[base16, Tr[#[[1]].#[[1]]] < 0 & → "Index"]
```

Out[ ]=
```
{5, 6, 7, 8, 9, 10, 11, 16, 17, 22, 31, 32, 33, 34, 35, 36, 37, 38, 43, 52, 53, 54, 55, 56, 57, 58,
 67, 68, 69, 70, 71, 72, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 94, 95, 96, 97,
 98, 99, 100, 101, 108, 109, 110, 111, 124, 125, 126, 127, 128, 129, 130, 131, 144, 145,
 146, 147, 154, 155, 156, 157, 158, 159, 160, 161, 163, 164, 165, 166, 179, 180, 181, 182,
 189, 190, 191, 192, 193, 194, 195, 196, 204, 205, 206, 207, 208, 209, 210, 211, 213, 214,
 215, 216, 219, 220, 221, 222, 223, 224, 233, 238, 239, 244, 245, 246, 251, 252, 253, 254}
```

In[ ]:=
```
{Length[positiveTrMM], Length[negativeTrMM]}
```

Out[ ]=
```
{136, 120}
```

In[ ]:=
```
base16[[#]] & /@ positiveTrMM;
{#[[2]], Tr[Transpose[#[[1]]].linTrans]} & /@ %
Select[%, #[[2]] ≠ 0 &]
linTransSymmetric = Table[Select[base16, #[[2]] == %[[j]][[1]] &], {j, 1, Length[%]}];
```

Out[ ]=
```
{{{0}, 0}, {{1}, 0}, {{2}, 0}, {{3}, 0}, {{0, 4}, 0}, {{0, 5}, 0}, {{0, 6}, 0}, {{0, 7}, -4},
 {{1, 4}, 0}, {{1, 5}, 0}, {{1, 6}, 0}, {{1, 7}, 0}, {{2, 4}, 0}, {{2, 5}, 0}, {{2, 6}, 0},
 {{2, 7}, 0}, {{3, 4}, -4}, {{3, 5}, 0}, {{3, 6}, 0}, {{3, 7}, 0}, {{0, 1, 4}, 0},
 {{0, 1, 5}, 0}, {{0, 1, 6}, 0}, {{0, 1, 7}, 0}, {{0, 2, 4}, 0}, {{0, 2, 5}, 0}, {{0, 2, 6}, 0},
 {{0, 2, 7}, 0}, {{0, 3, 4}, 0}, {{0, 3, 5}, 0}, {{0, 3, 6}, 0}, {{0, 3, 7}, 0},
 {{1, 2, 4}, 0}, {{1, 2, 5}, 0}, {{1, 2, 6}, 0}, {{1, 2, 7}, 0}, {{1, 3, 4}, 0},
 {{1, 3, 5}, 0}, {{1, 3, 6}, 0}, {{1, 3, 7}, 0}, {{2, 3, 4}, 0}, {{2, 3, 5}, 0},
 {{2, 3, 6}, 0}, {{2, 3, 7}, 0}, {{4, 5, 6}, -4}, {{4, 5, 7}, 0}, {{4, 6, 7}, 0},
 {{5, 6, 7}, 0}, {{0, 1, 2, 3}, 0}, {{0, 1, 4, 5}, 0}, {{0, 1, 4, 6}, 0}, {{0, 1, 4, 7}, 0},
 {{0, 1, 5, 6}, 0}, {{0, 1, 5, 7}, 0}, {{0, 1, 6, 7}, 0}, {{0, 2, 4, 5}, 0}, {{0, 2, 4, 6}, 0},
 {{0, 2, 4, 7}, 0}, {{0, 2, 5, 6}, 0}, {{0, 2, 5, 7}, 0}, {{0, 2, 6, 7}, 0}, {{0, 3, 4, 5}, 0},
 {{0, 3, 4, 6}, 0}, {{0, 3, 4, 7}, 4}, {{0, 3, 5, 6}, 0}, {{0, 3, 5, 7}, 0}, {{0, 3, 6, 7}, 0},
 {{1, 2, 4, 5}, 0}, {{1, 2, 4, 6}, 0}, {{1, 2, 4, 7}, 0}, {{1, 2, 5, 6}, 0}, {{1, 2, 5, 7}, 0},
 {{1, 2, 6, 7}, -4}, {{1, 3, 4, 5}, 0}, {{1, 3, 4, 6}, 0}, {{1, 3, 4, 7}, 0}, {{1, 3, 5, 6}, 0},
 {{1, 3, 5, 7}, 0}, {{1, 3, 6, 7}, 0}, {{2, 3, 4, 5}, 0}, {{2, 3, 4, 6}, 0}, {{2, 3, 4, 7}, 0},
 {{2, 3, 5, 6}, 0}, {{2, 3, 5, 7}, 0}, {{2, 3, 6, 7}, 0}, {{4, 5, 6, 7}, 0}, {{0, 1, 2, 4, 5}, 4},
 {{0, 1, 2, 4, 6}, 0}, {{0, 1, 2, 4, 7}, 0}, {{0, 1, 2, 5, 6}, 0}, {{0, 1, 2, 5, 7}, 0},
 {{0, 1, 2, 6, 7}, 0}, {{0, 1, 3, 4, 5}, 0}, {{0, 1, 3, 4, 6}, 0}, {{0, 1, 3, 4, 7}, 0},
 {{0, 1, 3, 5, 6}, 0}, {{0, 1, 3, 5, 7}, 0}, {{0, 1, 3, 6, 7}, 0}, {{0, 2, 3, 4, 5}, 0},
 {{0, 2, 3, 4, 6}, 0}, {{0, 2, 3, 4, 7}, 0}, {{0, 2, 3, 5, 6}, 0}, {{0, 2, 3, 5, 7}, 0},
 {{0, 2, 3, 6, 7}, 0}, {{0, 4, 5, 6, 7}, 4}, {{1, 2, 3, 4, 5}, 0}, {{1, 2, 3, 4, 6}, 0},
 {{1, 2, 3, 4, 7}, 0}, {{1, 2, 3, 5, 6}, 0}, {{1, 2, 3, 5, 7}, -4}, {{1, 2, 3, 6, 7}, 0},
 {{1, 4, 5, 6, 7}, 0}, {{2, 4, 5, 6, 7}, 0}, {{3, 4, 5, 6, 7}, 0}, {{0, 1, 2, 4, 5, 6}, 0},
 {{0, 1, 2, 4, 5, 7}, 0}, {{0, 1, 2, 4, 6, 7}, 0}, {{0, 1, 2, 5, 6, 7}, 0},
 {{0, 1, 3, 4, 5, 6}, 0}, {{0, 1, 3, 4, 5, 7}, 0}, {{0, 1, 3, 4, 6, 7}, 0},
 {{0, 1, 3, 5, 6, 7}, 0}, {{0, 2, 3, 4, 5, 6}, 0}, {{0, 2, 3, 4, 5, 7}, 0},
 {{0, 2, 3, 4, 6, 7}, 0}, {{0, 2, 3, 5, 6, 7}, 0}, {{1, 2, 3, 4, 5, 6}, 0},
 {{1, 2, 3, 4, 5, 7}, 0}, {{1, 2, 3, 4, 6, 7}, -4}, {{1, 2, 3, 5, 6, 7}, 0},
 {{0, 1, 2, 3, 4, 5, 6}, 0}, {{0, 1, 2, 3, 4, 5, 7}, 0}, {{0, 1, 2, 3, 4, 6, 7}, 0},
 {{0, 1, 2, 3, 5, 6, 7}, 0}, {{0, 1, 2, 3, 4, 5, 6, 7}, 0}, {{{0, 1, 2, 3, 4, 5, 6, 7, 8}}, 4}}
```

Out[ ]=
```
{{{0, 7}, -4}, {{3, 4}, -4}, {{4, 5, 6}, -4}, {{0, 3, 4, 7}, 4},
 {{1, 2, 6, 7}, -4}, {{0, 1, 2, 4, 5}, 4}, {{0, 4, 5, 6, 7}, 4},
 {{1, 2, 3, 5, 7}, -4}, {{1, 2, 3, 4, 6, 7}, -4}, {{{0, 1, 2, 3, 4, 5, 6, 7, 8}}, 4}}
```

In[ ]:=
```
linTransSymmetric[[1]]
```

Out[ ]=
```
{{{{-1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, -1, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0, 0,
    0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0,
    1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, -1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1}}, {0, 7}}}
```

In[ ]:=
```
base16[[#]] & /@ negativeTrMM;
{#[[2]], Tr[Transpose[#[[1]]].linTrans]} & /@ %
Select[%, #[[2]] ≠ 0 &]
linTransAntiSymmetric = Table[Select[base16, #[[2]] == %[[j]][[1]] &], {j, 1, Length[%]}];
```

Out[ ]=
```
{{{4}, 0}, {{5}, 0}, {{6}, 0}, {{7}, 0}, {{0, 1}, 0}, {{0, 2}, 0}, {{0, 3}, 0}, {{1, 2}, 0},
 {{1, 3}, 0}, {{2, 3}, 0}, {{4, 5}, 0}, {{4, 6}, 0}, {{4, 7}, 0}, {{5, 6}, 0}, {{5, 7}, 0},
 {{6, 7}, 0}, {{0, 1, 2}, 0}, {{0, 1, 3}, 0}, {{0, 2, 3}, 0}, {{0, 4, 5}, 0}, {{0, 4, 6}, 0},
 {{0, 4, 7}, 0}, {{0, 5, 6}, 0}, {{0, 5, 7}, 0}, {{0, 6, 7}, 0}, {{1, 2, 3}, 0}, {{1, 4, 5}, 0},
 {{1, 4, 6}, 0}, {{1, 4, 7}, 0}, {{1, 5, 6}, 0}, {{1, 5, 7}, 0}, {{1, 6, 7}, 0},
 {{2, 4, 5}, 0}, {{2, 4, 6}, 0}, {{2, 4, 7}, 0}, {{2, 5, 6}, 0}, {{2, 5, 7}, 0},
 {{2, 6, 7}, 0}, {{3, 4, 5}, 0}, {{3, 4, 6}, 0}, {{3, 4, 7}, 0}, {{3, 5, 6}, -4},
 {{3, 5, 7}, 0}, {{3, 6, 7}, 0}, {{0, 1, 2, 4}, 0}, {{0, 1, 2, 5}, 0}, {{0, 1, 2, 6}, -4},
 {{0, 1, 2, 7}, 0}, {{0, 1, 3, 4}, 0}, {{0, 1, 3, 5}, 0}, {{0, 1, 3, 6}, 0}, {{0, 1, 3, 7}, 0},
 {{0, 2, 3, 4}, 0}, {{0, 2, 3, 5}, 0}, {{0, 2, 3, 6}, 0}, {{0, 2, 3, 7}, 0}, {{0, 4, 5, 6}, 0},
 {{0, 4, 5, 7}, 0}, {{0, 4, 6, 7}, 0}, {{0, 5, 6, 7}, 0}, {{1, 2, 3, 4}, 0}, {{1, 2, 3, 5}, 0},
 {{1, 2, 3, 6}, 0}, {{1, 2, 3, 7}, 0}, {{1, 4, 5, 6}, 0}, {{1, 4, 5, 7}, 0}, {{1, 4, 6, 7}, 0},
 {{1, 5, 6, 7}, 0}, {{2, 4, 5, 6}, 0}, {{2, 4, 5, 7}, 0}, {{2, 4, 6, 7}, 0}, {{2, 5, 6, 7}, 0},
 {{3, 4, 5, 6}, 0}, {{3, 4, 5, 7}, 0}, {{3, 4, 6, 7}, 0}, {{3, 5, 6, 7}, 0}, {{0, 1, 2, 3, 4}, 0},
 {{0, 1, 2, 3, 5}, -4}, {{0, 1, 2, 3, 6}, 0}, {{0, 1, 2, 3, 7}, 0}, {{0, 1, 4, 5, 6}, 0},
 {{0, 1, 4, 5, 7}, 0}, {{0, 1, 4, 6, 7}, 0}, {{0, 1, 5, 6, 7}, 0}, {{0, 2, 4, 5, 6}, 0},
 {{0, 2, 4, 5, 7}, 0}, {{0, 2, 4, 6, 7}, 0}, {{0, 2, 5, 6, 7}, 0}, {{0, 3, 4, 5, 6}, 0},
 {{0, 3, 4, 5, 7}, 0}, {{0, 3, 4, 6, 7}, 0}, {{0, 3, 5, 6, 7}, 4}, {{1, 2, 4, 5, 6}, 0},
 {{1, 2, 4, 5, 7}, 4}, {{1, 2, 4, 6, 7}, 0}, {{1, 2, 5, 6, 7}, 0}, {{1, 3, 4, 5, 6}, 0},
 {{1, 3, 4, 5, 7}, 0}, {{1, 3, 4, 6, 7}, 0}, {{1, 3, 5, 6, 7}, 0}, {{2, 3, 4, 5, 6}, 0},
 {{2, 3, 4, 5, 7}, 0}, {{2, 3, 4, 6, 7}, 0}, {{2, 3, 5, 6, 7}, 0}, {{0, 1, 2, 3, 4, 5}, 0},
 {{0, 1, 2, 3, 4, 6}, -4}, {{0, 1, 2, 3, 4, 7}, 0}, {{0, 1, 2, 3, 5, 6}, 0},
 {{0, 1, 2, 3, 5, 7}, 0}, {{0, 1, 2, 3, 6, 7}, 0}, {{0, 1, 4, 5, 6, 7}, 0},
 {{0, 2, 4, 5, 6, 7}, 0}, {{0, 3, 4, 5, 6, 7}, 0}, {{1, 2, 4, 5, 6, 7}, 0},
 {{1, 3, 4, 5, 6, 7}, 0}, {{2, 3, 4, 5, 6, 7}, 0}, {{0, 1, 2, 4, 5, 6, 7}, 0},
 {{0, 1, 3, 4, 5, 6, 7}, 0}, {{0, 2, 3, 4, 5, 6, 7}, 0}, {{1, 2, 3, 4, 5, 6, 7}, 0}}
```

Out[ ]=
```
{{{3, 5, 6}, -4}, {{0, 1, 2, 6}, -4}, {{0, 1, 2, 3, 5}, -4},
 {{0, 3, 5, 6, 7}, 4}, {{1, 2, 4, 5, 7}, 4}, {{0, 1, 2, 3, 4, 6}, -4}}
```

In[ ]:=
```
{Length[linTransSymmetric], Length[linTransAntiSymmetric]}
```

Out[ ]=
```
{10, 6}
```

BASIS of 8 × 8 matrices :

In[∘]:=
```
tA = {}; Do[AppendTo[tA, {τ[j], {j}}], {j, 1, 7}]
Length[tA]
tAB = {}; Do[AppendTo[tAB, {τ[j].τ[k], {j, k}}], {j, 1, 6}, {k, j + 1, 7}]
Length[tAB]
tABC = {};
Do[AppendTo[tABC, {τ[j].τ[k].τ[h], {j, k, h}}], {j, 1, 5}, {k, j + 1, 6}, {h, k + 1, 7}];
Length[tABC]
```

Out[∘]=
```
7
```

Out[∘]=
```
21
```

Out[∘]=
```
35
```

In[∘]:=
```
tA[[1]]
```

Out[∘]=
```
{{{0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, 1, 0},
  {0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0},
  {0, 0, 1, 0, 0, 0, 0, 0}, {0, -1, 0, 0, 0, 0, 0, 0}, {-1, 0, 0, 0, 0, 0, 0, 0}}, {1}}
```

In[∘]:=
```
tA[[#]][[1]] == -Transpose[tA[[#]][[1]]] & /@ Range[Length[tA]]
```

Out[∘]=
```
{True, True, True, False, False, False, False}
```

In[∘]:=
```
bas64 = Flatten[{tA, tAB, tABC, {{Id, {64}}}}, 1]; Length[bas64]
```

Out[∘]=
```
64
```

In[∘]:=
```
determineIF8AntiSymmetric[m_] := Module[{t, tt, sum, res, r},
  t = m.τ[#] & /@ Range[0, 7];
  tt = Transpose[#] & /@ t;
  sum = FullSimplify[t[[#]] + tt[[#]]] & /@ Range[Length[t]];
  res = Union[Flatten[#]] & /@ sum;
  If[Length[#] > 1, Return[False]] & /@ res;
  r = Union[Flatten[res]];
  Return[r == {0}];
 ]
```

In[∘]:=
```
determineIF8AntiSymmetric[Zero8]
```

Out[∘]=
```
True
```

In[∘]:=
```
determineIF8AntiSymmetric[ID8]
```

Out[∘]=
```
False
```

In[ ]:=
```
find8AntiSymmetric = If[determineIF8AntiSymmetric[#[[1]]], #[[2]], ## &] & /@ bas64
```

Out[ ]=
```
{###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &,
 ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &,
 ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &,
 ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &,
 ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &, ###1 &}
```

In[ ]:=
```
anti = {};
Do[If[bas64[[k, 1]] == -Transpose[bas64[[k, 1]]],
  AppendTo[anti, {bas64[[k, 1]], {{k}, bas64[[k, 2]]}}] ], {k, 1, 64}];
Length[anti]
anti[[28]]
```

Out[ ]=
```
28
```

Out[ ]=
```
{{{0, 1, 0, 0, 0, 0, 0, 0}, {-1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, -1, 0, 0, 0, 0},
  {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, -1, 0}}, {{63}, {5, 6, 7}}}
```

In[ ]:=
```
symm = {};
Do[If[bas64[[k, 1]] == Transpose[bas64[[k, 1]]],
  AppendTo[symm, {bas64[[k, 1]], {{k}, bas64[[k, 2]]}}] ], {k, 1, 64}];
Length[symm]
symm[[%]]
```

Out[ ]=
```
35
```

Out[ ]=
```
{{{0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 1, 0, 0, 0, 0}, {1, 0, 0, 0, 0, 0, 0, 0},
  {0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 1, 0}, {0, 0, 0, 0, 0, 0, 0, 1},
  {0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0}}, {{59}, {3, 6, 7}}}
```

In[ ]:=
```
η64 = DiagonalMatrix[
  Table[FullSimplify[1/8 Tr[bas64[[A, 1]].bas64[[A, 1]]]], {A, 64}]];
Tr[η64]
```

Out[ ]=
$$7 + \frac{1}{8}\,\mathrm{Tr}[\mathrm{Id}.\mathrm{Id}]$$

In[ ]:=
```
(*(*(*(*(*(*(countTrace=
   Table[{A,B,FullSimplify[1/8 Tr[bas64[[A,1]].bas64[[B,1]]]] },
    {A,1, 64},{B,A, 64}])//MatrixForm*)*)*)*)*)*)
```

In[ ]:=
```
(*■*)
```

In[ ]:=
```
32 × 65
```
Out[ ]=
```
2080
```
In[ ]:=
```
(*Length[Flatten[countTrace,1]]*)
```
In[ ]:=
```
(*{Length[countTrace],Length[countTrace[[1]]],Length[countTrace[[1,1]]]}*)
```
In[ ]:=
```
(*{Length[countTrace],Length[countTrace[[2]]],Length[countTrace[[2,1]]]}*)
```
In[ ]:=
```
(*{Length[countTrace],Length[countTrace[[64]]],Length[countTrace[[64,1]]]}*)
```
In[ ]:=
```
(*{Length[Flatten[countTrace,1][[All,3]]],Count[Flatten[countTrace,1][[All,3]],0],
 Count[Flatten[countTrace,1][[All,3]],1],Count[Flatten[countTrace,1][[All,3]],-1]}*)
```
In[ ]:=
```
32 × 63
```
Out[ ]=
```
2016
```
In[ ]:=
```
anti = {};
Do[If[bas64[[k, 1]] == -Transpose[bas64[[k, 1]]],
  AppendTo[anti, {bas64[[k, 1]], {{k}, bas64[[k, 2]]}}] ], {k, 1, 64}];
Length[anti]
anti[[28]]
```
Out[ ]=
```
28
```
Out[ ]=
```
{{{0, 1, 0, 0, 0, 0, 0, 0}, {-1, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, -1, 0, 0, 0, 0},
  {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, -1, 0, 0}, {0, 0, 0, 0, 1, 0, 0, 0},
  {0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, -1, 0}}, {{63}, {5, 6, 7}}}
```
In[ ]:=
```
anti[[28, 1]]
```
Out[ ]=
```
{{0, 1, 0, 0, 0, 0, 0, 0}, {-1, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, -1, 0, 0, 0, 0}, {0, 0, 1, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, -1, 0, 0},
 {0, 0, 0, 0, 1, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 1}, {0, 0, 0, 0, 0, 0, -1, 0}}
```
In[ ]:=
```
anti[[28, 2]]
```
Out[ ]=
```
{{63}, {5, 6, 7}}
```
In[ ]:=
```
symm = {};
Do[If[bas64[[k, 1]] == Transpose[bas64[[k, 1]]],
  AppendTo[symm, {bas64[[k, 1]], {{k}, bas64[[k, 2]]}}] ], {k, 1, 64}];
Length[symm]
symm[[28]]
```
Out[ ]=
```
35
```
Out[ ]=
```
{{{-1, 0, 0, 0, 0, 0, 0, 0}, {0, 1, 0, 0, 0, 0, 0, 0}, {0, 0, -1, 0, 0, 0, 0, 0},
  {0, 0, 0, 1, 0, 0, 0, 0}, {0, 0, 0, 0, -1, 0, 0, 0}, {0, 0, 0, 0, 0, 1, 0, 0},
  {0, 0, 0, 0, 0, 0, -1, 0}, {0, 0, 0, 0, 0, 0, 0, 1}}, {{52}, {2, 5, 7}}}
```

Spinor Lagrangian

In[∘]:=
```
usegT16 = Table[FullSimplify[(T16^α[α1 - 1]), constraintVars], {α1, 1, Length[X]}];
```

In[∘]:=
```
useT16 = Table[FullSimplify[(T16^α[α1 - 1] /. ssgm4488), constraintVars] /.
    {Sqrt[e^(-2 a4[H x4])] → e^(-a4[H x4]), Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/3)] → e^(a4[H x4]) Sin[6 H x0]^(1/6),
     1/Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/3)] → 1/(e^(a4[H x4]) Sin[6 H x0]^(1/6))}, {α1, 1, Length[X]}] /.
  {1/Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/3)] → 1/(e^(a4[H x4]) Sin[6 H x0]^(1/6)), Sqrt[e^(2 a4[H x4])] → e^(a4[H x4])};
```

In[∘]:=
```
newuseT16 = Table[FullSimplify[(newT16^α[α1 - 1] /. ssgm4488), constraintVars] /.
    {Sqrt[e^(-2 a4[H x4])] → e^(-a4[H x4]), Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/3)] → e^(a4[H x4]) Sin[6 H x0]^(1/6),
     1/Sqrt[e^(2 a4[H x4]) Sin[6 H x0]^(1/3)] → 1/(e^(a4[H x4]) Sin[6 H x0]^(1/6))}, {α1, 1, Length[X]}] /.
  {1/Sqrt[e^(-2 a4[H x4]) Sin[6 H x0]^(1/3)] → 1/(e^(a4[H x4]) Sin[6 H x0]^(1/6)), Sqrt[e^(2 a4[H x4])] → e^(a4[H x4])};
```

In[∘]:=
```
Dimensions[useT16]
```

Out[∘]=
```
{8, 16, 16}
```

In[∘]:=
```
Det[MatrixMetric44]
```

Out[∘]=

$\text{Cos}[6\,H\,x0]^2$

In[∘]:=
```
useDSQRT = Cos[6 H x0]
```

Out[∘]=

$\text{Cos}[6\,H\,x0]$

In[∘]:=
```
ωmat /. sg /. ssgm4488 /. subsDefects;
(% /. {Sqrt[e^(2 a4[H x4])] → e^a4[H x4], Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) → e^a4[H x4] H Sin[6 H x0]^(1/6)}) -
    spinCoeffs // FullSimplify[#, constraintVars] & /. subsDefects /.
    {Sqrt[e^(2 a4[H x4])] → e^a4[H x4], Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) → e^a4[H x4] H Sin[6 H x0]^(1/6)} //
  FullSimplify[#, constraintVars] & /. subsDefects;
% // Flatten // Union
% // ExpandAll /. subsDefects /.
    {Sqrt[e^(2 a4[H x4])] → e^a4[H x4], Sqrt[e^(2 a4[H x4])] H Sin[6 H x0]^(1/6) → e^a4[H x4] H Sin[6 H x0]^(1/6)} /. subsDefects
% /. {a4[H x4] → π^4, Sin[6 H x0] → e^12}
```

Out[∘]=

$$\left\{0,\ e^{-a4[H\,x4]}\left(-1+e^{a4[H\,x4]}\sqrt{e^{-2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ -\left(\left(-e^{a4[H\,x4]}+\sqrt{e^{2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\right),\ \left(-e^{a4[H\,x4]}+\sqrt{e^{2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ e^{-a4[H\,x4]}\left(1-e^{a4[H\,x4]}\sqrt{e^{-2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ e^{-a4[H\,x4]}\left(-1+e^{a4[H\,x4]}\sqrt{e^{-2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ \left(-e^{a4[H\,x4]}+\sqrt{e^{2\,a4[H\,x4]}}\right)H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]\right\}$$

Out[∘]=

$$\left\{0,\ -e^{-a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}+\sqrt{e^{-2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ e^{a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}-\sqrt{e^{2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ -e^{a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}+\sqrt{e^{2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6},\ e^{-a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]-\sqrt{e^{-2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ -e^{-a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]+\sqrt{e^{-2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4],\ -e^{a4[H\,x4]}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]+\sqrt{e^{2\,a4[H\,x4]}}H\,\mathrm{Sin}[6\,H\,x0]^{1/6}\,a4'[H\,x4]\right\}$$

Out[∘]=

{0, 0, 0, 0, 0, 0, 0}

In[∘]:=
```
Protect[Q1, Q2]
```

Out[∘]=

{Q1, Q2}

In[∘]:=
```
(matTest = (Q1 * ID16 + Q2 * covariantDiffMatrix)) // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix}
Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q2\\
0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0\\
0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0\\
Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0\\
0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0\\
0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0\\
0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1
\end{pmatrix}$$

In[ ]:=
```
(newmatTest = similarityTransformation.(Q1 * ID16 + Q2 * covariantDiffMatrix).
    Transpose[similarityTransformation]) // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} Q1 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & Q1 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & Q1 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & Q1 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -Q2 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ Q2 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & Q2 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & Q2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & 0 & 0 & Q2 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 & -Q2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & Q1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & 0 & 0 & Q1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -Q2 & 0 & 0 & Q1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Q2 & 0 & 0 & 0 & 0 & Q1 \end{pmatrix}$$

In[ ]:=
```
Clear[Lg];
Lg[] :=
  √detgg * (Transpose[Ψ16].σ16.Sum[FullSimplify[(T16^α[α1 - 1] /. sg), constraintVars].
        (D[Ψ16, X[[α1]]] + (K/2 /. {K → 1}) * Sum[ωmat[[α1, a, b]] * SAB[[a, b]].matTest.Ψ16,
            {a, 1, 8}, {b, 1, 8}]), {α1, 1, Length[X]}] +
      (H * M) * Transpose[Ψ16].σ16.Ψ16) // Simplify[#, constraintVars] &
```

In[ ]:=
```
Clear[newLg];
newLg[] := √detgg *
    (Transpose[Ψ16].newσ16.Sum[FullSimplify[(newT16^α[α1 - 1] /. sg), constraintVars].
        (D[Ψ16, X[[α1]]] + (K/2 /. {K → 1}) * Sum[ωmat[[α1, a, b]] *
            similarityTransformation.SAB[[a, b]].Transpose[similarityTransformation].
             newmatTest.Ψ16, {a, 1, 8}, {b, 1, 8}]), {α1, 1, Length[X]}] +
      (H * M) * Transpose[Ψ16].newσ16.Ψ16) // Simplify[#, constraintVars] &
```

In[ ]:=
```
Block[{A1 = 1, B1 = 2},
 similarityTransformation.SAB⟦A1, B1⟧.Transpose[similarityTransformation] // MatrixForm]
```

Out[ ]//MatrixForm=

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\
0 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-\frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

In[ ]:=
```
Block[{A1 = 1, B1 = 2, m1, ms, m, j1, s1},
 m1 = ArrayFlatten[{{0, ID8}, {ID8, 0}}]; Print[m1 // MatrixForm];
 {s1, j1} = JordanDecomposition[m1];
 Print[m1 == s1.j1.Inverse[s1]];
 ms = Sqrt[j1];
 m = s1.ms.Inverse[s1];
 Print[m // MatrixForm];
 Print[Sqrt[m1] // MatrixForm];
 m.similarityTransformation.SAB⟦A1, B1⟧.
   Transpose[m.similarityTransformation] // MatrixForm]
```

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

True

$$\begin{pmatrix}
\frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} \\
\frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{2}+\frac{i}{2}
\end{pmatrix}$$

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} & 0 & 0 & 0 \\
0 & 0 & 0 & -\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-\frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{i}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

In[ ]:=
```
ωμIJ[1]
```

Out[ ]=
```
{{0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0},
 {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0}}
```

In[ ]:=
```
Clear[La];
La[] :=
 useDSQRT * (Transpose[Ψ16].σ16.Sum[useT16⟦α1⟧.(D[ Ψ16, X⟦α1⟧] + (K/2 /. {K → 1}) * Sum[
              ωμIJ[α1]⟦A1, B1⟧ * SAB⟦A1, B1⟧, {A1, 1, 8}, {B1, 1, 8}].matTest.Ψ16), {α1, 1,
         Length[X]}] + (H * M) * Transpose[Ψ16].σ16.Ψ16) // Simplify[#, constraintVars] &
```

NOT similarityTransformation . Ψ16 :

In[ ]:=
```
Clear[newLa];
newLa[] :=
 useDSQRT * (Transpose[Ψ16].newσ16.Sum[newuseT16⟦α1⟧.(D[ Ψ16, X⟦α1⟧] + (K/2 /. {K → 1}) *
            Sum[ωμIJ[α1]⟦A1, B1⟧ * (similarityTransformation.SAB⟦A1, B1⟧.Transpose[
                  similarityTransformation]), {A1, 1, 8}, {B1, 1, 8}].newmatTest.Ψ16),
        {α1, 1, Length[X]}] + (H * M) * Transpose[Ψ16].newσ16.Ψ16) //
  Simplify[#, constraintVars] &
```

```
In[•]:= (*testLa=La[]*)

In[•]:= (*testLg=Lg[];*)

In[•]:= (*D[testLa,a4[H x4]]//Flatten//Union*)
        (*D[testLa,a4′[H x4]]//(*Full*)Simplify[#,constraintVars]&//Flatten//Union*)

In[•]:= (*testLgm=testL/.sg/.ssgm4488//(*Full*)Simplify[#,constraintVars]&/.subsDefects*)

In[•]:= (*D[testLgm,a4[H x4]]
         D[testLgm,a4′[H x4]]//(*Full*)Simplify[#,constraintVars]&*)

In[•]:= Clear[Lj];
        Lj[j_] := useDSQRT * (((
                Transpose[Ψ16].σ16.useT16⟦1⟧.D[ Ψ16, X⟦1⟧] +

                  Transpose[Ψ16].σ16.useT16⟦5⟧.D[ Ψ16, X⟦5⟧] +
                  (K0/2) * Sum[(*useω⟦1,A1,B1⟧*)ωμIJ[1]⟦A1, B1⟧ × Transpose[Ψ16].σ16.
                      useT16⟦1⟧.SAB⟦A1, B1⟧.(base16⟦j, 1⟧).Ψ16, {A1, 1, 8}, {B1, 1, 8}]) +
              Transpose[Ψ16].σ16.useT16⟦5⟧.D[ Ψ16, X⟦5⟧] + (K4/2) * Sum[(*useω⟦5,A1,B1⟧*)
                ωμIJ[5]⟦A1, B1⟧ × Transpose[Ψ16].σ16.useT16⟦5⟧.SAB⟦A1, B1⟧.(base16⟦j, 1⟧).Ψ16,
                {A1, 1, 8}, {B1, 1, 8}]) +
            (H * M) * Transpose[Ψ16].σ16.Ψ16) // Simplify[#, constraintVars] &
```

In[∘]:=
```
Lj[92]
```

Out[∘]=
```
Cos[6 H x0] (-2 H M f16[2][x0, x4] × f16[6][x0, x4] -
   2 H M f16[3][x0, x4] × f16[7][x0, x4] + 2 H M f16[8][x0, x4] × f16[12][x0, x4] +
   2 H M f16[9][x0, x4] × f16[13][x0, x4] + 2 H M f16[10][x0, x4] × f16[14][x0, x4] +
   2 H M f16[11][x0, x4] × f16[15][x0, x4] + 2 f16[9][x0, x4] f16[0]^(0,1)[x0, x4] -
   2 f16[8][x0, x4] f16[1]^(0,1)[x0, x4] - 2 f16[11][x0, x4] f16[2]^(0,1)[x0, x4] +
   2 f16[10][x0, x4] f16[3]^(0,1)[x0, x4] - 2 f16[13][x0, x4] f16[4]^(0,1)[x0, x4] +
   2 f16[12][x0, x4] f16[5]^(0,1)[x0, x4] + 2 f16[15][x0, x4] f16[6]^(0,1)[x0, x4] -
   2 f16[14][x0, x4] f16[7]^(0,1)[x0, x4] - 2 f16[3][x0, x4] f16[10]^(0,1)[x0, x4] +
   2 f16[2][x0, x4] f16[11]^(0,1)[x0, x4] - 2 f16[5][x0, x4] f16[12]^(0,1)[x0, x4] +
   2 f16[4][x0, x4] f16[13]^(0,1)[x0, x4] + 2 f16[7][x0, x4] f16[14]^(0,1)[x0, x4] -
   2 f16[6][x0, x4] f16[15]^(0,1)[x0, x4] + Tan[6 H x0] f16[12][x0, x4] f16[0]^(1,0)[x0, x4] +
   Tan[6 H x0] f16[13][x0, x4] f16[1]^(1,0)[x0, x4] +
   Tan[6 H x0] f16[14][x0, x4] f16[2]^(1,0)[x0, x4] + Tan[6 H x0] f16[15][x0, x4]
    f16[3]^(1,0)[x0, x4] + Tan[6 H x0] f16[8][x0, x4] f16[4]^(1,0)[x0, x4] +
   Tan[6 H x0] f16[9][x0, x4] f16[5]^(1,0)[x0, x4] + Tan[6 H x0] f16[10][x0, x4]
    f16[6]^(1,0)[x0, x4] + Tan[6 H x0] f16[11][x0, x4] f16[7]^(1,0)[x0, x4] -
   Tan[6 H x0] f16[4][x0, x4] f16[8]^(1,0)[x0, x4] - Tan[6 H x0] f16[5][x0, x4]
    f16[9]^(1,0)[x0, x4] - Tan[6 H x0] f16[6][x0, x4] f16[10]^(1,0)[x0, x4] -
   Tan[6 H x0] f16[7][x0, x4] f16[11]^(1,0)[x0, x4] - f16[0][x0, x4]
    (2 H M f16[4][x0, x4] + 2 f16[9]^(0,1)[x0, x4] + Tan[6 H x0] f16[12]^(1,0)[x0, x4]) - f16[1][x0,
     x4] (2 H M f16[5][x0, x4] - 2 f16[8]^(0,1)[x0, x4] + Tan[6 H x0] f16[13]^(1,0)[x0, x4]) -
   Tan[6 H x0] f16[2][x0, x4] f16[14]^(1,0)[x0, x4] -
   Tan[6 H x0] f16[3][x0, x4] f16[15]^(1,0)[x0, x4])
```

In[∘]:=
```
detgg
```

Out[∘]=
```
g[0][0][x0, x4] × g[1][1][x0, x4] × g[2][2][x0, x4] × g[3][3][x0, x4] ×
 g[4][4][x0, x4] × g[5][5][x0, x4] × g[6][6][x0, x4] × g[7][7][x0, x4]
```

In[∘]:=
```
Clear[eL];
eL[Lagrangian_Symbol, detsqrt_] := Module[{L, t},
  L = Lagrangian[];
  t = Table[FullSimplify[1/detsqrt (D[L, f16[k][x0, x4]] - D[D[L, f16[k]^(1,0)[x0, x4]], x0] -
        D[D[L, f16[k]^(0,1)[x0, x4]], x4]), constraintVars], {k, 0, 15}];
  Return[t /. subsDefects];
 ]
```

eLa

In[∘]:=
```
(*Get[
  "2025-11-30-Q1-Q2-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-eLa.mx"];*)
```

In[∘]:=
```
eLa = eL[La, useDSQRT]
```

Out[∘]=
```
{H (-2 M f16[4][x0, x4] - 3 Q2 f16[5][x0, x4] - 6 f16[12][x0, x4] +
      (-3 Q2 f16[0][x0, x4] + (-1 + e^(-2 a4[H x4])) Q1 f16[9][x0, x4]) a4'[H x4]) -
```

```
 2 (f16[9]^(0,1)[x0, x4] + Tan[6 H x0] f16[12]^(1,0)[x0, x4]),
H (3 Q2 f16[4][x0, x4] - 2 M f16[5][x0, x4] - 6 f16[13][x0, x4] +
    (-2 Q2 f16[1][x0, x4] + Q1 f16[8][x0, x4]) a4′[H x4] -
    e^(-2 a4[H x4]) (Q2 f16[1][x0, x4] + Q1 f16[8][x0, x4]) a4′[H x4]) +
 2 (f16[8]^(0,1)[x0, x4] - Tan[6 H x0] f16[13]^(1,0)[x0, x4]),
H (-2 M f16[6][x0, x4] + 3 Q2 f16[7][x0, x4] - 6 f16[14][x0, x4] -
    e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[2][x0, x4] a4′[H x4]) +
 2 (f16[11]^(0,1)[x0, x4] - Tan[6 H x0] f16[14]^(1,0)[x0, x4]),
H (-3 Q2 f16[6][x0, x4] - 2 M f16[7][x0, x4] - 6 f16[15][x0, x4] -
    e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[3][x0, x4] a4′[H x4]) -
 2 (f16[10]^(0,1)[x0, x4] + Tan[6 H x0] f16[15]^(1,0)[x0, x4]),
H (-2 M f16[0][x0, x4] + 3 Q2 f16[1][x0, x4] - 6 f16[8][x0, x4] -
    e^(-2 a4[H x4]) (3 Q2 f16[4][x0, x4] + (-1 + e^(2 a4[H x4])) Q1 f16[13][x0, x4]) a4′[H x4]) +
 2 (f16[13]^(0,1)[x0, x4] - Tan[6 H x0] f16[8]^(1,0)[x0, x4]),
H (-3 Q2 f16[0][x0, x4] - 2 M f16[1][x0, x4] - 6 f16[9][x0, x4] -
    e^(-2 a4[H x4]) ((2 + e^(2 a4[H x4])) Q2 f16[5][x0, x4] - (-1 + e^(2 a4[H x4])) Q1 f16[12][x0, x4]) a4′[H x4]) -
 2 (f16[12]^(0,1)[x0, x4] + Tan[6 H x0] f16[9]^(1,0)[x0, x4]),
H (-2 M f16[2][x0, x4] - 3 Q2 f16[3][x0, x4] - 6 f16[10][x0, x4] -
    e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[6][x0, x4] a4′[H x4]) -
 2 (f16[15]^(0,1)[x0, x4] + Tan[6 H x0] f16[10]^(1,0)[x0, x4]),
H (3 Q2 f16[2][x0, x4] - 2 M f16[3][x0, x4] - 6 f16[11][x0, x4] -
    e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[7][x0, x4] a4′[H x4]) +
 2 (f16[14]^(0,1)[x0, x4] - Tan[6 H x0] f16[11]^(1,0)[x0, x4]),
H (6 f16[4][x0, x4] + 2 M f16[12][x0, x4] - 3 Q2 f16[13][x0, x4] +
    e^(-2 a4[H x4]) ((-1 + e^(2 a4[H x4])) Q1 f16[1][x0, x4] + 3 Q2 f16[8][x0, x4]) a4′[H x4]) -
 2 f16[1]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[4]^(1,0)[x0, x4],
H (6 f16[5][x0, x4] + 3 Q2 f16[12][x0, x4] + 2 M f16[13][x0, x4] +
    (-Q1 f16[0][x0, x4] + Q2 f16[9][x0, x4]) a4′[H x4] +
    e^(-2 a4[H x4]) (Q1 f16[0][x0, x4] + 2 Q2 f16[9][x0, x4]) a4′[H x4]) +
 2 (f16[0]^(0,1)[x0, x4] + Tan[6 H x0] f16[5]^(1,0)[x0, x4]),
H (6 f16[6][x0, x4] + 2 M f16[14][x0, x4] + 3 Q2 f16[15][x0, x4] +
    e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[10][x0, x4] a4′[H x4]) +
 2 (f16[3]^(0,1)[x0, x4] + Tan[6 H x0] f16[6]^(1,0)[x0, x4]),
H (6 f16[7][x0, x4] - 3 Q2 f16[14][x0, x4] + 2 M f16[15][x0, x4] +
    e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[11][x0, x4] a4′[H x4]) -
 2 f16[2]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[7]^(1,0)[x0, x4],
H (6 f16[0][x0, x4] + 2 M f16[8][x0, x4] + 3 Q2 f16[9][x0, x4] +
    ((Q1 - e^(-2 a4[H x4]) Q1) f16[5][x0, x4] + 3 Q2 f16[12][x0, x4]) a4′[H x4]) +
 2 (f16[5]^(0,1)[x0, x4] + Tan[6 H x0] f16[0]^(1,0)[x0, x4]),
H (6 f16[1][x0, x4] - 3 Q2 f16[8][x0, x4] + 2 M f16[9][x0, x4] +
    e^(-2 a4[H x4]) (Q1 f16[4][x0, x4] + Q2 f16[13][x0, x4]) a4′[H x4] +
    (-Q1 f16[4][x0, x4] + 2 Q2 f16[13][x0, x4]) a4′[H x4]) -
 2 f16[4]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[1]^(1,0)[x0, x4],
```

```
 H (6 f16[2][x0, x4] + 2 M f16[10][x0, x4] - 3 Q2 f16[11][x0, x4] +
      ⅇ^(-2 a4[H x4]) (1 + 2 ⅇ^(2 a4[H x4])) Q2 f16[14][x0, x4] a4′[H x4]) -
  2 f16[7]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[2]^(1,0)[x0, x4],
 H (6 f16[3][x0, x4] + 3 Q2 f16[10][x0, x4] + 2 M f16[11][x0, x4] +
      ⅇ^(-2 a4[H x4]) (2 + ⅇ^(2 a4[H x4])) Q2 f16[15][x0, x4] a4′[H x4]) +
  2 (f16[6]^(0,1)[x0, x4] + Tan[6 H x0] f16[3]^(1,0)[x0, x4])}
```

In[∘]:=
```
Length[eLa]
```

Out[∘]=

16

In[∘]:=
```
DumpSave[ToString[header <> "eLa.mx"], eLa];
```

In[∘]:=
```
Print[ToString[header <> "eLa.mx"]]
```

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-eLa.mx

In[∘]:=
```
"2025-12-07-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-mmM4p-fix 3-eLa.mx"
```

Out[∘]=

2025-12-07-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-mmM4p-fix 3-eLa.mx

In[∘]:=
```
(*Get["2025-11-29-Q1-Q28-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-mmM4p-fix
   3-eLa.mx"]*)
```

In[∘]:=
```
(*newLa[]*)
```

In[∘]:=
```
enewLa = eL[newLa, useDSQRT]
```

Out[∘]=

```
{H (-2 M f16[2][x0, x4] - 3 Q2 f16[3][x0, x4] - 6 f16[6][x0, x4] +
      (-3 Q2 f16[0][x0, x4] + (-1 + ⅇ^(-2 a4[H x4])) Q1 f16[5][x0, x4]) a4′[H x4]) -
  2 (f16[5]^(0,1)[x0, x4] + Tan[6 H x0] f16[6]^(1,0)[x0, x4]),
 H (3 Q2 f16[2][x0, x4] - 2 M f16[3][x0, x4] - 6 f16[7][x0, x4] +
      (-2 Q2 f16[1][x0, x4] + Q1 f16[4][x0, x4]) a4′[H x4] -
      ⅇ^(-2 a4[H x4]) (Q2 f16[1][x0, x4] + Q1 f16[4][x0, x4]) a4′[H x4]) +
  2 (f16[4]^(0,1)[x0, x4] - Tan[6 H x0] f16[7]^(1,0)[x0, x4]),
 H (-2 M f16[0][x0, x4] + 3 Q2 f16[1][x0, x4] - 6 f16[4][x0, x4] -
      ⅇ^(-2 a4[H x4]) (3 Q2 f16[2][x0, x4] + (-1 + ⅇ^(2 a4[H x4])) Q1 f16[7][x0, x4]) a4′[H x4]) +
  2 (f16[7]^(0,1)[x0, x4] - Tan[6 H x0] f16[4]^(1,0)[x0, x4]),
 -ⅇ^(-2 a4[H x4]) H (2 Q2 f16[3][x0, x4] + Q1 f16[6][x0, x4]) a4′[H x4] -
  H (3 Q2 f16[0][x0, x4] + 2 M f16[1][x0, x4] + 6 f16[5][x0, x4] +
      (Q2 f16[3][x0, x4] - Q1 f16[6][x0, x4]) a4′[H x4]) -
  2 (f16[6]^(0,1)[x0, x4] + Tan[6 H x0] f16[5]^(1,0)[x0, x4]),
 H (6 f16[2][x0, x4] + 2 M f16[6][x0, x4] - 3 Q2 f16[7][x0, x4] +
      ⅇ^(-2 a4[H x4]) ((-1 + ⅇ^(2 a4[H x4])) Q1 f16[1][x0, x4] + 3 Q2 f16[4][x0, x4]) a4′[H x4]) -
  2 f16[1]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[2]^(1,0)[x0, x4],
 H (6 f16[3][x0, x4] + 3 Q2 f16[6][x0, x4] + 2 M f16[7][x0, x4] +
      (-Q1 f16[0][x0, x4] + Q2 f16[5][x0, x4]) a4′[H x4] +
      ⅇ^(-2 a4[H x4]) (Q1 f16[0][x0, x4] + 2 Q2 f16[5][x0, x4]) a4′[H x4]) +
  2 (f16[0]^(0,1)[x0, x4] + Tan[6 H x0] f16[3]^(1,0)[x0, x4]),
 H (6 f16[0][x0, x4] + 2 M f16[4][x0, x4] + 3 Q2 f16[5][x0, x4] +
      ((Q1 - ⅇ^(-2 a4[H x4]) Q1) f16[3][x0, x4] + 3 Q2 f16[6][x0, x4]) a4′[H x4]) +
```

```
  2 (f16[3]^(0,1)[x0, x4] + Tan[6 H x0] f16[0]^(1,0)[x0, x4]),
 H (6 f16[1][x0, x4] - 3 Q2 f16[4][x0, x4] + 2 M f16[5][x0, x4] +
     e^(-2 a4[H x4]) (Q1 f16[2][x0, x4] + Q2 f16[7][x0, x4]) a4'[H x4] +
     (-Q1 f16[2][x0, x4] + 2 Q2 f16[7][x0, x4]) a4'[H x4]) -
  2 f16[2]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[1]^(1,0)[x0, x4],
 H (-2 M f16[10][x0, x4] + 3 Q2 f16[11][x0, x4] - 6 f16[14][x0, x4] -
     e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[8][x0, x4] a4'[H x4]) +
  2 (f16[13]^(0,1)[x0, x4] - Tan[6 H x0] f16[14]^(1,0)[x0, x4]),
 H (-3 Q2 f16[10][x0, x4] - 2 M f16[11][x0, x4] - 6 f16[15][x0, x4] -
     e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[9][x0, x4] a4'[H x4]) -
  2 (f16[12]^(0,1)[x0, x4] + Tan[6 H x0] f16[15]^(1,0)[x0, x4]),
 H (-2 M f16[8][x0, x4] - 3 Q2 f16[9][x0, x4] - 6 f16[12][x0, x4] -
     e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[10][x0, x4] a4'[H x4]) -
  2 (f16[15]^(0,1)[x0, x4] + Tan[6 H x0] f16[12]^(1,0)[x0, x4]),
 H (3 Q2 f16[8][x0, x4] - 2 M f16[9][x0, x4] - 6 f16[13][x0, x4] -
     e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[11][x0, x4] a4'[H x4]) +
  2 (f16[14]^(0,1)[x0, x4] - Tan[6 H x0] f16[13]^(1,0)[x0, x4]),
 H (6 f16[10][x0, x4] + 2 M f16[14][x0, x4] + 3 Q2 f16[15][x0, x4] +
     e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[12][x0, x4] a4'[H x4]) +
  2 (f16[9]^(0,1)[x0, x4] + Tan[6 H x0] f16[10]^(1,0)[x0, x4]),
 H (6 f16[11][x0, x4] - 3 Q2 f16[14][x0, x4] + 2 M f16[15][x0, x4] +
     e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[13][x0, x4] a4'[H x4]) -
  2 f16[8]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[11]^(1,0)[x0, x4],
 H (6 f16[8][x0, x4] + 2 M f16[12][x0, x4] - 3 Q2 f16[13][x0, x4] +
     e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[14][x0, x4] a4'[H x4]) -
  2 f16[11]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[8]^(1,0)[x0, x4],
 H (6 f16[9][x0, x4] + 3 Q2 f16[12][x0, x4] + 2 M f16[13][x0, x4] +
     e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[15][x0, x4] a4'[H x4]) +
  2 (f16[10]^(0,1)[x0, x4] + Tan[6 H x0] f16[9]^(1,0)[x0, x4])}
```

In[∘]:=
```
DumpSave[ToString[header <> "enewLa.mx"], enewLa];
```

In[∘]:=
```
Print[ToString[header <> "enewLa.mx"]]
```

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-enewLa.mx

In[∘]:=
```
"2025-12-07-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-mmM4p-fix 3-enewLa.mx"
```

Out[∘]=

2025-12-07-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-mmM4p-fix 3-enewLa.mx

eLazt

In[∘]:=
```
(*Get["2025-11-30-Q1-Q2-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix
    3-eLazt.mx"];*)
```

In[ ]:=

```
time1 = Now
AbsoluteTiming[
 eLazt = (2 Sqrt[Sin[z]])/(6 * H) * eLa /. sfψ16Aa /. sx0x4 // FullSimplify[#, constraintVars] &]
Now - time1
```

Out[ ]=

Tue 9 Dec 2025 05:55:14 GMT-8

Out[ ]=

$$\{43.452,$$

$$\Big\{\frac{1}{3}\left(-2\,M\,Z[4][z,t]-3\,Q2\,Z[5][z,t]+\left(-3\,Q2\,Z[0][z,t]+\left(-1+e^{-2\,a4[t]}\right)Q1\,Z[9][z,t]\right)a4'[t]-2\left(Z[9]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[12]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(3\,Q2\,Z[4][z,t]-2\,M\,Z[5][z,t]-e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)Z[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,Z[8][z,t]\right)a4'[t]+2\left(Z[8]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,Z[13]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-2\,M\,Z[6][z,t]+3\,Q2\,Z[7][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,Z[2][z,t]\,a4'[t]+2\left(Z[11]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,Z[14]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-3\,Q2\,Z[6][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,Z[3][z,t]\,a4'[t]-2\left(M\,Z[7][z,t]+Z[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[15]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-2\,M\,Z[0][z,t]+3\,Q2\,Z[1][z,t]-e^{-2\,a4[t]}\left(3\,Q2\,Z[4][z,t]+\left(-1+e^{2\,a4[t]}\right)Q1\,Z[13][z,t]\right)a4'[t]+2\left(Z[13]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,Z[8]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-3\,Q2\,Z[0][z,t]+e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)Z[5][z,t]+2\,Q1\,\mathrm{Sinh}[a4[t]]\,Z[12][z,t]\right)a4'[t]-2\left(M\,Z[1][z,t]+Z[12]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[9]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-2\,M\,Z[2][z,t]-3\,Q2\,Z[3][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,Z[6][z,t]\,a4'[t]-2\left(Z[15]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[10]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(3\,Q2\,Z[2][z,t]-2\,M\,Z[3][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,Z[7][z,t]\,a4'[t]+2\left(Z[14]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,Z[11]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(2\,M\,Z[12][z,t]-3\,Q2\,Z[13][z,t]+e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,Z[1][z,t]+3\,Q2\,Z[8][z,t]\right)a4'[t]-2\left(Z[1]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,Z[4]^{(1,0)}[z,t]\right)\right),$$

$$Q2\,Z[12][z,t]-\frac{1}{3}e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,Z[0][z,t]+Q2\left(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)Z[9][z,t]\right)a4'[t]+\frac{2}{3}\left(M\,Z[13][z,t]+Z[0]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[5]^{(1,0)}[z,t]\right),$$

$$\frac{1}{3}\left(2\,M\,Z[14][z,t]+3\,Q2\,Z[15][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,Z[10][z,t]\,a4'[t]+2\left(Z[3]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,Z[6]^{(1,0)}[z,t]\right)\right),$$

```
 1/3 (-3 Q2 Z[14][z, t] + 2 M Z[15][z, t] + (2 + e^(-2 a4[t])) Q2 Z[11][z, t] a4'[t] -
    2 (Z[2]^(0,1)[z, t] - 6 Tan[z] Z[7]^(1,0)[z, t])),
 1/3 (2 M Z[8][z, t] + 3 Q2 Z[9][z, t] + (2 e^(-a4[t]) Q1 Sinh[a4[t]] Z[5][z, t] + 3 Q2 Z[12][z, t]) a4'[
      t] + 2 (Z[5]^(0,1)[z, t] + 6 Tan[z] Z[0]^(1,0)[z, t])), 1/3 (-3 Q2 Z[8][z, t] + 2 M Z[9][z, t] +
    e^(-a4[t]) (-2 Q1 Sinh[a4[t]] Z[4][z, t] + Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) Z[13][z, t]) a4'[t] -
    2 (Z[4]^(0,1)[z, t] - 6 Tan[z] Z[1]^(1,0)[z, t])),
 1/3 (2 M Z[10][z, t] - 3 Q2 Z[11][z, t] + (2 + e^(-2 a4[t])) Q2 Z[14][z, t] a4'[t] -
    2 (Z[7]^(0,1)[z, t] - 6 Tan[z] Z[2]^(1,0)[z, t])),
 1/3 (3 Q2 Z[10][z, t] + 2 M Z[11][z, t] + e^(-2 a4[t]) (2 + e^(2 a4[t])) Q2 Z[15][z, t] a4'[t] +
    2 (Z[6]^(0,1)[z, t] + 6 Tan[z] Z[3]^(1,0)[z, t]))}}
```

Out[•]=

43.4525573 s

In[•]:=
```
DumpSave[ToString[header <> "eLazt.mx"], eLazt];
```

In[•]:=
```
Print[ToString[header <> "eLazt.mx"]]
```

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-eLazt.mx

In[•]:=
```
"2025-12-03A-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-eLazt.mx"
```

Out[•]=

2025-12-03A-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-eLazt.mx

In[•]:=
```
enewLa
```

Out[•]=

```
{H (-2 M f16[2][x0, x4] - 3 Q2 f16[3][x0, x4] - 6 f16[6][x0, x4] +
      (-3 Q2 f16[0][x0, x4] + (-1 + e^(-2 a4[H x4])) Q1 f16[5][x0, x4]) a4'[H x4]) -
   2 (f16[5]^(0,1)[x0, x4] + Tan[6 H x0] f16[6]^(1,0)[x0, x4]),
  H (3 Q2 f16[2][x0, x4] - 2 M f16[3][x0, x4] - 6 f16[7][x0, x4] +
      (-2 Q2 f16[1][x0, x4] + Q1 f16[4][x0, x4]) a4'[H x4] -
      e^(-2 a4[H x4]) (Q2 f16[1][x0, x4] + Q1 f16[4][x0, x4]) a4'[H x4]) +
   2 (f16[4]^(0,1)[x0, x4] - Tan[6 H x0] f16[7]^(1,0)[x0, x4]),
  H (-2 M f16[0][x0, x4] + 3 Q2 f16[1][x0, x4] - 6 f16[4][x0, x4] -
      e^(-2 a4[H x4]) (3 Q2 f16[2][x0, x4] + (-1 + e^(2 a4[H x4])) Q1 f16[7][x0, x4]) a4'[H x4]) +
   2 (f16[7]^(0,1)[x0, x4] - Tan[6 H x0] f16[4]^(1,0)[x0, x4]),
  -e^(-2 a4[H x4]) H (2 Q2 f16[3][x0, x4] + Q1 f16[6][x0, x4]) a4'[H x4] -
   H (3 Q2 f16[0][x0, x4] + 2 M f16[1][x0, x4] + 6 f16[5][x0, x4] +
      (Q2 f16[3][x0, x4] - Q1 f16[6][x0, x4]) a4'[H x4]) -
   2 (f16[6]^(0,1)[x0, x4] + Tan[6 H x0] f16[5]^(1,0)[x0, x4]),
  H (6 f16[2][x0, x4] + 2 M f16[6][x0, x4] - 3 Q2 f16[7][x0, x4] +
      e^(-2 a4[H x4]) ((-1 + e^(2 a4[H x4])) Q1 f16[1][x0, x4] + 3 Q2 f16[4][x0, x4]) a4'[H x4]) -
   2 f16[1]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[2]^(1,0)[x0, x4],
  H (6 f16[3][x0, x4] + 3 Q2 f16[6][x0, x4] + 2 M f16[7][x0, x4] +
      (-Q1 f16[0][x0, x4] + Q2 f16[5][x0, x4]) a4'[H x4] +
```

```
      e^(-2 a4[H x4]) (Q1 f16[0][x0, x4] + 2 Q2 f16[5][x0, x4]) a4′[H x4]) +
  2 (f16[0]^(0,1)[x0, x4] + Tan[6 H x0] f16[3]^(1,0)[x0, x4]),
H (6 f16[0][x0, x4] + 2 M f16[4][x0, x4] + 3 Q2 f16[5][x0, x4] +
      ((Q1 - e^(-2 a4[H x4]) Q1) f16[3][x0, x4] + 3 Q2 f16[6][x0, x4]) a4′[H x4]) +
  2 (f16[3]^(0,1)[x0, x4] + Tan[6 H x0] f16[0]^(1,0)[x0, x4]),
H (6 f16[1][x0, x4] - 3 Q2 f16[4][x0, x4] + 2 M f16[5][x0, x4] +
      e^(-2 a4[H x4]) (Q1 f16[2][x0, x4] + Q2 f16[7][x0, x4]) a4′[H x4] +
      (-Q1 f16[2][x0, x4] + 2 Q2 f16[7][x0, x4]) a4′[H x4]) -
  2 f16[2]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[1]^(1,0)[x0, x4],
H (-2 M f16[10][x0, x4] + 3 Q2 f16[11][x0, x4] - 6 f16[14][x0, x4] -
      e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[8][x0, x4] a4′[H x4]) +
  2 (f16[13]^(0,1)[x0, x4] - Tan[6 H x0] f16[14]^(1,0)[x0, x4]),
H (-3 Q2 f16[10][x0, x4] - 2 M f16[11][x0, x4] - 6 f16[15][x0, x4] -
      e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[9][x0, x4] a4′[H x4]) -
  2 (f16[12]^(0,1)[x0, x4] + Tan[6 H x0] f16[15]^(1,0)[x0, x4]),
H (-2 M f16[8][x0, x4] - 3 Q2 f16[9][x0, x4] - 6 f16[12][x0, x4] -
      e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[10][x0, x4] a4′[H x4]) -
  2 (f16[15]^(0,1)[x0, x4] + Tan[6 H x0] f16[12]^(1,0)[x0, x4]),
H (3 Q2 f16[8][x0, x4] - 2 M f16[9][x0, x4] - 6 f16[13][x0, x4] -
      e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[11][x0, x4] a4′[H x4]) +
  2 (f16[14]^(0,1)[x0, x4] - Tan[6 H x0] f16[13]^(1,0)[x0, x4]),
H (6 f16[10][x0, x4] + 2 M f16[14][x0, x4] + 3 Q2 f16[15][x0, x4] +
      e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[12][x0, x4] a4′[H x4]) +
  2 (f16[9]^(0,1)[x0, x4] + Tan[6 H x0] f16[10]^(1,0)[x0, x4]),
H (6 f16[11][x0, x4] - 3 Q2 f16[14][x0, x4] + 2 M f16[15][x0, x4] +
      e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[13][x0, x4] a4′[H x4]) -
  2 f16[8]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[11]^(1,0)[x0, x4],
H (6 f16[8][x0, x4] + 2 M f16[12][x0, x4] - 3 Q2 f16[13][x0, x4] +
      e^(-2 a4[H x4]) (1 + 2 e^(2 a4[H x4])) Q2 f16[14][x0, x4] a4′[H x4]) -
  2 f16[11]^(0,1)[x0, x4] + 2 Tan[6 H x0] f16[8]^(1,0)[x0, x4],
H (6 f16[9][x0, x4] + 3 Q2 f16[12][x0, x4] + 2 M f16[13][x0, x4] +
      e^(-2 a4[H x4]) (2 + e^(2 a4[H x4])) Q2 f16[15][x0, x4] a4′[H x4]) +
  2 (f16[10]^(0,1)[x0, x4] + Tan[6 H x0] f16[9]^(1,0)[x0, x4])}
```

In[ ]:=

```
time1 = Now
AbsoluteTiming[enewLazt =
  2 Sqrt[Sin[z]] / (6 * H) * enewLa /. snewfψ16Aa /. sx0x4 // FullSimplify[#, constraintVars] &]
Now - time1
```

Out[ ]=

Tue 9 Dec 2025 05:55:58 GMT-8

Out[ ]=

```
{43.2427,
```

```
{1/3 (-2 M nZ[2][z, t] - 3 Q2 nZ[3][z, t] + (-3 Q2 nZ[0][z, t] + (-1 + e^(-2 a4[t])) Q1 nZ[5][z, t])
    a4'[t] - 2 (nZ[5]^(0,1)[z, t] + 6 Tan[z] nZ[6]^(1,0)[z, t])),
 1/3 (3 Q2 nZ[2][z, t] - 2 M nZ[3][z, t] - e^(-a4[t]) (Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[1][z, t] -
      2 Q1 Sinh[a4[t]] nZ[4][z, t]) a4'[t] + 2 (nZ[4]^(0,1)[z, t] - 6 Tan[z] nZ[7]^(1,0)[z, t])),
 1/3 (-2 M nZ[0][z, t] + 3 Q2 nZ[1][z, t] - e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t])
    a4'[t] + 2 (nZ[7]^(0,1)[z, t] - 6 Tan[z] nZ[4]^(1,0)[z, t])), 1/3 (-3 Q2 nZ[0][z, t] +
   e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t])
    a4'[t] - 2 (M nZ[1][z, t] + nZ[6]^(0,1)[z, t] + 6 Tan[z] nZ[5]^(1,0)[z, t])),
 1/3 (2 M nZ[6][z, t] - 3 Q2 nZ[7][z, t] + e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t])
    a4'[t] - 2 (nZ[1]^(0,1)[z, t] - 6 Tan[z] nZ[2]^(1,0)[z, t])), Q2 nZ[6][z, t] -
  1/3 e^(-a4[t]) (2 Q1 Sinh[a4[t]] nZ[0][z, t] + Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[5][z, t])
   a4'[t] + 2/3 (M nZ[7][z, t] + nZ[0]^(0,1)[z, t] + 6 Tan[z] nZ[3]^(1,0)[z, t]),
 1/3 (2 M nZ[4][z, t] + 3 Q2 nZ[5][z, t] + (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t])
    a4'[t] + 2 (nZ[3]^(0,1)[z, t] + 6 Tan[z] nZ[0]^(1,0)[z, t])),
 1/3 (-3 Q2 nZ[4][z, t] + 2 M nZ[5][z, t] + e^(-a4[t])
    (-2 Q1 Sinh[a4[t]] nZ[2][z, t] + Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[7][z, t]) a4'[t] -
   2 (nZ[2]^(0,1)[z, t] - 6 Tan[z] nZ[1]^(1,0)[z, t])),
 1/3 (-2 M nZ[10][z, t] + 3 Q2 nZ[11][z, t] - e^(-2 a4[t]) (1 + 2 e^(2 a4[t])) Q2 nZ[8][z, t] a4'[t] +
   2 (nZ[13]^(0,1)[z, t] - 6 Tan[z] nZ[14]^(1,0)[z, t])),
 1/3 (-3 Q2 nZ[10][z, t] - e^(-2 a4[t]) (2 + e^(2 a4[t])) Q2 nZ[9][z, t] a4'[t] -
   2 (M nZ[11][z, t] + nZ[12]^(0,1)[z, t] + 6 Tan[z] nZ[15]^(1,0)[z, t])),
 1/3 (-2 M nZ[8][z, t] - 3 Q2 nZ[9][z, t] - e^(-2 a4[t]) (2 + e^(2 a4[t])) Q2 nZ[10][z, t] a4'[t] -
   2 (nZ[15]^(0,1)[z, t] + 6 Tan[z] nZ[12]^(1,0)[z, t])),
 1/3 (3 Q2 nZ[8][z, t] - 2 M nZ[9][z, t] - e^(-2 a4[t]) (1 + 2 e^(2 a4[t])) Q2 nZ[11][z, t] a4'[t] +
   2 (nZ[14]^(0,1)[z, t] - 6 Tan[z] nZ[13]^(1,0)[z, t])),
 1/3 (2 M nZ[14][z, t] + 3 Q2 nZ[15][z, t] + e^(-2 a4[t]) (2 + e^(2 a4[t])) Q2 nZ[12][z, t] a4'[t] +
   2 (nZ[9]^(0,1)[z, t] + 6 Tan[z] nZ[10]^(1,0)[z, t])),
 1/3 (-3 Q2 nZ[14][z, t] + 2 M nZ[15][z, t] + (2 + e^(-2 a4[t])) Q2 nZ[13][z, t] a4'[t] -
   2 (nZ[8]^(0,1)[z, t] - 6 Tan[z] nZ[11]^(1,0)[z, t])),
```

$$\frac{1}{3}\left(2\,M\,nZ[12][z,t]-3\,Q2\,nZ[13][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t]-2\left(nZ[11]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(3\,Q2\,nZ[12][z,t]+2\,M\,nZ[13][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]+2\left(nZ[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]\right)\right)\Big\}\Big\}$$

Out[•]=

43.2471959 s

In[•]:=
```
DumpSave[ToString[header <> "enewLazt.mx"], enewLazt];
```

In[•]:=
```
Print[ToString[header <> "enewLazt.mx"]]
```

2025-12-09-newPARSERWaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-enewLazt.mx

In[•]:=
```
"2025-12-03A-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-enewLazt.mx"
```

Out[•]=

2025-12-03A-WaveFunctionUniverse-4+4-Einstein-Lovelock-Nash-L9i-fix 3-enewLazt.mx

In[•]:=
```
enewLazt // Column
```

Out[•]=

$$\frac{1}{3}\left(-2\,M\,nZ[2][z,t]-3\,Q2\,nZ[3][z,t]+\left(-3\,Q2\,nZ[0][z,t]+\left(-1+e^{-2\,a4[t]}\right)Q1\,nZ[5][z,t]\right)a4'[t]-2\left(nZ[5]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(3\,Q2\,nZ[2][z,t]-2\,M\,nZ[3][z,t]-e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\right)a4'[t]+2\left(nZ[4]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-2\,M\,nZ[0][z,t]+3\,Q2\,nZ[1][z,t]-e^{-2\,a4[t]}\left(3\,Q2\,nZ[2][z,t]+\left(-1+e^{2\,a4[t]}\right)Q1\,nZ[7][z,t]\right)a4'[t]+2\left(nZ[7]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[0][z,t]+e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[3][z,t]+2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z,t]\right)a4'[t]-2\left(M\,nZ[1][z,t]+nZ[6]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[5]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(2\,M\,nZ[6][z,t]-3\,Q2\,nZ[7][z,t]+e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,nZ[1][z,t]+3\,Q2\,nZ[4][z,t]\right)a4'[t]-2\left(nZ[1]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\right)\right)$$

$$Q2\,nZ[6][z,t]-\frac{1}{3}e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t]+Q2\left(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[5][z,t]\right)a4'[t]+\frac{2}{3}\left(M\,nZ[7][z,t]+nZ[0]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$\frac{1}{3}\left(2\,M\,nZ[4][z,t]+3\,Q2\,nZ[5][z,t]+\left(2\,e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]+3\,Q2\,nZ[6][z,t]\right)a4'[t]+2\left(nZ[3]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[4][z,t]+2\,M\,nZ[5][z,t]+e^{-a4[t]}\left(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]+Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[7][z,t]\right)a4'[t]-2\left(nZ[2]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-2\,M\,nZ[10][z,t]+3\,Q2\,nZ[11][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+2\left(nZ[13]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[10][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]-2\left(M\,nZ[11][z,t]+nZ[12]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-2\,M\,nZ[8][z,t]-3\,Q2\,nZ[9][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]-2\left(nZ[15]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(3\,Q2\,nZ[8][z,t]-2\,M\,nZ[9][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+2\left(nZ[14]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(2\,M\,nZ[14][z,t]+3\,Q2\,nZ[15][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t]\,a4'[t]+2\left(nZ[9]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[14][z,t]+2\,M\,nZ[15][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[13][z,t]\,a4'[t]-2\left(nZ[8]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(2\,M\,nZ[12][z,t]-3\,Q2\,nZ[13][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t]-2\left(nZ[11]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]\right)\right)$$

$$\frac{1}{3}\left(3\,Q2\,nZ[12][z,t]+2\,M\,nZ[13][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]+2\left(nZ[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]\right)\right)$$

In[ ]:=
```
Clear[resolveWithRemainder];
resolveWithRemainder[xy_, wrt_List] := Module[{b},
  b = D[xy, #] & /@ wrt;
  Return[Flatten[{b, {xy - b.wrt}}]];]
```

In[ ]:=
```
resolved18 = resolveWithRemainder[#, {M, a4'[t], Tan[z]}] & /@ Take[enewLazt, 8]
```

Out[ ]=

$$\Big\{\Big\{-\frac{2}{3}\,nZ[2][z,t],\ \frac{1}{3}\left(-3\,Q2\,nZ[0][z,t]+\left(-1+e^{-2\,a4[t]}\right)Q1\,nZ[5][z,t]\right),$$
$$-4\,nZ[6]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[2][z,t]-\frac{1}{3}\left(-3\,Q2\,nZ[0][z,t]+\left(-1+e^{-2\,a4[t]}\right)Q1\,nZ[5][z,t]\right)a4'[t]+4\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]+\frac{1}{3}\left(-2\,M\,nZ[2][z,t]-3\,Q2\,nZ[3][z,t]+\left(-3\,Q2\,nZ[0][z,t]+\left(-1+e^{-2\,a4[t]}\right)Q1\,nZ[5][z,t]\right)a4'[t]-2\left(nZ[5]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\right)\right)\Big\},$$
$$\Big\{-\frac{2}{3}\,nZ[3][z,t],\ -\frac{1}{3}\,e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\right),$$
$$-4\,nZ[7]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[3][z,t]+\frac{1}{3}\,e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\right)a4'[t]+4\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]+\frac{1}{3}\left(3\,Q2\,nZ[2][z,t]-2\,M\,nZ[3][z,t]-e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]]\right)nZ[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\right)a4'[t]+2\left(nZ[4]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]\right)\right)\Big\},$$

```
{-2/3 nZ[0][z, t], -1/3 e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t]),
 -4 nZ[4]^(1,0)[z, t],
 2/3 M nZ[0][z, t] + 1/3 e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t]) a4'[t] +
  4 Tan[z] nZ[4]^(1,0)[z, t] + 1/3 (-2 M nZ[0][z, t] + 3 Q2 nZ[1][z, t] -
      e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t]) a4'[t] +
      2 (nZ[7]^(0,1)[z, t] - 6 Tan[z] nZ[4]^(1,0)[z, t]))}, {-2/3 nZ[1][z, t],
 1/3 e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t]),
 -4 nZ[5]^(1,0)[z, t], 2/3 M nZ[1][z, t] -
  1/3 e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t])
   a4'[t] + 4 Tan[z] nZ[5]^(1,0)[z, t] + 1/3 (-3 Q2 nZ[0][z, t] +
      e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t])
       a4'[t] - 2 (M nZ[1][z, t] + nZ[6]^(0,1)[z, t] + 6 Tan[z] nZ[5]^(1,0)[z, t]))},
{2/3 nZ[6][z, t], 1/3 e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t]),
 4 nZ[2]^(1,0)[z, t],
 -2/3 M nZ[6][z, t] - 1/3 e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t]) a4'[t] -
  4 Tan[z] nZ[2]^(1,0)[z, t] + 1/3 (2 M nZ[6][z, t] - 3 Q2 nZ[7][z, t] +
      e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t]) a4'[t] -
      2 (nZ[1]^(0,1)[z, t] - 6 Tan[z] nZ[2]^(1,0)[z, t]))}, {2/3 nZ[7][z, t],
 -1/3 e^(-a4[t]) (2 Q1 Sinh[a4[t]] nZ[0][z, t] + Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[5][z, t]),
 4 nZ[3]^(1,0)[z, t],
 Q2 nZ[6][z, t] - 2/3 M nZ[7][z, t] - 4 Tan[z] nZ[3]^(1,0)[z, t] +
  2/3 (M nZ[7][z, t] + nZ[0]^(0,1)[z, t] + 6 Tan[z] nZ[3]^(1,0)[z, t])},
{2/3 nZ[4][z, t], 1/3 (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t]),
 4 nZ[0]^(1,0)[z, t],
 -2/3 M nZ[4][z, t] - 1/3 (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t]) a4'[t] -
  4 Tan[z] nZ[0]^(1,0)[z, t] + 1/3 (2 M nZ[4][z, t] + 3 Q2 nZ[5][z, t] +
      (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t]) a4'[t] +
```

$$2\left(nZ[3]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\right)\Big)\Big\},\ \Big\{\frac{2}{3}\,nZ[5][z,t],$$
$$\frac{1}{3}\,e^{-a4[t]}\,(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]+Q2\,(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[7][z,t]),$$
$$4\,nZ[1]^{(1,0)}[z,t],\ -\frac{2}{3}\,M\,nZ[5][z,t]-\frac{1}{3}\,e^{-a4[t]}$$
$$(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]+Q2\,(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[7][z,t])\,a4'[t]-$$
$$4\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]+\frac{1}{3}\Big(-3\,Q2\,nZ[4][z,t]+2\,M\,nZ[5][z,t]+$$
$$e^{-a4[t]}\,(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]+Q2\,(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[7][z,t])$$
$$a4'[t]-2\left(nZ[2]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\Big)\Big\}\Big\}$$

In[ ]:=
```
resolved28 = resolveWithRemainder[#, {M, a4'[t], Tan[z]}] & /@ Take[enewLazt, -8]
```

Out[ ]=

$$\Big\{\Big\{-\frac{2}{3}\,nZ[10][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t],\ -4\,nZ[14]^{(1,0)}[z,t],$$
$$\frac{2}{3}\,M\,nZ[10][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]+$$
$$\frac{1}{3}\Big(-2\,M\,nZ[10][z,t]+3\,Q2\,nZ[11][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+$$
$$2\left(nZ[13]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]\right)\Big)\Big\},$$
$$\Big\{-\frac{2}{3}\,nZ[11][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t],\ -4\,nZ[15]^{(1,0)}[z,t],$$
$$\frac{2}{3}\,M\,nZ[11][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]+$$
$$\frac{1}{3}\Big(-3\,Q2\,nZ[10][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]-$$
$$2\left(M\,nZ[11][z,t]+nZ[12]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]\right)\Big)\Big\},$$
$$\Big\{-\frac{2}{3}\,nZ[8][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t],\ -4\,nZ[12]^{(1,0)}[z,t],$$
$$\frac{2}{3}\,M\,nZ[8][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]+$$
$$\frac{1}{3}\Big(-2\,M\,nZ[8][z,t]-3\,Q2\,nZ[9][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]-$$
$$2\left(nZ[15]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]\right)\Big)\Big\},$$
$$\Big\{-\frac{2}{3}\,nZ[9][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t],\ -4\,nZ[13]^{(1,0)}[z,t],$$
$$\frac{2}{3}\,M\,nZ[9][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]+$$
$$\frac{1}{3}\Big(3\,Q2\,nZ[8][z,t]-2\,M\,nZ[9][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+$$
$$2\left(nZ[14]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]\right)\Big)\Big\},$$
$$\Big\{\frac{2}{3}\,nZ[14][z,t],\ \frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t],\ 4\,nZ[10]^{(1,0)}[z,t],$$

$$-\frac{2}{3} M\, nZ[14][z, t] - \frac{1}{3} e^{-2 a4[t]} \left(2 + e^{2 a4[t]}\right) Q2\, nZ[12][z, t]\, a4'[t] - 4 \operatorname{Tan}[z]\, nZ[10]^{(1,0)}[z, t] + \frac{1}{3} \left(2 M\, nZ[14][z, t] + 3 Q2\, nZ[15][z, t] + e^{-2 a4[t]} \left(2 + e^{2 a4[t]}\right) Q2\, nZ[12][z, t]\, a4'[t] + 2 \left(nZ[9]^{(0,1)}[z, t] + 6 \operatorname{Tan}[z]\, nZ[10]^{(1,0)}[z, t]\right)\right)\Big\},$$

$$\Big\{\frac{2}{3} nZ[15][z, t], \frac{1}{3} \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[13][z, t], 4\, nZ[11]^{(1,0)}[z, t], -\frac{2}{3} M\, nZ[15][z, t] - \frac{1}{3} \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[13][z, t]\, a4'[t] - 4 \operatorname{Tan}[z]\, nZ[11]^{(1,0)}[z, t] + \frac{1}{3} \left(-3 Q2\, nZ[14][z, t] + 2 M\, nZ[15][z, t] + \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[13][z, t]\, a4'[t] - 2 \left(nZ[8]^{(0,1)}[z, t] - 6 \operatorname{Tan}[z]\, nZ[11]^{(1,0)}[z, t]\right)\right)\Big\},$$

$$\Big\{\frac{2}{3} nZ[12][z, t], \frac{1}{3} \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[14][z, t], 4\, nZ[8]^{(1,0)}[z, t], -\frac{2}{3} M\, nZ[12][z, t] - \frac{1}{3} \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[14][z, t]\, a4'[t] - 4 \operatorname{Tan}[z]\, nZ[8]^{(1,0)}[z, t] + \frac{1}{3} \left(2 M\, nZ[12][z, t] - 3 Q2\, nZ[13][z, t] + \left(2 + e^{-2 a4[t]}\right) Q2\, nZ[14][z, t]\, a4'[t] - 2 \left(nZ[11]^{(0,1)}[z, t] - 6 \operatorname{Tan}[z]\, nZ[8]^{(1,0)}[z, t]\right)\right)\Big\},$$

$$\Big\{\frac{2}{3} nZ[13][z, t], \frac{1}{3} e^{-2 a4[t]} \left(2 + e^{2 a4[t]}\right) Q2\, nZ[15][z, t], 4\, nZ[9]^{(1,0)}[z, t], -\frac{2}{3} M\, nZ[13][z, t] - \frac{1}{3} e^{-2 a4[t]} \left(2 + e^{2 a4[t]}\right) Q2\, nZ[15][z, t]\, a4'[t] - 4 \operatorname{Tan}[z]\, nZ[9]^{(1,0)}[z, t] + \frac{1}{3} \left(3 Q2\, nZ[12][z, t] + 2 M\, nZ[13][z, t] + e^{-2 a4[t]} \left(2 + e^{2 a4[t]}\right) Q2\, nZ[15][z, t]\, a4'[t] + 2 \left(nZ[10]^{(0,1)}[z, t] + 6 \operatorname{Tan}[z]\, nZ[9]^{(1,0)}[z, t]\right)\right)\Big\}\Big\}$$

In[ ]:=
```
snZzt = Flatten[{nZ[#][z, t] → nZ[#] & /@ Range[0, 15]}]
```

Out[ ]=
```
{nZ[0][z, t] → nZ[0], nZ[1][z, t] → nZ[1], nZ[2][z, t] → nZ[2], nZ[3][z, t] → nZ[3],
 nZ[4][z, t] → nZ[4], nZ[5][z, t] → nZ[5], nZ[6][z, t] → nZ[6], nZ[7][z, t] → nZ[7],
 nZ[8][z, t] → nZ[8], nZ[9][z, t] → nZ[9], nZ[10][z, t] → nZ[10], nZ[11][z, t] → nZ[11],
 nZ[12][z, t] → nZ[12], nZ[13][z, t] → nZ[13], nZ[14][z, t] → nZ[14], nZ[15][z, t] → nZ[15]}
```

In[ ]:=
```
resolved18;
% /. {(*nZ→xxx,*)Times → imes, Power → imes, Plus → qid, Derivative → der(*,Rational→rat*)};
Flatten[#] & /@ %;
Union[#] & /@ %;
Table[Block[{r1, s1, q1, t1},
   s1 = %⟦j1⟧;
   r1 = Length[s1];
   t1 = Table[Block[{qq, rr, tt},
      qq = Length[s1⟦k1⟧];
      tt = Table[If[Head[s1⟦k1⟧⟦n1⟧] == Symbol || Head[Head[s1⟦k1⟧⟦n1⟧]] == Symbol,
         {s1⟦k1⟧, s1⟦k1⟧⟦n1⟧}(*,##[]&*)], {n1, 1, qq}];
       tt], {k1, 1, r1}];
   t1 ], {j1, 1, Length[%]}];
Union[Flatten[#]] & /@ %
Complement[#, {t, z, a4[t], Tan[z], Sinh[a4[t]], Cosh[a4[t]]}] & /@ %
(var12 = Union[Drop[#, 2]] /. snZzt & /@ %) // Column
Union[Flatten[%⟦1⟧]]
```

Out[ ]=
```
{{5, 6, t, z, a4[t], nZ[5], nZ[6], Tan[z], nZ[0][z, t], nZ[2][z, t], nZ[3][z, t], nZ[5][z, t]},
 {4, 7, t, z, a4[t], Cosh[a4[t]], nZ[4], nZ[7], Sinh[a4[t]],
  Tan[z], nZ[1][z, t], nZ[2][z, t], nZ[3][z, t], nZ[4][z, t]},
 {4, 7, t, z, a4[t], nZ[4], nZ[7], Tan[z], nZ[0][z, t], nZ[1][z, t], nZ[2][z, t], nZ[7][z, t]},
 {5, 6, t, z, a4[t], Cosh[a4[t]], nZ[5], nZ[6], Sinh[a4[t]],
  Tan[z], nZ[0][z, t], nZ[1][z, t], nZ[3][z, t], nZ[6][z, t]},
 {1, 2, t, z, a4[t], nZ[1], nZ[2], Tan[z], nZ[1][z, t], nZ[4][z, t], nZ[6][z, t], nZ[7][z, t]},
 {0, 3, t, z, a4[t], Cosh[a4[t]], nZ[0], nZ[3], Sinh[a4[t]],
  Tan[z], nZ[0][z, t], nZ[5][z, t], nZ[6][z, t], nZ[7][z, t]},
 {0, 3, t, z, a4[t], nZ[0], nZ[3], Sinh[a4[t]], Tan[z], nZ[3][z, t], nZ[4][z, t],
  nZ[5][z, t], nZ[6][z, t]}, {1, 2, t, z, a4[t], Cosh[a4[t]], nZ[1], nZ[2],
  Sinh[a4[t]], Tan[z], nZ[2][z, t], nZ[4][z, t], nZ[5][z, t], nZ[7][z, t]}}
```

Out[ ]=
```
{{5, 6, nZ[5], nZ[6], nZ[0][z, t], nZ[2][z, t], nZ[3][z, t], nZ[5][z, t]},
 {4, 7, nZ[4], nZ[7], nZ[1][z, t], nZ[2][z, t], nZ[3][z, t], nZ[4][z, t]},
 {4, 7, nZ[4], nZ[7], nZ[0][z, t], nZ[1][z, t], nZ[2][z, t], nZ[7][z, t]},
 {5, 6, nZ[5], nZ[6], nZ[0][z, t], nZ[1][z, t], nZ[3][z, t], nZ[6][z, t]},
 {1, 2, nZ[1], nZ[2], nZ[1][z, t], nZ[4][z, t], nZ[6][z, t], nZ[7][z, t]},
 {0, 3, nZ[0], nZ[3], nZ[0][z, t], nZ[5][z, t], nZ[6][z, t], nZ[7][z, t]},
 {0, 3, nZ[0], nZ[3], nZ[3][z, t], nZ[4][z, t], nZ[5][z, t], nZ[6][z, t]},
 {1, 2, nZ[1], nZ[2], nZ[2][z, t], nZ[4][z, t], nZ[5][z, t], nZ[7][z, t]}}
```

Out[ ]=
```
{nZ[5], nZ[6], nZ[0], nZ[2], nZ[3], nZ[5]}
{nZ[4], nZ[7], nZ[1], nZ[2], nZ[3], nZ[4]}
{nZ[4], nZ[7], nZ[0], nZ[1], nZ[2], nZ[7]}
{nZ[5], nZ[6], nZ[0], nZ[1], nZ[3], nZ[6]}
{nZ[1], nZ[2], nZ[1], nZ[4], nZ[6], nZ[7]}
{nZ[0], nZ[3], nZ[0], nZ[5], nZ[6], nZ[7]}
{nZ[0], nZ[3], nZ[3], nZ[4], nZ[5], nZ[6]}
{nZ[1], nZ[2], nZ[2], nZ[4], nZ[5], nZ[7]}
```

Out[•]=

```
{nZ[0], nZ[1], nZ[2], nZ[3], nZ[4], nZ[5], nZ[6], nZ[7]}
```

In[•]:=

```
resolved28;
% /. {(*nZ→xxx,*)Times → imes, Power → imes, Plus → qid, Derivative → der(*,Rational→rat*)};
Flatten[#] & /@ %;
Union[#] & /@ %;
Table[Block[{r1, s1, q1, t1},
   s1 = %[[j1]];
   r1 = Length[s1];
   t1 = Table[Block[{qq, rr, tt},
      qq = Length[s1[[k1]]];
      tt = Table[If[Head[s1[[k1]][[n1]]] == Symbol || Head[Head[s1[[k1]][[n1]]]] == Symbol,
         {s1[[k1]], s1[[k1]][[n1]]}(*,##[]&*)], {n1, 1, qq}];
       tt], {k1, 1, r1}];
   t1 ], {j1, 1, Length[%]}];
Union[Flatten[#]] & /@ %
Complement[#, {t, z, a4[t], Tan[z]}] & /@ %
(var22 = Union[Drop[#, 2]] /. snZzt & /@ %) // Column
Union[Flatten[%[[1]]]]
```

Out[•]=

```
{{13, 14, t, z, a4[t], nZ[13], nZ[14], Tan[z], nZ[8][z, t], nZ[10][z, t], nZ[11][z, t]},
 {12, 15, t, z, a4[t], nZ[12], nZ[15], Tan[z], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t]},
 {12, 15, t, z, a4[t], nZ[12], nZ[15], Tan[z], nZ[8][z, t], nZ[9][z, t], nZ[10][z, t]},
 {13, 14, t, z, a4[t], nZ[13], nZ[14], Tan[z], nZ[8][z, t], nZ[9][z, t], nZ[11][z, t]},
 {9, 10, t, z, a4[t], nZ[9], nZ[10], Tan[z], nZ[12][z, t], nZ[14][z, t], nZ[15][z, t]},
 {8, 11, t, z, a4[t], nZ[8], nZ[11], Tan[z], nZ[13][z, t], nZ[14][z, t], nZ[15][z, t]},
 {8, 11, t, z, a4[t], nZ[8], nZ[11], Tan[z], nZ[12][z, t], nZ[13][z, t], nZ[14][z, t]},
 {9, 10, t, z, a4[t], nZ[9], nZ[10], Tan[z], nZ[12][z, t], nZ[13][z, t], nZ[15][z, t]}}
```

Out[•]=

```
{{13, 14, nZ[13], nZ[14], nZ[8][z, t], nZ[10][z, t], nZ[11][z, t]},
 {12, 15, nZ[12], nZ[15], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t]},
 {12, 15, nZ[12], nZ[15], nZ[8][z, t], nZ[9][z, t], nZ[10][z, t]},
 {13, 14, nZ[13], nZ[14], nZ[8][z, t], nZ[9][z, t], nZ[11][z, t]},
 {9, 10, nZ[9], nZ[10], nZ[12][z, t], nZ[14][z, t], nZ[15][z, t]},
 {8, 11, nZ[8], nZ[11], nZ[13][z, t], nZ[14][z, t], nZ[15][z, t]},
 {8, 11, nZ[8], nZ[11], nZ[12][z, t], nZ[13][z, t], nZ[14][z, t]},
 {9, 10, nZ[9], nZ[10], nZ[12][z, t], nZ[13][z, t], nZ[15][z, t]}}
```

Out[•]=

```
{nZ[13], nZ[14], nZ[8], nZ[10], nZ[11]}
{nZ[12], nZ[15], nZ[9], nZ[10], nZ[11]}
{nZ[12], nZ[15], nZ[8], nZ[9], nZ[10]}
{nZ[13], nZ[14], nZ[8], nZ[9], nZ[11]}
{nZ[9], nZ[10], nZ[12], nZ[14], nZ[15]}
{nZ[8], nZ[11], nZ[13], nZ[14], nZ[15]}
{nZ[8], nZ[11], nZ[12], nZ[13], nZ[14]}
{nZ[9], nZ[10], nZ[12], nZ[13], nZ[15]}
```

Out[•]=

```
{nZ[8], nZ[9], nZ[10], nZ[11], nZ[12], nZ[13], nZ[14], nZ[15]}
```

18

In[ ]:=
```
enewLazt18 = Take[enewLazt, 8]
```

Out[ ]=

$$\Big\{\frac{1}{3}\Big(-2\,M\,nZ[2][z,t]-3\,Q2\,nZ[3][z,t]+\big(-3\,Q2\,nZ[0][z,t]+\big(-1+e^{-2\,a4[t]}\big)\,Q1\,nZ[5][z,t]\big)\,a4'[t]-2\,\big(nZ[5]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\big)\Big),\ \frac{1}{3}\Big(3\,Q2\,nZ[2][z,t]-2\,M\,nZ[3][z,t]-e^{-a4[t]}\,(Q2\,(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[1][z,t]-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t])\,a4'[t]+2\,\big(nZ[4]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]\big)\Big),$$

$$\frac{1}{3}\Big(-2\,M\,nZ[0][z,t]+3\,Q2\,nZ[1][z,t]-e^{-2\,a4[t]}\,\big(3\,Q2\,nZ[2][z,t]+\big(-1+e^{2\,a4[t]}\big)\,Q1\,nZ[7][z,t]\big)\,a4'[t]+2\,\big(nZ[7]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t]\big)\Big),\ \frac{1}{3}\Big(-3\,Q2\,nZ[0][z,t]+e^{-a4[t]}\,(Q2\,(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[3][z,t]+2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z,t])\,a4'[t]-2\,\big(M\,nZ[1][z,t]+nZ[6]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[5]^{(1,0)}[z,t]\big)\Big),$$

$$\frac{1}{3}\Big(2\,M\,nZ[6][z,t]-3\,Q2\,nZ[7][z,t]+e^{-2\,a4[t]}\,\big(\big(-1+e^{2\,a4[t]}\big)\,Q1\,nZ[1][z,t]+3\,Q2\,nZ[4][z,t]\big)\,a4'[t]-2\,\big(nZ[1]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\big)\Big),\ Q2\,nZ[6][z,t]-\frac{1}{3}\,e^{-a4[t]}\,(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t]+Q2\,(-3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[5][z,t])\,a4'[t]+\frac{2}{3}\,\big(M\,nZ[7][z,t]+nZ[0]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\big),$$

$$\frac{1}{3}\Big(2\,M\,nZ[4][z,t]+3\,Q2\,nZ[5][z,t]+\big(2\,e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]+3\,Q2\,nZ[6][z,t]\big)\,a4'[t]+2\,\big(nZ[3]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\big)\Big),\ \frac{1}{3}\Big(-3\,Q2\,nZ[4][z,t]+2\,M\,nZ[5][z,t]+e^{-a4[t]}\,(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]+Q2\,(3\,\mathrm{Cosh}[a4[t]]+\mathrm{Sinh}[a4[t]])\,nZ[7][z,t])\,a4'[t]-2\,\big(nZ[2]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\big)\Big)\Big\}$$

In[ ]:=
```
Dimensions[resolved18]
```

Out[ ]=

{8, 4}

In[ ]:=
```
resolved18 // Column
```

Out[ ]=

$$\Big\{-\frac{2}{3}\,nZ[2][z,t],\ \frac{1}{3}\,\big(-3\,Q2\,nZ[0][z,t]+\big(-1+e^{-2\,a4[t]}\big)\,Q1\,nZ[5][z,t]\big),\ -4\,nZ[6]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[2][z,t]-\frac{1}{3}\,\big(-3\,Q2\,nZ[0][z,t]+\big(-1+e^{-2\,a4[t]}\big)\,Q1\,nZ[5][z,t]\big)\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]+\frac{1}{3}\Big(-2\,M\,nZ[2][z,t]-3\,Q2\,nZ[3][z,t]+\big(-3\,Q2\,nZ[0][z,t]+\big(-1+e^{-2\,a4[t]}\big)\,Q1\,nZ[5][z,t]\big)\,a4'[t]-2\,\big(nZ[5]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\big)\Big)\Big\}$$

```
{-2/3 nZ[3][z, t],
 -1/3 e^(-a4[t]) (Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[1][z, t] - 2 Q1 Sinh[a4[t]] nZ[4][z, t]),
 -4 nZ[7]^(1,0)[z, t], 2/3 M nZ[3][z, t] +
  1/3 e^(-a4[t]) (Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[1][z, t] - 2 Q1 Sinh[a4[t]] nZ[4][z, t]) a4'[t] +
  4 Tan[z] nZ[7]^(1,0)[z, t] + 1/3 (3 Q2 nZ[2][z, t] - 2 M nZ[3][z, t] -
      e^(-a4[t]) (Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[1][z, t] - 2 Q1 Sinh[a4[t]] nZ[4][z, t]) a4'[t] +
      2 (nZ[4]^(0,1)[z, t] - 6 Tan[z] nZ[7]^(1,0)[z, t]))}
{-2/3 nZ[0][z, t], -1/3 e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t]),
 -4 nZ[4]^(1,0)[z, t], 2/3 M nZ[0][z, t] +
  1/3 e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t]) a4'[t] + 4 Tan[z] nZ[4]^(1,0)[z, t] +
  1/3 (-2 M nZ[0][z, t] + 3 Q2 nZ[1][z, t] - e^(-2 a4[t]) (3 Q2 nZ[2][z, t] + (-1 + e^(2 a4[t])) Q1 nZ[7][z, t])
       a4'[t] + 2 (nZ[7]^(0,1)[z, t] - 6 Tan[z] nZ[4]^(1,0)[z, t]))}
{-2/3 nZ[1][z, t],
 1/3 e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t]),
 -4 nZ[5]^(1,0)[z, t], 2/3 M nZ[1][z, t] -
  1/3 e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t]) a4'[t] +
  4 Tan[z] nZ[5]^(1,0)[z, t] + 1/3 (-3 Q2 nZ[0][z, t] +
      e^(-a4[t]) (Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[3][z, t] + 2 Q1 Sinh[a4[t]] nZ[6][z, t])
       a4'[t] - 2 (M nZ[1][z, t] + nZ[6]^(0,1)[z, t] + 6 Tan[z] nZ[5]^(1,0)[z, t]))}
{2/3 nZ[6][z, t], 1/3 e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t]),
 4 nZ[2]^(1,0)[z, t], -2/3 M nZ[6][z, t] -
  1/3 e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t]) a4'[t] - 4 Tan[z] nZ[2]^(1,0)[z, t] +
  1/3 (2 M nZ[6][z, t] - 3 Q2 nZ[7][z, t] + e^(-2 a4[t]) ((-1 + e^(2 a4[t])) Q1 nZ[1][z, t] + 3 Q2 nZ[4][z, t])
       a4'[t] - 2 (nZ[1]^(0,1)[z, t] - 6 Tan[z] nZ[2]^(1,0)[z, t]))}
{2/3 nZ[7][z, t],
 -1/3 e^(-a4[t]) (2 Q1 Sinh[a4[t]] nZ[0][z, t] + Q2 (-3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[5][z, t]),
 4 nZ[3]^(1,0)[z, t], Q2 nZ[6][z, t] - 2/3 M nZ[7][z, t] - 4 Tan[z] nZ[3]^(1,0)[z, t] +
  2/3 (M nZ[7][z, t] + nZ[0]^(0,1)[z, t] + 6 Tan[z] nZ[3]^(1,0)[z, t])}
{2/3 nZ[4][z, t], 1/3 (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t]),
 4 nZ[0]^(1,0)[z, t], -2/3 M nZ[4][z, t] -
  1/3 (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t]) a4'[t] - 4 Tan[z] nZ[0]^(1,0)[z, t] +
  1/3 (2 M nZ[4][z, t] + 3 Q2 nZ[5][z, t] + (2 e^(-a4[t]) Q1 Sinh[a4[t]] nZ[3][z, t] + 3 Q2 nZ[6][z, t])
       a4'[t] + 2 (nZ[3]^(0,1)[z, t] + 6 Tan[z] nZ[0]^(1,0)[z, t]))}
```

```
{2/3 nZ[5][z, t],
 1/3 e^(-a4[t]) (-2 Q1 Sinh[a4[t]] nZ[2][z, t] + Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[7][z, t]),
 4 nZ[1]^(1,0)[z, t], -2/3 M nZ[5][z, t] -
  1/3 e^(-a4[t]) (-2 Q1 Sinh[a4[t]] nZ[2][z, t] + Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[7][z, t]) a4'[t] -
  4 Tan[z] nZ[1]^(1,0)[z, t] + 1/3 (-3 Q2 nZ[4][z, t] + 2 M nZ[5][z, t] +
      e^(-a4[t]) (-2 Q1 Sinh[a4[t]] nZ[2][z, t] + Q2 (3 Cosh[a4[t]] + Sinh[a4[t]]) nZ[7][z, t])
       a4'[t] - 2 (nZ[2]^(0,1)[z, t] - 6 Tan[z] nZ[1]^(1,0)[z, t]))}
```

In[ ]:=
```
var12 // Column
```

Out[ ]=
```
{nZ[5], nZ[6], nZ[0], nZ[2], nZ[3], nZ[5]}
{nZ[4], nZ[7], nZ[1], nZ[2], nZ[3], nZ[4]}
{nZ[4], nZ[7], nZ[0], nZ[1], nZ[2], nZ[7]}
{nZ[5], nZ[6], nZ[0], nZ[1], nZ[3], nZ[6]}
{nZ[1], nZ[2], nZ[1], nZ[4], nZ[6], nZ[7]}
{nZ[0], nZ[3], nZ[0], nZ[5], nZ[6], nZ[7]}
{nZ[0], nZ[3], nZ[3], nZ[4], nZ[5], nZ[6]}
{nZ[1], nZ[2], nZ[2], nZ[4], nZ[5], nZ[7]}
```

In[ ]:=
```
var12Z = #[z, t] & /@ Union[Flatten[var12]]
```

Out[ ]=
```
{nZ[0][z, t], nZ[1][z, t], nZ[2][z, t],
 nZ[3][z, t], nZ[4][z, t], nZ[5][z, t], nZ[6][z, t], nZ[7][z, t]}
```

In[ ]:=
```
Dzvar12Z = D[var12Z, z]
```

Out[ ]=
```
{nZ[0]^(1,0)[z, t], nZ[1]^(1,0)[z, t], nZ[2]^(1,0)[z, t], nZ[3]^(1,0)[z, t],
 nZ[4]^(1,0)[z, t], nZ[5]^(1,0)[z, t], nZ[6]^(1,0)[z, t], nZ[7]^(1,0)[z, t]}
```

In[ ]:=
```
Dtvar12Z = D[var12Z, t]
```

Out[ ]=
```
{nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t],
 nZ[4]^(0,1)[z, t], nZ[5]^(0,1)[z, t], nZ[6]^(0,1)[z, t], nZ[7]^(0,1)[z, t]}
```

In[ ]:=
```
sDtvar12Z =
 Solve[And @@ Thread[0 == enewLazt18], Dtvar12Z][[1]] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$\Big\{nZ[0]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-3\,Q2\,nZ[6][z,t] - 2\,M\,nZ[7][z,t] + e^{-a4[t]}\big(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[5][z,t]\big)\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\Big),$$

$$nZ[1]^{(0,1)}[z,t] \to M\,nZ[6][z,t] - \frac{3}{2}\,Q2\,nZ[7][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\Big(\big(-1 + e^{2\,a4[t]}\big)\,Q1\,nZ[1][z,t] + 3\,Q2\,nZ[4][z,t]\Big)\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],$$

$$nZ[2]^{(0,1)}[z,t] \to -\frac{3}{2}\,Q2\,nZ[4][z,t] + M\,nZ[5][z,t] + \frac{1}{2}\,e^{-a4[t]}\big(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t] + Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[7][z,t]\big)\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t],$$

$$nZ[3]^{(0,1)}[z,t] \to -M\,nZ[4][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\,(nZ[5][z,t] + nZ[6][z,t]\,a4'[t]) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t],$$

$$nZ[4]^{(0,1)}[z,t] \to -\frac{3}{2}\,Q2\,nZ[2][z,t] + M\,nZ[3][z,t] + \frac{1}{2}\,e^{-a4[t]}\big(Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\big)\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t],$$

$$nZ[5]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-2\,M\,nZ[2][z,t] - 3\,Q2\,nZ[3][z,t] + \big(-3\,Q2\,nZ[0][z,t] + \big(-1 + e^{-2\,a4[t]}\big)\,Q1\,nZ[5][z,t]\big)\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\Big),$$

$$nZ[6]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-3\,Q2\,nZ[0][z,t] + e^{-a4[t]}\big(Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t] + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z,t]\big)\,a4'[t] - 2\,\big(M\,nZ[1][z,t] + 6\,\mathrm{Tan}[z]\,nZ[5]^{(1,0)}[z,t]\big)\Big),$$

$$nZ[7]^{(0,1)}[z,t] \to M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\Big(3\,Q2\,nZ[2][z,t] + \big(-1 + e^{2\,a4[t]}\big)\,Q1\,nZ[7][z,t]\Big)\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t]\Big\}$$

In[ ]:=
```
(*FullForm[#]&/@sDtvar12Z*)
```

In[ ]:=
```
Clear[swap];
swap[j_Integer, k_Integer, list_] := Module[{tmp, stmp, sj, sk, ret},
  stmp = {nZ[j] → ((TMP[#1, #2]) &)};
  sj = {nZ[j] → ToExpression["((nZ[" <> ToString[k] <> "][#1,#2])&)"]};
  sk = {nZ[k] → ToExpression["((nZ[" <> ToString[j] <> "][#1,#2])&)"]};
  tmp = (# /. stmp) & /@ list;
  tmp = (# /. sk) & /@ tmp;
  ret = (# /. {TMP → ToExpression["((nZ[" <> ToString[k] <> "][#1,#2])&)"]}) & /@ tmp;
  Return[ret // FullSimplify[#, constraintVars] &];]
```

In[ ]:=
```
ToString[FullForm[#]] & /@ sDtvar12Z;
StringReplace[#, "Rule" → "Equal"] & /@ %;
(Dtvar12ZEQS = ToExpression[#] & /@ %) // Column
```

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] == \frac{1}{2}\left(-3\,Q2\,nZ[6][z,t] - 2\,M\,nZ[7][z,t] + e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[5][z,t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[6][z,t] - \frac{3}{2}\,Q2\,nZ[7][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1 + e^{2\,a4[t]}\right)Q1\,nZ[1][z,t] + 3\,Q2\,nZ[4][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]$$

$$nZ[2]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[4][z,t] + M\,nZ[5][z,t] + \frac{1}{2}\,e^{-a4[t]}\left(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t] + Q2\left(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[7][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]$$

$$nZ[3]^{(0,1)}[z,t] == -M\,nZ[4][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\left(nZ[5][z,t] + nZ[6][z,t]\,a4'[t]\right) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]$$

$$nZ[4]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[2][z,t] + M\,nZ[3][z,t] + \frac{1}{2}\,e^{-a4[t]}\left(Q2\left(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]$$

$$nZ[5]^{(0,1)}[z,t] == \frac{1}{2}\left(-2\,M\,nZ[2][z,t] - 3\,Q2\,nZ[3][z,t] + \left(-3\,Q2\,nZ[0][z,t] + \left(-1 + e^{-2\,a4[t]}\right)Q1\,nZ[5][z,t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[6]^{(1,0)}[z,t]\right)$$

$$nZ[6]^{(0,1)}[z,t] == \frac{1}{2}\left(-3\,Q2\,nZ[0][z,t] + e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[3][z,t] + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z,t]\right)a4'[t] - 2\left(M\,nZ[1][z,t] + 6\,\mathrm{Tan}[z]\,nZ[5]^{(1,0)}[z,t]\right)\right)$$

$$nZ[7]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(3\,Q2\,nZ[2][z,t] + \left(-1 + e^{2\,a4[t]}\right)Q1\,nZ[7][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t]$$

In[ ]:=
```
Dtvar12ZEQS[[1]]
swap[0, 6, %]
swap[6, 0, %%] === %
```

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] == \frac{1}{2}\left(-3\,Q2\,nZ[6][z,t] - 2\,M\,nZ[7][z,t] + e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[5][z,t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

Out[ ]=

$$\frac{3}{2}\,Q2\,nZ[0][z,t] + M\,nZ[7][z,t] + nZ[6]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t] == \frac{1}{2}\,e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[5][z,t] + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z,t]\right)a4'[t]$$

Out[ ]=

True

In[ ]:=
```
Dtvar12ZEQS[[1 + 0]]
swap[0, 6, %]
Dtvar12ZEQS[[1 + 6]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, Q1] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[0]^{(0,1)}[z, t] == \frac{1}{2}\left(-3\,Q2\,nZ[6][z, t] - 2\,M\,nZ[7][z, t] + e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z, t] + Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[5][z, t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z, t]\right)$$

Out[ ]=

$$\frac{3}{2}\,Q2\,nZ[0][z, t] + M\,nZ[7][z, t] + nZ[6]^{(0,1)}[z, t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z, t] == \frac{1}{2}\,e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[5][z, t] + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z, t]\right)a4'[t]$$

Out[ ]=

$$nZ[6]^{(0,1)}[z, t] == \frac{1}{2}\left(-3\,Q2\,nZ[0][z, t] + e^{-a4[t]}\left(Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[3][z, t] + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z, t]\right)a4'[t] - 2\left(M\,nZ[1][z, t] + 6\,\mathrm{Tan}[z]\,nZ[5]^{(1,0)}[z, t]\right)\right)$$

Out[ ]=

$$\frac{1}{2}\left(-3\,Q2\,nZ[0][z, t] - 2\,M\,nZ[1][z, t] + 3\,Q2\,nZ[6][z, t] + 2\,M\,nZ[7][z, t] + e^{-a4[t]}\left(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z, t] - Q2\left(3\,\mathrm{Cosh}[a4[t]] - \mathrm{Sinh}[a4[t]]\right)\left(nZ[3][z, t] - nZ[5][z, t]\right) + 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[6][z, t]\right)a4'[t] + 12\,\mathrm{Tan}[z]\left(nZ[3]^{(1,0)}[z, t] - nZ[5]^{(1,0)}[z, t]\right)\right)$$

Out[ ]=

$$e^{-a4[t]}\,\mathrm{Sinh}[a4[t]]\left(-nZ[0][z, t] + nZ[6][z, t]\right)a4'[t]$$

Out[ ]=

$$\frac{1}{2}\left(-3\,nZ[0][z, t] + 3\,nZ[6][z, t] - e^{-2\,a4[t]}\left(2 + e^{2\,a4[t]}\right)\left(nZ[3][z, t] - nZ[5][z, t]\right)a4'[t]\right)$$

In[ ]:=
```
Dtvar12ZEQS /. Flatten[{{nZ[6] → ((nZ[0][#1, #2]) &), nZ[5] → ((nZ[3][#1, #2]) &)}}] //
  FullSimplify[#, constraintVars] & // Union
Length[%]
```

Out[ ]=

$$\Big\{nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[7][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,nZ[1][z,t] + 3\,Q2\,nZ[4][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],$$

$$nZ[7]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(3\,Q2\,nZ[2][z,t] + \left(-1+e^{2\,a4[t]}\right)Q1\,nZ[7][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t],$$

$$M\,nZ[2][z,t] + \frac{3}{2}\,Q2\,nZ[0][z,t]\,a4'[t] + \frac{1}{2}\,nZ[3][z,t]\left(3\,Q2 + \left(1-e^{-2\,a4[t]}\right)Q1\,a4'[t]\right) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0,$$

$$M\,nZ[4][z,t] + e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] + \frac{3}{2}\,Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0,$$

$$(-2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t] + Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[7][z,t])\,a4'[t] + e^{a4[t]}\left(2\,M\,nZ[3][z,t] - 3\,Q2\,nZ[4][z,t] - 2\,nZ[2]^{(0,1)}[z,t] + 12\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right) == 0,$$

$$e^{a4[t]}\left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t],$$

$$e^{a4[t]}\left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[7][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t],$$

$$e^{a4[t]}\left(3\,Q2\,nZ[2][z,t] + 2\left(-M\,nZ[3][z,t] + nZ[4]^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ[7]^{(1,0)}[z,t]\right)\right) == (Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[4][z,t])\,a4'[t]\Big\}$$

Out[ ]=

8

In[ ]:=
```
Dtvar12ZEQS[[1 + 3]]
swap[3, 5, %]
Dtvar12ZEQS[[1 + 5]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, Q1] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[3]^{(0,1)}[z, t] == -M\, nZ[4][z, t] - e^{-a4[t]}\, Q1\, \mathrm{Sinh}[a4[t]]\, nZ[3][z, t]\, a4'[t] - \frac{3}{2} Q2\, (nZ[5][z, t] + nZ[6][z, t]\, a4'[t]) - 6\, \mathrm{Tan}[z]\, nZ[0]^{(1,0)}[z, t]$$

Out[ ]=

$$M\, nZ[4][z, t] + e^{-a4[t]}\, Q1\, \mathrm{Sinh}[a4[t]]\, nZ[5][z, t]\, a4'[t] + \frac{3}{2} Q2\, (nZ[3][z, t] + nZ[6][z, t]\, a4'[t]) + nZ[5]^{(0,1)}[z, t] + 6\, \mathrm{Tan}[z]\, nZ[0]^{(1,0)}[z, t] == 0$$

Out[ ]=

$$nZ[5]^{(0,1)}[z, t] == \frac{1}{2} \Big(-2\, M\, nZ[2][z, t] - 3\, Q2\, nZ[3][z, t] + \Big(-3\, Q2\, nZ[0][z, t] + \Big(-1 + e^{-2\, a4[t]}\Big)\, Q1\, nZ[5][z, t]\Big)\, a4'[t] - 12\, \mathrm{Tan}[z]\, nZ[6]^{(1,0)}[z, t]\Big)$$

Out[ ]=

$$\frac{1}{2} \Big(2\, M\, (-nZ[2][z, t] + nZ[4][z, t]) + 3\, Q2\, (-nZ[0][z, t] + nZ[6][z, t])\, a4'[t] + nZ[5][z, t] \Big(3\, Q2 + \Big(-1 + e^{-2\, a4[t]}\Big)\, Q1\, a4'[t]\Big) + nZ[3][z, t] \Big(-3\, Q2 + \Big(Q1 - e^{-2\, a4[t]}\, Q1\Big)\, a4'[t]\Big) + 12\, \mathrm{Tan}[z] \Big(nZ[0]^{(1,0)}[z, t] - nZ[6]^{(1,0)}[z, t]\Big)\Big)$$

Out[ ]=

$$e^{-a4[t]}\, \mathrm{Sinh}[a4[t]]\, (nZ[3][z, t] - nZ[5][z, t])\, a4'[t]$$

Out[ ]=

$$\frac{3}{2} (-nZ[3][z, t] + nZ[5][z, t] + (-nZ[0][z, t] + nZ[6][z, t])\, a4'[t])$$

In[ ]:=
```
Dtvar12ZEQS[[1 + 1]]
swap[1, 7, %]
Dtvar12ZEQS[[1 + 7]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, Q1] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[6][z,t] - \frac{3}{2} Q2\,nZ[7][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(\left(-1 + e^{2\,a4[t]}\right) Q1\,nZ[1][z,t] + 3\,Q2\,nZ[4][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[7]^{(0,1)}[z,t] == -\frac{3}{2} Q2\,nZ[1][z,t] + M\,nZ[6][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(3\,Q2\,nZ[4][z,t] + \left(-1 + e^{2\,a4[t]}\right) Q1\,nZ[7][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[7]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2} Q2\,nZ[1][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(3\,Q2\,nZ[2][z,t] + \left(-1 + e^{2\,a4[t]}\right) Q1\,nZ[7][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[4]^{(1,0)}[z,t]$$

Out[ ]=

$$M\,(nZ[0][z,t] - nZ[6][z,t]) + \frac{1}{2} e^{-2\,a4[t]} (Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t] - 3\,Q2\,nZ[4][z,t] - Q1\,nZ[7][z,t])\,a4'[t] - \frac{1}{2} (nZ[1][z,t] - nZ[7][z,t])\,(3\,Q2 + Q1\,a4'[t]) + 6\,\mathrm{Tan}[z] \left(-nZ[2]^{(1,0)}[z,t] + nZ[4]^{(1,0)}[z,t]\right)$$

Out[ ]=

$$\mathrm{Sinh}[a4[t]]\,(-\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,(nZ[1][z,t] - nZ[7][z,t])\,a4'[t]$$

Out[ ]=

$$\frac{3}{2} \left(-nZ[1][z,t] + nZ[7][z,t] + e^{-2\,a4[t]} (nZ[2][z,t] - nZ[4][z,t])\,a4'[t]\right)$$

In[ ]:=
```
sredu1 = Flatten[{{nZ[6] → ((nZ[0][#1, #2]) &), nZ[5] → ((nZ[3][#1, #2]) &)},
    {nZ[7] → ((nZ[1][#1, #2]) &), nZ[4] → ((nZ[2][#1, #2]) &)}}]
```

Out[ ]=
```
{nZ[6] → (nZ[0][#1, #2] &), nZ[5] → (nZ[3][#1, #2] &),
 nZ[7] → (nZ[1][#1, #2] &), nZ[4] → (nZ[2][#1, #2] &)}
```

In[ ]:=

```
(Dtvar12ZEQSTo5 = Dtvar12ZEQS /. sredu1 // FullSimplify[#, constraintVars] & // Union) //
 Column
Length[%[[1]]]
sDt0123 =
 Solve[And @@ %%[[1]], {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t]}][[
   1]] // FullSimplify[#, constraintVars] &
%%%[[1]] /. sDt0123 // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2} Q2\,nZ[1][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(\left(-1 + e^{2\,a4[t]}\right) Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]$$

$$M\,nZ[2][z,t] + \frac{3}{2} Q2\,nZ[0][z,t]\,a4'[t] + \frac{1}{2} nZ[3][z,t] \left(3\,Q2 + \left(1 - e^{-2\,a4[t]}\right) Q1\,a4'[t]\right) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0$$

$$M\,nZ[2][z,t] + e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] + \frac{3}{2} Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0$$

$$e^{a4[t]} \left(3\,Q2\,nZ[2][z,t] + 2\left(-M\,nZ[3][z,t] + nZ[2]^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\right) == (Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t])\,a4'[t]$$

$$e^{a4[t]} \left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t]$$

Out[ ]=

5

Out[ ]=

$$\Big\{nZ[0]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-3\,Q2\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\,(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\Big),$$

$$nZ[1]^{(0,1)}[z,t] \to M\,nZ[0][z,t] - \frac{3}{2} Q2\,nZ[1][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(\left(-1 + e^{2\,a4[t]}\right) Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],$$

$$nZ[2]^{(0,1)}[z,t] \to M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right) Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2} nZ[2][z,t] \left(-3\,Q2 + \left(-1 + e^{-2\,a4[t]}\right) Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t],$$

$$nZ[3]^{(0,1)}[z,t] \to -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2} Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\Big\}$$

Out[ ]=

{True, True, True, True, True}

In[ ]:=
```
Dtvar12ZEQSTo5 // Column
```

Out[ ]=

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2} Q2\,nZ[1][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(\left(-1+e^{2\,a4[t]}\right) Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]$$

$$M\,nZ[2][z,t] + \frac{3}{2} Q2\,nZ[0][z,t]\,a4'[t] + \frac{1}{2} nZ[3][z,t] \left(3\,Q2 + \left(1-e^{-2\,a4[t]}\right) Q1\,a4'[t]\right) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0$$

$$M\,nZ[2][z,t] + e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] + \frac{3}{2} Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0$$

$$e^{a4[t]} \left(3\,Q2\,nZ[2][z,t] + 2\left(-M\,nZ[3][z,t] + nZ[2]^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\right) == (Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t])\,a4'[t]$$

$$e^{a4[t]} \left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t]$$

In[ ]:=
```
sDt0123a =
 Solve[And @@ Drop[Dtvar12ZEQSTo5, -1], {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t],
     nZ[3]^(0,1)[z, t]}][[1]] // FullSimplify[#, constraintVars] &
Dtvar12ZEQSTo5 /. sDt0123a // FullSimplify[#, constraintVars] &
```

Solve: Equations may not give solutions for all "solve" variables.

Out[ ]=

$$\left\{nZ[1]^{(0,1)}[z,t] \to M\,nZ[0][z,t] - \frac{3}{2} Q2\,nZ[1][z,t] + \frac{1}{2} e^{-2\,a4[t]} \left(\left(-1+e^{2\,a4[t]}\right) Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right) a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],\right.$$

$$nZ[2]^{(0,1)}[z,t] \to M\,nZ[3][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2} nZ[2][z,t] \left(-3\,Q2 + \left(-1+e^{-2\,a4[t]}\right) Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t],$$

$$\left.nZ[3]^{(0,1)}[z,t] \to -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2} Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\right\}$$

Out[ ]=

$$\{\mathrm{True}, \mathrm{True}, \mathrm{True}, \mathrm{True}, e^{a4[t]} \left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t]\}$$

In[ ]:=
```
sDt0123b =
 Solve[And @@ Drop[Dtvar12ZEQSTo5, 1], {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t],
    nZ[3]^(0,1)[z, t]}][[1]] // FullSimplify[#, constraintVars] &
Dtvar12ZEQSTo5 /. sDt0123b // FullSimplify[#, constraintVars] &
```

Solve: Equations may not give solutions for all "solve" variables.

Out[ ]=

$$\Big\{nZ[0]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-3\,Q2\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\big(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t]\big)\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\Big),$$

$$nZ[2]^{(0,1)}[z,t] \to M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right)Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2}\,nZ[2][z,t]\left(-3\,Q2 + \left(-1 + e^{-2\,a4[t]}\right)Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t],$$

$$nZ[3]^{(0,1)}[z,t] \to -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\Big\}$$

Out[ ]=

$$\Big\{nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1 + e^{2\,a4[t]}\right)Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],\ \mathrm{True},\ \mathrm{True},\ \mathrm{True},\ \mathrm{True}\Big\}$$

In[ ]:=
```
CoefficientArrays[Dtvar12ZEQSTo5[[#]] & /@ {1, 3, 4, 5},
   {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t]}][[2]] // Det[#] &
```

Out[ ]=

$$4\,e^{2\,a4[t]}$$

In[ ]:=
```
Dtvar12ZEQSTo4 = Dtvar12ZEQSTo5[[#]] & /@ {1, 3, 4, 5};
```

In[∘]:=
```
sDt0123c = Solve[And @@ Dtvar12ZEQSTo4, {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t],
    nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t]}][[1]] // FullSimplify[#, constraintVars] &
Dtvar12ZEQSTo5 /. sDt0123c // FullSimplify[#, constraintVars] &
```

Out[∘]=

$$\Big\{nZ[0]^{(0,1)}[z,t] \to \frac{1}{2}\Big(-3\,Q2\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\big(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t]\big)\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\Big),$$

$$nZ[1]^{(0,1)}[z,t] \to M\,nZ[0][z,t] + \frac{1}{2}\Big(e^{-2\,a4[t]}\,(-Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t])\,a4'[t] + nZ[1][z,t]\,(-3\,Q2 + Q1\,a4'[t]) + 12\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\Big),$$

$$nZ[2]^{(0,1)}[z,t] \to M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right)Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2}\,nZ[2][z,t]\left(-3\,Q2 + \left(-1 + e^{-2\,a4[t]}\right)Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t],$$

$$nZ[3]^{(0,1)}[z,t] \to -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]\Big\}$$

Out[∘]=

```
{True, True, True, True, True}
```

In[∘]:=
```
CoefficientArrays[Dtvar12ZEQSTo5[[#]] & /@ {1, 2, 3, 4},
    {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t]}][[2]] // Det[#] &
```

Out[∘]=

0

In[∘]:=
```
CoefficientArrays[Dtvar12ZEQSTo5[[#]] & /@ {2, 3, 4, 5},
    {nZ[0]^(0,1)[z, t], nZ[1]^(0,1)[z, t], nZ[2]^(0,1)[z, t], nZ[3]^(0,1)[z, t]}][[2]] // Det[#] &
```

Out[∘]=

0

In[∘]:=
```
DSolve[Dtvar12ZEQSTo4, {nZ[0][z, t], nZ[1][z, t], nZ[2][z, t], nZ[3][z, t]}, {z, t}]
```

Out[∘]=

$$\mathrm{DSolve}\Big[\Big\{nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1 + e^{2\,a4[t]}\right)Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],$$

$$M\,nZ[2][z,t] + e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] + \frac{3}{2}\,Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0,$$

$$e^{a4[t]}\left(3\,Q2\,nZ[2][z,t] + 2\left(-M\,nZ[3][z,t] + nZ[2]^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\right) == \left(Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t]\right)a4'[t],$$

$$e^{a4[t]}\left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == \left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t]\right)a4'[t]\Big\},$$

$$\{nZ[0][z,t], nZ[1][z,t], nZ[2][z,t], nZ[3][z,t]\}, \{z,t\}\Big]$$

In[ ]:=
```
sDt0123c // Column
ToString[FullForm[#]] & /@ %[[1]];
StringReplace[#, "Rule" → "Equal"] & /@ %;
(sDt0123cEQS = ToExpression[#] & /@ %) // Column
```

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] \to \frac{1}{2}\left(-3\,Q2\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[3][z,t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$nZ[1]^{(0,1)}[z,t] \to M\,nZ[0][z,t] + \frac{1}{2}\left(e^{-2\,a4[t]}\left(-Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right)a4'[t] + nZ[1][z,t]\left(-3\,Q2 + Q1\,a4'[t]\right) + 12\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\right)$$

$$nZ[2]^{(0,1)}[z,t] \to M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right)Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2}\,nZ[2][z,t]\left(-3\,Q2 + \left(-1 + e^{-2\,a4[t]}\right)Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]$$

$$nZ[3]^{(0,1)}[z,t] \to -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\left(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]\right) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] == \frac{1}{2}\left(-3\,Q2\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\left(2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[3][z,t]\right)a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] + \frac{1}{2}\left(e^{-2\,a4[t]}\left(-Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right)a4'[t] + nZ[1][z,t]\left(-3\,Q2 + Q1\,a4'[t]\right) + 12\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\right)$$

$$nZ[2]^{(0,1)}[z,t] == M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right)Q2\,nZ[1][z,t]\,a4'[t] + \frac{1}{2}\,nZ[2][z,t]\left(-3\,Q2 + \left(-1 + e^{-2\,a4[t]}\right)Q1\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]$$

$$nZ[3]^{(0,1)}[z,t] == -M\,nZ[2][z,t] - e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - \frac{3}{2}\,Q2\left(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]\right) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]$$

for MATLAB :

In[ ]:=
```
(sDt0123cEQSQ1 = sDt0123cEQS /. {Q1 → 1, Q2 → 0}) // Column
```

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] == \frac{1}{2}\left(-2\,M\,nZ[1][z,t] + 2\,e^{-a4[t]}\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t]\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] + \frac{1}{2}\left(nZ[1][z,t]\,a4'[t] - e^{-2\,a4[t]}\,nZ[1][z,t]\,a4'[t] + 12\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\right)$$

$$nZ[2]^{(0,1)}[z,t] == M\,nZ[3][z,t] + \frac{1}{2}\left(-1 + e^{-2\,a4[t]}\right)nZ[2][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]$$

$$nZ[3]^{(0,1)}[z,t] == -M\,nZ[2][z,t] - e^{-a4[t]}\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]$$

In[ ]:=
```
(sDt0123cEQSQ2 = sDt0123cEQS /. {Q1 → 0, Q2 → 1}) // Column
```

Out[ ]=

$$nZ[0]^{(0,1)}[z,t] == \frac{1}{2}\left(-3\,nZ[0][z,t] - 2\,M\,nZ[1][z,t] + e^{-a4[t]}\left(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]\right)nZ[3][z,t]\,a4'[t] - 12\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)$$

$$nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] + \frac{1}{2}\left(-3\,nZ[1][z,t] + 3\,e^{-2\,a4[t]}\,nZ[2][z,t]\,a4'[t] + 12\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t]\right)$$

$$nZ[2]^{(0,1)}[z,t] == -\frac{3}{2}\,nZ[2][z,t] + M\,nZ[3][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right)nZ[1][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]$$

$$nZ[3]^{(0,1)}[z,t] == -M\,nZ[2][z,t] - \frac{3}{2}\left(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]\right) - 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t]$$

In[ ]:=
```
Dtvar12ZEQSTo4 /. sreplacenZ
% // Column
```

Out[ ]=

$$\Big\{nZ1^{(0,1)}[z,t] == M\,nZ0[z,t] - \frac{3}{2}\,Q2\,nZ1[z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,nZ1[z,t] + 3\,Q2\,nZ2[z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ2^{(1,0)}[z,t],$$

$$M\,nZ2[z,t] + e^{-a4[t]}\,Q1\,nZ3[z,t]\,\mathrm{Sinh}[a4[t]]\,a4'[t] + \frac{3}{2}\,Q2\,(nZ3[z,t] + nZ0[z,t]\,a4'[t]) + nZ3^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ0^{(1,0)}[z,t] == 0,$$

$$e^{a4[t]}\left(3\,Q2\,nZ2[z,t] + 2\left(-M\,nZ3[z,t] + nZ2^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ1^{(1,0)}[z,t]\right)\right) == (-2\,Q1\,nZ2[z,t]\,\mathrm{Sinh}[a4[t]] + Q2\,nZ1[z,t]\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]))\,a4'[t],$$

$$e^{a4[t]}\left(3\,Q2\,nZ0[z,t] + 2\left(M\,nZ1[z,t] + nZ0^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ3^{(1,0)}[z,t]\right)\right) == (2\,Q1\,nZ0[z,t]\,\mathrm{Sinh}[a4[t]] + Q2\,nZ3[z,t]\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]))\,a4'[t]\Big\}$$

Out[ ]=

$$nZ1^{(0,1)}[z,t] == M\,nZ0[z,t] - \frac{3}{2}\,Q2\,nZ1[z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,nZ1[z,t] + 3\,Q2\,nZ2[z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ2^{(1,0)}[z,t]$$

$$M\,nZ2[z,t] + e^{-a4[t]}\,Q1\,nZ3[z,t]\,\mathrm{Sinh}[a4[t]]\,a4'[t] + \frac{3}{2}\,Q2\,(nZ3[z,t] + nZ0[z,t]\,a4'[t]) + nZ3^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ0^{(1,0)}[z,t] == 0$$

$$e^{a4[t]}\left(3\,Q2\,nZ2[z,t] + 2\left(-M\,nZ3[z,t] + nZ2^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ1^{(1,0)}[z,t]\right)\right) == (-2\,Q1\,nZ2[z,t]\,\mathrm{Sinh}[a4[t]] + Q2\,nZ1[z,t]\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]))\,a4'[t]$$

$$e^{a4[t]}\left(3\,Q2\,nZ0[z,t] + 2\left(M\,nZ1[z,t] + nZ0^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ3^{(1,0)}[z,t]\right)\right) == (2\,Q1\,nZ0[z,t]\,\mathrm{Sinh}[a4[t]] + Q2\,nZ3[z,t]\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]]))\,a4'[t]$$

In[ ]:=
```
Dtvar12ZEQSTo4
FullForm[%] /. sreplacenZ
{nZ[0][z, t], nZ[1][z, t], nZ[2][z, t], nZ[3][z, t]}
FullForm[%] /. sreplacenZ
```

Out[ ]=

$$\Big\{nZ[1]^{(0,1)}[z,t] == M\,nZ[0][z,t] - \frac{3}{2}\,Q2\,nZ[1][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(\left(-1+e^{2\,a4[t]}\right)Q1\,nZ[1][z,t] + 3\,Q2\,nZ[2][z,t]\right)a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[2]^{(1,0)}[z,t],$$

$$M\,nZ[2][z,t] + e^{-a4[t]}\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[3][z,t]\,a4'[t] + \frac{3}{2}\,Q2\,(nZ[3][z,t] + nZ[0][z,t]\,a4'[t]) + nZ[3]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[0]^{(1,0)}[z,t] == 0,$$

$$e^{a4[t]}\left(3\,Q2\,nZ[2][z,t] + 2\left(-M\,nZ[3][z,t] + nZ[2]^{(0,1)}[z,t] - 6\,\mathrm{Tan}[z]\,nZ[1]^{(1,0)}[z,t]\right)\right) == (Q2\,(3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[1][z,t] - 2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[2][z,t])\,a4'[t],$$

$$e^{a4[t]}\left(3\,Q2\,nZ[0][z,t] + 2\left(M\,nZ[1][z,t] + nZ[0]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[3]^{(1,0)}[z,t]\right)\right) == (2\,Q1\,\mathrm{Sinh}[a4[t]]\,nZ[0][z,t] + Q2\,(-3\,\mathrm{Cosh}[a4[t]] + \mathrm{Sinh}[a4[t]])\,nZ[3][z,t])\,a4'[t]\Big\}$$

Out[ ]//FullForm=

```
List[Equal[Derivative[0, 1][nZ1][z, t],
  Plus[Times[M, nZ0[z, t]], Times[Rational[-3, 2], Q2, nZ1[z, t]],
   Times[Rational[1, 2], Power[E, Times[-2, a4[t]]], Plus[
     Times[Plus[-1, Power[E, Times[2, a4[t]]]], Q1, nZ1[z, t]], Times[3, Q2, nZ2[z, t]]],
    Derivative[1][a4][t]], Times[6, Tan[z], Derivative[1, 0][nZ2][z, t]]]],
 Equal[Plus[Times[M, nZ2[z, t]], Times[Power[E, Times[-1, a4[t]]],
    Q1, nZ3[z, t], Sinh[a4[t]], Derivative[1][a4][t]],
   Times[Rational[3, 2], Q2, Plus[nZ3[z, t], Times[nZ0[z, t], Derivative[1][a4][t]]]],
   Derivative[0, 1][nZ3][z, t], Times[6, Tan[z], Derivative[1, 0][nZ0][z, t]]], 0],
 Equal[Times[Power[E, a4[t]], Plus[Times[3, Q2, nZ2[z, t]],
    Times[2, Plus[Times[-1, M, nZ3[z, t]], Derivative[0, 1][nZ2][z, t],
      Times[-6, Tan[z], Derivative[1, 0][nZ1][z, t]]]]]],
  Times[Plus[Times[-2, Q1, nZ2[z, t], Sinh[a4[t]]], Times[Q2, nZ1[z, t],
     Plus[Times[3, Cosh[a4[t]]], Sinh[a4[t]]]]], Derivative[1][a4][t]]], Equal[
  Times[Power[E, a4[t]], Plus[Times[3, Q2, nZ0[z, t]], Times[2, Plus[Times[M, nZ1[z, t]],
      Derivative[0, 1][nZ0][z, t], Times[6, Tan[z], Derivative[1, 0][nZ3][z, t]]]]]],
  Times[Plus[Times[2, Q1, nZ0[z, t], Sinh[a4[t]]], Times[Q2, nZ3[z, t],
     Plus[Times[-3, Cosh[a4[t]]], Sinh[a4[t]]]]], Derivative[1][a4][t]]]]
```

Out[ ]=

```
{nZ[0][z, t], nZ[1][z, t], nZ[2][z, t], nZ[3][z, t]}
```

Out[ ]//FullForm=

```
List[nZ0[z, t], nZ1[z, t], nZ2[z, t], nZ3[z, t]]
```

28

In[ ]:=
```
enewLazt28 = Take[enewLazt, -8]
```

Out[ ]=

$$\left\{\frac{1}{3}\left(-2\,M\,nZ[10][z,t]+3\,Q2\,nZ[11][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+2\left(nZ[13]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]\right)\right),\right.$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[10][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]-2\left(M\,nZ[11][z,t]+nZ[12]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-2\,M\,nZ[8][z,t]-3\,Q2\,nZ[9][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]-2\left(nZ[15]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(3\,Q2\,nZ[8][z,t]-2\,M\,nZ[9][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+2\left(nZ[14]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(2\,M\,nZ[14][z,t]+3\,Q2\,nZ[15][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t]\,a4'[t]+2\left(nZ[9]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(-3\,Q2\,nZ[14][z,t]+2\,M\,nZ[15][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[13][z,t]\,a4'[t]-2\left(nZ[8]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]\right)\right),$$

$$\frac{1}{3}\left(2\,M\,nZ[12][z,t]-3\,Q2\,nZ[13][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t]-2\left(nZ[11]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]\right)\right),$$

$$\left.\frac{1}{3}\left(3\,Q2\,nZ[12][z,t]+2\,M\,nZ[13][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]+2\left(nZ[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]\right)\right)\right\}$$

In[ ]:=
```
Dimensions[resolved28]
```

Out[ ]=

{8, 4}

In[ ]:=
```
resolved28 // Column
```

Out[ ]=

$$\left\{-\frac{2}{3}\,nZ[10][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t],\ -4\,nZ[14]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[10][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]+\frac{1}{3}\left(-2\,M\,nZ[10][z,t]+3\,Q2\,nZ[11][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+2\left(nZ[13]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{-\frac{2}{3}\,nZ[11][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t],\ -4\,nZ[15]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[11][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]+\frac{1}{3}\left(-3\,Q2\,nZ[10][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t]-2\left(M\,nZ[11][z,t]+nZ[12]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{-\frac{2}{3}\,nZ[8][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t],\ -4\,nZ[12]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[8][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]+\frac{1}{3}\left(-2\,M\,nZ[8][z,t]-3\,Q2\,nZ[9][z,t]-e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t]-2\left(nZ[15]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{-\frac{2}{3}\,nZ[9][z,t],\ -\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t],\ -4\,nZ[13]^{(1,0)}[z,t],\ \frac{2}{3}\,M\,nZ[9][z,t]+\frac{1}{3}\,e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+4\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]+\frac{1}{3}\left(3\,Q2\,nZ[8][z,t]-2\,M\,nZ[9][z,t]-e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+2\left(nZ[14]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[13]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{\frac{2}{3}\,nZ[14][z,t],\ \frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t],\ 4\,nZ[10]^{(1,0)}[z,t],\ -\frac{2}{3}\,M\,nZ[14][z,t]-\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t]\,a4'[t]-4\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]+\frac{1}{3}\left(2\,M\,nZ[14][z,t]+3\,Q2\,nZ[15][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t]\,a4'[t]+2\left(nZ[9]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{\frac{2}{3}\,nZ[15][z,t],\ \frac{1}{3}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[13][z,t],\ 4\,nZ[11]^{(1,0)}[z,t],\ -\frac{2}{3}\,M\,nZ[15][z,t]-\frac{1}{3}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[13][z,t]\,a4'[t]-4\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]+\frac{1}{3}\left(-3\,Q2\,nZ[14][z,t]+2\,M\,nZ[15][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[13][z,t]\,a4'[t]-2\left(nZ[8]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{\frac{2}{3}\,nZ[12][z,t],\ \frac{1}{3}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t],\ 4\,nZ[8]^{(1,0)}[z,t],\ -\frac{2}{3}\,M\,nZ[12][z,t]-\frac{1}{3}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t]-4\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]+\frac{1}{3}\left(2\,M\,nZ[12][z,t]-3\,Q2\,nZ[13][z,t]+\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t]-2\left(nZ[11]^{(0,1)}[z,t]-6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]\right)\right)\right\}$$

$$\left\{\frac{2}{3}\,nZ[13][z,t],\ \frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t],\ 4\,nZ[9]^{(1,0)}[z,t],\ -\frac{2}{3}\,M\,nZ[13][z,t]-\frac{1}{3}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]-4\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]+\frac{1}{3}\left(3\,Q2\,nZ[12][z,t]+2\,M\,nZ[13][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]+2\left(nZ[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]\right)\right)\right\}$$

In[ ]:=
```
var22 // Column
```

Out[ ]=
```
{nZ[13], nZ[14], nZ[8], nZ[10], nZ[11]}
{nZ[12], nZ[15], nZ[9], nZ[10], nZ[11]}
{nZ[12], nZ[15], nZ[8], nZ[9], nZ[10]}
{nZ[13], nZ[14], nZ[8], nZ[9], nZ[11]}
{nZ[9], nZ[10], nZ[12], nZ[14], nZ[15]}
{nZ[8], nZ[11], nZ[13], nZ[14], nZ[15]}
{nZ[8], nZ[11], nZ[12], nZ[13], nZ[14]}
{nZ[9], nZ[10], nZ[12], nZ[13], nZ[15]}
```

In[ ]:=
```
var22Z = #[z, t] & /@ Union[Flatten[var22]]
```

Out[ ]=
```
{nZ[8][z, t], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t],
 nZ[12][z, t], nZ[13][z, t], nZ[14][z, t], nZ[15][z, t]}
```

In[ ]:=
```
Dzvar22Z = D[var22Z, z]
```

Out[ ]=
```
{nZ[8]^(1,0)[z, t], nZ[9]^(1,0)[z, t], nZ[10]^(1,0)[z, t], nZ[11]^(1,0)[z, t],
 nZ[12]^(1,0)[z, t], nZ[13]^(1,0)[z, t], nZ[14]^(1,0)[z, t], nZ[15]^(1,0)[z, t]}
```

In[ ]:=
```
Dtvar22Z = D[var22Z, t]
```

Out[ ]=
```
{nZ[8]^(0,1)[z, t], nZ[9]^(0,1)[z, t], nZ[10]^(0,1)[z, t], nZ[11]^(0,1)[z, t],
 nZ[12]^(0,1)[z, t], nZ[13]^(0,1)[z, t], nZ[14]^(0,1)[z, t], nZ[15]^(0,1)[z, t]}
```

In[ ]:=
```
sDtvar22Z =
 Solve[And @@ Thread[0 == enewLazt28], Dtvar22Z][[1]] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$\Big\{nZ[8]^{(0,1)}[z,t] \to -\frac{3}{2} Q2\, nZ[14][z,t] + M\, nZ[15][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[13][z,t]\, a4'[t] + 6\,\mathrm{Tan}[z]\, nZ[11]^{(1,0)}[z,t],$$

$$nZ[9]^{(0,1)}[z,t] \to -M\, nZ[14][z,t] - \frac{3}{2} Q2\, nZ[15][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[12][z,t]\, a4'[t] - 6\,\mathrm{Tan}[z]\, nZ[10]^{(1,0)}[z,t],$$

$$nZ[10]^{(0,1)}[z,t] \to -\frac{3}{2} Q2\, nZ[12][z,t] - M\, nZ[13][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[15][z,t]\, a4'[t] - 6\,\mathrm{Tan}[z]\, nZ[9]^{(1,0)}[z,t],$$

$$nZ[11]^{(0,1)}[z,t] \to M\, nZ[12][z,t] - \frac{3}{2} Q2\, nZ[13][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[14][z,t]\, a4'[t] + 6\,\mathrm{Tan}[z]\, nZ[8]^{(1,0)}[z,t],$$

$$nZ[12]^{(0,1)}[z,t] \to -\frac{3}{2} Q2\, nZ[10][z,t] - M\, nZ[11][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[9][z,t]\, a4'[t] - 6\,\mathrm{Tan}[z]\, nZ[15]^{(1,0)}[z,t],$$

$$nZ[13]^{(0,1)}[z,t] \to M\, nZ[10][z,t] - \frac{3}{2} Q2\, nZ[11][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[8][z,t]\, a4'[t] + 6\,\mathrm{Tan}[z]\, nZ[14]^{(1,0)}[z,t],$$

$$nZ[14]^{(0,1)}[z,t] \to -\frac{3}{2} Q2\, nZ[8][z,t] + M\, nZ[9][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[11][z,t]\, a4'[t] + 6\,\mathrm{Tan}[z]\, nZ[13]^{(1,0)}[z,t],$$

$$nZ[15]^{(0,1)}[z,t] \to -M\, nZ[8][z,t] - \frac{3}{2} Q2\, nZ[9][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[10][z,t]\, a4'[t] - 6\,\mathrm{Tan}[z]\, nZ[12]^{(1,0)}[z,t]\Big\}$$

In[ ]:=
```
(*FullForm[#]&/@sDtvar22Z*)
```

In[ ]:=
```
(*Clear[swap];
  swap[j_Integer,k_Integer,list_]:=Module[{tmp,stmp,sj,sk,ret},
  stmp={nZ[j]→((TMP[#1,#2])&)};
  sj={nZ[j]→ToExpression["((nZ["<>ToString[k]<>"][#1,#2])&)"]};
  sk={nZ[k]→ToExpression["((nZ["<>ToString[j]<>"][#1,#2])&)"]};
  tmp=(#/.stmp)&/@list;
  tmp=(#/.sk)&/@tmp;
  ret=(#/.{TMP→ToExpression["((nZ["<>ToString[k]<>"][#1,#2])&)"]})&/@tmp;
  Return[ret//FullSimplify[#,constraintVars]&];]*)
```

In[ ]:=
```
ToString[FullForm[#]] & /@ sDtvar22Z;
StringReplace[#, "Rule" → "Equal"] & /@ %;
(Dtvar22ZEQS = ToExpression[#] & /@ %) // Column
```

Out[ ]=

$$nZ[8]^{(0,1)}[z,t] == -\frac{3}{2} Q2\, nZ[14][z,t] + M\, nZ[15][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[13][z,t]\, a4'[t] + 6\, Tan[z]\, nZ[11]^{(1,0)}[z,t]$$

$$nZ[9]^{(0,1)}[z,t] == -M\, nZ[14][z,t] - \frac{3}{2} Q2\, nZ[15][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[12][z,t]\, a4'[t] - 6\, Tan[z]\, nZ[10]^{(1,0)}[z,t]$$

$$nZ[10]^{(0,1)}[z,t] == -\frac{3}{2} Q2\, nZ[12][z,t] - M\, nZ[13][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[15][z,t]\, a4'[t] - 6\, Tan[z]\, nZ[9]^{(1,0)}[z,t]$$

$$nZ[11]^{(0,1)}[z,t] == M\, nZ[12][z,t] - \frac{3}{2} Q2\, nZ[13][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[14][z,t]\, a4'[t] + 6\, Tan[z]\, nZ[8]^{(1,0)}[z,t]$$

$$nZ[12]^{(0,1)}[z,t] == -\frac{3}{2} Q2\, nZ[10][z,t] - M\, nZ[11][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[9][z,t]\, a4'[t] - 6\, Tan[z]\, nZ[15]^{(1,0)}[z,t]$$

$$nZ[13]^{(0,1)}[z,t] == M\, nZ[10][z,t] - \frac{3}{2} Q2\, nZ[11][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[8][z,t]\, a4'[t] + 6\, Tan[z]\, nZ[14]^{(1,0)}[z,t]$$

$$nZ[14]^{(0,1)}[z,t] == -\frac{3}{2} Q2\, nZ[8][z,t] + M\, nZ[9][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right) Q2\, nZ[11][z,t]\, a4'[t] + 6\, Tan[z]\, nZ[13]^{(1,0)}[z,t]$$

$$nZ[15]^{(0,1)}[z,t] == -M\, nZ[8][z,t] - \frac{3}{2} Q2\, nZ[9][z,t] - \frac{1}{2} e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right) Q2\, nZ[10][z,t]\, a4'[t] - 6\, Tan[z]\, nZ[12]^{(1,0)}[z,t]$$

In[ ]:=
```
D[Dtvar22ZEQS, M] // ExpandAll // Column
```

Out[ ]=

$$0 == nZ[15][z,t]$$
$$0 == -nZ[14][z,t]$$
$$0 == -nZ[13][z,t]$$
$$0 == nZ[12][z,t]$$
$$0 == -nZ[11][z,t]$$
$$0 == nZ[10][z,t]$$
$$0 == nZ[9][z,t]$$
$$0 == -nZ[8][z,t]$$

In[ ]:=
```
{9, 10, 12, 15}
```

Out[ ]=

{9, 10, 12, 15}

In[ ]:=
```
D[Dtvar22ZEQS, Q2] // ExpandAll // Column
```

Out[ ]=

$$0 == -\frac{3}{2}\,nZ[14][z,t] + nZ[13][z,t]\,a4'[t] + \frac{1}{2}\,e^{-2\,a4[t]}\,nZ[13][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[15][z,t] - \frac{1}{2}\,nZ[12][z,t]\,a4'[t] - e^{-2\,a4[t]}\,nZ[12][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[12][z,t] - \frac{1}{2}\,nZ[15][z,t]\,a4'[t] - e^{-2\,a4[t]}\,nZ[15][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[13][z,t] + nZ[14][z,t]\,a4'[t] + \frac{1}{2}\,e^{-2\,a4[t]}\,nZ[14][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[10][z,t] - \frac{1}{2}\,nZ[9][z,t]\,a4'[t] - e^{-2\,a4[t]}\,nZ[9][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[11][z,t] + nZ[8][z,t]\,a4'[t] + \frac{1}{2}\,e^{-2\,a4[t]}\,nZ[8][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[8][z,t] + nZ[11][z,t]\,a4'[t] + \frac{1}{2}\,e^{-2\,a4[t]}\,nZ[11][z,t]\,a4'[t]$$
$$0 == -\frac{3}{2}\,nZ[9][z,t] - \frac{1}{2}\,nZ[10][z,t]\,a4'[t] - e^{-2\,a4[t]}\,nZ[10][z,t]\,a4'[t]$$

In[ ]:=
```
Clear[swap8];
swap8[j_Integer] := Module[{a1, a2, a3, a4, a5, a6},
  a1 = swap[8, j, Dtvar22ZEQS[[8 - 7]]];
  a2 = Dtvar22ZEQS[[j - 7]];
  a3 = a2[[2]] - a1[[2]] // FullSimplify[#, constraintVars] &;
  a4 = D[a3, M] // FullSimplify[#, constraintVars] &;
  a5 = D[a3, Q2] // FullSimplify[#, constraintVars] &;
  a6 = {a3, a4, a5};
  Return[a6];]
```

In[ ]:=
```
Dtvar22ZEQS[[1]]
swap[8, 14, %]
swap[14, 8, %%] === %
```

Out[ ]=

$$nZ[8]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[14][z,t] + M\,nZ[15][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right) Q2\,nZ[13][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[14]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[8][z,t] + M\,nZ[15][z,t] + \frac{1}{2}\left(2 + e^{-2\,a4[t]}\right) Q2\,nZ[13][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t]$$

Out[ ]=

True

In[ ]:=
```
swap8[14]
```

Out[ ]=

$$\left\{M\,nZ[9][z,t] - M\,nZ[15][z,t] + \frac{1}{2}\,e^{-2\,a4[t]}\left(1 + 2\,e^{2\,a4[t]}\right) Q2\,(nZ[11][z,t] - nZ[13][z,t])\,a4'[t] + 6\,\mathrm{Tan}[z]\left(-nZ[11]^{(1,0)}[z,t] + nZ[13]^{(1,0)}[z,t]\right),\ nZ[9][z,t] - nZ[15][z,t],\ \frac{1}{2}\,e^{-2\,a4[t]}\left(1 + 2\,e^{2\,a4[t]}\right)(nZ[11][z,t] - nZ[13][z,t])\,a4'[t]\right\}$$

In[ ]:=
```
Dtvar22ZEQS[[9 - 7]]
swap[9, 15, %]
Dtvar22ZEQS[[15 - 7]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, M] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[9]^{(0,1)}[z,t] == -M\,nZ[14][z,t] - \frac{3}{2}\,Q2\,nZ[15][z,t] - \frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[12][z,t]\,a4'[t] - 6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]$$

Out[ ]=

$$M\,nZ[14][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[9][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[12][z,t]\,a4'[t]\right) + nZ[15]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t] == 0$$

Out[ ]=

$$nZ[15]^{(0,1)}[z,t] == -M\,nZ[8][z,t] - \frac{3}{2}\,Q2\,nZ[9][z,t] - \frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[10][z,t]\,a4'[t] - 6\,\mathrm{Tan}[z]\,nZ[12]^{(1,0)}[z,t]$$

Out[ ]=

$$\frac{1}{2}\Big(-2\,M\,nZ[8][z,t] - 3\,Q2\,nZ[9][z,t] + 2\,M\,nZ[14][z,t] + 3\,Q2\,nZ[15][z,t] - e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,(nZ[10][z,t] - nZ[12][z,t])\,a4'[t] + 12\,\mathrm{Tan}[z]\left(nZ[10]^{(1,0)}[z,t] - nZ[12]^{(1,0)}[z,t]\right)\Big)$$

Out[ ]=

$$-nZ[8][z,t] + nZ[14][z,t]$$

Out[ ]=

$$\frac{1}{2}\left(-3\,nZ[9][z,t] + 3\,nZ[15][z,t] - e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)(nZ[10][z,t] - nZ[12][z,t])\,a4'[t]\right)$$

In[ ]:=
```
{{8, 14}, {9, 15}, {11, 13}}
```

Out[ ]=

{{8, 14}, {9, 15}, {11, 13}}

In[ ]:=
```
Dtvar22ZEQS[[11 - 7]]
swap[11, 13, %]
Dtvar22ZEQS[[13 - 7]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, M] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[ ]=

$$nZ[11]^{(0,1)}[z,t] == M\,nZ[12][z,t] - \frac{3}{2}\,Q2\,nZ[13][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[13]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[11][z,t] + M\,nZ[12][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[14][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t]$$

Out[ ]=

$$nZ[13]^{(0,1)}[z,t] == M\,nZ[10][z,t] - \frac{3}{2}\,Q2\,nZ[11][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t] + 6\,\mathrm{Tan}[z]\,nZ[14]^{(1,0)}[z,t]$$

Out[ ]=

$$\frac{1}{2}\Big(2\,M\,nZ[10][z,t] - 3\,Q2\,nZ[11][z,t] - 2\,M\,nZ[12][z,t] + 3\,Q2\,nZ[13][z,t] + e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)Q2\,(nZ[8][z,t] - nZ[14][z,t])\,a4'[t] + 12\,\mathrm{Tan}[z]\left(-nZ[8]^{(1,0)}[z,t] + nZ[14]^{(1,0)}[z,t]\right)\Big)$$

Out[ ]=

$$nZ[10][z,t] - nZ[12][z,t]$$

Out[ ]=

$$\frac{1}{2}\left(-3\,nZ[11][z,t] + 3\,nZ[13][z,t] + e^{-2\,a4[t]}\left(1+2\,e^{2\,a4[t]}\right)(nZ[8][z,t] - nZ[14][z,t])\,a4'[t]\right)$$

In[∘]:=
```
Dtvar22ZEQS[[10 - 7]]
swap[10, 12, %]
Dtvar22ZEQS[[12 - 7]]
%[[2]] - %%%[[2]] // FullSimplify[#, constraintVars] &
D[%, M] // FullSimplify[#, constraintVars] &
D[%%, Q2] // FullSimplify[#, constraintVars] &
```

Out[∘]=

$$nZ[10]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[12][z,t] - M\,nZ[13][z,t] - \frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t] - 6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]$$

Out[∘]=

$$M\,nZ[13][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[10][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[15][z,t]\,a4'[t]\right) + nZ[12]^{(0,1)}[z,t] + 6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t] == 0$$

Out[∘]=

$$nZ[12]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[10][z,t] - M\,nZ[11][z,t] - \frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[9][z,t]\,a4'[t] - 6\,\mathrm{Tan}[z]\,nZ[15]^{(1,0)}[z,t]$$

Out[∘]=

$$-M\,nZ[11][z,t] + M\,nZ[13][z,t] + \frac{1}{2}\,Q2\left(-3\,nZ[10][z,t] + 3\,nZ[12][z,t] - e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)(nZ[9][z,t] - nZ[15][z,t])\,a4'[t]\right) + 6\,\mathrm{Tan}[z]\left(nZ[9]^{(1,0)}[z,t] - nZ[15]^{(1,0)}[z,t]\right)$$

Out[∘]=

$$-nZ[11][z,t] + nZ[13][z,t]$$

Out[∘]=

$$\frac{1}{2}\left(-3\,nZ[10][z,t] + 3\,nZ[12][z,t] - e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)(nZ[9][z,t] - nZ[15][z,t])\,a4'[t]\right)$$

In[∘]:=
```
{9, 10, 12, 15}
```

Out[∘]=

{9, 10, 12, 15}

In[∘]:=
```
Clear[swap9];
swap9[j_Integer] := Module[{a1, a2, a3, a4, a5, a6},
  a1 = swap[9, j, Dtvar22ZEQS[[9 - 7]]];
  a2 = Dtvar22ZEQS[[j - 7]];
  a3 = a2[[2]] - a1[[2]] // FullSimplify[#, constraintVars] &;
  a4 = D[a3, M] // FullSimplify[#, constraintVars] &;
  a5 = D[a3, Q2] // FullSimplify[#, constraintVars] &;
  a6 = {a3, a4, a5};
  Return[a6];]
```

In[ ]:=
```
swap9[10]
```

Out[ ]=

$$\left\{-\frac{3}{2}\,Q2\,nZ[12][z,t]-M\,nZ[13][z,t]-\frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)Q2\,nZ[15][z,t]\,a4'[t]-6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t],\ -nZ[13][z,t],\ -\frac{3}{2}\,nZ[12][z,t]-\frac{1}{2}\,e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[15][z,t]\,a4'[t]\right\}$$

In[ ]:=
```
{{8, 14}, {9, 15}, {11, 13}}
```

Out[ ]=

{{8, 14}, {9, 15}, {11, 13}}

In[ ]:=
```
Dtvar22ZEQST04 =
 Dtvar22ZEQS /. Flatten[{{nZ[12] → ((nZ[10][#1, #2]) &), nZ[13] → ((nZ[11][#1, #2]) &),
       nZ[14] → ((nZ[8][#1, #2]) &), nZ[15] → ((nZ[9][#1, #2]) &)}}] //
   FullSimplify[#, constraintVars] & // Union
Length[%]
```

Out[ ]=

$$\left\{nZ[8]^{(0,1)}[z,t]==-\frac{3}{2}\,Q2\,nZ[8][z,t]+M\,nZ[9][z,t]+\frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t]+6\,\mathrm{Tan}[z]\,nZ[11]^{(1,0)}[z,t],\right.$$
$$nZ[11]^{(0,1)}[z,t]==M\,nZ[10][z,t]-\frac{3}{2}\,Q2\,nZ[11][z,t]+\frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t]+6\,\mathrm{Tan}[z]\,nZ[8]^{(1,0)}[z,t],$$
$$M\,nZ[11][z,t]+\frac{1}{2}\,Q2\left(3\,nZ[10][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[9][z,t]\,a4'[t]\right)+nZ[10]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[9]^{(1,0)}[z,t]==0,$$
$$\left.M\,nZ[8][z,t]+\frac{1}{2}\,Q2\left(3\,nZ[9][z,t]+e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[10][z,t]\,a4'[t]\right)+nZ[9]^{(0,1)}[z,t]+6\,\mathrm{Tan}[z]\,nZ[10]^{(1,0)}[z,t]==0\right\}$$

Out[ ]=

4

In[ ]:=
```
DSolve[Dtvar22ZEQST04, {nZ[8][z, t], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t]}, {z, t}]
```

Out[ ]=

$$\text{DSolve}\Big[\Big\{nZ[8]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[8][z,t] + M\,nZ[9][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t] + 6\,\text{Tan}[z]\,nZ[11]^{(1,0)}[z,t],\ nZ[11]^{(0,1)}[z,t] == M\,nZ[10][z,t] - \frac{3}{2}\,Q2\,nZ[11][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t] + 6\,\text{Tan}[z]\,nZ[8]^{(1,0)}[z,t],$$

$$M\,nZ[11][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[10][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[9][z,t]\,a4'[t]\right) + nZ[10]^{(0,1)}[z,t] + 6\,\text{Tan}[z]\,nZ[9]^{(1,0)}[z,t] == 0,$$

$$M\,nZ[8][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[9][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[10][z,t]\,a4'[t]\right) + nZ[9]^{(0,1)}[z,t] + 6\,\text{Tan}[z]\,nZ[10]^{(1,0)}[z,t] == 0\Big\},$$

$$\{nZ[8][z,t], nZ[9][z,t], nZ[10][z,t], nZ[11][z,t]\}, \{z,t\}\Big]$$

In[ ]:=
```
Dtvar22ZEQST04
FullForm[%] /. sreplacenZ
{nZ[8][z, t], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t]}
FullForm[%] /. sreplacenZ
```

Out[ ]=

$$\left\{nZ[8]^{(0,1)}[z,t] == -\frac{3}{2}\,Q2\,nZ[8][z,t] + M\,nZ[9][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[11][z,t]\,a4'[t] + 6\,Tan[z]\,nZ[11]^{(1,0)}[z,t],\right.$$

$$nZ[11]^{(0,1)}[z,t] == M\,nZ[10][z,t] - \frac{3}{2}\,Q2\,nZ[11][z,t] + \frac{1}{2}\left(2+e^{-2\,a4[t]}\right)Q2\,nZ[8][z,t]\,a4'[t] + 6\,Tan[z]\,nZ[8]^{(1,0)}[z,t],$$

$$M\,nZ[11][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[10][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[9][z,t]\,a4'[t]\right) + nZ[10]^{(0,1)}[z,t] + 6\,Tan[z]\,nZ[9]^{(1,0)}[z,t] == 0,$$

$$\left.M\,nZ[8][z,t] + \frac{1}{2}\,Q2\left(3\,nZ[9][z,t] + e^{-2\,a4[t]}\left(2+e^{2\,a4[t]}\right)nZ[10][z,t]\,a4'[t]\right) + nZ[9]^{(0,1)}[z,t] + 6\,Tan[z]\,nZ[10]^{(1,0)}[z,t] == 0\right\}$$

Out[ ]//FullForm=
```
List[Equal[Derivative[0, 1][nZ8][z, t],
  Plus[Times[Rational[-3, 2], Q2, nZ8[z, t]], Times[M, nZ9[z, t]],
   Times[Rational[1, 2], Plus[2, Power[E, Times[-2, a4[t]]]], Q2, nZ11[z, t],
    Derivative[1][a4][t]], Times[6, Tan[z], Derivative[1, 0][nZ11][z, t]]]],
 Equal[Derivative[0, 1][nZ11][z, t], Plus[Times[M, nZ10[z, t]],
   Times[Rational[-3, 2], Q2, nZ11[z, t]], Times[Rational[1, 2],
    Plus[2, Power[E, Times[-2, a4[t]]]], Q2, nZ8[z, t], Derivative[1][a4][t]],
   Times[6, Tan[z], Derivative[1, 0][nZ8][z, t]]]], Equal[Plus[Times[M, nZ11[z, t]],
   Times[Rational[1, 2], Q2, Plus[Times[3, nZ10[z, t]], Times[Power[E, Times[-2, a4[t]]],
      Plus[2, Power[E, Times[2, a4[t]]]], nZ9[z, t], Derivative[1][a4][t]]]],
   Derivative[0, 1][nZ10][z, t], Times[6, Tan[z], Derivative[1, 0][nZ9][z, t]]], 0],
 Equal[Plus[Times[M, nZ8[z, t]], Times[Rational[1, 2], Q2,
    Plus[Times[3, nZ9[z, t]], Times[Power[E, Times[-2, a4[t]]],
      Plus[2, Power[E, Times[2, a4[t]]]], nZ10[z, t], Derivative[1][a4][t]]]],
   Derivative[0, 1][nZ9][z, t], Times[6, Tan[z], Derivative[1, 0][nZ10][z, t]]], 0]]
```

Out[ ]=
```
{nZ[8][z, t], nZ[9][z, t], nZ[10][z, t], nZ[11][z, t]}
```

Out[ ]//FullForm=
```
List[nZ8[z, t], nZ9[z, t], nZ10[z, t], nZ11[z, t]]
```

In[ ]:=
```
ToExpression[MathMLForm[]]
```

ToExpression: MathMLForm[] is not a string or a box. ToExpression can only interpret strings or boxes as Wolfram Language input.

Out[ ]=
```
$Failed
```

In[ ]:=
```
ToExpression[MathMLForm[]]
```

ToExpression: MathMLForm[] is not a string or a box. ToExpression can only interpret strings or boxes as Wolfram Language input.

Out[ ]=
```
$Failed
```

In[ ]:=
```
ToExpression[MathMLForm[ ]]
```

ToExpression: <math> <mi>Null</mi> </math> is not a string or a box. ToExpression can only interpret strings or boxes as Wolfram Language input.

Out[ ]=
```
$Failed
```

DESol is a data structure to represent the solution of a differential equation . It is to dsolve as RootOf is to solve . • The DESol data structure makes manipulation of differential equations much easier . Its existence allows many hooks to the rest of Maple, diff, int, evalf, series, simplify, just to name the most prominent . DESol can be used as an operator (using D), or as an expression (using diff (..., x)) . The examples below illustrate some of the operations that can be performed with DESol .

In[ ]:=
```
seq2Q1A := {nZ10 (z, t) = (c2C7 * sin (C2Q1 * t) + c2C8 * cos (C2Q1 * t)) *
    (c2C5 * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + c2C6 * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6)),
  nZ11 (z, t) = (c2C3 * sin (C2Q1 * t) + c2C4 * cos (C2Q1 * t)) *
    (c2C1 * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + c2C2 * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6)),
  nZ8 (z, t) = (((-C2Q1 * c2C2 * c2C3 + M * c2C6 * c2C8) * cos (C2Q1 * t) + sin (C2Q1 * t) *
          (C2Q1 * c2C2 * c2C4 + M * c2C6 * c2C7)) * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) +
      ((C2Q1 * c2C1 * c2C3 - M * c2C5 * c2C8) * cos (C2Q1 * t) - sin (C2Q1 * t) *
          (C2Q1 * c2C1 * c2C4 + M * c2C5 * c2C7)) * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) +
      (-cos (M * t) * c2C10 + sin (M * t) * c2C9) * sqrt (-C2Q1 ^ 2 + M ^ 2)) / sqrt (-C2Q1 ^ 2 + M ^ 2),
  nZ9 (z, t) = (((C2Q1 * c2C6 * c2C7 + M * c2C2 * c2C4) * cos (C2Q1 * t) + sin (C2Q1 * t) *
         (-C2Q1 * c2C6 * c2C8 + M * c2C2 * c2C3)) * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 3) +
     sqrt (-C2Q1 ^ 2 + M ^ 2) * (cos (M * t) * c2C9 + sin (M * t) * c2C10) * sin
      (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + (-C2Q1 * c2C5 * c2C7 - M * c2C1 * c2C4) * cos (C2Q1 * t) -
     sin (C2Q1 * t) * (-C2Q1 * c2C5 * c2C8 + M * c2C1 * c2C3)) *
    sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) / sqrt (-C2Q1 ^ 2 + M ^ 2)}
```

$$\left\{ nZ10(z,t) = \left(c2C7 \sin(C2Q1\, t) + c2C8 \cos(C2Q1\, t)\right) \left(c2C5 \sin(z)^{\frac{\sqrt{-C2Q1^2 + M^2}}{6}} + c2C6 \sin(z)^{-\frac{\sqrt{-C2Q1^2 + M^2}}{6}} \right), nZ11(z,t) \right.$$

$$= (c2C3 \sin(C2Q1\, t)$$

$$+ c2C4 \cos(C2Q1\, t)) \left(c2C1 \sin(z)^{\frac{\sqrt{-C2Q1^2 + M^2}}{6}}\right.$$

$$\left. + c2C2 \sin(z)^{-\frac{\sqrt{-C2Q1^2 + M^2}}{6}} \right), nZ8(z, t)$$

$$= \frac{1}{\sqrt{-C2Q1^2 + M^2}} \left(((-C2Q1\, c2C2\, c2C3\right.$$

$$+ M\, c2C6\, c2C8) \cos(C2Q1\, t)$$

$$+ \sin(C2Q1\, t)\, (C2Q1\, c2C2\, c2C4 + M\, c2C6\, c2C7))$$

$$\sin(z)^{-\frac{\sqrt{-C2Q1^2 + M^2}}{6}} + ((C2Q1\, c2C1\, c2C3$$

$$- M\, c2C5\, c2C8) \cos(C2Q1\, t)$$

$$- \sin(C2Q1\, t)\, (C2Q1\, c2C1\, c2C4 + M\, c2C5\, c2C7))$$

$$\sin(z)^{\frac{\sqrt{-C2Q1^2 + M^2}}{6}} + (-\cos(M\, t)\, c2C10$$

$$+ \sin(M\, t)\, c2C9) \left. \sqrt{-C2Q1^2 + M^2} \right) nZ9(z, t)$$

$$+ \sin(M t)\, c2C9) \sqrt{-C2Q1^2 + M^2}\,), nZ9(z, t)$$

$$= \frac{1}{\sqrt{-C2Q1^2 + M^2}} \Bigg(\Bigg(((C2Q1\, c2C6\, c2C7$$

$$+ M\, c2C2\, c2C4) \cos(C2Q1\, t) + \sin(C2Q1\, t)\, ($$

$$- C2Q1\, c2C6\, c2C8 + M\, c2C2\, c2C3))\, \sin(z)^{-\frac{\sqrt{-C2Q1^2 + M^2}}{3}}$$

$$+ \sqrt{-C2Q1^2 + M^2}\, (\cos(M t)\, c2C9$$

$$+ \sin(M t)\, c2C10)\, \sin(z)^{-\frac{\sqrt{-C2Q1^2 + M^2}}{6}} + ($$

$$- C2Q1\, c2C5\, c2C7 - M\, c2C1\, c2C4) \cos(C2Q1\, t)$$

$$- \sin(C2Q1\, t)\, (-C2Q1\, c2C5\, c2C8 + M\, c2C1\, c2C3) \Bigg)$$

$$\sin(z)^{\frac{\sqrt{-C2Q1^2 + M^2}}{6}} \Bigg) \Bigg\}$$

In[ ]:=
```
seq2Q1A := {nZ10 (z, t) = (c2C7 * sin (C2Q1 * t) + c2C8 * cos (C2Q1 * t)) *
    (c2C5 * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + c2C6 * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6)),
  nZ11 (z, t) = (c2C3 * sin (C2Q1 * t) + c2C4 * cos (C2Q1 * t)) *
    (c2C1 * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + c2C2 * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6)),
  nZ8 (z, t) = (((-C2Q1 * c2C2 * c2C3 + M * c2C6 * c2C8) * cos (C2Q1 * t) + sin (C2Q1 * t) *
          (C2Q1 * c2C2 * c2C4 + M * c2C6 * c2C7)) * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) +
      ((C2Q1 * c2C1 * c2C3 - M * c2C5 * c2C8) * cos (C2Q1 * t) - sin (C2Q1 * t) *
          (C2Q1 * c2C1 * c2C4 + M * c2C5 * c2C7)) * sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) +
      (-cos (M * t) * c2C10 + sin (M * t) * c2C9) * sqrt (-C2Q1 ^ 2 + M ^ 2)) / sqrt (-C2Q1 ^ 2 + M ^ 2),
  nZ9 (z, t) = (((C2Q1 * c2C6 * c2C7 + M * c2C2 * c2C4) * cos (C2Q1 * t) + sin (C2Q1 * t) *
         (-C2Q1 * c2C6 * c2C8 + M * c2C2 * c2C3)) * sin (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 3) +
     sqrt (-C2Q1 ^ 2 + M ^ 2) * (cos (M * t) * c2C9 + sin (M * t) * c2C10) * sin
      (z) ^ (-sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) + (-C2Q1 * c2C5 * c2C7 - M * c2C1 * c2C4) * cos (C2Q1 * t) -
     sin (C2Q1 * t) * (-C2Q1 * c2C5 * c2C8 + M * c2C1 * c2C3)) *
    sin (z) ^ (sqrt (-C2Q1 ^ 2 + M ^ 2) / 6) / sqrt (-C2Q1 ^ 2 + M ^ 2)}
```

In[ ]:=
```
ConvertMapleToMathematica[
 "{nZ10(z,t)=(c2C7*sin(C2Q1*t)+c2C8*cos(C2Q1*t))*(c2C5*sin(z)^(sqrt(-C2Q1^2+M^2)/6)+c2C6*
   sin(z)^(-sqrt(-C2Q1^2+M^2)/6)),nZ11(z,t)=(c2C3*sin(C2Q1*t)+c2C4*cos(C2Q1*t))*(c2C1*
   sin(z)^(sqrt(-C2Q1^2+M^2)/6)+c2C2*sin(z)^(-sqrt(-C2Q1^2+M^2)/6)),nZ8(z,t)=(((-C2Q1*
   c2C2*c2C3+M*c2C6*c2C8)*cos(C2Q1*t)+sin(C2Q1*t)*(C2Q1*c2C2*c2C4+M*c2C6*c2C7))*sin(z)^(-s
   c2C1*c2C4+M*c2C5*c2C7))*sin(z)^(sqrt(-C2Q1^2+M^2)/6)+(-cos(M*t)*c2C10+sin(M*t)*c2C9)
   *sqrt(-C2Q1^2+M^2))/sqrt(-C2Q1^2+M^2),nZ9(z,t)=(((C2Q1*c2C6*c2C7+M*c2C2*c2C4)*cos(
   C2Q1*t)+sin(C2Q1*t)*(-C2Q1*c2C6*c2C8+M*c2C2*c2C3))*sin(z)^(-sqrt(-C2Q1^2+M^2)/3)+
   sqrt(-C2Q1^2+M^2)*(cos(M*t)*c2C9+sin(M*t)*c2C10)*sin(z)^(-sqrt(-C2Q1^2+M^2)/6)+(-C2
    Q1*c2C5*c2C7-M*c2C1*c2C4)*cos(C2Q1*t)-sin(C2Q1*t)*(-C2Q1*c2C5*c2C8+M*c2C1*c2C3))*sin
   (z)^(sqrt(-C2Q1^2+M^2)/6)/sqrt(-C2Q1^2+M^2)}"]
snZ8nZ9nZ10nZ11 = ToExpression[%]
```

Out[ ]=
```
{nZ10[z, t] == (((c2C7 * Sin[(C2Q1 * t)]) + (c2C8 * Cos[(C2Q1 * t)])) * ((c2C5 * (Sin[z]
  ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6))) + (c2C6 * (Sin[z] ^ (-(Sqrt[((-(C2Q1)
  ^ 2) + (M ^ 2))]) / 6))))), nZ11[z, t] == (((c2C3 * Sin[(C2Q1 * t)]) + (c2C4 *
  Cos[(C2Q1 * t)])) * ((c2C1 * (Sin[z] ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6)))
  + (c2C2 * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) / 6))))), nZ8[z, t] ==
  (((((((((-(C2Q1) * c2C2) * c2C3) + ((M * c2C6) * c2C8)) * Cos[(C2Q1 * t)]) +
  (Sin[(C2Q1 * t)] * (((C2Q1 * c2C2) * c2C4) + ((M * c2C6) * c2C7)))) * (Sin[z] ^
  (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) / 6))) + ((((((C2Q1 * c2C1) * c2C3) - ((M *
  c2C5) * c2C8)) * Cos[(C2Q1 * t)]) - (Sin[(C2Q1 * t)] * (((C2Q1 * c2C1) * c2C4)
  + ((M * c2C5) * c2C7)))) * (Sin[z] ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6)))) +
  (((-(Cos[(M * t)]) * c2C10) + (Sin[(M * t)] * c2C9)) * Sqrt[((-(C2Q1) ^ 2) + (M ^
  2))])) / Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]), nZ9[z, t] == ((((((((((C2Q1 * c2C6) *
  c2C7) + ((M * c2C2) * c2C4)) * Cos[(C2Q1 * t)]) + (Sin[(C2Q1 * t)] * (((-(C2Q1)
  * c2C6) * c2C8) + ((M * c2C2) * c2C3)))) * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) +
  (M ^ 2))]) / 3))) + ((Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] * ((Cos[(M * t)] * c2C9)
  + (Sin[(M * t)] * c2C10))) * (Sin[z] ^ (-(Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))]) /
  6)))) + ((((-(C2Q1) * c2C5) * c2C7) - ((M * c2C1) * c2C4)) * Cos[(C2Q1 * t)])) -
  (Sin[(C2Q1 * t)] * (((-(C2Q1) * c2C5) * c2C8) + ((M * c2C1) * c2C3)))) * (Sin[z]
  ^ (Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))] / 6))) / Sqrt[((-(C2Q1) ^ 2) + (M ^ 2))])}
```

Out[ ]=

$$\Big\{nZ10[z,t] == (c2C8\,\mathrm{Cos}[C2Q1\,t] + c2C7\,\mathrm{Sin}[C2Q1\,t])\left(c2C6\,\mathrm{Sin}[z]^{-\frac{1}{6}\sqrt{-C2Q1^2+M^2}} + c2C5\,\mathrm{Sin}[z]^{\frac{1}{6}\sqrt{-C2Q1^2+M^2}}\right),\ nZ11[z,t] == (c2C4\,\mathrm{Cos}[C2Q1\,t] + c2C3\,\mathrm{Sin}[C2Q1\,t])\left(c2C2\,\mathrm{Sin}[z]^{-\frac{1}{6}\sqrt{-C2Q1^2+M^2}} + c2C1\,\mathrm{Sin}[z]^{\frac{1}{6}\sqrt{-C2Q1^2+M^2}}\right),$$

$$nZ8[z,t] == \frac{1}{\sqrt{-C2Q1^2+M^2}}\Big(\sqrt{-C2Q1^2+M^2}\,(-c2C10\,\mathrm{Cos}[M\,t] + c2C9\,\mathrm{Sin}[M\,t]) + ((-c2C2\,c2C3\,C2Q1 + c2C6\,c2C8\,M)\,\mathrm{Cos}[C2Q1\,t] + (c2C2\,c2C4\,C2Q1 + c2C6\,c2C7\,M)\,\mathrm{Sin}[C2Q1\,t])\,\mathrm{Sin}[z]^{-\frac{1}{6}\sqrt{-C2Q1^2+M^2}} + ((c2C1\,c2C3\,C2Q1 - c2C5\,c2C8\,M)\,\mathrm{Cos}[C2Q1\,t] - (c2C1\,c2C4\,C2Q1 + c2C5\,c2C7\,M)\,\mathrm{Sin}[C2Q1\,t])\,\mathrm{Sin}[z]^{\frac{1}{6}\sqrt{-C2Q1^2+M^2}}\Big),$$

$$nZ9[z,t] == \frac{1}{\sqrt{-C2Q1^2+M^2}}\,\mathrm{Sin}[z]^{\frac{1}{6}\sqrt{-C2Q1^2+M^2}}\Big((-c2C5\,c2C7\,C2Q1 - c2C1\,c2C4\,M)\,\mathrm{Cos}[C2Q1\,t] - (-c2C5\,c2C8\,C2Q1 + c2C1\,c2C3\,M)\,\mathrm{Sin}[C2Q1\,t] + ((c2C6\,c2C7\,C2Q1 + c2C2\,c2C4\,M)\,\mathrm{Cos}[C2Q1\,t] + (-c2C6\,c2C8\,C2Q1 + c2C2\,c2C3\,M)\,\mathrm{Sin}[C2Q1\,t])\,\mathrm{Sin}[z]^{-\frac{1}{3}\sqrt{-C2Q1^2+M^2}} + \sqrt{-C2Q1^2+M^2}\,(c2C9\,\mathrm{Cos}[M\,t] + c2C10\,\mathrm{Sin}[M\,t])\,\mathrm{Sin}[z]^{-\frac{1}{6}\sqrt{-C2Q1^2+M^2}}\Big)\Big\}$$