```
> restart; with(grtensor);
```

libname := "/Users/peter/maple/gitlab/GRTensorIII/lib",
"/Library/Frameworks/Maple.framework/Versions/2017/lib"

"GRTensor III v2.0.2+ Debug"

"Copyright 2017, Peter Musgrave, Denis Pollney, Kayll Lake"

"Latest version is at http://github.com/grtensor/grtensor"

"For help ?grtensor"

[*Asym*, *KillingCoords*, *PetrovReport*, *Sym*, *autoAlias*, *difftool*, *grDalias*, *grF_strToDef*, *gralter*, *grapply*, *grarray*, *grcalc*, *grcalc1*, *grcalcalter*, *grcalcd*, *grclear*, *grcomponent*, *grconstraint*, *grdata*, *grdebug*, *grdef*, *grdisplay*, *grdump*, *greqn2set*, *grinit*, *grload*, *grload_maplet*, *grmap*, *grmetric*, *grnewmetric*, *grnormalize*, *groptions*, *grsaveg*, *grtestinput*, *grtransform*, *grundef*, *hypersurf*, *join*, *kdelta*, *makeg*, *nprotate*, *nptetrad*, *qload*, *spacetime*]

grOptionqloadPath := "/Users/peter/maple/gitlab/GRTensorIII/kayll/metrics"

grOptionMetricPath := "/Users/peter/maple/gitlab/grtensor/metrics"

[*Asym*, *KillingCoords*, *PetrovReport*, *Sym*, *autoAlias*, *difftool*, *grDalias*, *grF_strToDef*, *gralter*, *grapply*, *grarray*, *grcalc*, *grcalc1*, *grcalcalter*, *grcalcd*, *grclear*, *grcomponent*, *grconstraint*, *grdata*, *grdebug*, *grdef*, *grdisplay*, *grdump*, *greqn2set*, *grinit*, *grload*, *grload_maplet*, *grmap*, *grmetric*, *grnewmetric*, *grnormalize*, *groptions*, *grsaveg*, *grtestinput*, *grtransform*, *grundef*, *hypersurf*, *join*, *kdelta*, *makeg*, *nprotate*, *nptetrad*, *qload*, *spacetime*] **(1)**

```
> qload(schw);
Calculated ds for schw (0.001000 sec.)
```

Default spacetime = schw

For the schw spacetime:

Coordinates

$x(up)$

$$x^a = \left[\begin{array}{cccc} r & \theta & \phi & t \end{array}\right]$$

Line element

$$ds^2 = \frac{dr^2}{1 - \frac{2m}{r}} + r^2\, d\theta^2 + r^2 \sin(\theta)^2\, d\phi^2 + \left(-1 + \frac{2m}{r}\right) dt^2$$

The Schwarzschild metric in curvature coordinates **(2)**

```
> grcalc(Winvars);
Created definition for C(up,up,up,up)
Calculated g(dn,dn,pdn) for schw (0.002000 sec.)
Calculated Chr(dn,dn,dn) for schw (0.001000 sec.)
Calculated detg for schw (0.003000 sec.)
Calculated g(up,up) for schw (0.005000 sec.)
Calculated Chr(dn,dn,up) for schw (0.002000 sec.)
Calculated R(dn,dn) for schw (0.001000 sec.)
Calculated Ricciscalar for schw (0.000000 sec.)
Calculated R(dn,dn,dn,dn) for schw (0.003000 sec.)
Calculated C(dn,dn,dn,dn) for schw (0.001000 sec.)
```

```
Calculated C(dn,dn,up,up) for schw (0.002000 sec.)
Calculated WeylSq for schw (0.000000 sec.)
Calculated W1R for schw (0.000000 sec.)
Calculated C(up,up,up,up) for schw (0.014000 sec.)
Calculated detg for schw (0.000000 sec.)
Calculated LevC(dn,dn,dn,dn) for schw (0.015000 sec.)
Calculated Cstar(dn,dn,up,up) for schw (0.001000 sec.)
Calculated W1I for schw (0.000000 sec.)
Calculated C2(dn,dn,up,up) for schw (0.001000 sec.)
Calculated W2R for schw (0.000000 sec.)
Calculated W2I for schw (0.000000 sec.)
```

$$CPU\ Time = 0.059$$ **(3)**

> *grdisplay*(_);

For the schw spacetime:

CM invariant Re(W1)

$$W1R = \frac{6\,m^2}{r^6}$$

CM invariant Im(W1)

$$W1I = 0$$

CM invariant Re(W2)

$$W2R = -\frac{6\,m^3}{r^9}$$

CM invariant Im(W2)

$$W2I = 0$$ **(4)**

>