Punto cuántico

In[◦]:=
```
rho = Table[Subscript[ρ, i - 1, j - 1], {i, 1, 2}, {j, 1, 2}];
      ⌊tabla     ⌊subíndice
H = {{0, 0}, {0, ϵ}};
L1 = {{0, 0}, {1, 0}} * Sqrt[Γ1];
                        ⌊raíz cuadrada
L2 = {{0, 1}, {0, 0}} * Sqrt[Γ2];
                        ⌊raíz cuadrada
Ls = {L1, L2};
```

In[◦]:=
```
coh = - I * (H.rho - rho.H);
        ⌊número i
incoh = Sum[
        ⌊suma
   ConjugateTranspose[Ls[[i]]].rho.Ls[[i]] - 1 / 2 * (Ls[[i]].ConjugateTranspose[Ls[[i]]].rho +
   ⌊transpuesto conjugado                                ⌊transpuesto conjugado
       rho.Ls[[i]].ConjugateTranspose[Ls[[i]]]), {i, 1, 2}] ;
                   ⌊transpuesto conjugado
incoh = FullSimplify[incoh, Assumptions → {Γ1 > 0, Γ2 > 0}];
        ⌊simplifica completamente  ⌊asunciones
```

In[◦]:=
```
coh // MatrixForm
       ⌊forma de matriz
incoh // MatrixForm
         ⌊forma de matri
```

Out[◦]//MatrixForm=

$$\begin{pmatrix} 0 & i\,\epsilon\,\rho_{0,1} \\ -i\,\epsilon\,\rho_{1,0} & 0 \end{pmatrix}$$

Out[◦]//MatrixForm=

$$\begin{pmatrix} -\Gamma2\,\rho_{0,0} + \Gamma1\,\rho_{1,1} & -\frac{1}{2}\,(\Gamma1 + \Gamma2)\,\rho_{0,1} \\ -\frac{1}{2}\,(\Gamma1 + \Gamma2)\,\rho_{1,0} & \Gamma2\,\rho_{0,0} - \Gamma1\,\rho_{1,1} \end{pmatrix}$$

In[◦]:=
```
Solve[{- coh == incoh, Tr[rho] == 1}, Flatten[rho]]
⌊resuelve                ⌊traza          ⌊aplana
```

Out[◦]=

$$\left\{\left\{\rho_{0,0} \to \frac{\Gamma1}{\Gamma1 + \Gamma2},\ \rho_{0,1} \to 0,\ \rho_{1,0} \to 0,\ \rho_{1,1} \to \frac{\Gamma2}{\Gamma1 + \Gamma2}\right\}\right\}$$

Doble punto cuántico

In[∘]:=
```
rho = Table[Subscript[ρ, i - 1, j - 1], {i, 1, 3}, {j, 1, 3}];
          tabla   subíndice
H = {{0, 0, 0}, {0, ϵ / 2, τ / 2}, {0, τ / 2, -ϵ / 2}};
L1 = {{0, 0, 0}, {1, 0, 0}, {0, 0, 0}} * Sqrt[Γ1];
                                          raíz cuadrada
L2 = {{0, 0, 1}, {0, 0, 0}, {0, 0, 0}} * Sqrt[Γ2];
                                          raíz cuadrada
Ls = {L1, L2};
Ls[[1]] // MatrixForm
           forma de matriz
Ls[[2]] // MatrixForm
           forma de matriz
```

Out[∘]//MatrixForm=

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

Out[∘]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & \sqrt{\Gamma 2} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

In[∘]:=
```
coh = -I * (H.rho - rho.H);
      número i
incoh = Sum[
        suma
   Ls[[i]].rho.ConjugateTranspose[Ls[[i]]] - 1 / 2 * (ConjugateTranspose[Ls[[i]]].Ls[[i]].rho +
               transpuesto conjugado                  transpuesto conjugado
       rho.ConjugateTranspose[Ls[[i]]].Ls[[i]]), {i, 1, 2}] ;
           transpuesto conjugado
incoh = FullSimplify[incoh, Assumptions → {Γ1 > 0, Γ2 > 0}];
        simplifica completamente  asunciones
```

In[∘]:=
```
coh // MatrixForm
       forma de matriz
incoh // MatrixForm
         forma de matri:
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} 0 & -i\left(-\frac{1}{2}\epsilon\rho_{0,1}-\frac{1}{2}\tau\rho_{0,2}\right) & -i\left(-\frac{1}{2}\tau\rho_{0,1}+\frac{1}{2}\epsilon\rho_{0,2}\right) \\ -i\left(\frac{1}{2}\epsilon\rho_{1,0}+\frac{1}{2}\tau\rho_{2,0}\right) & -i\left(-\frac{1}{2}\tau\rho_{1,2}+\frac{1}{2}\tau\rho_{2,1}\right) & -i\left(-\frac{1}{2}\tau\rho_{1,1}+\epsilon\rho_{1,2}+\frac{1}{2}\tau\rho_{2,2}\right) \\ -i\left(\frac{1}{2}\tau\rho_{1,0}-\frac{1}{2}\epsilon\rho_{2,0}\right) & -i\left(\frac{1}{2}\tau\rho_{1,1}-\epsilon\rho_{2,1}-\frac{1}{2}\tau\rho_{2,2}\right) & -i\left(\frac{1}{2}\tau\rho_{1,2}-\frac{1}{2}\tau\rho_{2,1}\right) \end{pmatrix}$$

Out[∘]//MatrixForm=

$$\begin{pmatrix} -\Gamma 1\,\rho_{0,0}+\Gamma 2\,\rho_{2,2} & -\frac{1}{2}\Gamma 1\,\rho_{0,1} & -\frac{1}{2}(\Gamma 1+\Gamma 2)\,\rho_{0,2} \\ -\frac{1}{2}\Gamma 1\,\rho_{1,0} & \Gamma 1\,\rho_{0,0} & -\frac{1}{2}\Gamma 2\,\rho_{1,2} \\ -\frac{1}{2}(\Gamma 1+\Gamma 2)\,\rho_{2,0} & -\frac{1}{2}\Gamma 2\,\rho_{2,1} & -\Gamma 2\,\rho_{2,2} \end{pmatrix}$$

```
In[∘]:= sol = Solve[{-coh == incoh, Tr[rho] == 1}, Flatten[rho]] // FullSimplify
              resuelve                traza          aplana            simplifica complet
```

Out[∘]=

$$\left\{\left\{\rho_{0,0}\to\frac{\Gamma 2\,\tau^2}{\Gamma 1\left(\Gamma 2^2+4\,\epsilon^2\right)+(2\,\Gamma 1+\Gamma 2)\,\tau^2},\ \rho_{0,1}\to 0,\ \rho_{0,2}\to 0,\ \rho_{1,0}\to 0,\right.\right.$$

$$\rho_{1,1}\to 1-\frac{(\Gamma 1+\Gamma 2)\,\tau^2}{\Gamma 1\left(\Gamma 2^2+4\,\epsilon^2\right)+(2\,\Gamma 1+\Gamma 2)\,\tau^2},\ \rho_{1,2}\to\frac{\Gamma 1\,(i\,\Gamma 2+2\,\epsilon)\,\tau}{\Gamma 1\left(\Gamma 2^2+4\,\epsilon^2\right)+(2\,\Gamma 1+\Gamma 2)\,\tau^2},$$

$$\left.\left.\rho_{2,0}\to 0,\ \rho_{2,1}\to\frac{\Gamma 1\,(-i\,\Gamma 2+2\,\epsilon)\,\tau}{\Gamma 1\left(\Gamma 2^2+4\,\epsilon^2\right)+(2\,\Gamma 1+\Gamma 2)\,\tau^2},\ \rho_{2,2}\to\frac{\Gamma 1\,\tau^2}{\Gamma 1\left(\Gamma 2^2+4\,\epsilon^2\right)+(2\,\Gamma 1+\Gamma 2)\,\tau^2}\right\}\right\}$$

```
In[∘]:= (sol /. {ϵ → 0, τ → 0}) // FullSimplify
                                   simplifica completamente
```

Out[∘]=

$$\{\{\rho_{0,0}\to 0,\ \rho_{0,1}\to 0,\ \rho_{0,2}\to 0,\ \rho_{1,0}\to 0,\ \rho_{1,1}\to 1,\ \rho_{1,2}\to 0,\ \rho_{2,0}\to 0,\ \rho_{2,1}\to 0,\ \rho_{2,2}\to 0\}\}$$

Triple punto cuántico

```
In[∘]:= rho = Table[Subscript[ρ, i - 1, j - 1], {i, 1, 4}, {j, 1, 4}];
              tabla  subíndice
        H = {{0, 0, 0, 0}, {0, ϵ / 2, τ / 2, 0}, {0, τ / 2, -ϵ / 2, τ / 2}, {0, 0, τ / 2, 0}};
        L1 = {{0, 0, 0, 0}, {1, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} * Sqrt[Γ1];
                                                                    raíz cuadrada
        L2 = {{0, 0, 0, 1}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} * Sqrt[Γ2];
                                                                    raíz cuadrada
        Ls = {L1, L2};
        Ls[[1]] // MatrixForm
                   forma de matriz
        Ls[[2]] // MatrixForm
                   forma de matriz
```

Out[∘]//MatrixForm=

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

Out[∘]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & \sqrt{\Gamma 2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

```
In[∘]:= coh = -I * (H.rho - rho.H);
               número i
        incoh = Sum[
                suma
           Ls[[i]].rho.ConjugateTranspose[Ls[[i]]] - 1 / 2 * (ConjugateTranspose[Ls[[i]]].Ls[[i]].rho +
                       transpuesto conjugado                 transpuesto conjugado
               rho.ConjugateTranspose[Ls[[i]]].Ls[[i]]), {i, 1, 2}];
                   transpuesto conjugado
        incoh = FullSimplify[incoh, Assumptions → {Γ1 > 0, Γ2 > 0}];
                simplifica completamente  asunciones
```

In[ ]:=
```
sol = Solve[{-coh == incoh, Tr[rho] == 1}, Flatten[rho]] // FullSimplify
```
resuelve traza aplana simplifica complet

Out[ ]=

$$\left\{\left\{\rho_{0,0} \to \frac{\Gamma 2\, \tau^4}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},\ \rho_{0,1} \to 0,\ \rho_{0,2} \to 0,\right.\right.$$

$$\rho_{0,3} \to 0,\ \rho_{1,0} \to 0,\ \rho_{1,1} \to \frac{\Gamma 1 \left(4\,\epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+\left(\Gamma 2^2+\epsilon^2\right) \tau^2+\tau^4\right)}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{1,2} \to \frac{2\,\Gamma 1\, \epsilon \left(\Gamma 2^2+\epsilon^2\right) \tau+\Gamma 1\, (i\,\Gamma 2+\epsilon)\, \tau^3}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{1,3} \to \frac{2\,\Gamma 1\, \epsilon\, (i\,\Gamma 2+\epsilon)\, \tau^2}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{2,0} \to 0,\ \rho_{2,1} \to \frac{\Gamma 1\, (-i\,\Gamma 2+\epsilon)\, \tau \left(2\,\epsilon\, (i\,\Gamma 2+\epsilon)+\tau^2\right)}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{2,2} \to \frac{\Gamma 1\, \tau^2 \left(\Gamma 2^2+\epsilon^2+\tau^2\right)}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{2,3} \to \frac{\Gamma 1\, (i\,\Gamma 2+\epsilon)\, \tau^3}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{3,0} \to 0,\ \rho_{3,1} \to \frac{2\,\Gamma 1\, \epsilon\, (-i\,\Gamma 2+\epsilon)\, \tau^2}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\rho_{3,2} \to \frac{\Gamma 1\, (-i\,\Gamma 2+\epsilon)\, \tau^3}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4},$$

$$\left.\left.\rho_{3,3} \to \frac{\Gamma 1\, \tau^4}{4\,\Gamma 1\, \epsilon^2 \left(\Gamma 2^2+\epsilon^2\right)+2\,\Gamma 1 \left(\Gamma 2^2+\epsilon^2\right) \tau^2+(3\,\Gamma 1+\Gamma 2)\, \tau^4}\right\}\right\}$$