

```
> #Brinkmann metric
s:=2*D(U)*D(V)+Dirac(u)*(Y^2-X^2)*(D(u))^2-(D(X))^2-(D(Y))^2;
```

$$s := 2 D(U) D(V) + \text{Dirac}(u) (Y^2 - X^2) D(u)^2 - D(X)^2 - D(Y)^2 \quad (1)$$

```
> a:=subs({U=u,V=v-1/2*Heaviside(u)*(1-u)*x^2+1/2*Heaviside(u)*(1+u)*y^2,X=(1-u*Heaviside(u))*x,Y=(1+u*Heaviside(u))*y},s);
```

$$a := 2 D(u) D\left(v - \frac{1}{2} \text{Heaviside}(u) (1 - u) x^2 + \frac{1}{2} \text{Heaviside}(u) (1 + u) y^2\right) + \text{Dirac}(u) \left((1 + u \text{Heaviside}(u))^2 y^2 - (1 - u \text{Heaviside}(u))^2 x^2 \right) D(u)^2 - D\left((1 - u \text{Heaviside}(u)) x \right)^2 - D\left((1 + u \text{Heaviside}(u)) y \right)^2 \quad (2)$$

```
> b:=expand(a);
```

$$b := 2 D(x)^2 u \text{Heaviside}(u) + D(u) D(\text{Heaviside}(u)) x^2 u + D(u) D(\text{Heaviside}(u)) y^2 u + 2 x u D(\text{Heaviside}(u)) D(x) - 2 y u D(\text{Heaviside}(u)) D(y) + 2 D(u) \text{Heaviside}(u) D(x) x u + 2 D(u) \text{Heaviside}(u) D(y) y u + 2 \text{Dirac}(u) D(u)^2 \text{Heaviside}(u) y^2 u + \text{Dirac}(u) D(u)^2 y^2 u^2 \text{Heaviside}(u)^2 + 2 \text{Dirac}(u) D(u)^2 \text{Heaviside}(u) x^2 u - \text{Dirac}(u) D(u)^2 x^2 u^2 \text{Heaviside}(u)^2 - 2 x^2 D(u) \text{Heaviside}(u) u D(\text{Heaviside}(u)) - 2 x D(u) \text{Heaviside}(u)^2 D(x) u - 2 x u^2 D(\text{Heaviside}(u)) D(x) \text{Heaviside}(u) - 2 y^2 D(u) \text{Heaviside}(u) u D(\text{Heaviside}(u)) - 2 y D(u) \text{Heaviside}(u)^2 D(y) u - 2 y u^2 D(\text{Heaviside}(u)) D(y) \text{Heaviside}(u) - D(u) D(\text{Heaviside}(u)) x^2 + \text{Heaviside}(u) D(u)^2 x^2 - y^2 D(u)^2 \text{Heaviside}(u)^2 + D(u) D(\text{Heaviside}(u)) y^2 + \text{Heaviside}(u) D(u)^2 y^2 + \text{Dirac}(u) D(u)^2 y^2 - \text{Dirac}(u) D(u)^2 x^2 - x^2 D(u)^2 \text{Heaviside}(u)^2 - x^2 u^2 D(\text{Heaviside}(u))^2 - D(x)^2 u^2 \text{Heaviside}(u)^2 - y^2 u^2 D(\text{Heaviside}(u))^2 - 2 D(y)^2 u \text{Heaviside}(u) - D(y)^2 u^2 \text{Heaviside}(u)^2 + 2 D(u) D(v) - D(x)^2 - D(y)^2 \quad (3)$$

```
> c:=simplify(b);
```

$$c := 2 D(x)^2 u \text{Heaviside}(u) - 2 D(y)^2 u \text{Heaviside}(u) + 2 D(u) D(v) - D(x)^2 - D(y)^2 - D(x)^2 u^2 \text{Heaviside}(u) - D(y)^2 u^2 \text{Heaviside}(u) \quad (4)$$

```
> factor(c);
```

$$2 D(x)^2 u \text{Heaviside}(u) - 2 D(y)^2 u \text{Heaviside}(u) + 2 D(u) D(v) - D(x)^2 - D(y)^2 - D(x)^2 u^2 \text{Heaviside}(u) - D(y)^2 u^2 \text{Heaviside}(u) \quad (5)$$

```
> #Specific package
> with(DifferentialGeometry);
```

[−, &mult;, +, &tensor;, ∧, Annihilator, ApplyTransformation, ChangeFrame, ComplementaryBasis, ComposeTransformations, DGbasis, DGsetup, DGzip, DeRhamHomotopy, DualBasis, ExteriorDerivative, Flow, FrameData, GetComponents, GroupActions, Hook, InfinitesimalTransformation, IntegrateForm, IntersectSubspaces, InverseTransformation, JetCalculus, Library, LieAlgebras, LieBracket, LieDerivative, Preferences, Pullback, PullbackVector, Pushforward, RemoveFrame, Tensor, Tools, Transformation, evalDG]

(6)

```
> with(tensor); #no with(Tensor)
[Christoffel1, Christoffel2, Einstein, Jacobian, Killing_eqns, Levi_Civita, Lie_diff, Ricci,
RicciScalar, Riemann, RiemannF, Weyl, act, antisymmetrize, change_basis, commutator,
compare, conj, connexF, contract, convertNP, cov_diff, create, d1metric, d2metric,
directional_diff, displayGR, display_allGR, dual, entermetric, exterior_diff, exterior_prod,
frame, geodesic_eqns, get_char, get_compts, get_rank, init, invars, invert, lin_com, lower,
npcurve, npspin, partial_diff, permute_indices, petrov, prod, raise, symmetrize, tensorsGR,
transform]
```

```
> coord:=[u,v,x,y]:
> g_compts:=array(symmetric, sparse, 1..4, 1..4):
> g_compts[1,2]:=1:
> g_compts[2,1]:=1:
> g_compts[3,3]:=-(1-u*Heaviside(u))^2:
> g_compts[4,4]:=-(1+u*Heaviside(u))^2:
> g:=create([-1,-1],eval(g_compts)); #metric
```

$$g := \text{table} \left(\begin{array}{l} \text{index_char} = [-1, -1], \text{compts} \\ \left[\begin{array}{cccc} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & -(1 - u \text{Heaviside}(u))^2 & 0 \\ 0 & 0 & 0 & -(1 + u \text{Heaviside}(u))^2 \end{array} \right] \end{array} \right) \quad (8)$$

```
> ginv:=invert(g, `detg`);
```

$$\text{ginv} := \text{table} \left(\begin{array}{l} \text{index_char} = [1, 1], \text{compts} \\ \left[\begin{array}{cccc} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & -\frac{1}{(-1 + u \text{Heaviside}(u))^2} & 0 \\ 0 & 0 & 0 & -\frac{1}{(1 + u \text{Heaviside}(u))^2} \end{array} \right] \end{array} \right) \quad (9)$$

```
> D1g:=d1metric(g, coord); #First derivative
D1g:=table([index_char=[-1,-1,-1],compts=ARRAY(cfl,[1..4,1..4,1..4],[(1,1,1) \quad (10)
```

=0, (1, 1, 2) =0, (1, 1, 3) =0, (1, 1, 4) =0, (1, 2, 1) =0, (1, 2, 2) =0, (1, 2, 3) =0, (1, 2, 4) =0, (1, 3, 1) =0, (1, 3, 2) =0, (1, 3, 3) =0, (1, 3, 4) =0, (1, 4, 1) =0, (1, 4, 2) =0, (1, 4, 3) =0, (1, 4, 4) =0, (2, 1, 1) =0, (2, 1, 2) =0, (2, 1, 3) =0, (2, 1, 4) =0, (2, 2, 1) =0, (2, 2, 2) =0, (2, 2, 3) =0, (2, 2, 4) =0, (2, 3, 1) =0, (2, 3, 2) =0, (2, 3, 3) =0, (2, 3, 4) =0, (2, 4, 1) =0, (2, 4, 2) =0, (2, 4, 3) =0, (2, 4, 4) =0, (3, 1, 1) =0, (3, 1, 2) =0, (3, 1, 3) =0, (3, 1, 4) =0, (3, 2, 1) =0, (3, 2, 2) =0, (3, 2, 3) =0, (3, 2, 4) =0, (3, 3, 1) = -2 (-1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (3, 3, 2) =0, (3, 3, 3) =0, (3, 3, 4) =0, (3, 4, 1) =0, (3, 4, 2) =0, (3, 4, 3) =0, (3, 4, 4) =0, (4, 1, 1) =0, (4, 1, 2) =0, (4, 1, 3) =0, (4, 1, 4) =0, (4, 2, 1) =0, (4, 2, 2) =0, (4, 2, 3) =0, (4, 2, 4) =0, (4, 3, 1) =0, (4, 3, 2) =0, (4, 3, 3) =0, (4, 3, 4) =0, (4, 4, 1) = -2 (1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (4, 4, 2) =0, (4, 4, 3) =0, (4, 4, 4) =0]]]

> Cfl:=Christoffel1(D1g); #Christoffel symbols

Cfl := table([index_char = [-1, -1, -1], compts = ARRAY(cfl, [1..4, 1..4, 1..4], [(1, 1, 1) =0, (1, 1, 2) =0, (1, 1, 3) =0, (1, 1, 4) =0, (1, 2, 1) =0, (1, 2, 2) =0, (1, 2, 3) =0, (1, 2, 4) =0, (1, 3, 1) =0, (1, 3, 2) =0, (1, 3, 3) = - (-1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (1, 3, 4) =0, (1, 4, 1) =0, (1, 4, 2) =0, (1, 4, 3) =0, (1, 4, 4) = - (1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (2, 1, 1) =0, (2, 1, 2) =0, (2, 1, 3) =0, (2, 1, 4) =0, (2, 2, 1) =0, (2, 2, 2) =0, (2, 2, 3) =0, (2, 2, 4) =0, (2, 3, 1) =0, (2, 3, 2) =0, (2, 3, 3) =0, (2, 3, 4) =0, (2, 4, 1) =0, (2, 4, 2) =0, (2, 4, 3) =0, (2, 4, 4) =0, (3, 1, 1) =0, (3, 1, 2) =0, (3, 1, 3) = - (-1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (3, 1, 4) =0, (3, 2, 1) =0, (3, 2, 2) =0, (3, 2, 3) =0, (3, 2, 4) =0, (3, 3, 1) = (-1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (3, 3, 2) =0, (3, 3, 3) =0, (3, 3, 4) =0, (3, 4, 1) =0, (3, 4, 2) =0, (3, 4, 3) =0, (3, 4, 4) =0, (4, 1, 1) =0, (4, 1, 2) =0, (4, 1, 3) =0, (4, 1, 4) = - (1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (4, 2, 1) =0, (4, 2, 2) =0, (4, 2, 3) =0, (4, 2, 4) =0, (4, 3, 1) =0, (4, 3, 2) =0, (4, 3, 3) =0, (4, 3, 4) =0, (4, 4, 1) = (1 + u Heaviside(u)) (Heaviside(u) + u Dirac(u)), (4, 4, 2) =0, (4, 4, 3) =0, (4, 4, 4) =0]]])

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> D2g:=d2metric(D1g, coord); #Second derivative

D2g := table([index_char = [-1, -1, -1, -1], compts = ARRAY(d2met, [1..4, 1..4, 1..4, 1..4], [(1, 1, 1, 1) =0, (1, 1, 1, 2) =0, (1, 1, 1, 3) =0, (1, 1, 1, 4) =0, (1, 1, 2, 1) =0, (1, 1, 2, 2) =0, (1, 1, 2, 3) =0, (1, 1, 2, 4) =0, (1, 1, 3, 1) =0, (1, 1, 3, 2) =0, (1, 1, 3, 3) =0, (1, 1, 3, 4) =0, (1, 1, 4, 1) =0, (1, 1, 4, 2) =0, (1, 1, 4, 3) =0, (1, 1, 4, 4) =0, (1, 2, 1, 1) =0, (1, 2, 1, 2) =0, (1, 2, 1, 3) =0, (1, 2, 1, 4) =0, (1, 2, 2, 1) =0, (1, 2, 2, 2) =0, (1, 2, 2, 3) =0, (1, 2, 2, 4) =0, (1, 2, 3, 1) =0, (1, 2, 3, 2) =0, (1, 2, 3, 3) =0, (1, 2, 3, 4) =0, (1, 2, 4, 1) =0, (1, 2, 4, 2) =0, (1, 2, 4, 3) =0, (1, 2, 4, 4) =0, (1, 3, 1, 1) =0, (1, 3, 1, 2) =0, (1, 3, 1, 3) =0, (1, 3, 1, 4) =0, (1, 3, 2, 1) =0, (1, 3, 2, 2) =0, (1, 3, 2, 3) =0, (1, 3, 2, 4) =0, (1, 3, 3, 1) =0, (1, 3, 3, 2) =0, (1, 3, 3, 3) =0, (1, 3, 3, 4) =0, (1, 3, 4, 1) =0, (1, 3, 4, 2) =0, (1, 3, 4, 3) =0, (1, 3, 4, 4) =0, (1, 4, 1, 1) =0, (1, 4, 1, 2) =0, (1, 4,

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$$\begin{aligned}
& 1, 3) = 0, (1, 4, 1, 4) = 0, (1, 4, 2, 1) = 0, (1, 4, 2, 2) = 0, (1, 4, 2, 3) = 0, (1, 4, 2, 4) = 0, \\
& (1, 4, 3, 1) = 0, (1, 4, 3, 2) = 0, (1, 4, 3, 3) = 0, (1, 4, 3, 4) = 0, (1, 4, 4, 1) = 0, (1, 4, 4, 2) \\
& = 0, (1, 4, 4, 3) = 0, (1, 4, 4, 4) = 0, (2, 1, 1, 1) = 0, (2, 1, 1, 2) = 0, (2, 1, 1, 3) = 0, (2, 1, \\
& 1, 4) = 0, (2, 1, 2, 1) = 0, (2, 1, 2, 2) = 0, (2, 1, 2, 3) = 0, (2, 1, 2, 4) = 0, (2, 1, 3, 1) = 0, \\
& (2, 1, 3, 2) = 0, (2, 1, 3, 3) = 0, (2, 1, 3, 4) = 0, (2, 1, 4, 1) = 0, (2, 1, 4, 2) = 0, (2, 1, 4, 3) \\
& = 0, (2, 1, 4, 4) = 0, (2, 2, 1, 1) = 0, (2, 2, 1, 2) = 0, (2, 2, 1, 3) = 0, (2, 2, 1, 4) = 0, (2, 2, \\
& 2, 1) = 0, (2, 2, 2, 2) = 0, (2, 2, 2, 3) = 0, (2, 2, 2, 4) = 0, (2, 2, 3, 1) = 0, (2, 2, 3, 2) = 0, \\
& (2, 2, 3, 3) = 0, (2, 2, 3, 4) = 0, (2, 2, 4, 1) = 0, (2, 2, 4, 2) = 0, (2, 2, 4, 3) = 0, (2, 2, 4, 4) \\
& = 0, (2, 3, 1, 1) = 0, (2, 3, 1, 2) = 0, (2, 3, 1, 3) = 0, (2, 3, 1, 4) = 0, (2, 3, 2, 1) = 0, (2, 3, \\
& 2, 2) = 0, (2, 3, 2, 3) = 0, (2, 3, 2, 4) = 0, (2, 3, 3, 1) = 0, (2, 3, 3, 2) = 0, (2, 3, 3, 3) = 0, \\
& (2, 3, 3, 4) = 0, (2, 3, 4, 1) = 0, (2, 3, 4, 2) = 0, (2, 3, 4, 3) = 0, (2, 3, 4, 4) = 0, (2, 4, 1, 1) \\
& = 0, (2, 4, 1, 2) = 0, (2, 4, 1, 3) = 0, (2, 4, 1, 4) = 0, (2, 4, 2, 1) = 0, (2, 4, 2, 2) = 0, (2, 4, \\
& 2, 3) = 0, (2, 4, 2, 4) = 0, (2, 4, 3, 1) = 0, (2, 4, 3, 2) = 0, (2, 4, 3, 3) = 0, (2, 4, 3, 4) = 0, \\
& (2, 4, 4, 1) = 0, (2, 4, 4, 2) = 0, (2, 4, 4, 3) = 0, (2, 4, 4, 4) = 0, (3, 1, 1, 1) = 0, (3, 1, 1, 2) \\
& = 0, (3, 1, 1, 3) = 0, (3, 1, 1, 4) = 0, (3, 1, 2, 1) = 0, (3, 1, 2, 2) = 0, (3, 1, 2, 3) = 0, (3, 1, \\
& 2, 4) = 0, (3, 1, 3, 1) = 0, (3, 1, 3, 2) = 0, (3, 1, 3, 3) = 0, (3, 1, 3, 4) = 0, (3, 1, 4, 1) = 0, \\
& (3, 1, 4, 2) = 0, (3, 1, 4, 3) = 0, (3, 1, 4, 4) = 0, (3, 2, 1, 1) = 0, (3, 2, 1, 2) = 0, (3, 2, 1, 3) \\
& = 0, (3, 2, 1, 4) = 0, (3, 2, 2, 1) = 0, (3, 2, 2, 2) = 0, (3, 2, 2, 3) = 0, (3, 2, 2, 4) = 0, (3, 2, \\
& 3, 1) = 0, (3, 2, 3, 2) = 0, (3, 2, 3, 3) = 0, (3, 2, 3, 4) = 0, (3, 2, 4, 1) = 0, (3, 2, 4, 2) = 0, \\
& (3, 2, 4, 3) = 0, (3, 2, 4, 4) = 0, (3, 3, 1, 1) = -2 \operatorname{Heaviside}(u)^2 \\
& - 8 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) - 2 u^2 \operatorname{Dirac}(u)^2 + 4 \operatorname{Dirac}(u) + 2 u \operatorname{Dirac}(1, u) \\
& - 2 u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u), (3, 3, 1, 2) = 0, (3, 3, 1, 3) = 0, (3, 3, 1, 4) = 0, (3, 3, 2, \\
& 1) = 0, (3, 3, 2, 2) = 0, (3, 3, 2, 3) = 0, (3, 3, 2, 4) = 0, (3, 3, 3, 1) = 0, (3, 3, 3, 2) = 0, (3, \\
& 3, 3, 3) = 0, (3, 3, 3, 4) = 0, (3, 3, 4, 1) = 0, (3, 3, 4, 2) = 0, (3, 3, 4, 3) = 0, (3, 3, 4, 4) \\
& = 0, (3, 4, 1, 1) = 0, (3, 4, 1, 2) = 0, (3, 4, 1, 3) = 0, (3, 4, 1, 4) = 0, (3, 4, 2, 1) = 0, (3, 4, \\
& 2, 2) = 0, (3, 4, 2, 3) = 0, (3, 4, 2, 4) = 0, (3, 4, 3, 1) = 0, (3, 4, 3, 2) = 0, (3, 4, 3, 3) = 0, \\
& (3, 4, 3, 4) = 0, (3, 4, 4, 1) = 0, (3, 4, 4, 2) = 0, (3, 4, 4, 3) = 0, (3, 4, 4, 4) = 0, (4, 1, 1, 1) \\
& = 0, (4, 1, 1, 2) = 0, (4, 1, 1, 3) = 0, (4, 1, 1, 4) = 0, (4, 1, 2, 1) = 0, (4, 1, 2, 2) = 0, (4, 1, \\
& 2, 3) = 0, (4, 1, 2, 4) = 0, (4, 1, 3, 1) = 0, (4, 1, 3, 2) = 0, (4, 1, 3, 3) = 0, (4, 1, 3, 4) = 0, \\
& (4, 1, 4, 1) = 0, (4, 1, 4, 2) = 0, (4, 1, 4, 3) = 0, (4, 1, 4, 4) = 0, (4, 2, 1, 1) = 0, (4, 2, 1, 2) \\
& = 0, (4, 2, 1, 3) = 0, (4, 2, 1, 4) = 0, (4, 2, 2, 1) = 0, (4, 2, 2, 2) = 0, (4, 2, 2, 3) = 0, (4, 2, \\
& 2, 4) = 0, (4, 2, 3, 1) = 0, (4, 2, 3, 2) = 0, (4, 2, 3, 3) = 0, (4, 2, 3, 4) = 0, (4, 2, 4, 1) = 0, \\
& (4, 2, 4, 2) = 0, (4, 2, 4, 3) = 0, (4, 2, 4, 4) = 0, (4, 3, 1, 1) = 0, (4, 3, 1, 2) = 0, (4, 3, 1, 3) \\
& = 0, (4, 3, 1, 4) = 0, (4, 3, 2, 1) = 0, (4, 3, 2, 2) = 0, (4, 3, 2, 3) = 0, (4, 3, 2, 4) = 0, (4, 3, \\
& 3, 1) = 0, (4, 3, 3, 2) = 0, (4, 3, 3, 3) = 0, (4, 3, 3, 4) = 0, (4, 3, 4, 1) = 0, (4, 3, 4, 2) = 0, \\
& (4, 3, 4, 3) = 0, (4, 3, 4, 4) = 0, (4, 4, 1, 1) = -2 \operatorname{Heaviside}(u)^2
\end{aligned}$$

$- 8 \text{Heaviside}(u) u \text{Dirac}(u) - 2 u^2 \text{Dirac}(u)^2 - 4 \text{Dirac}(u) - 2 u \text{Dirac}(1, u)$
 $- 2 u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (4, 4, 1, 2) = 0, (4, 4, 1, 3) = 0, (4, 4, 1, 4) = 0, (4, 4, 2,$
 $1) = 0, (4, 4, 2, 2) = 0, (4, 4, 2, 3) = 0, (4, 4, 2, 4) = 0, (4, 4, 3, 1) = 0, (4, 4, 3, 2) = 0, (4,$
 $4, 3, 3) = 0, (4, 4, 3, 4) = 0, (4, 4, 4, 1) = 0, (4, 4, 4, 2) = 0, (4, 4, 4, 3) = 0, (4, 4, 4, 4)$
 $= 0]]]$

> RIEMANN:=Riemann(ginv, D2g, Cf1); #Riemann Tensor

RIEMANN:=table([index_char=[-1, -1, -1, -1], compts=ARRAY(cov_riemann, [1..4, 1 (13)

$..4, 1..4, 1..4], [(1, 1, 1, 1) = 0, (1, 1, 1, 2) = 0, (1, 1, 1, 3) = 0, (1, 1, 1, 4) = 0, (1, 1, 2,$
 $1) = 0, (1, 1, 2, 2) = 0, (1, 1, 2, 3) = 0, (1, 1, 2, 4) = 0, (1, 1, 3, 1) = 0, (1, 1, 3, 2) = 0, (1,$
 $1, 3, 3) = 0, (1, 1, 3, 4) = 0, (1, 1, 4, 1) = 0, (1, 1, 4, 2) = 0, (1, 1, 4, 3) = 0, (1, 1, 4, 4)$
 $= 0, (1, 2, 1, 1) = 0, (1, 2, 1, 2) = 0, (1, 2, 1, 3) = 0, (1, 2, 1, 4) = 0, (1, 2, 2, 1) = 0, (1, 2,$
 $2, 2) = 0, (1, 2, 2, 3) = 0, (1, 2, 2, 4) = 0, (1, 2, 3, 1) = 0, (1, 2, 3, 2) = 0, (1, 2, 3, 3) = 0,$
 $(1, 2, 3, 4) = 0, (1, 2, 4, 1) = 0, (1, 2, 4, 2) = 0, (1, 2, 4, 3) = 0, (1, 2, 4, 4) = 0, (1, 3, 1, 1)$
 $= 0, (1, 3, 1, 2) = 0, (1, 3, 1, 3) = -2 \text{Dirac}(u) - u \text{Dirac}(1, u)$
 $+ 2 \text{Heaviside}(u) u \text{Dirac}(u) + u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (1, 3, 1, 4) = 0, (1, 3, 2, 1)$
 $= 0, (1, 3, 2, 2) = 0, (1, 3, 2, 3) = 0, (1, 3, 2, 4) = 0, (1, 3, 3, 1) = 2 \text{Dirac}(u) + u \text{Dirac}(1,$
 $u) - 2 \text{Heaviside}(u) u \text{Dirac}(u) - u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (1, 3, 3, 2) = 0, (1, 3, 3,$
 $3) = 0, (1, 3, 3, 4) = 0, (1, 3, 4, 1) = 0, (1, 3, 4, 2) = 0, (1, 3, 4, 3) = 0, (1, 3, 4, 4) = 0, (1,$
 $4, 1, 1) = 0, (1, 4, 1, 2) = 0, (1, 4, 1, 3) = 0, (1, 4, 1, 4) = 2 \text{Dirac}(u) + u \text{Dirac}(1, u)$
 $+ 2 \text{Heaviside}(u) u \text{Dirac}(u) + u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (1, 4, 2, 1) = 0, (1, 4, 2, 2)$
 $= 0, (1, 4, 2, 3) = 0, (1, 4, 2, 4) = 0, (1, 4, 3, 1) = 0, (1, 4, 3, 2) = 0, (1, 4, 3, 3) = 0, (1, 4,$
 $3, 4) = 0, (1, 4, 4, 1) = -2 \text{Dirac}(u) - u \text{Dirac}(1, u) - 2 \text{Heaviside}(u) u \text{Dirac}(u)$
 $- u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (1, 4, 4, 2) = 0, (1, 4, 4, 3) = 0, (1, 4, 4, 4) = 0, (2, 1, 1, 1)$
 $= 0, (2, 1, 1, 2) = 0, (2, 1, 1, 3) = 0, (2, 1, 1, 4) = 0, (2, 1, 2, 1) = 0, (2, 1, 2, 2) = 0, (2, 1,$
 $2, 3) = 0, (2, 1, 2, 4) = 0, (2, 1, 3, 1) = 0, (2, 1, 3, 2) = 0, (2, 1, 3, 3) = 0, (2, 1, 3, 4) = 0,$
 $(2, 1, 4, 1) = 0, (2, 1, 4, 2) = 0, (2, 1, 4, 3) = 0, (2, 1, 4, 4) = 0, (2, 2, 1, 1) = 0, (2, 2, 1, 2)$
 $= 0, (2, 2, 1, 3) = 0, (2, 2, 1, 4) = 0, (2, 2, 2, 1) = 0, (2, 2, 2, 2) = 0, (2, 2, 2, 3) = 0, (2, 2,$
 $2, 4) = 0, (2, 2, 3, 1) = 0, (2, 2, 3, 2) = 0, (2, 2, 3, 3) = 0, (2, 2, 3, 4) = 0, (2, 2, 4, 1) = 0,$
 $(2, 2, 4, 2) = 0, (2, 2, 4, 3) = 0, (2, 2, 4, 4) = 0, (2, 3, 1, 1) = 0, (2, 3, 1, 2) = 0, (2, 3, 1, 3)$
 $= 0, (2, 3, 1, 4) = 0, (2, 3, 2, 1) = 0, (2, 3, 2, 2) = 0, (2, 3, 2, 3) = 0, (2, 3, 2, 4) = 0, (2, 3,$
 $3, 1) = 0, (2, 3, 3, 2) = 0, (2, 3, 3, 3) = 0, (2, 3, 3, 4) = 0, (2, 3, 4, 1) = 0, (2, 3, 4, 2) = 0,$
 $(2, 3, 4, 3) = 0, (2, 3, 4, 4) = 0, (2, 4, 1, 1) = 0, (2, 4, 1, 2) = 0, (2, 4, 1, 3) = 0, (2, 4, 1, 4)$
 $= 0, (2, 4, 2, 1) = 0, (2, 4, 2, 2) = 0, (2, 4, 2, 3) = 0, (2, 4, 2, 4) = 0, (2, 4, 3, 1) = 0, (2, 4,$
 $3, 2) = 0, (2, 4, 3, 3) = 0, (2, 4, 3, 4) = 0, (2, 4, 4, 1) = 0, (2, 4, 4, 2) = 0, (2, 4, 4, 3) = 0,$
 $(2, 4, 4, 4) = 0, (3, 1, 1, 1) = 0, (3, 1, 1, 2) = 0, (3, 1, 1, 3) = 2 \text{Dirac}(u) + u \text{Dirac}(1, u)$
 $- 2 \text{Heaviside}(u) u \text{Dirac}(u) - u^2 \text{Heaviside}(u) \text{Dirac}(1, u), (3, 1, 1, 4) = 0, (3, 1, 2, 1)$

$=0, (3, 1, 2, 2) = 0, (3, 1, 2, 3) = 0, (3, 1, 2, 4) = 0, (3, 1, 3, 1) = -2 \text{ Dirac}(u)$
 $- u \text{ Dirac}(1, u) + 2 \text{ Heaviside}(u) u \text{ Dirac}(u) + u^2 \text{ Heaviside}(u) \text{ Dirac}(1, u), (3, 1, 3, 2)$
 $=0, (3, 1, 3, 3) = 0, (3, 1, 3, 4) = 0, (3, 1, 4, 1) = 0, (3, 1, 4, 2) = 0, (3, 1, 4, 3) = 0, (3, 1,$
 $4, 4) = 0, (3, 2, 1, 1) = 0, (3, 2, 1, 2) = 0, (3, 2, 1, 3) = 0, (3, 2, 1, 4) = 0, (3, 2, 2, 1) = 0,$
 $(3, 2, 2, 2) = 0, (3, 2, 2, 3) = 0, (3, 2, 2, 4) = 0, (3, 2, 3, 1) = 0, (3, 2, 3, 2) = 0, (3, 2, 3, 3)$
 $=0, (3, 2, 3, 4) = 0, (3, 2, 4, 1) = 0, (3, 2, 4, 2) = 0, (3, 2, 4, 3) = 0, (3, 2, 4, 4) = 0, (3, 3,$
 $1, 1) = 0, (3, 3, 1, 2) = 0, (3, 3, 1, 3) = 0, (3, 3, 1, 4) = 0, (3, 3, 2, 1) = 0, (3, 3, 2, 2) = 0,$
 $(3, 3, 2, 3) = 0, (3, 3, 2, 4) = 0, (3, 3, 3, 1) = 0, (3, 3, 3, 2) = 0, (3, 3, 3, 3) = 0, (3, 3, 3, 4)$
 $=0, (3, 3, 4, 1) = 0, (3, 3, 4, 2) = 0, (3, 3, 4, 3) = 0, (3, 3, 4, 4) = 0, (3, 4, 1, 1) = 0, (3, 4,$
 $1, 2) = 0, (3, 4, 1, 3) = 0, (3, 4, 1, 4) = 0, (3, 4, 2, 1) = 0, (3, 4, 2, 2) = 0, (3, 4, 2, 3) = 0,$
 $(3, 4, 2, 4) = 0, (3, 4, 3, 1) = 0, (3, 4, 3, 2) = 0, (3, 4, 3, 3) = 0, (3, 4, 3, 4) = 0, (3, 4, 4, 1)$
 $=0, (3, 4, 4, 2) = 0, (3, 4, 4, 3) = 0, (3, 4, 4, 4) = 0, (4, 1, 1, 1) = 0, (4, 1, 1, 2) = 0, (4, 1,$
 $1, 3) = 0, (4, 1, 1, 4) = -2 \text{ Dirac}(u) - u \text{ Dirac}(1, u) - 2 \text{ Heaviside}(u) u \text{ Dirac}(u)$
 $- u^2 \text{ Heaviside}(u) \text{ Dirac}(1, u), (4, 1, 2, 1) = 0, (4, 1, 2, 2) = 0, (4, 1, 2, 3) = 0, (4, 1, 2, 4)$
 $=0, (4, 1, 3, 1) = 0, (4, 1, 3, 2) = 0, (4, 1, 3, 3) = 0, (4, 1, 3, 4) = 0, (4, 1, 4, 1)$
 $= 2 \text{ Dirac}(u) + u \text{ Dirac}(1, u) + 2 \text{ Heaviside}(u) u \text{ Dirac}(u) + u^2 \text{ Heaviside}(u) \text{ Dirac}(1,$
 $u), (4, 1, 4, 2) = 0, (4, 1, 4, 3) = 0, (4, 1, 4, 4) = 0, (4, 2, 1, 1) = 0, (4, 2, 1, 2) = 0, (4, 2,$
 $1, 3) = 0, (4, 2, 1, 4) = 0, (4, 2, 2, 1) = 0, (4, 2, 2, 2) = 0, (4, 2, 2, 3) = 0, (4, 2, 2, 4) = 0,$
 $(4, 2, 3, 1) = 0, (4, 2, 3, 2) = 0, (4, 2, 3, 3) = 0, (4, 2, 3, 4) = 0, (4, 2, 4, 1) = 0, (4, 2, 4, 2)$
 $=0, (4, 2, 4, 3) = 0, (4, 2, 4, 4) = 0, (4, 3, 1, 1) = 0, (4, 3, 1, 2) = 0, (4, 3, 1, 3) = 0, (4, 3,$
 $1, 4) = 0, (4, 3, 2, 1) = 0, (4, 3, 2, 2) = 0, (4, 3, 2, 3) = 0, (4, 3, 2, 4) = 0, (4, 3, 3, 1) = 0,$
 $(4, 3, 3, 2) = 0, (4, 3, 3, 3) = 0, (4, 3, 3, 4) = 0, (4, 3, 4, 1) = 0, (4, 3, 4, 2) = 0, (4, 3, 4, 3)$
 $=0, (4, 3, 4, 4) = 0, (4, 4, 1, 1) = 0, (4, 4, 1, 2) = 0, (4, 4, 1, 3) = 0, (4, 4, 1, 4) = 0, (4, 4,$
 $2, 1) = 0, (4, 4, 2, 2) = 0, (4, 4, 2, 3) = 0, (4, 4, 2, 4) = 0, (4, 4, 3, 1) = 0, (4, 4, 3, 2) = 0,$
 $(4, 4, 3, 3) = 0, (4, 4, 3, 4) = 0, (4, 4, 4, 1) = 0, (4, 4, 4, 2) = 0, (4, 4, 4, 3) = 0, (4, 4, 4, 4)$
 $=0]]])$

> RICCI:=Ricci(ginv, RIEMANN); #Ricci Tensor

$\text{RICCI} := \text{table} \left(\begin{array}{l} \text{index_char} = [-1, -1], \text{compts} \end{array} \right)$

$$= \begin{pmatrix} \frac{2 \text{ Heaviside}(u) u (2 \text{ Dirac}(u) + u \text{ Dirac}(1, u))}{(1 + u \text{ Heaviside}(u)) (-1 + u \text{ Heaviside}(u))} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

(14)

$$\begin{aligned}
&> \text{RICCI_SCALAR} := \text{RicciScalar}(\text{ginv}, \text{RICCI}); \\
&\quad \text{RICCI_SCALAR} := \text{table}([\text{index_char} = [], \text{compts} = 0]) \tag{15}
\end{aligned}$$

$$\begin{aligned}
&> \text{WEYL} := \text{Weyl}(\text{g}, \text{RIEMANN}, \text{RICCI}, \text{RICCI_SCALAR}); \\
\text{WEYL} := \text{table}\left(\left[\text{index_char} = [-1, -1, -1, -1], \text{compts} = \text{ARRAY}\left(\text{cov_riemann}, [1..4, 1..4, 1..4, 1..4]\right)\right], \right. & \tag{16}
\end{aligned}$$

$$\begin{aligned}
&\left. \left[(1, 1, 1, 1) = 0, (1, 1, 1, 2) = 0, (1, 1, 1, 3) = 0, (1, 1, 1, 4) = 0, (1, 1, 2, 1) \right. \right. \\
&= 0, (1, 1, 2, 2) = 0, (1, 1, 2, 3) = 0, (1, 1, 2, 4) = 0, (1, 1, 3, 1) = 0, (1, 1, 3, 2) = 0, (1, 1, \\
&3, 3) = 0, (1, 1, 3, 4) = 0, (1, 1, 4, 1) = 0, (1, 1, 4, 2) = 0, (1, 1, 4, 3) = 0, (1, 1, 4, 4) = 0, \\
&(1, 2, 1, 1) = 0, (1, 2, 1, 2) = 0, (1, 2, 1, 3) = 0, (1, 2, 1, 4) = 0, (1, 2, 2, 1) = 0, (1, 2, 2, 2) \\
&= 0, (1, 2, 2, 3) = 0, (1, 2, 2, 4) = 0, (1, 2, 3, 1) = 0, (1, 2, 3, 2) = 0, (1, 2, 3, 3) = 0, (1, 2, \\
&3, 4) = 0, (1, 2, 4, 1) = 0, (1, 2, 4, 2) = 0, (1, 2, 4, 3) = 0, (1, 2, 4, 4) = 0, (1, 3, 1, 1) = 0, \\
&(1, 3, 1, 2) = 0, (1, 3, 1, 3) \\
&= \frac{1}{1 + u \text{Heaviside}(u)} \left(-2 \text{Dirac}(u) - u \text{Dirac}(1, u) + 2 \text{Heaviside}(u) u \text{Dirac}(u) \right. \\
&\left. + u^2 \text{Heaviside}(u) \text{Dirac}(1, u) \right), (1, 3, 1, 4) = 0, (1, 3, 2, 1) = 0, (1, 3, 2, 2) = 0, (1, 3, 2, \\
&3) = 0, (1, 3, 2, 4) = 0, (1, 3, 3, 1) = \\
&- \frac{1}{1 + u \text{Heaviside}(u)} \left(-2 \text{Dirac}(u) - u \text{Dirac}(1, u) + 2 \text{Heaviside}(u) u \text{Dirac}(u) \right. \\
&\left. + u^2 \text{Heaviside}(u) \text{Dirac}(1, u) \right), (1, 3, 3, 2) = 0, (1, 3, 3, 3) = 0, (1, 3, 3, 4) = 0, (1, 3, 4, \\
&1) = 0, (1, 3, 4, 2) = 0, (1, 3, 4, 3) = 0, (1, 3, 4, 4) = 0, (1, 4, 1, 1) = 0, (1, 4, 1, 2) = 0, (1, \\
&4, 1, 3) = 0, (1, 4, 1, 4) = \\
&- \frac{1}{-1 + u \text{Heaviside}(u)} \left(2 \text{Dirac}(u) + u \text{Dirac}(1, u) + 2 \text{Heaviside}(u) u \text{Dirac}(u) \right. \\
&\left. + u^2 \text{Heaviside}(u) \text{Dirac}(1, u) \right), (1, 4, 2, 1) = 0, (1, 4, 2, 2) = 0, (1, 4, 2, 3) = 0, (1, 4, 2, \\
&4) = 0, (1, 4, 3, 1) = 0, (1, 4, 3, 2) = 0, (1, 4, 3, 3) = 0, (1, 4, 3, 4) = 0, (1, 4, 4, 1)
\end{aligned}$$

$$\begin{aligned}
&= \frac{1}{-1 + u \operatorname{Heaviside}(u)} \left(2 \operatorname{Dirac}(u) + u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) \right. \\
&\quad \left. + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u) \right), (1, 4, 4, 2) = 0, (1, 4, 4, 3) = 0, (1, 4, 4, 4) = 0, (2, 1, 1, \\
&\quad 1) = 0, (2, 1, 1, 2) = 0, (2, 1, 1, 3) = 0, (2, 1, 1, 4) = 0, (2, 1, 2, 1) = 0, (2, 1, 2, 2) = 0, (2, \\
&\quad 1, 2, 3) = 0, (2, 1, 2, 4) = 0, (2, 1, 3, 1) = 0, (2, 1, 3, 2) = 0, (2, 1, 3, 3) = 0, (2, 1, 3, 4) \\
&\quad = 0, (2, 1, 4, 1) = 0, (2, 1, 4, 2) = 0, (2, 1, 4, 3) = 0, (2, 1, 4, 4) = 0, (2, 2, 1, 1) = 0, (2, 2, \\
&\quad 1, 2) = 0, (2, 2, 1, 3) = 0, (2, 2, 1, 4) = 0, (2, 2, 2, 1) = 0, (2, 2, 2, 2) = 0, (2, 2, 2, 3) = 0, \\
&\quad (2, 2, 2, 4) = 0, (2, 2, 3, 1) = 0, (2, 2, 3, 2) = 0, (2, 2, 3, 3) = 0, (2, 2, 3, 4) = 0, (2, 2, 4, 1) \\
&\quad = 0, (2, 2, 4, 2) = 0, (2, 2, 4, 3) = 0, (2, 2, 4, 4) = 0, (2, 3, 1, 1) = 0, (2, 3, 1, 2) = 0, (2, 3, \\
&\quad 1, 3) = 0, (2, 3, 1, 4) = 0, (2, 3, 2, 1) = 0, (2, 3, 2, 2) = 0, (2, 3, 2, 3) = 0, (2, 3, 2, 4) = 0, \\
&\quad (2, 3, 3, 1) = 0, (2, 3, 3, 2) = 0, (2, 3, 3, 3) = 0, (2, 3, 3, 4) = 0, (2, 3, 4, 1) = 0, (2, 3, 4, 2) \\
&\quad = 0, (2, 3, 4, 3) = 0, (2, 3, 4, 4) = 0, (2, 4, 1, 1) = 0, (2, 4, 1, 2) = 0, (2, 4, 1, 3) = 0, (2, 4, \\
&\quad 1, 4) = 0, (2, 4, 2, 1) = 0, (2, 4, 2, 2) = 0, (2, 4, 2, 3) = 0, (2, 4, 2, 4) = 0, (2, 4, 3, 1) = 0, \\
&\quad (2, 4, 3, 2) = 0, (2, 4, 3, 3) = 0, (2, 4, 3, 4) = 0, (2, 4, 4, 1) = 0, (2, 4, 4, 2) = 0, (2, 4, 4, 3) \\
&\quad = 0, (2, 4, 4, 4) = 0, (3, 1, 1, 1) = 0, (3, 1, 1, 2) = 0, (3, 1, 1, 3) = \\
&\quad - \frac{1}{1 + u \operatorname{Heaviside}(u)} \left(-2 \operatorname{Dirac}(u) - u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) \right. \\
&\quad \left. + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u) \right), (3, 1, 1, 4) = 0, (3, 1, 2, 1) = 0, (3, 1, 2, 2) = 0, (3, 1, 2, \\
&\quad 3) = 0, (3, 1, 2, 4) = 0, (3, 1, 3, 1) \\
&\quad = \frac{1}{1 + u \operatorname{Heaviside}(u)} \left(-2 \operatorname{Dirac}(u) - u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) \right. \\
&\quad \left. + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u) \right), (3, 1, 3, 2) = 0, (3, 1, 3, 3) = 0, (3, 1, 3, 4) = 0, (3, 1, 4, \\
&\quad 1) = 0, (3, 1, 4, 2) = 0, (3, 1, 4, 3) = 0, (3, 1, 4, 4) = 0, (3, 2, 1, 1) = 0, (3, 2, 1, 2) = 0, (3,
\end{aligned}$$

$2, 1, 3) = 0, (3, 2, 1, 4) = 0, (3, 2, 2, 1) = 0, (3, 2, 2, 2) = 0, (3, 2, 2, 3) = 0, (3, 2, 2, 4)$
 $= 0, (3, 2, 3, 1) = 0, (3, 2, 3, 2) = 0, (3, 2, 3, 3) = 0, (3, 2, 3, 4) = 0, (3, 2, 4, 1) = 0, (3, 2,$
 $4, 2) = 0, (3, 2, 4, 3) = 0, (3, 2, 4, 4) = 0, (3, 3, 1, 1) = 0, (3, 3, 1, 2) = 0, (3, 3, 1, 3) = 0,$
 $(3, 3, 1, 4) = 0, (3, 3, 2, 1) = 0, (3, 3, 2, 2) = 0, (3, 3, 2, 3) = 0, (3, 3, 2, 4) = 0, (3, 3, 3, 1)$
 $= 0, (3, 3, 3, 2) = 0, (3, 3, 3, 3) = 0, (3, 3, 3, 4) = 0, (3, 3, 4, 1) = 0, (3, 3, 4, 2) = 0, (3, 3,$
 $4, 3) = 0, (3, 3, 4, 4) = 0, (3, 4, 1, 1) = 0, (3, 4, 1, 2) = 0, (3, 4, 1, 3) = 0, (3, 4, 1, 4) = 0,$
 $(3, 4, 2, 1) = 0, (3, 4, 2, 2) = 0, (3, 4, 2, 3) = 0, (3, 4, 2, 4) = 0, (3, 4, 3, 1) = 0, (3, 4, 3, 2)$
 $= 0, (3, 4, 3, 3) = 0, (3, 4, 3, 4) = 0, (3, 4, 4, 1) = 0, (3, 4, 4, 2) = 0, (3, 4, 4, 3) = 0, (3, 4,$
 $4, 4) = 0, (4, 1, 1, 1) = 0, (4, 1, 1, 2) = 0, (4, 1, 1, 3) = 0, (4, 1, 1, 4)$
 $= \frac{1}{-1 + u \text{Heaviside}(u)} (2 \text{Dirac}(u) + u \text{Dirac}(1, u) + 2 \text{Heaviside}(u) u \text{Dirac}(u)$
 $+ u^2 \text{Heaviside}(u) \text{Dirac}(1, u)), (4, 1, 2, 1) = 0, (4, 1, 2, 2) = 0, (4, 1, 2, 3) = 0, (4, 1, 2,$
 $4) = 0, (4, 1, 3, 1) = 0, (4, 1, 3, 2) = 0, (4, 1, 3, 3) = 0, (4, 1, 3, 4) = 0, (4, 1, 4, 1) =$
 $-\frac{1}{-1 + u \text{Heaviside}(u)} (2 \text{Dirac}(u) + u \text{Dirac}(1, u) + 2 \text{Heaviside}(u) u \text{Dirac}(u)$
 $+ u^2 \text{Heaviside}(u) \text{Dirac}(1, u)), (4, 1, 4, 2) = 0, (4, 1, 4, 3) = 0, (4, 1, 4, 4) = 0, (4, 2, 1,$
 $1) = 0, (4, 2, 1, 2) = 0, (4, 2, 1, 3) = 0, (4, 2, 1, 4) = 0, (4, 2, 2, 1) = 0, (4, 2, 2, 2) = 0, (4,$
 $2, 2, 3) = 0, (4, 2, 2, 4) = 0, (4, 2, 3, 1) = 0, (4, 2, 3, 2) = 0, (4, 2, 3, 3) = 0, (4, 2, 3, 4)$
 $= 0, (4, 2, 4, 1) = 0, (4, 2, 4, 2) = 0, (4, 2, 4, 3) = 0, (4, 2, 4, 4) = 0, (4, 3, 1, 1) = 0, (4, 3,$
 $1, 2) = 0, (4, 3, 1, 3) = 0, (4, 3, 1, 4) = 0, (4, 3, 2, 1) = 0, (4, 3, 2, 2) = 0, (4, 3, 2, 3) = 0,$
 $(4, 3, 2, 4) = 0, (4, 3, 3, 1) = 0, (4, 3, 3, 2) = 0, (4, 3, 3, 3) = 0, (4, 3, 3, 4) = 0, (4, 3, 4, 1)$
 $= 0, (4, 3, 4, 2) = 0, (4, 3, 4, 3) = 0, (4, 3, 4, 4) = 0, (4, 4, 1, 1) = 0, (4, 4, 1, 2) = 0, (4, 4,$
 $1, 3) = 0, (4, 4, 1, 4) = 0, (4, 4, 2, 1) = 0, (4, 4, 2, 2) = 0, (4, 4, 2, 3) = 0, (4, 4, 2, 4) = 0,$
 $(4, 4, 3, 1) = 0, (4, 4, 3, 2) = 0, (4, 4, 3, 3) = 0, (4, 4, 3, 4) = 0, (4, 4, 4, 1) = 0, (4, 4, 4, 2)$
 $= 0, (4, 4, 4, 3) = 0, (4, 4, 4, 4) = 0]]]$

> displayGR(`Weyl`, WEYL);

The Weyl Tensor
non-zero components :

C1313

$$= \frac{1}{1 + u \operatorname{Heaviside}(u)} (-2 \operatorname{Dirac}(u) - u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u))$$

C1414 =

$$\frac{-2 \operatorname{Dirac}(u) + u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u)}{-1 + u \operatorname{Heaviside}(u)}$$

character : [-1, -1, -1, -1]

(17)

1, 3, 1, 3

(18)

```
> C1313:=(-2*Dirac(u)-u*Dirac(1, u)+2*Heaviside(u)*u*Dirac(u)+u^2*Heaviside(u)*Dirac(1, u))/(1+u*Heaviside(u));
```

C1313 :=

(19)

$$\frac{-2 \operatorname{Dirac}(u) - u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u)}{1 + u \operatorname{Heaviside}(u)}$$

```
> C1414:=- (2*Dirac(u)+u*Dirac(1, u)+2*Heaviside(u)*u*Dirac(u)+u^2*Heaviside(u)*Dirac(1, u))/(-1+u*Heaviside(u));
```

C1414 :=

(20)

$$\frac{2 \operatorname{Dirac}(u) + u \operatorname{Dirac}(1, u) + 2 \operatorname{Heaviside}(u) u \operatorname{Dirac}(u) + u^2 \operatorname{Heaviside}(u) \operatorname{Dirac}(1, u)}{-1 + u \operatorname{Heaviside}(u)}$$

```
> psi:=simplify(expand(-C1313+C1414)/2); #Psi_4
```

$\psi := \operatorname{Dirac}(u)$

(21)