```
> 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 (0.000000 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)**

```
> gdd := grarray(g(dn, dn));
```

(3)

$$gdd := \begin{bmatrix} \frac{1}{1-\frac{2m}{r}} & 0 & 0 & 0 \\ 0 & r^2 & 0 & 0 \\ 0 & 0 & r^2 \sin(\theta)^2 & 0 \\ 0 & 0 & 0 & -1+\frac{2m}{r} \end{bmatrix} \quad (3)$$

```
> gdd[1, 1];
```

$$\frac{1}{1-\frac{2m}{r}} \quad (4)$$

```
> grcalc1(Chr(dn, dn, up), [theta, theta, r]);
Calculated g(dn,dn,pdn) for schw (0.005000 sec.)
Calculated Chr(dn,dn,dn) for schw (0.001000 sec.)
Calculated detg for schw (0.005000 sec.)
Calculated g(up,up) for schw (0.008000 sec.)
Calculated the [theta, theta, r] component of Chr(dn,dn,up) for
schw.
```

ERROR expected

```
> grcomponent(Chr(dn, dn, up), [theta, theta, phi]);
Error, (in grtensor:-grcomponent) The requested component has not
been calculated.
```

```
> grcomponent(Chr(dn, dn, up), [ theta, theta, r]);
```

$$-r+2m \quad (5)$$

```
> grclear(g(up, up));
Cleared g(up,up) for the schw metric.
> grcalc(g(up, up));
Calculated g(up,up) for schw (0.002000 sec.)
```

$$CPU\ Time = 0.003 \quad (6)$$

```
>
```