BLACK HOLE SIMLATIONS

1. Einstein field equation

2. Schwarzschild metric

A *pseudo-group* on a topological space is a wide subgroupoid of the groupoid of open subsets satisfying a sheaf property.

(or inverse semi-groups?)

Let U be a Einstein Lorentzian four-dimensional manifold. Suppose a local action of $\mathrm{SO}(3) \times \mathbb{R}$ on U is given. We assume that the metric is invariant under this local action. This is the definition of Schwarzschild metrics. There only one parameter, the mass of the black hole....

Definition 2.1 (Schwarzschild metric)**.** spherically symmetric static vacuum solution

coordinate functions naturally arising from a continuous Lie group action?

The line element of the Schwarzschild metric is given in the Schwarzschild coordinates as

$$ds^2 = -\left(1 - \frac{r_S}{r}\right) c^2\, dt^2 + \left(1 - \frac{r_S}{r}\right)^{-1} dr + r^2\, d\Omega,$$

where

$$r_S := \frac{2GM}{c^2}, \qquad d\Omega = d\theta^2 + \sin^2\theta\, d\varphi^2$$

3. Kerr metric

Definition 3.1 (Kerr metric)**.**

3.1. Boyer-Lindquist coordinates.

For $G = c = 1$

M, J, Q

Q Carter constant, charge?

3.2. Singularities.

4. Geodesic equation

4.1. Constant of motions.

4.2. Initial condition transformation.

How can we set a hyperplane M with an observer in the Boyer-Lindquist coordinates?

How can we transform the ray-casting direction in the Boyer-Lindquist coordinates.