General Relativity: Exercises 5

Till: June 15, 2011

Homework 1: Embedding of Schwarzchild metric

In order to visualize curvature of some space we usually consider its embedding in higher dimensional space. For example, we can "see" that surface of ball is curved, because what we "naturally see" is embedding of ball suface in 3-dimensional flat space.

In similar way treat Schwarzchild black hole. Consider hypersurface $\{t = \text{const}, \ \theta = \pi/2\}$ in Schwarzchild solution. Find its embedding in 3-dimensional flat space. Draw this hypersurface in embedding space. You should be able to obtain visualization of "black-hole throat".

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Hint: Use metric of embedding space expressed in cyllindrical coordinates.

Homework 2: Electron as black hole

In similar way as in Schwarzhild solution find from Reissner-Nordström solution expression for gravitational radius. Consider electron as charged massive black hole without spin. What result would You obtain for gravitational radius in this case?