general relativity – December 7, 2006

material discussed in class

Roughly appendix H in the book.

exercises

- Consider the Penrose diagram for a Schwarzschild black hole. Verify that any particle, whether massive or massless, whether it moves just in the radial direction or also in the θ, ϕ direction, always moves in a direction in the u, v plane which is upward and makes an angle of 45 degrees of less. This verifies e.g. the statement that there is no escape once someone crosses the horizon.
- Consider again the Schwarzschild solution. Someone is at $t = 0$ at $r = 2MG$. Show that no matter what this person does, he or she will always hit the singularity in a proper time $\Delta\tau \leq \pi MG$.
- Carroll exercise G.1
- Consider the three cosmological solutions with $\Lambda > 0$ and $p = \rho = 0$ that we constructed two lectures ago. The three solutions corresponded to $k = -1, 0, 1$. Rederive them if necessary. Find a Penrose diagram for each of these metrics, and verify that two of the three are actually submanifolds of the third one. Which of these have something that is reminiscent of an horizon?