Ph 161 Black Holes

Homework Assignment 5

Due Tuesday, March 7, 2006

This should be your own work; do not copy problem solutions.

(1.) Why don't orbits close on themselves in General Relativity? Discuss where the precession of, *e.g.,* Mercury's orbit comes from in terms of the conserved quantities along geodesics in Schwarzschild geometry. (Consult Hartle Chapter 9.)

(2.) Discuss why stars supported by pressure coming from particles with relativistic speeds become unstable in General Relativity. Look carefully at Hartle Chapter 12, problem 2 and note that the pressure forces must always balance gravitational forces for stars to be in equilibrium.

(3.) Decide on your paper/talk topic. You may want to give a very rough outline.

Hint for (1.) & (2.): The basic answer for both of these questions is that gravity is nonlinear in General Relativity. Spacetime curvature has mass-energy and so curves spacetime! Therefore, unlike Newtonian gravitation, the "gravitational forces" in General Relativity grow faster than $1/r^2$.