**Astronomy 84: Black Holes**

***Luminosity of a “Failed” Black Hole***

**Discussion 7.2 Fall 2017**

This problem requires that you work with the group or person that calculated free fall times for objects with different masses and radii (D6.1) and use those results to feed into the calculations below.

In the 1940’s and 1950’s, John Wheeler, Albert Einstein and others believed that something must prevent the collapse of a star to a black hole. Wheeler’s belief was that the protons and electrons formed neutrons, then the neutrons somehow were converted to x-rays and the mass was lost as x-rays streamed out from the star as it was collapsing.

You have already gotten estimates for the time to collapse from D6.1, and you should have general equations that allow you to estimate the collapse time for stars of different mass and size. You can use these results to estimate the average luminosity (the power or energy/second emitted in light) that would result of all of a star’s mass were converted to light more quickly than the free-fall time of the star.

Look up the radius of normal and giant stars for several different masses: 2, 4, 10, and 30 M🞊. Using the radius and mass, calculate the free-fall times to the event horizons (note *C*S is a function of the star’s mass). Then, assuming enough of the mass is converted to energy (E = mc2) during the free-fall time to leave the remaining mass below the Chandrasekhar limit of 1.4 M🞊, calculate the luminosity (total energy/emission time) that would have to come from each type of star so as to prevent a black hole forming.

Prepare to discuss these results with the class in the context of other luminous sources in the universe: stars and galaxies, say. If stars convert their mass to light prior to forming a black hole, could we observe these phases in principle? What are the impediments to observation?