

AL05: STARS AND GALAXIES
MR. LUBELL
THESIS LAB HOMEWORK

The globular cluster M15 is notable for being a particularly dense and old system. There is some evidence that may indicate that within the cluster core is an intermediate-mass black hole, which formed as the result of stellar collisions within the extreme environment. Knowing this, please consider the following questions and record your responses on a separate piece of paper.

1. What are two possible methods that could be used to detect the presence of a black hole within the cluster core? (2 points)
2. Suppose the black hole that lives in M15's core has a mass of $4,000 M_{\odot}$, which is the current best estimate. Please calculate the Schwarzschild radius for such a black hole. (3 points)
3. M15 has a radius of about 8.33×10^{17} meters. How does the black hole's radius compare? I.e., is it a significant fraction? Please show some work. (2 points)
4. Based on the above information, do you think most stars face a significant threat from the black hole? Why or why not? (2 points)
5. Please calculate the Schwarzschild radius for your own mass. Would you make a very threatening black hole were you to be squished to that size? What other objects would your size be similar to? (4 points)

The homework portion of this lab is worth 13 points and the in-class portion is worth 40 points. To help you with this assignment, please keep in mind the fact that *units are important!!!* To compare quantities, you will want to be sure you are comparing them in similar units. If you don't know the conversion factor between any two particular units, Google.com has a built-in calculator that can perform such operations. Simply type in a statement like “___ units in new units.” The value of the gravitational constant is

$G = 6.67 \times 10^{-11} \frac{m^3}{kg s^2}$, the speed of light is $c = 3.0 \times 10^8 \frac{m}{s}$, and M_{\odot} stands for the mass of the Sun.