


Arvind Borde

# AST 10: Homework 5

1. Do you think black holes might be detectable by observations? What might be some difficulties? How are they surmounted?
2. What are the different types of black holes we think there are?
3. By the “size” of a black hole astronomers usually mean its Schwarzschild radius. If the mass of a black hole doubles, how does its size change? What if the mass halves?
4. Look at the “galactic center animation” on the course webpage. The animation is based on ongoing observations of the motion of stars at the center of our galaxy (represented by ). There is no visible physical object at that precise location. What does the animation show?
5. One of the smallest known black holes was announced at (link also on course page)  
[http://www.nasa.gov/centers/goddard/news/topstory/2008/smallest\\_blackhole.html](http://www.nasa.gov/centers/goddard/news/topstory/2008/smallest_blackhole.html).  
What is the mass of the black hole? What is its Schwarzschild radius? How does that compare with the value given in the linked article?
6. Here's the Wikipedia list of the most massive black holes (link also on course page):  
[http://en.wikipedia.org/wiki/List\\_of\\_most\\_massive\\_black\\_holes](http://en.wikipedia.org/wiki/List_of_most_massive_black_holes).  
Roughly how many candidates are on the list? What is their range of masses (using  $M_{\odot}$  as the unit and expressing yourself in “millions,” “billions,” etc.)?
7. What are the difficulties with the Newtonian view of black holes?
8. In the 1960s a strong source of x-rays was discovered in a constellation called Cygnus. The x-ray source was named Cygnus X-1. Closer observations revealed a large blue star orbiting every 5 days around an unseen companion. On the right is an artist's rendering. What does the picture show? What might be the source of the x-rays?

