

AST 301
Homework #8
Due Friday Nov. 7

1. a) Make a sketch showing the Sun, the Earth 1 AU from the Sun, and a star 1 pc from the Sun. (Your sketch won't be to scale.) Draw lines from the star to the Sun and from the star to the Earth, and indicate which angle is the parallax angle.
b) Now look at your drawing from the point of view of an observer on the star. What is the angular separation between the Sun and the Earth? Or put differently, what is the angular size of an object 1 AU across seen from a distance of 1 pc? What is the angular size of an object 1000 AU across seen from a distance of 1 kiloparsec (kpc)?
c) I have found a planetary nebula with an angular size of 1 arcminute at a distance of 1 kpc. What is its diameter in AU? (Use your answer to part b to help you figure this out.) What is that in km?
d) Using the Doppler shift, I have measured the expansion speed of the planetary nebula to be 30 km/s. What is its age in seconds? What is that in years?
2. a) Assume the mass of the black hole at the center of the Milky Way is $3 \times 10^6 M_{\text{Sun}}$. Convert that mass to kg and calculate the Schwarzschild radius of the black hole. You will have to look up the values of G , M_{Sun} , and c in the back of your book. How does that compare to the radius of the Sun? (What is the ratio to the radius of the Sun?)
b) What is your Schwarzschild radius? How does that compare to the radius of an atom (about 10^{-10} m)?