PROBLEM SET 6
Physics 2021

1. Suppose your Newtonian reflector has an objective mirror 20 cm (8 inches) in diameter with a focal length of 2 m. What magnification do you get with eyepieces whose focal lengths are (a) 9 mm, (b) 20 mm, (c) 55 mm?

2. How does the light-gathering power of a 300-m diameter radio telescope compare to that of a 50-m diameter radio telescope?

3. How much larger than a 1-m telescope would another telescope have to be in order to have 1000 times the light-gathering power?

4. The observing cage in which an astronomer sits at the prime focus of the 5-m telescope on Palomar Mountain is about 1 m in diameter. Calculate what fraction of the incoming starlight is blocked by the cage.

5. (a) Compare the light-gathering power of the Subaru 8.3-m telescope with that of the Hubble Space Telescope (HST), which has a 2.4-m objective mirror. (b) What advantages does Subaru have over HST? What advantages does HST have over Subaru?

6. A 4-m optical telescope operates at a wavelength of 5×10^{-7} m. How large would an infrared telescope operating at a wavelength of 10^{-4} m have to be to have the same resolution as the optical telescope?

7. The four largest moons of Jupiter are roughly the same size as our Moon and are about 628 million (6.28×10^{8}) kilometers from Earth at opposition. What is the size in kilometers of the smallest surface that the Hubble Space Telescope (resolution of 0.1 arcsec) can detect? How does this compare with the smallest features that can be seen on the Moon with the unaided human eye (resolution of 1 arcmin)?

8. The Hubble Space Telescope (HST) has been used to observe the galaxy M100, some 70 million light-years from Earth. (a) If the angular resolution of the HST image is 0.1 arcsec, what is the diameter in light-years of the smallest detail that can be discerned in the image? (b) At what distance would a U.S. dime (diameter 1.8 cm) have an angular size 0.1 arcsec? Give you answer in kilometers.