PHYS 171: Planetary & Stellar Astronomy
Due: Friday, October 4, 2019

Problem Set #5

1. Secondary mirror shadow
The primary mirror for the Gemini telescopes has a diameter of 8.1 m, while the secondary mirror has a diameter of 1 m. The back face of the secondary mirror blocks incident light from getting to the primary mirror: what fraction of the total light incident going into the telescope is blocked by the back face of the secondary mirror?

2. Angular resolution
Suppose that you want to image the lunar landing sites of the Apollo program, and in particular the lunar lander base (i.e. platform) that has a diameter of about 10 m. Assume that you are using visible light.

a) What is the angular size of the lunar lander base for an observer on Earth?

b) Use this angular size to calculate the diameter of an Earth-based telescope that would have this angular resolution.

c) To actually image the lunar lander base, you would want to have an angular resolution that is about 10 times smaller than the object that you are trying to see. What diameter would an Earth-based telescope need to image the lunar lander base at this resolution? Is this a realistic size? And is so, then suggest an existing telescope that can take such an image.

Note: The Earth-Moon distance is 3.8×10^5 km.

3. Photons
Suppose that in the not so distant future an astronaut on the Moon turns on a 100 W light bulb during a lunar eclipse (i.e. the Moon becomes dark as seen from Earth). You can assume that all of the emitted power is in the visble. The light is emitted uniformly in all directions
a) Calculate the number of photons per second emitted by the light bulb.
c) In the dark, when your pupils are dilated, they have a diameter of about 7 mm. Calculate the number of photons per second that enter one of your eye from the light bulb.
b) Calculate the number of photons per second from the lightbulb that can be captured by one of the Gemini telescopes.
c) Do you think that you will be able to see the light bulb? Do you think that the Gemini telescope will be able to detect the light bulb?