Homework 5

Should be submitted as a single Jupyter notebook file (.ipynb) to the course Moodle site by midnight on Monday, March 6.

1. Write 4-5 paragraphs describing key features of the telescope that you presented to the class. At a minimum, your explanation should include a discussion of the resolution and light gathering ability of the telescope relative to a reference that we discussed in class (either the hubble space telescope or today's 8m diameter ground-based optical telescopes), a discussion of what kinds of science questions or astronomical objects it is (or will be) uniquely capable of answering/studying, and any unique features of its design relative to classical monolithic mirror reflecting optical telescopes.

2. Answer the following questions. Use equations, units and quantitative comparisons in your answers wherever possible.
    a. Write a paragraph comparing the light gathering ability and resolution of the human eye (pupil diameter ~8mm) and that of an 8m telescope.
    b. Your brain "reads out" images collected by your eye once every 0.1 seconds. The famous Hubble Deep Field (HDF) image amounted to approximately 1 million seconds of integration time. Accounting for the diameter differences as well as the integration time, approximately how many times fainter are the faintest objects seen in the HDF than the faintest objects that you can see with you eye?

3. Using the definition provided in class, write a function that takes wavelength, diameter and pixel scale of a telescope and returns an image (raster plot) of an airy pattern with the appropriate spatial units (arcseconds, preferably) as the x and y coordinates. You will need the b1 (the Bessel function of the first kind, order 1) function from scipy.special package. You may use the built-in airy function to check your answer, but not to create your plot (use a function that you define instead). As the airy function is defined in one dimension as a function of a single spatial coordinate (distance from a reference point), the function that you wrote in Lab 8 that creates an array where every pixel has a value equal to its distance from the image center will help.