AST 475/875 Exercise #5

Due F, Dec 3rd Preferred (No Later than F Dec 10th)

Currently, there is a good deal of debate and concern in astronomy concerning the role of and support for small aperture telescopes. Here, let's try to tie some different concepts and sections of the course together to see what all the hub-bub about stopping support for small aperture telescopes and concentrating on large telescope funding is about. Acquiring this big picture view will be difficult at first—perhaps uncomfortable. But, it is neither technically difficult nor mathematically sophisticated by any means. We want you to pull together ideas about the very basic telescope optics, pixel scale, seeing and optimal sampling, CCD equation, S/N ratio, and radiation definitions that we've talked in class to answer these realistic questions. The answers may be illuminating for you.

Assume that you are given acess to a 1-meter and a 4-meter telescope at an astronomical site with good seeing (about 1 arcsecond). Both telescopes have an f/10 focus and a CCD camera with 1:1 optics (meaning there is no change of plate scale by the camera optics). The CCD has a format of 1000 x 1000 pixels, each 20 microns in size. Assume that the observations are *sky noise* limited.

A) Which telescope is most suitable for mapping the optical emission of a nebula over a 5 arcminute by 5 arcminute region, and explain why. Quantitatively consider plate scale, match to seeing conditions, and observational efficiency in terms of how many pointings you require to map the nebula.

B) What is the ratio of observing time required to map the nebula with the 1-m and 4-m telescopes? Assume: the nebula has a constant surface brightness; that the mapping can be done without any overlapping frames; that you will want to achieve the same S/N per pixel with both telescopes; and that the region to be mapped is 5' x 5'.