AST 475/875 Homework #5
Due Th, Sept 23rd

Astronomer Skippy Fleaman is trying to calculate and justify exposure time estimates for a telescope proposal on the Kitt Peak National Observatory 4-m telescope. As might be the case, information on S/N estimates or an exposure time calculator may not be readily available; data on overall telescope+instrument efficiency is also not available to calculate S/N from first principles.   Another way to get an exposure time estimate is to gauge off other observations (either on the same telescope+instrument or a different one). Let's do this here.

Astronomer Ophelia Oats reports that she obtained spectra with per resolution element signal-to-noise ratio of 250 on a *V*=7.5 point source with an exposure time of 1 minute using the Keck 10-m telescope and its high-resolution spectrograph. Astronomer Skippy Fleaman wants to obtain spectra with the same spectral resolution at the KPNO 4-m telescope using its high resolution spectrograph. He has found out that the relative efficiency of the Keck mirror+instrument+detector combination is a factor of 2 better than the KPNO 4-m and its spectrograph.   If Skippy obtains spectra of the same resolution at the KPNO 4-m, how long will he have to expose to obtain a signal-to-noise ratio of 100 on a *V*=10.0 star?   Assume that the noise in both Ophelia's and Skippy's spectra is photon noise (i.e., dominated by photon counting statistics parameterized by a Poisson distribution).

Write a couple-to-few sentence paragraph that might be part of a telescope proposal which qualitatively explains your reasoning and summarizes the simple mathematical estimate.