Problem Set 1

Prof. Beck–Observational Techniques

Due March 21

1 Problem 1

a) Show that the Etendue ("throughput") of a diffraction-limited beam depends only on the wavelength λ and numerical constants.

b) Find the background sky flux in $ergs\ s^{-1}\ cm^{-2}$ in a diffraction limited beam at wavelength 2.2 micron. Assume that the sky is a 300 K black body, with emissivity ϵ of 10%, and that the bandpass is 0.1 micron. No, you don't need to know the size of the telescope.

c) How many photons/sec is that? Convert that number into approximate magnitudes. (Use the link on the course page for magnitude transformations).

d) Your part c result was for a diffraction-limited beam. If your telescope has D of 5 meters, what is your background in $magnitude/arcsecond^2$? What is your background in a more realistic aperture of $1 arcsecond^2$?

2 Problem 2

You have to observe the star Arcturus in band U ($3500A$) from the Cerro Tololo Interamerican Observatory.

a) What will the airmass be at sideral time 14^h00? at 18^h30? at 22^h20?

b) If the atmospheric extinction coefficient at U is $0.65 mag/airmass$, how much fainter will Artcturus be at each of those airmasses, relative to its brightness at the zenith? How much fainter relative to its true brightness outside the atmosphere?

c) What is the lowest airmass that the NGP (North Galactic Pole) can have at Cerro Tololo? What is the lowest airmass of the Galactic Center? Of the North Ecliptic Pole?