

ASTR 257 - Homework 1

Due: April 11

1. What are the major atmospheric effects at $1\mu\text{m}$, $10\mu\text{m}$, 1 cm, and 100m? Of these choices, which wavelength is the best for ground based observing?

2. A $B = 20$ star observed with LRIS (the Keck imaging spectrograph) produces 1500 detected photo-electrons per second at an airmass of 1.0. The B-band sky brightness at Mauna Kea is listed as 23 mag/arcsec². The LRIS pixel scale is 0.135 arcseconds/pixel, and the readout noise is 3.8e-

(a) What is the rate of detected e-/pixel from the sky in the B band?

(b) What is the rate of detected e- from a $B = 26$ magnitude star observed at an airmass of 1.2 assuming the extinction coefficient in B is 0.25 mag/(unit airmass)?

(c) Assume that you are measuring all of the light for the $B = 26$ magnitude star in an aperture with a radius of 7 pixels. What is the exposure time required to make an observation of this star with a S/N of 20?

(d) How does the S/N scale with seeing (assume you scale the measuring radius linearly with the FWHM of point sources)?

(e) What exposure time would you need to measure the magnitude of the star with an accuracy of ~ 0.1 mag?

3. (a) How would the measured color of a star change throughout the night? (b) Why is the sky blue? (Here I am looking for qualitative answers. No need to be technical.)

4. For the future assignments you will need access to the following software, which you may want to start installing:

(a) CIAO: <http://cxc.harvard.edu/ciao/download/>

(Note: If you are concerned about space, you don't need the CALDB.)

(b) FTOOLS: http://heasarc.gsfc.nasa.gov/docs/software/ftools/ftools_menu.html

You can either install this package on your own machine or get an account on HERA which will allow you to run the tools online (<http://heasarc.gsfc.nasa.gov/webHera/>). Particularly helpful will be the fv tool.

(c) SExtractor: <http://www.astromatic.net/software/sextractor>

(The version I have is 2.5.0, though more recent versions should be ok.)