ASTR 8060
Homework 6

Learning Goals: Create apertures, calculate instrumental magnitudes, convert to the standard magnitude system.

For the following tasks, document each step as best you can with text and by graphical representation in a Jupyter notebook. Turn in plots and quantitative notes, along with your reasoning for each step. Think of these as guidelines for assessing astronomical data, rather than an exact to-do list. Be creative and careful in your in-depth analysis of the data.

1. CCDs are ideal because over the available dynamic range, they are very linear (that is, one photon produces on electron).Test the linearity of the CCD using the sequence of exposures labeled linearity test in the log. Make a plot of ADU versus time and determine whether the chip is linear to the full 16 bits of the A-D converter. What you care about here is whether the signal stays linear with exposure time as the flux in the peak pixel approaches the 2^{16} ADU limit.

2. Use PHOTUTILS to perform aperture photometry on three (non saturated) stars in the PG1633+099 standard field: a really faint one, a medium bright one, and a bright one. Perform aperture photometry using at least 5 aperture sizes from very small to very large and make a plot that reproduces the one from Howell Figure 5.7 showing S/N as a function of aperture radius. What is a good aperture size to use for this dataset?

3. Identify the standard stars in the PG1633+099 frame from Landolt (1992).

4. Extract instrumental magnitudes for all of your standard stars using an approach that you've advocated for as best you can in the questions above.

5. Plot your standard star instrumental magnitudes versus their airmass (or since you have many different standard stars taken at different airmass, plot the difference between the accepted magnitude and your instrumental magnitude versus airmass). Use one of the linear fitting routines in Python to do a least squares fit to find and plot the extinction coefficients at each filter. You can find their magnitudes and colors in Landolt (1992).

6. After extinction correcting your standard stars to zero airmasses (i.e., you're correcting to the top of the atmosphere), make a plot of the difference between real magnitudes and instrumental magnitudes using your standard stars as a function of V−R color and B−V color. Fit a linear relation to this trend. The fit gives you your instrumental zero points and the first order color term which let you transform your instrumental photometry to the standard system. Tabulate the instrumental zero point and first order color terms for each band in a neat, digestible way.

7. Using the extinction terms and color terms derived for the imaging dataset previously, do photometry on the stars in NGC6823 and make a color magnitude diagram of this open cluster. Either V vs. B−V or R vs. R−I are the most common ones you might find, but there may be others in the literature and you are welcome to follow their lead.