Homework 3

Due Date/Time: Beginning of class (7 pm), Wednesday, September 26th 2018

Observing Proposal

We will be doing our observing at Smith in the first part of the night (~9pm-midnight) over the course of the next month or so, and each of you will pick one cluster and one backup cluster for us to potentially observe. The following information about the Smith telescope and camera will be relevant in choosing your targets:

- Camera FOV = 15' x 24'
- Magnitude limit = ~14-15th magnitude for clear filter in 60 sec
- Pixel scale = 0.5"/pixel
- Typical FWHM (size) of target stars on camera = 6 pixels

And some things to consider in choosing your two clusters:

a. They should transit at different times in the early evening in case there are clouds
b. At least 50 individual stars within the cluster should be bright enough to detect with the Smith telescope
c. These bright stars should also be far enough apart to avoid them falling onto the same pixel on the Smith camera
d. These stars should fit within the field of view of the Smith telescope

To get this information, you should use a combination of iObserve and the Vizier database that you used last week. iObserve is installed on computers at Amherst College and at UMass (LGRT 6th floor computer lab) but can also be used via a free web interface at:

https://www.arcsecond.io/iobserve

Once you select a couple of targets that you think look good, enter their names into VizieR or its parent website, the CDS portal (http://cdsportal.u-strasbg.fr/) and you can find a list of digital data for those clusters. Look for a table with lots of entries/individual stars from that cluster, ideally listing the photometry (magnitudes) of the stars. The positions of the stars can also be given in decimal degrees and plotted in the VizieR interface. You can use this (and python) to be quantitative about your magnitude limit, field of view, and separation criteria.

Note that the Smith telescope and camera parameters make globular clusters particularly hard to observe. You should only choose a globular cluster as your primary or secondary target if you're confident that you will be able to isolate at least 50 stars at a range of magnitudes (and not just the brightest stars in the cluster).

Your observing proposal should be 3-4 pages in length. It should include the following sections, and as many calculations, screenshots from iObserve, etc. as you need to justify your arguments.

1. Introduction
    a. Explain what an H-R diagram is and how it can be used to determine the age of a cluster.
    b. Explain the basic difference between color-magnitude and H-R diagrams.
    c. Explain what an open and/or globular (depending on the targets your chose) cluster is and what you expect a cluster's color-magnitude diagram to look like. What are the main features?
    d. Explain why a cluster's color magnitude diagram can use apparent (rather than absolute) magnitude on the Y-axis. What is special about the stars in a cluster that allows for this?

2. Targets
    a. List the name, RA, Dec, transit time (in local time), angular size, and range of magnitudes for your clusters in tabular form

3. Observing Plan
   For all questions in this section, you should use screenshots from iObserve, calculations done in a Jupyter notebook from Vizier data, etc. liberally.
    a. Justify your choice of targets by discussing why you think their location in the sky, distance, angular size, range of magnitudes, etc. makes them good targets for this project
    b. Predict roughly how many stars you expect to be able to resolve in each cluster by tying data on the cluster to the properties of the Smith telescope and detector

Pre-Lab Reading and Questions for Week 4

Reading

(1) Please read Birney, Gonzalez & Oesper, Chapter 7: *Effects of the atmosphere* (scanned/uploaded to Moodle; hard copy of book available in Amherst College library)

(2) Please also read the following sections in Chromey:

- Section 6.3: *Telescopes in space*
- Section 6.4: *The current revolution in ground-based observing*
- Section 6.5: *Atmospheric blur*

Questions

1. At what altitude (elevation) above the horizon is our view of a star least affected by atmospheric extinction? What is the airmass value at this altitude?
2. Why might it be important to open the telescope enclosure at the beginning of the night to let the interior structures cool down?
3. In your own words, describe the following terms:
    a. seeing disk
    b. airglow
    c. coherence length
4. Write down the atmospheric effects most likely to impact our observations when we use the Smith telescope.
5. Why do stars appear to twinkle while planets do not? Relate this phenomenon to the concepts of scintillation and angular size.
6. Briefly list three advantages and three disadvantages each for space-based telescopes and ground-based telescopes.
7. Write down three important/main points from this week's reading.
8. List a concept you found complex or unclear in this week's reading, and try to write a brief description of that concept at a level understandable to a peer.