ASTR 8060
HOMEWORK 1
Due 08:45 February 8

Learning goals: become familiar with astronomical coordinate systems; Practice positional conversions in sexigesimal format; practice figuring out what is observable when; learn about common astronomical catalogs; practice using basic telescope parameters to define and become familiar with their observational capabilities in wavelength-angular resolution space. Equip yourself as an observational astronomer with common calibration papers that will come in handy at an observatory.

1. Compute starting from their RA and Dec. the angular distance in arcseconds between Alcor and Mizar starting from their Right Ascension and Declination. Also compute their position angle, usually defined east of north (make the assumption of plane geometry, given that their separation is small, so no need to do spherical trigonometry).

2. Derive the law of cosines (Chromey equation 3.1) and then rewrite it in terms of RA and declination. Use this to determine the separations for which the assumption of plane geometry is valid. To do this, make a plot comparing separations calculated with the law of cosines and the plane geometry assumption and see where they diverge from one-to-one.

3. Using a tool such as `astropy` skycoords, find the RA and DEC of, and the constellation which contains:

   - Galactic Center
   - Galactic anti-center
   - Galactic North Pole
   - Galactic South Pole
   - The location(s) where the ecliptic crosses the Galactic Plane

   Commit these, roughly, to memory.

4. You're going observing (Scroogishly) on Christmas eve at Kitt Peak. Without resorting to any software (you may use references to find coordinates of things), estimate approximately when, local time, the following objects will rise and set to within a couple hours. Use what you know about the Sun's track across the sky, and how its declination varies with seasons. Give the minimum airmass achieved by each object during that 24-hour period. (Take note of how the RAs of the NGC and Messier catalog are organized...could you tell when each one will be up, given only the catalog number?)

   - M1
   - The Galactic Center
   - NGC 4565
   - M31 (Andromeda Galaxy)
   - Virgo

- The Orion Nebula
- NGC 625

When you're convinced you can do this, check your answers using JSkyCalc[1] or another tool of your choosing.

5. Based on Chromey Chapter 4, make a table summarizing the characteristics of the various star and galaxy catalogs in common use. Include columns for catalog name, abbreviation, year of publication, number of stars, magnitude limit, and notes pertaining to things such as the area of the sky included in each, and the method of data collection for each catalog. Also include from web sources: the most recent USNO catalog, the 2MASS survey, the NRAO VLA Sky Survey, the WISE survey, the Sloan Sky Survey, PanSTARRS, and the UKIDSS survey.

6. Write a table of vital stats for the following telescopes: Chandra, HST, Gemini, SOAR, LCO, Spitzer, Herschel, ALMA, NOEMA, VLBA, VLA

   Break up the assignment so that each student does a handful of telescopes then merge your answers. Include at least the following:

   - aperture size
   - minimum operational wavelength (will depend on the instrument, so list the instrument and detector type, e.g. CCD, bolometer)
   - maximum operational wavelength (also instrument dependent, so list the instrument and detector)
   - diffraction limit (or e.g., angular resolution in the case of interferometers) at bother operational wavelength extremes
   - the maximum field of view (choose the instrument with the largest field of view)
   - the effective focal length at each operational focus (optical telescopes only)
   - the f-ratio at each operational focus (e.g., prime, Cassegrain, Nasmyth, optical telescopes only)
   - the plate scale at each operational focus (optical telescopes only)

   Based on this table, use Python to make a plot of wavelength versus field of view/diffraction limit for all these telescopes (you may need to break it up into several plots, at your discretion, and you'll probably want to use log wavelength rather than linear wavelength). Use polygons to outline the parameter space of each telescope/instrument combination with the lower y-limit of the polygon being diffraction limit and the upper y-limit being FOV.

7. Create a folder on your computer for your "observational notebook". This is the folder you will take with you whenever you go observing so that you have a complete list of useful references at the telescope. (Never assume that you'll have working internet at a telescope!) Compile some papers from the literature for your observational notebook.

[1]https://github.com/jrthorstensen/JSkyCalc

Choose an electronic format for saving your notes (e.g., Evernote). For each write up a 2–3 sentence summary of the usefulness and contents of each paper. Are there other papers you'd recommend be in this list?

- The Kitt Peak Direct Imaging Manual
- Photometric Standards: Landolt, 1992, AJ, 104, 340
- Photometric Standards: Odewahn et al., 1992, PASP, 104, 553
- Photometric Standards: Christian et al., 1985, PASP, 97, 363
- JHK Standard stars: Hawarden et al. 2001
- SpectroPhotometric Standards: Oke, 1990, AJ, 99, 1621
- SpectroPhotometric Standards: Hamuy et al. 1992 PASP, 104, 533
- SpectroPhotometric Standards: Stritzinger et al. 2005, PASP 117, 810
- ugriz Standards by Smith et al., 2002, AJ, 123, 2121
- Polarimetric, & Spectrophotometric Standards: Turnshek et al., 1990, AJ, 99, 1243
- Skyglow: Osterbrock et al., 1996, PASP 108, 277
- Atmospheric Refraction: Filippenko 1982, PASP, 94, 715
- Bandpasses: Fukugita et al., 1995, PASP, 107, 945
- Lamp Spectra: CCD Atlas of Helium/Neon/Argon Spectra with lines labeled: E. Carder at Kitt Peak (https://www.noao.edu/kpno/KPManuals/henear.pdf)
- Lamp Spectra: CCD Atlas of CuAr Spectra with lines labeled see http://www.gemini.edu/node/10704.