AS.171.618 Observational astronomy / Zakamska / Homework 2.

Problem 1 (3 points): observing proposals. There is a lot of interest in submitting proposals "for real". The first deadlines are coming up by end-March. So if we are serious about this, we need to prioritize this, and we will be making progress toward this goal with every homework.

1) Download, install and register as necessary the relevant Phase 1 tool for your facility and familiarize yourself with how it works. 2) Download the relevant .tex template for your facility. Some facilities do not publicize a particular template, just give you page limits. In that case, set up a .tex file in any format you prefer compatible with the proposal requirements. 3) Figure out the page limits. 4) It is your responsibility to notify your advisor that you are doing this and clear any issues of collaboration politics (i.e., warn your co-authors that you are leading the proposal and make sure everybody is ok with that!).

By the Feb 24 HW2 submission date, **we will focus on the target selection and on the feasibility of your observations.** All of the text you produce goes straight into your proposal tex template and you either submit the printout of the whole thing or email it to me.

Target selection: how are the objects selected? Are they observable in the relevant observing semester? How many targets? Why that many? Why these particular ones? We always start with target selection, because if there are no suitable targets to observe, there can be no proposal :)

Feasibility: what are the expected fluxes for the relevant observations? Why are these fluxes expected? What settings do you put in the ITC / ETC? What signal-to-noise expectations do you get? We start with feasibility because the sooner you discover difficulties in your proposed observations, the more chances that you can rethink the strategy and make it feasible.

For target selection I expect to see 1-2 paragraphs (e.g. there will be one paragraph describing your exciting targets in the science justification and another more technical one in the experimental design). For feasibility, I expect 2 paragraphs in the experimental design and screenshots of the ITC / ETC calculations (many proposals now require this too; Gemini does). I also expect to see ~5-7 citations at this stage. You are of course welcome to get started on the other parts of the proposal if you wish.

What to submit for HW: confirm that you have done 1-4 above and submit the pdf or the printout of your proposal template and a screenshot of ITC / ETC calculations.

For those of you doing the "fake" proposals everything is the same, except you do not have to notify your advisor or do collaboration politics. Upon review of your HW2 submission I might relax your page limits if they are excessive for a "fake" proposal.

Problem 2. Do not forget to log your talk questions, present at astroph coffees and honor thy constants. Undergraduates: if you do not want to present at the astroph coffees, you will present 2 papers in class. For this homework, pick a refereed paper in observational astronomy from the last ~2 years of interest to you and send me the ADS link for approval. Then we will decide the timing of your presentations.

Problem 3 (3 points). Distance measures in cosmology. Use NED (or any other resource of your choice) to look up the redshift z of another radio galaxy, 3C368. Calculate the luminosity distance to this object in Mpc using the h=0.7, Ω_M=0.3, Ω_Λ=0.7 cosmology. Same in h=0.5, Ω_M=1, Ω_Λ=0 cosmology. (Hint: http://xxx.lanl.gov/abs/astro-ph/9905116 is your best friend). Use NED (or any other resource of your choice) to look up the optical flux of this source at some wavelength λ. Use this measurement to calculate **monochromatic luminosity** nu' L_nu' of 3C368 at rest-frame wavelength λ/(1+z) in the two cosmologies in erg/sec and in solar luminosities.

If you consider our earlier source 3C273 instead, by what factor are the luminosities different in the two cosmologies?

Problem 4 (5 points). Quasar.

(a - 1 point) Use https://dr12.sdss.org/basicSpectra/ to view the plot of and download the fits file for the spectrum at RA=54.27596 deg and dec=-0.79658 deg (you want the advanced search by sky region, and you want to be clever how you define your sky region; how many spectra do you find? Why? Which one do you use? Why?). You can read the data using

```
from astropy.io import fits
hdul=fits.open('name_of_your_download.fits')
spec=hdul[1].data
```

and spec['loglam'] (log base 10 of wavelength in A) and spec['flux'] are the two columns you want.

(b - 1 point) Use python to make the same plot of flux density vs wavelength as that available on the SDSS webpages for this quasar. Make it pretty with the relevant stretches and label the axes!

(c - 1 point) Replot the spectrum but now average the value of each pixel with the four adjacent pixels. That is, if the spectrum is in an array f(i), where i is an index running through all elements of the array, replace f(i) with [f(i-2)+f(i-1)+f(i)+f(i+1)+f(i+2)]/5. What you have done is a smoothing operation, convolving the spectrum with a 5-pixel boxcar. You should notice that the spectrum does indeed appear much smoother.

(d - 2 points) Calculate **synthetic AB g-r-i magnitudes** of this object from the spectrum. AB magnitudes are (mercifully) directly related to spectral flux densities, so to solve the problem you need some sort of average spectral flux densities through SDSS filters. If you do something sensible and describe what exactly you did and what the limitations of your method are, you will get full credit.

The "right way" is to download the filter curves and convolve the spectrum with the filter curve. Exactly how the convolution is set up depends on whether the SDSS filter curves are "energy counting" or "photon counting" and the units in which the spectra are given. If you make progress on this, describe what you have done.

Compare your synthetic magnitudes and colors to those observed, which you can find for this object on the SDSS Navigate Page: http://skyserver.sdss.org/dr14/en/tools/chart/navi.aspx (or by navigating appropriately from the spectrum page). Are the observed ones given on the AB system? Do your calculated magnitudes agree with the observed ones? Are you getting within 0.2 mag? 0.1 mag? 0.05 mag (what is the corresponding relative flux error?).

Anything reasonable for this problem will get you full score. However, if you figure out how to set up the correct convolutions, you will likely find yourself using your code for years.