

AS.171.618 Observational astronomy / Zakamska / Homework 4

**Problem 1 (3 points): observing proposals.** I have reviewed the proposal drafts. Of the 6 proposals, to my knowledge:

one is planned for submission for the April 7 Gemini deadline (Liza);  
one is planned for a later JWST deadline (Yuzo);  
one may potentially be submitted in the fall (Carrie);  
the remaining three are not planned for submission.

I think everybody had feedback from me, and I would like to wrap up the proposal project by April 13, so that in the remaining couple of weeks of the semester we can do something else (like play with archival data, since we won't be able to do our roof-top project).

I would like to see the "minimal proposal" from all of you:

1 page of science justification: nice text  
2 pages of figures and references  
1 page of experimental design  
some snapshots of exposure time calculations

I am happy to review work in progress before April 13 if more feedback is desired.

**Problem 2: Catalog cross-match.** We have started talking about multi-wavelength astronomy. One important issue is to carefully "cross-match" objects between observations at different wavelengths so that cross-matching has **the maximum completeness and the minimum contamination**. In this problem we will learn how to figure out the right cross-matching distance between two catalogs.

a -- 2 points. Download SDSS quasar catalog from DR14. How many quasars are there with redshift  $<0.3$ ? Select a random subsample of a few hundred quasars at  $z < 0.3$ . (If you take the first quasars, they will be at a very similar RA since the objects are arranged by RA, so do something else.)

b -- 2 points. Download FIRST radio catalog (it is a manageable size). How many catalog sources are there? Plot the distribution of catalog fluxes. Make the flux axis scale logarithmic. Explain qualitatively the shape of this distribution.

c -- 2 points. For your selected few hundred quasars at  $z < 0.3$ , find all the matches between their positions and the FIRST catalog within 2 arcmin. Then calculate the pairwise distances (remember that the angular distances on the sky are slightly non-trivial -- there is a  $\cos^2$  correction to the pythagorean theorem for angles...) between the optical position of the quasar and each of the FIRST catalog matches.

d -- 2 points. Plot the distribution of offsets: how many matches are within 1 arcsec? how many are between 1 and 2 arcsec? how many between 2 and 3 arcsec? Etc.

e -- 2 points. Explain what's going on in this plot (the shape of this distribution). What is the answer -- what is the right matching distance to choose for cross-matching optical quasars and FIRST catalog? Why do you think I asked you to choose  $z < 0.3$  quasars? What would happen if I asked you to choose  $z > 2$  quasars?