



CODE FOR SHOWING YOUR FINAL SAMPLE *(note: your variable names may be different)*

```
# pick your final sample of objects to check
want=np.logical_and(well_matched,matched_inside_1Mpc)
want=np.logical_and(want,CROSSMATCHED['r']<=20.5)
want=np.logical_and(want,CROSSMATCHED['g']-CROSSMATCHED['r']<=1.1)
FINAL_SAMPLE=CROSSMATCHED[want]

# sort it in r-band magnitude (brightest ones first) and display the table
FINAL_SAMPLE.sort(['r'])
FINAL_SAMPLE.show_in_browser(jsviewer=True)

# then make a schematic CMD to show where each matched object lies
# and also print out their SDSS coordinates
for i in range(len(FINAL_SAMPLE['r'])):
    plt.text(FINAL_SAMPLE['r'][i],
             FINAL_SAMPLE['g'][i]-FINAL_SAMPLE['r'][i],
             i,ha='center',va='center',fontsize=8)
    print(i,FINAL_SAMPLE['ra_SDSS'][i],FINAL_SAMPLE['dec_SDSS'][i])

plt.xlabel('$r$')
plt.ylabel('$g-r$')
plt.xlim([13,24])
plt.ylim([-1,2])
```

Things to think about when looking at cross-matched sources in Navigator

Is it a good X-ray/optical cross-match?

- Close to an optical source, small X-ray uncertainty.
- Close to an optical source, large X-ray uncertainty?
- Far from an optical source?
- In a crowded field?

Is it likely to be in the cluster?

- If it has a spectroscopic redshift, you know whether or not it is in the cluster.
- What if it doesn't?

What kind of galaxy is it in?

- Morphology: Spiral? Elliptical? Interacting?
- Color: Blue cloud? Red sequence?
- SDSS Spectroscopic Classification: star forming? non-star-forming? AGN noted?

X-ray hardness (“HRhs” column in the dataset)

- Logarithmic measure of ratio of hard:soft X-rays. Larger number, harder spectrum (more energetic X-rays)
- HRhs $>$ -0.5 : very likely AGN
- HRhs $<$ -0.5 : possibly(?) an AGN (but soft X-rays may also be hot gas halo around the galaxy...)

Final Cluster CMDs Workflow *(do this for each of Abell 2065, Abell 2063, and Abell 1795)*

1. Look at the redshifts for all SDSS objects projected within 30 arcmin of the cluster center. Find the cluster redshift range visually, then work out the average redshift for all objects in that redshift range. That's your cluster redshift. Use astropy to work out the angular size that corresponds to a 1 Mpc radius at that redshift.
2. Make a cluster color magnitude diagram for all SDSS objects projected within 1 Mpc of the cluster center. On your plot, using different marker styles/colors, plot:
 - All resolved sources (SDSS['type']==3)
 - All point sources (SDSS['type']==6)
 - All sources spectroscopically confirmed to be in the cluster redshift range.
3. Overplot on that cluster CMD all Chandra X-ray sources that are:
 - Projected within 1 Mpc of the cluster center, and
 - Well-matched to SDSS optical sources
4. For **each** X-ray source matched to an SDSS optical source **brighter than $r=20.5$** and **bluer than $g-r=1.1$** ,
 - Examine their morphology using SDSS Navigate
 - Look at their SDSS spectra (if they have one), to find redshift, spectral type, etc.
 - Discuss them in terms of morphology, color, spectroscopic properties, cluster location, X-ray properties etc.

Overarching question: Are we finding cluster AGN? If so, what can we say about their properties, or how they might be triggered? What kind of follow-up studies might be interesting? What additional data would you need?