

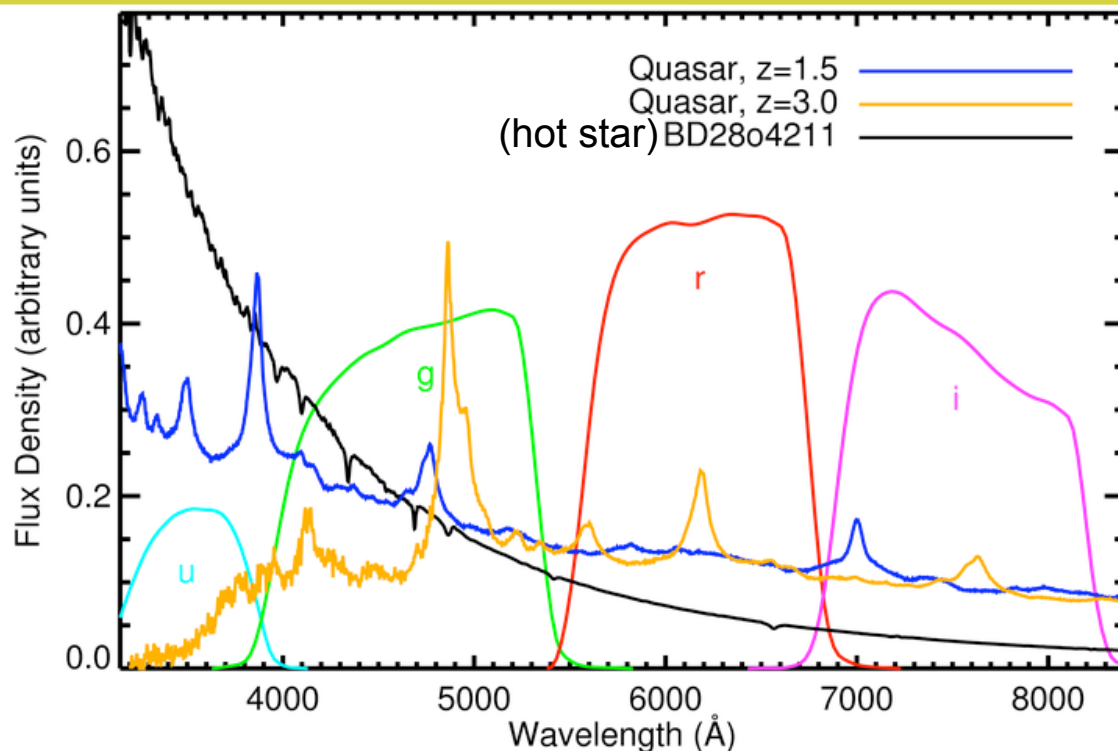
Classification in Imaging

Classifying objects in imaging

- Objects in the sky have different spectra
 - i.e. different fluxes as a function of wavelength
 - Different spectra are produced by different underlying physics, e.g.,
 - black bodies for objects of different temperature
 - emission or absorption lines according to Kirchhoff's Laws of Spectroscopy
 - Doppler shifts and cosmological redshifts
 - Ideally, we'd take a spectrum of every object at every wavelength, but this is expensive. Often, we infer information about objects based solely on imaging
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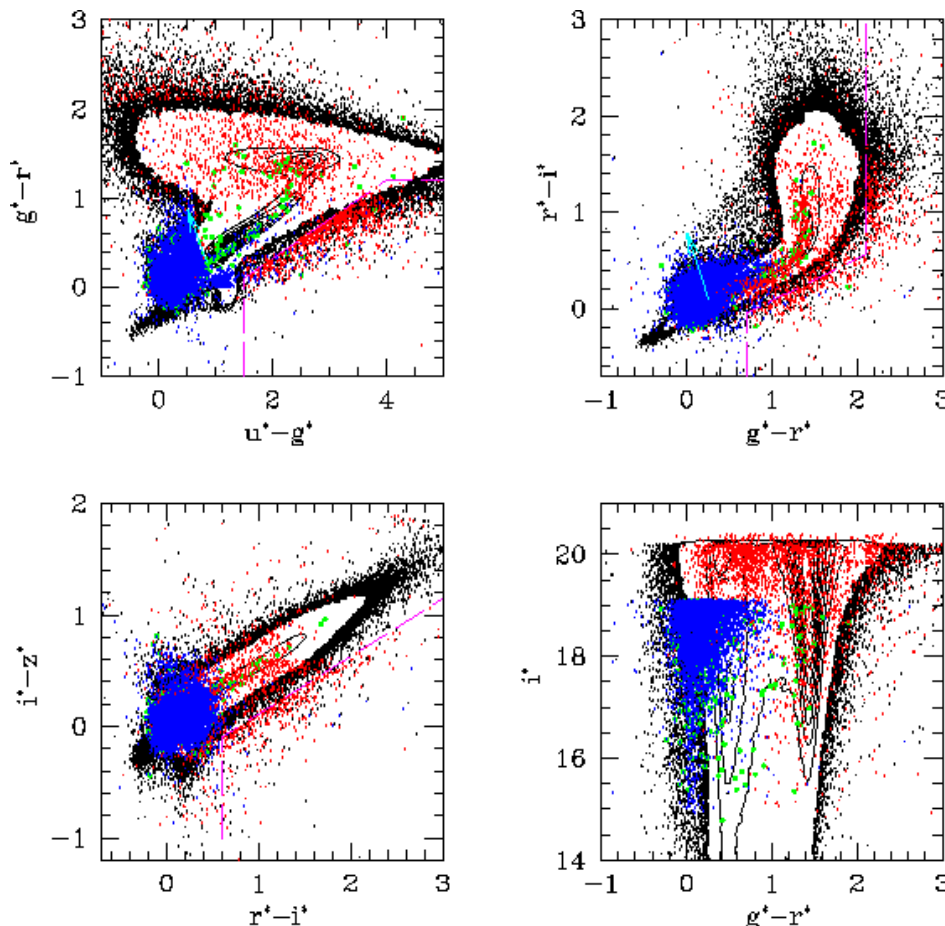
Classifying objects in imaging

- For instance, consider the three spectra to the right
- One is a (hot) star
- Two are quasars that have been cosmologically redshifted by different amounts (i.e. are at different distances)
- Note how the different spectra would produce different fluxes through different filters
 - e.g., the star would have much more flux in u-band than the quasars, but about the same flux in g-band



Classifying objects in imaging

- By comparing the difference in magnitude between different imaging bands (*colors*) it is possible to classify different astronomical sources in imaging
- The figure (Richards et al. 2002) shows how stars (black) have different colors to quasars (blue)
 - In today's tasks we will approach this problem using simple *color cuts*. For example, a color cut of $-0.3 < u-g < 0.6$ might help distinguish quasars from stars



Python tasks

1. My week 10 Git directory contains two files named *stars-ra180-dec30-rad3.fits* and *qsos-ra180-dec30-rad3.fits*. These list coordinates for some spectroscopically confirmed stars and quasars that lie within 3° of $(\alpha, \delta) = (180^\circ, 30^\circ)$
 - Match to the imaging in the sweeps files (stored on /*astro*/) to retrieve the *ugriz* fluxes for objects in the *stars*- and *qsos*- files. The column that contains the fluxes in the sweeps files is named “PSFFLUX”
 - When considering a circular area (and not matching to *WISE* forced photometry), it will be easier to retrieve (imaging) objects in the region of interest by using the *sdss_sweep_circle.py* code in my week 10 directory rather than by using *sdss_sweep_data_index.py*
 - *Coordinate-match the stars-/qsos- objects to the sweeps objects to know which imaging objects have spectroscopy*
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Python tasks

- Once you have the fluxes for each spectroscopically confirmed quasar and star of interest, convert the fluxes to magnitudes
- as a check, ensure that some objects' magnitudes agree with the *SDSS Navigate Tool* values
- Correct the magnitudes for Galactic dust. Dust extinction is in the sweeps column “EXTINCTION”

2. Find color cuts in $u-g$, $g-r$, $r-i$ and $i-z$ that distinguish the stars from the quasars...write code that uses your color cuts to classify whether an object is a star or is a quasar

- Start by plotting $u-g$ (y-axis) against $g-r$ (x-axis)
 - Determine cuts that separate the stars and the quasars
 - If you have time, consider other colors (e.g. $r-i$ vs. $g-r$)
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