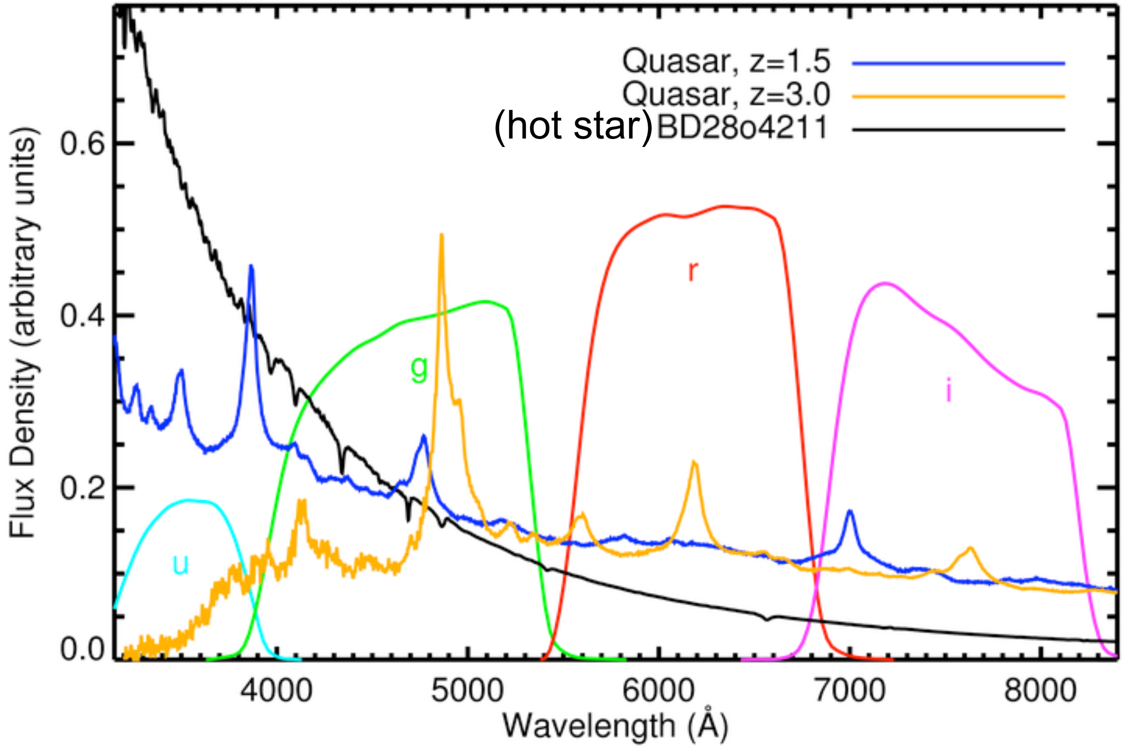
Classification in Imaging

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

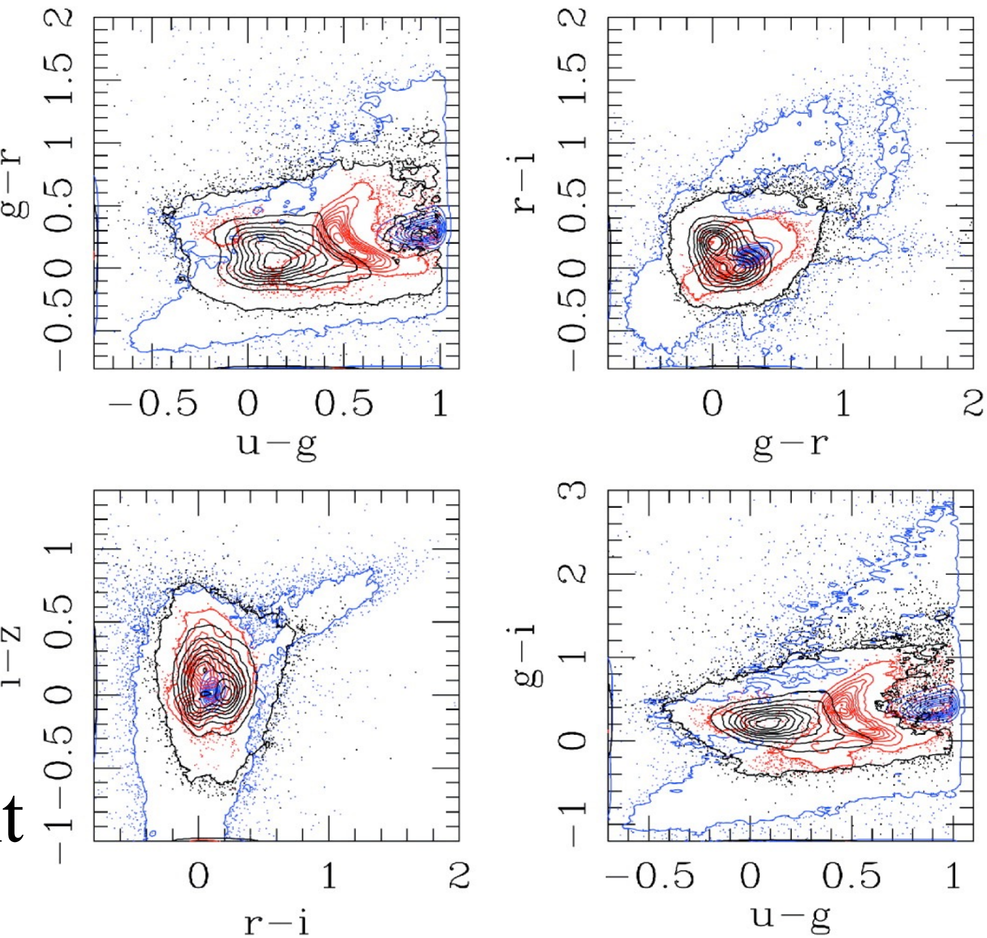
Classifying objects in imaging



- 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. 2004) shows how hot stars (blue) have different colors to quasars (black)



  – The Richards et al. method assigns complex contours in color space, in today’s tasks we will approach this problem using simpler color cuts

Python tasks

1. My week 10 SVN 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^o of $(\alpha,\delta) = (180^o,30^o)$
   - Match to the imaging in the sweeps files (stored locally at */d/quasar2/dr8*) 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 *GALEX* 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*

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*)