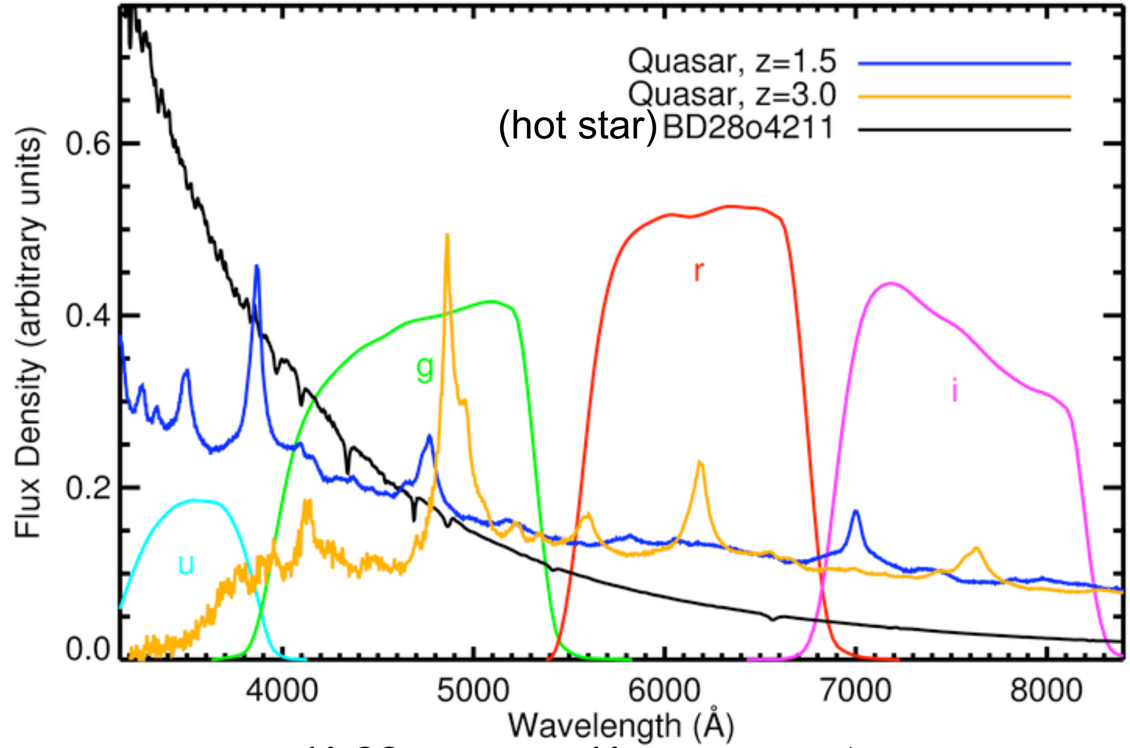
Classification in Imaging

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)

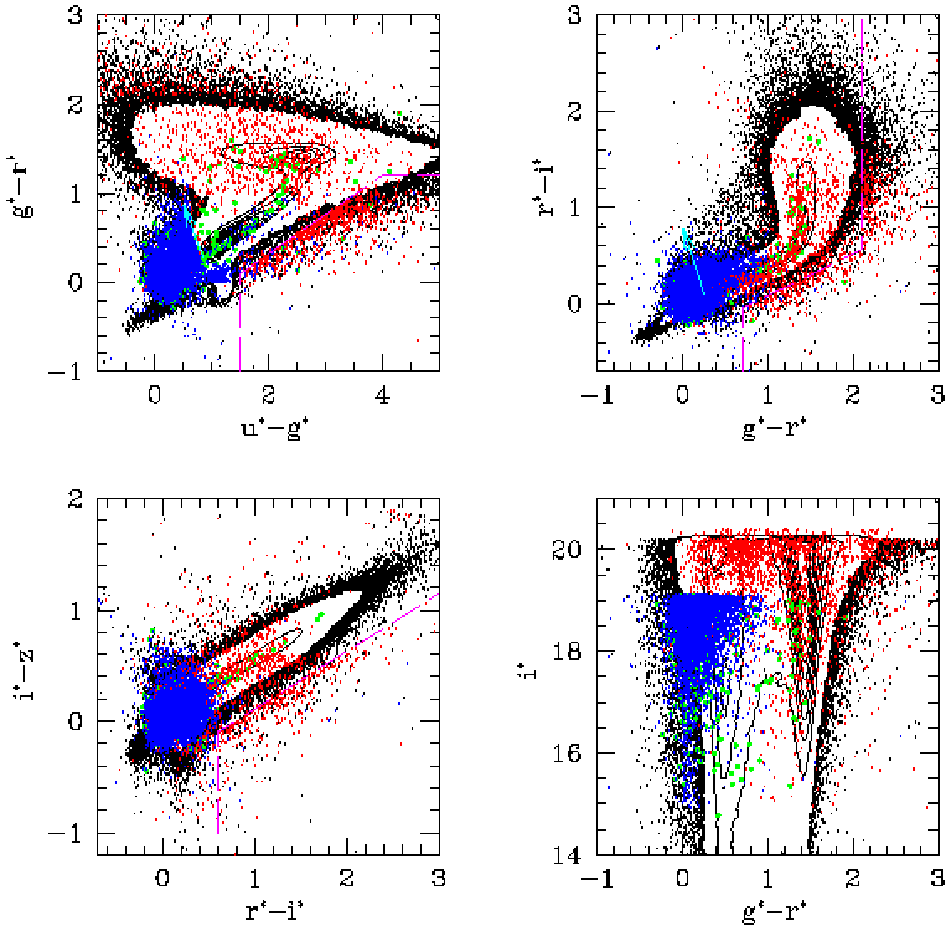


- Note how the different spectra would produce different fluxes through different filters
  – e.g., the star would have much more flux in u-band than the quasars, but about the same flux in g-band

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. 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 $-0.3 < u\text{-}g < 0.6$ might help distinguish quasars from stars

Python tasks

1. My week 9 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 $(\alpha,\delta) = (180^{o},30^{o})$
   - 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 7 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*)