Galactic Chemical Evolution Tutorial (with thanks to Katie Schlesinger!)

Observational astronomy is increasingly becoming survey astronomy. Data products from large surveys can be accessed using a SQL (Structured Query Language) query.

The goal of this tutorial is to run a simple SQL query of APOGEE/SDSS-III data, generate some plots and examine the data.

1.
The following link provides access to SDSS DR12.
http://skyserver.sdss.org/dr12/en/tools/search/sql.aspx

2.
Sample queries are provided here.
http://skyserver.sdss.org/dr12/en/help/docs/realquery.aspx

3.
Look at the Schema Browser for correct names/syntax.
http://skyserver.sdss.org/dr12/en/help/browser/browser.aspx

4.
Find the example: ASPCAP Parameters for Cluster Members
http://skyserver.sdss.org/dr12/en/help/docs/realquery.aspx#apogeeClusterCenters

Load the query, then edit the search form to also return:
  i)   Errors on metallicity
  ii)   Other element abundances (and errors) including alpha, C, N, O, Mg, Ti
  iii)   For one of C, N or O, also get the "original fit [X/M]" and "empirically calibrated [X/M] from ASPCAP"
  iv)   Radial velocities

(Hint: search "metal" or "alpha" in the Schema Browser or look at other examples)

5.
Plot Teff vs. logg.
Plot the radial velocity distribution.
Plot [alpha/M] vs. [m/H], [Mg/M] vs. [m/H] and [Ti/M] vs. [M/H].
Fit these data with a line and measure the slope, error in the slope and dispersion about the linear fit. How does the dispersion about the linear fit compare to the (average) error? Do alpha, Mg and Ti all behave similarly?

For (i) C and O and (ii) any other pair of elements, plot [x/M] vs. [y/M]. Fit the data with a line and measure the slope, error and dispersion about the linear fit.

Compare the "original fit [X/M]" with the "empirically calibrated [X/M] from ASPCAP", and plot the differences as a function of Teff, logg, [X/M] and [alpha/Fe]. Any obvious trends?

(Time permitting) Repeat the process for another "cluster" or random part of the sky. You will need to look up the coordinates.

Feel free to use any language.

IDL tips, if needed:

How to read an ascii data file
http://idlastro.gsfc.nasa.gov/ftp/pro/misc/readcol.pro

How to plot data
http://www.exelisvis.com/docs/PLOT_Procedure.html

How to fit a polynomial to data
http://www.exelisvis.com/docs/POLY_FIT.html
… with errors in X and Y
http://idlastro.gsfc.nasa.gov/ftp/pro/math/fitexy.pro

The handy "Where" function
http://www.exelisvis.com/docs/WHERE.html