A503: Computational Assignment

Summary
Using a programming language of your choice, produce a synthetic quasar spectrum which includes absorption due to the Lyα forest, a damped Lyα system and associated metals.

Details
Make a synthetic 1D spectrum (i.e. wavelength versus flux) for a QSO at $z = 3$ (ignoring the proximity effect). Plot your spectrum in normalized flux units (i.e. no absorption means flux=1) and angstroms over the range $3500 - 10000$ Å. Include the Lyα forest according to the column density distribution function, include Lyβ, but no higher order lines. Assume that the number density of lines does not depend on redshift. Include a DLA with $z_{abs} = 2.3$ and log N(HI) = 20.8. For the DLA include single component absorption line for the following species: MgII, SiII, FeII and ZnII. Assume a fixed abundance of each metal [X/H] $= -1.5$. Measure the EWs of these metal lines and comment on their inferred column densities based on the linear curve of growth approximation.

The following items must be submitted:

1. An electronic ascii version of your spectrum
2. A paper copy of your spectrum
3. An electronic version of your computer program
4. A (word-processed) description of your techniques, any assumptions you make and your commentary

Hints

- Atomic data is available from the A503 web site. Columns are species, λ, f, Γ.
- Choice of b value for DLA doesn't matter. For Lyα forest clouds you can either look up their typical distribution in the literature, or assume a reasonable range e.g. Gaussian distribution with mean 15 km/s and σ of 5 km/s.
- Use the solar meteoritic abundances from Asplund et al astro-ph/0410214.
- The following paper has a handy approximation for the Voigt profile: Humlicek, 1979, J. Quantatative Spectroscopy and Radiative Transfer, 21, 309. Copies available from Sara on request. In the notation of Humlicek (cf the lecture notes) H(a,u) $\equiv$ H(y,x), i.e.

$$u \equiv x = c/b \times (1 - \lambda/\lambda_0) \qquad a \equiv y = \frac{\lambda_0 \Gamma}{4\pi b} \tag{1}$$

- The 1998 Annual Review article by Rauch includes lots of info and references that might be useful