7/22/04

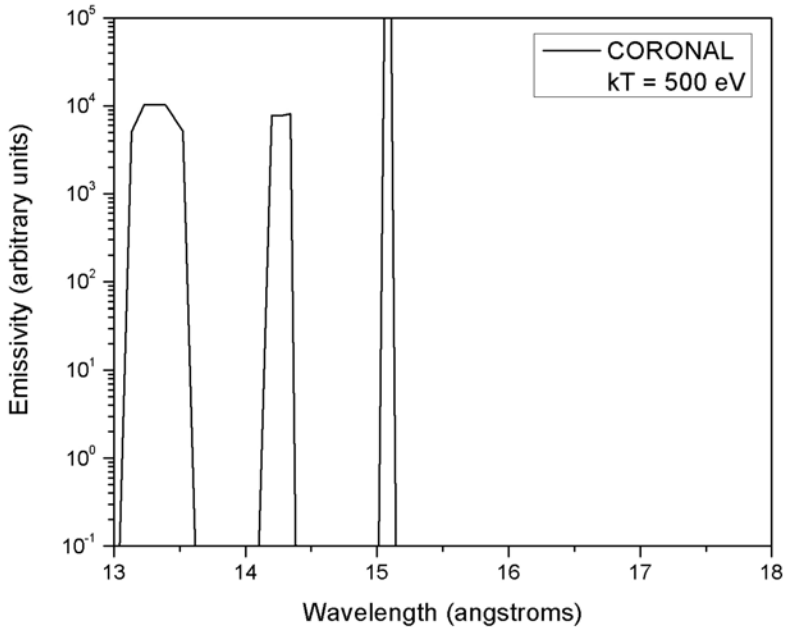
Hi Joe:

Using the ATBASE 4.2 Fe file you sent to me, I was able to run an NLTE simulation in PrismSPECT 2.2.0 for the coronal case of iron: $n_{ion} = 10^{11}$ cm^{-3} and T_{plasma} = 500 eV [`iron_coronal.psi`]. For the input *.atm file [`iron_coronal_2.atm`], I selected all of the levels I had selected for `iron_coronal_1.atm` [see http://astro.swarthmore.edu/~shupe/joe.html for the file and my last e-mail for explanation of selected levels] except for the ground states of the three lowest ions (as you suggested – I actually ran the simulation once with these ground states selected to verify that the simulation would crash: it did and returned the same error message we received before, `prismspect_error_message.jpg`). The atomic processes I selected for the NLTE atomic modeling where

Collisional Excitation/Deexcitation
Spontaneous Emission
Radiative Recombination
Collisional Ionization/Recombination
Autoionization/Dielectronic Recombination

I used a steady-state solution to the atomic rates equations, and zero-width geometry for the plasma. Below is the spectrum I synthesized for these parameters (the wavelength interval is the same as those of the spectra in the Liedahl et al. 1990 paper).

`coronal_spectrum.jpg`



Here is a list of the ionization balance and the relevant transitions.

Ionization Balance

Fe XVII	1.5%
Fe XVIII	5.3%
Fe XIX	19%
Fe XX	4.6%
Fe XXI	5.3%
Fe XXII	19.5%
Fe XXIII	23.7%
Fe XXIV	16.1%
Fe XXV	5.1%

Relevant Transitions

Ion	Transition	Wavelength	Oscillator Strength
Fe XIX	3d – 2p	13.3417	2.661
Fe XVIII	3d – 2p	14.2785	2.77
Fe XVIII	3d – 2p	14.399	3.081
Fe XVII	3d – 2p	15.0854	2.96
Fe XVI	3d – 2p	15.153	3.31 (Not in Liedahl Paper)
Fe XVIII	3s – 2p	15.8204	0.1769
Fe XVIII	3s – 2p	15.994	0.226
Fe XVII	3s – 2p	16.9508	0.1937

Overall, the quality of the synthesized spectrum is not very good. While the transitions that do show up appear to be in the right places, they are generally broader than in the Liedahl et al. paper, and certainly stronger when compared to the other lines in the spectrum. Except for the Fe XVI transition, which does not show up in the Liedahl et al. spectrum, many of the transitions which should be in our plotted spectrum are much too weak or simply not there.

My concern here is that even if I include more levels, the additional transitions which will be added to the table will be too weak to even show up on the plotted spectrum. I am also troubled by the shape and strength of the lines that currently show up on the

spectrum – their relative intensities are much higher than they should be according to Liedahl et al.
I'm hoping that the problem is on my end, but I am starting to worry that it isn't. **Do you have any other suggestions for things we could try on our end?**

On a related issue, David and I were not convinced that there exists a problem with PrismSPECT for LTE simulations with low density. We agreed with you that the flat spectrum we got for Neon was odd given the ionization balance, but we also recalled that the flat spectrum we got for the Iron in the coronal case was because everything was fully ionized. Thus, to prove to ourselves that there really is a problem, we reran an iron simulation for the XPN case in which the plasma temperature is much lower, ~ 10 eV. Like the neon simulation, this simulation also gave us a flat spectrum even though the ionization balance indicated that the iron was not fully ionized. So, I suppose we are now more convinced that there really is a problem.

As I did with the last e-mail, all of the files you should need are available on the webpage I set up for you:

http://astro.swarthmore.edu/~shupe/joe.html

Thanks.

--Nate