Nuclear Engineering 280
Homework Set 1 Due 3 February

1 . The ionization energies for lithium ($Z = 3$) are:

$$\text{Li I } 1s^2 2s\ {}^2S_{1/2} \rightarrow \text{Li II } 1s^2 1S_0 \qquad 5.392\text{eV}$$

$$\text{Li II } 1s^2 1S_0 \rightarrow \text{Li III } 1s\,{}^2S_{1/2} \qquad 75.638\text{eV}$$

$$\text{Li III } 1s\,{}^2S_{1/2} \rightarrow \text{Li Nucleus} \qquad 122.451\text{eV}$$

Assume that there are 10^{12} cm^{-3} total lithium nuclei and that there is a free electron density of 10^{14} cm^{-3}. Use the Saha equilibrium model given on p. 55 in the NRL plasma formulary:

$$\frac{n_e n_Z}{n_{Z-1}} = 6.0 \times 10^{21} T_e^{3/2} \frac{g_1^Z}{g_n^{Z-1}} \exp\left(-\frac{E_\infty^Z(n,l)}{T_e}\right) \text{cm}^{-3}$$

where T_e is in eV, Draw a plot of the concentration of species Li I, Li II, Li III, and Li^{3+} as a function of electron temperature T_e from 1 eV to 1 keV. Assume that the statistical g factors are unity.