Modeling non local thermodynamic equilibrium plasma using the Flexible Atomic Code data

Bo Han[a,b], Feilu Wang[a], David Salzmann[c], Gang Zhao[a]
[a]Key laboratory of Optical Astronomy, National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China
[b]University of Chinese Academy of Sciences, Beijing 100049, China
[c]Weizmann Institute of Science, Rehovot, Israel

We developed a new code, Radiative-Collisional code based on FAC (abbreviated RCF), which is used to simulate steady-state plasmas under non local thermodynamic equilibrium condition, especially photoionization dominated plasmas. RCF takes almost all of the radiative and collisional atomic processes into rate equation to interpret the plasmas systematically. The Flexible Atomic Code (FAC) supplies all the atomic data RCF needed, which insures calculating completeness and consistency of atomic data. With four input parameters relating to the radiation source and target plasma, RCF calculates the population of levels and charge states, as well as potentially emission spectrum.

In preliminary application [1], RCF successfully reproduces the results of a photoionization experiment at Sandia National Laboratory Z-facility [2] with reliable atomic data. The effects of the most important atomic processes on the charge state distribution are also discussed. In the calculations of RCF, the charge state distribution of this experiment is a composite result of different atomic processes. The external field dominates the ionizations in the plasma by photoionization directly and photoexcitation plus autoionization indirectly. The transitions within any given single charge state can significantly affect the charge state distribution, and one of the interesting results of our computations is the role played by collisional excitation in this experiment, in which it reduces the total ionization rate by competing with photoionization and photoexcitation.

References:

[1] Han, B., Wang, F.L., Salzmann, D., Zhao, G. Modeling non local thermodynamic equilibrium plasma using the Flexible Atomic Code data. Publications of the Astronomical Society of Japan, 2014, accepted

[2] Foord, M. E., Heeter, R. F., van Hoof, P. A., et al. Charge-State Distribution and Doppler Effect in an Expanding Photoionized Plasma. 2004, Physical Review Letters, 93, 055002