U054-P074 **Room: Poster Session Hall** **Time: May 15**

Study of detailed atomic processes in high temperature plasmas

Akira Sasaki[1]

[1] KPSI, JAEA

We study the atomic model of multiple charged ions toward their application to x-ray lasers and x-ray sources. We calculate the level population, ion charge as well as emission spectrum from the plasma for the identification of atomic transitions in the emission from laser and discharge pumped plasmas. Furthermore, we calculate the emissivity and opacity of the plasma, which is used in the radiation hydrodynamics simulation for the design and optimization of x-ray lasers and x-ray sources.

We solve the rate equations of ground and excited states of various charge states of an atom from the neutral atom to the fully ionized ion in our collisional radiative model. The calculation is carried out based on atomic data including rate coefficients of radiative and collisional, ionization and excitation processes. In the case of simple hydrogen atom, energy levels and rate coefficients can be obtained analytically. In constrast, in the case complex ions such as Fe, a large amount of atomic data should be calculated using numerical methods.

In the present paper, we study detailed collisional radiative model based on the atomic data from the HULLAC code [1]. In the case of complex ions, multiply- and inner shell- excited states of each charge state should be taken into account, because some of low-lying levels have a significant population which may change the ion charge, through excitation-autoionization (EA) or dielectronic recombination (DR) processes. On the other hand, the population of highly excited states decreases rapidly, thus their effect to the population kinetics becomes negligible.

We develop atomic models of C, Al, Fe, Sn, Xe, and Au ions. We investigate the effect of multiply- and inner-shell excited states. We determine the set of atomic states should be included in the model by increasing the number of states until the convergence of the ion charge is obtained.

The emission spectrum from multiply charged ions usually consists of sharp line emission from H-like, He-like, and other closed shell ions such as Ne-like ion, continuum emission from the radiative recombination process, as well as broad quasi-continuum peaks, which arise from overlapping a large number of fine structure transition from ions with half-filled subshells. Even the intensity of the quasi-continuum is weaker than the sharp line emission, it may contribute to the radiative energy transfer in the plasma. In the present model, we consider detailed structure of the sharp resonance lines and apply UTA (Unresolved Transition Array) model [2] to the quasi-continuum spectrum, to reproduce the experimental spectrum.

Calculated population and spectrum depends on the atomic model and the accuracy of the atomic data. In order to validate our model, we compared the results with those from different collisional radiative models [3] to find the present model with detailed atomic level structure reproduce experiments better than conventional models based on screened hydrogenic approximation [4].

We also carry out a comparison of Fe results with those by Arnaud & Raymond [5]. It is found that within the temperature range of 15-300eV, and ion charge range of 6-15, the difference of ion charge of is less than 1.5. The difference may originate from the effect of the metastable states in the fine structure of each charge states.

[References]
[1] A. Bar-Shalom, et al., Phys. Rev. E56, R70 (1997).
[2] C. Bauche-Arnoult, et al., Phys. Rev. A31, 2248 (1985).
[3] C. Bowen, et al., J. Quant. Spectrosc. Radiat. Transf. 99, 102 (2006).
[4] D. E. Post, et al., ADANDT, 20, 397 (1977).
[5] M. Arnaud, et al., ApJ, 398, 394 (1992).