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Overview of A&M research at Shanghai EBIT for fusion research

K. Yao, J. Xiao, Y. Yang, S. Shen, Y. Fu, X. Wang, B. Wei, L. Y. Huang, R. Hutton, and Y. Zou
Shanghai-EBIT Lab, Institute of Modern Physics, Fudan University, Shanghai 200433, China

In an electron beam ion trap (EBIT), a highly compressed energetic electron beam is employed to produce highly charged ions. In such a device, the electron density is at the region of 10^{10}-10^{12} cm^{-3}, and the beam energy is tunable and monochromatic. Therefore, EBIT is suitable for the high precision spectroscopy measurement of HCI. It is also suitable for disentangling study the electron-ion collisional processes in complex plasmas, in which the electron has a temperature distribution, such as TOKAMAKS, ICF.

In the past few year, Shanghai-EBIT (see Fig.1) [1] was dedicated to study the atomic process for application of fusion research.

Tungsten is used as the divertor material of the International Thermonuclear Experimental Reactor (ITER), for the reason of its high melting point, low sputtering, corrosion resistance, and low hydrogen retention characteristics. For the purpose of diagnostics, the requirement of tungsten spectroscopy data is urgent. In our EBIT, tungsten spectroscopies from visible to EUV region were observed for the charge states of W^{7+}-W^{28+} [2-6]. Many of them are identified for the first time.

DR plays an important role in the high temperature plasma. It significantly affects the plasma temperature, the charge state distribution, and the ion level population. The radiative processes in DR often cause unresolvable satellites, which may disturb the main line shape, line intensity, and line width, while the resolved satellite lines are often used for electron temperature diagnostics. Furthermore, DR of highly charged ions contributes significantly to radiation energy loss in fusion plasmas. Satellite lines from Li-like argon ions were measured at a special electron energy scanning scheme. K*a* lines from different KLn manifolds were fully separated. The inner-shell excitation dielectronic recombination processes of He-like to O-like argon, xenon [7,8] and tungsten [9-11] were carefully studied in Shanghai-EBIT. The cross sections of the resonant process were measured at an accuracy level of about 10%.

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Figure 1. Shanghai-EBIT.