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# Collisional and radiative processes of highly charged iron ions studied with an electron beam ion trap

Nobuyuki Nakamura[1], Masashi Monobe[1], Ryunosuke Kodama[1], Takashi Tsuda[1], Safdar Ali[1], Erina Shimizu[1], Hiroyuki A. Sakaue[2], Daiji Kato[2,3], Izumi Murakami[2,4], Hirohisa Hara[5,6], and Tetsuya Watanabe[5,6]

[1] Institute for Laser Science, The University of Electro-Communications, [2] National Institute for Fusion Science, [3] Department of Advanced Energy Engineering Science, Kyushu University, [4] Department of Fusion Science, SOKENDAI, [5] National Astronomical Observatory of Japan, [6] Department of Astronomical Science, SOKENDAI

e-mail (speaker): n_nakamu@ils.uec.ac.jp

Spectra of highly charged Fe ions in the extreme ultraviolet (EUV) range are important for the spectroscopic diagnostics of astrophysical hot plasmas such as the solar corona. In the diagnostics, plasma parameters, such as electron temperature and density, are determined through the comparison between the observed spectra and theoretical spectra calculated with a collisional radiative (CR) model. For accurate diagnostics, the model spectra should thus be examined by laboratory benchmark spectra obtained with a well-defined condition. We have been studying EUV spectra of highly charged Fe ions with an electron beam ion trap (EBIT), which can realize well-defined plasma consisting of a quasi-monoenergetic electron beam and trapped ions with a narrow charge state distribution. In this talk, we present our recent results on electron density and energy dependences of iron spectra studied with a compact EBIT, called CoBIT [1].

CoBIT mainly consists of an electron gun, an ion trap and an electron collector. The ion trap consists of three successive drift tubes and a superconducting magnet surrounding the drift tubes. The drift tubes provide a well potential which traps the ions axially, and the axial magnetic field produced by the superconducting magnet can trap the ions radially. The magnetic field is also used to compress the electron beam going through the trap. The space charge potential of the compressed beam electrons can also help to trap ions radially. Highly charged ions are produced through successive electron impact ionization and trapped in the middle of the drift tube. For producing Fe ions, a $Fe(C_5H_5)_2$ vapor is injected into CoBIT through a variable leak valve. EUV emission from the trapped ions excited by the beam electrons is observed with a grazing incidence flat-field grating spectrometer [2, 3].

Figure 1 shows a typical result of electron density dependence of line intensity ratios [4]. The experimentally obtained ratios are compared with a CR model calculation. Figure 2 shows a typical result of electron energy dependence measurements [5]. Resonant excitation is confirmed as an enhancement of the photon intensity at specific electron energies. The experimental excitation function is compared with a theoretical excitation cross section. Further results will be presented in the talk after brief introduction of the experimental devices.

References

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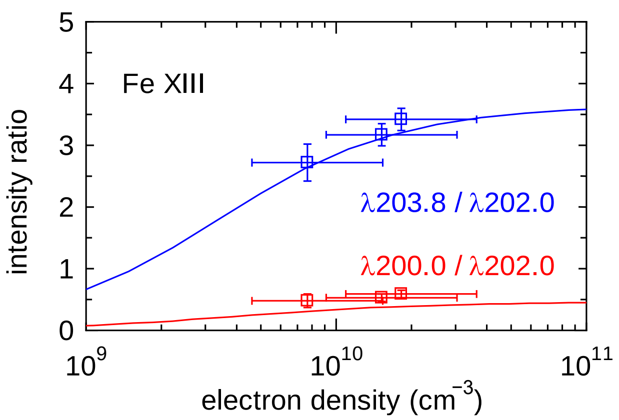


Figure 1. Electron density dependence of line intensity ratios in Fe XIII [4]. λ represents the wavelength of the lines in angstrom. The open squares represent the experimental ratios, and the solid lines theoretical ratios obtained by a collisional radiative model.

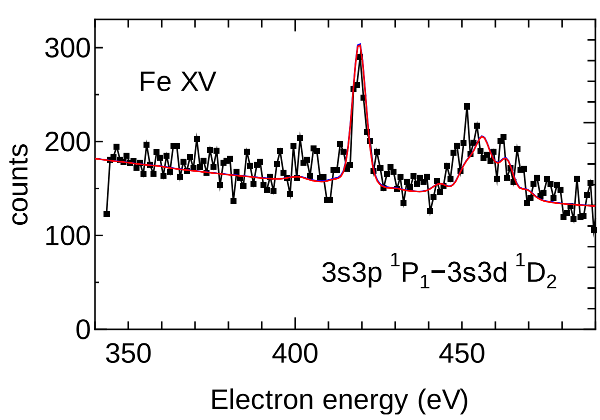


Figure 2. Electron energy dependence of the intensity for the 3s3p $^1P_1$ – 3s3d $^1D_2$ transition in Fe XV. The solid line represents the theoretical excitation cross section normalized at non-resonant region.