§4. EUV Spectroscopy of Highly Charged Iron Ions with Electron Beam Ion Traps

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Spectroscopic studies of highly charged ions are very important not only for atomic physics but also for astrophysical and laboratory fusion plasmas. For example, the atomic data of highly charged iron ions with charge state around 10 are extremely needed for the spectroscopic diagnostics of the solar corona with the recently launched satellite Hinode. For spectroscopic studies of such moderately charged ions, we have recently constructed a compact electron beam ion trap (EBIT)[1]. The electron energy range of our compact EBIT is 100-2000 eV, which is rather low compared to that of ordinary EBITs, and thus enabled us to downsize it. We have also developed a dedicated slitless spectrometer consisting of a 1200 lines/mm laminar-type replica diffraction grating and a back-illuminated CCD. The cross sectional view of our compact EBIT and the spectrometer is shown in Fig. 1. It is possible to employ a slitless type of spectrometer because an EBIT represents a line source with a width of ~ 0.3 mm. Typical EUV spectra of highly charged iron ions are shown in Fig. 2. Furthermore, the spectra of the LHD and Hinode are shown for comparison. As shown in this example, various charge state ions can be selectively produced with a narrow charge state distribution by adjusting the electron beam energy. Thus the charge state of unknown lines can be identified through such energy dependence measurements. Additionally, in the present EBIT, the electron density dependence of the EUV spectral line ratios, which are very important for astrophysical and laboratory fusion plasma diagnostics, can be studied by changing the electron beam current at a fixed energy.

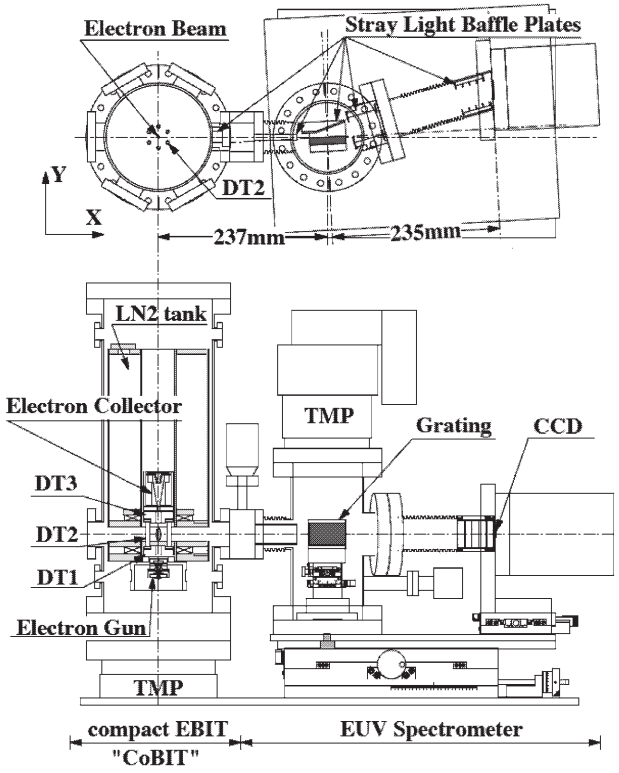

Fig.1 Cross sectional view of the EBIT and the spectrometer

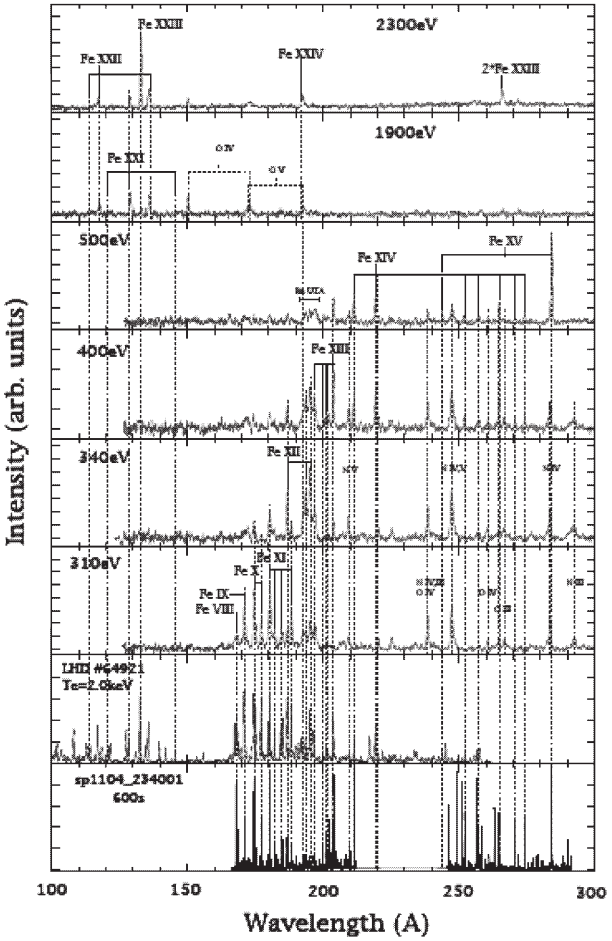

Fig.2 Typical EUV spectra of highly charged iron ions

1) N. Nakamura et al., Phys. Scr. T73 (1997) 362-364.