

## §24. Measurement of Soft X-Ray Emission from LHD Plasma

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A grazing incidence monochromator equipped with a laminar grating with the radius of 10 m was completed in 2004 under the joint research project for LHD. The monochromator is designed to cover the wavelength region below 2 nm. We expect that emission lines caused from 2s-3p transitions of H-like(Fe XXVI) and He-like(Fe XXV) ions of Fe could be observed at 0.963 nm and 1.018nm, respectively, from LHD plasma by using the monochromator. Furthermore, it is important to observe a spatial distribution of 1.502 nm line of Ne-like(Fe XVIII) ion which has a closed shell structure with a high ionization potential. This observation makes the determination of the transportation coefficient possible with a high precision, independent of such atomic processes such as ionization and recombination.

In addition, there are many lines due to the 2l-3l transitions from Li-like ion of Fe to F-like ion in the 0.7-2 nm region, the intensities of which are strongly depend on the electron temperature. The observation of these lines is expected to provide basic data on energy transportation from the core plasma to the surrounding.

In 2005, the monochromator was attached to the LHD chamber through a differential pumping system. Measurements on LHD plasma were carried out in 2006. The monochromator has a large f-number of 143, which seems to suggest that the observed spectra may have a poor S/N ratio. However, we succeeded in observing spectra with a good S/N ratio, as seen in Fig.1. We consider that this is probably due to a reduction of the scattered component of the zero-order light, which is diffracted by using a SiO<sub>2</sub> holographic ion-beam etched laminar grating with a small surface roughness in the nanometer order. (The grating has the groove density of 1600 gr/mm, effective area of 76 × 76 mm<sup>2</sup> and groove depth of 6 nm, and is coated with Au of the

thickness 20 nm.)

In Fig.1, the 2p-3d transitions of Ne-like ion of Fe at 1.501 nm and 1.526 nm, and Fe-like ion at 1.563 nm are a tentatively assigned to the observed spectrum. The spectral lines in Fig.1 have a inclination with respect to the perpendicular, and those in the short wavelength side have a broad width. The distortions may be due to insufficient adjustment of the position of the MCP and CCD camera. We will complete the optical adjustment of the monochromator this year by using LHD in the operation mode of long duration discharge.

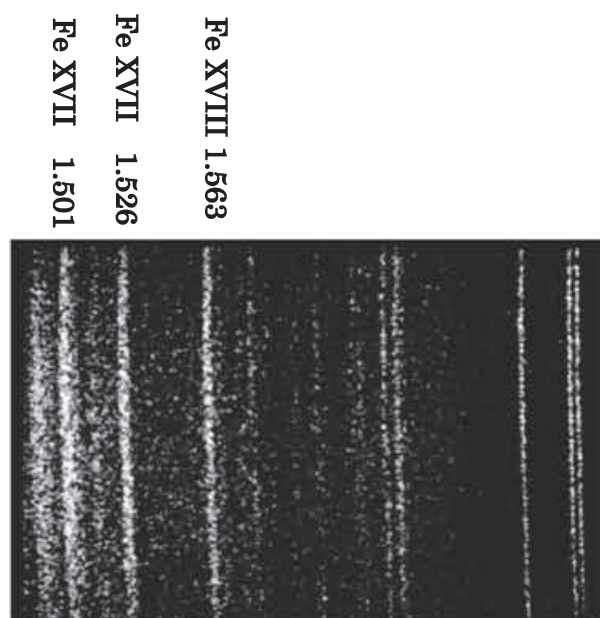


Fig.1. Example of a Soft X-ray spectrum of the LHD plasma. The exposure time was 4 sec.