§14. Identification of Ne-like Ion Fe XVII Spectrum at 116.98nm in LHD Plasma

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Special interest in forbidden lines of highly ionized atoms arises from their relatively long wavelength in plasma diagnostics, because optics (mirrors, windows and lenses) can be effectively used. The spectra with long wavelength have been extensively used for measurements of ion temperature. Combination of profile measurement with spatial resolved measurement of emission will be able to give us a ion temperature radial distribution.

We report the first observation of a Fe XVII forbidden transition,

$2p^5(^2P_{3/2}^o)3s(3/2,1/2)^o_1 - 2p^5(^2P_{1/2}^o)3s(1/2,1/2)^o_0$.

Figure 1 shows the energy levels of four low exited states of Fe^{16+}. The wavelength was expected as 116.98 ± 0.05nm from energy difference between these levels. Though transition probability of this line ($10^4 sec^{-1}$) is 10^7 times smaller than allowed lines, the emission of this transition is expected to be as intense as allowed lines, because the upper level of this transition is metastable, with 10^7 times larger populations than other exited levels.

This spectrum was observed with the Schwob - Fraenkel type spectrometer (SOXMOS). A spectrum appeared at expected wavelength in NBI+ICH heating plasma, is shown in Figure 2. The identification of this transition is supported by the observed temporal variation of the emission in the discharge.

In this time, Doppler ion temperature measurement using this line has not been attempted with. The wavelength resolution of SOXMOS equipped with 133g/mm coarse grating was too poor to measure the spectral profile. A normal incidence spectrometer with higher wavelength resolution may enable us to measure the Doppler ion temperature from this transition.

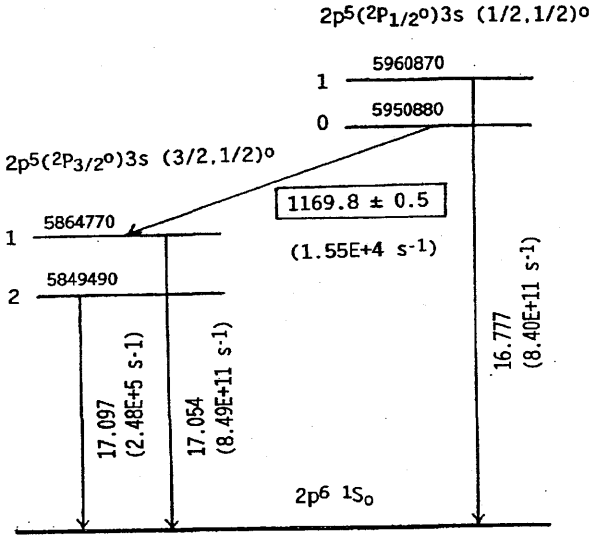

Figure 1: Schematics of Partial Grotrian Diagram for Fe XVII (Ne - sequence)

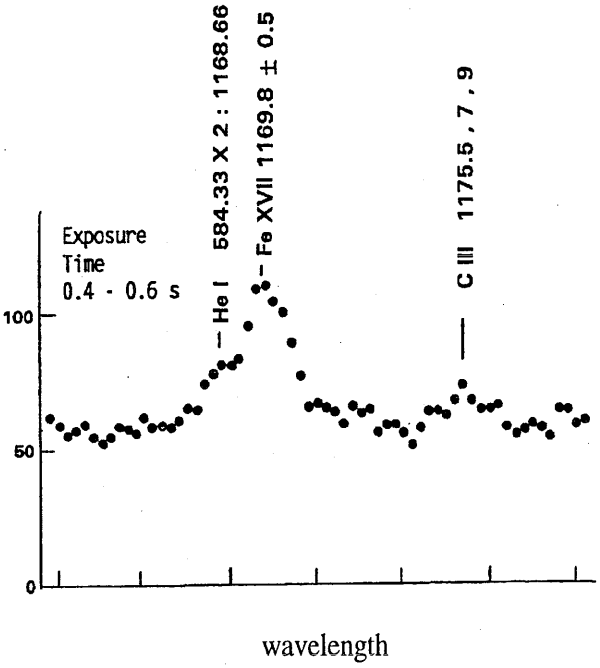

Figure 2: Measured profile of Fe XVII (110.98nm). #6908 ECH+NBI+ICH, B=1.5T,H/He=5.8%