

## §28. Time Resolved Electron Temperature Measurement by The Multi-Layer Mirror Soft X-ray Spectrometer on CHS

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In recent CHS (Compact Helical System) experiments, X-ray oscillations related with  $m=2$  interchange instability, or electric potential pulsation are observed. However, the time evolution measurement for electron temperature in low density plasma has not been done due to difficulty of ECE (electron cyclotron emission). The soft X-ray intensity of emission is a function of the electron temperature  $T_e(r)$ , the density  $n_e(r)$  and the concentration of impurities along the sight line. We have applied the multi-layer mirror soft X-ray spectrometer (MLSX) to fast temperature measurement in low density CHS plasma.

In the CHS MLSX, the plasma X-ray bremsstrahlung is reflected with the Silicon and Tungsten multi layer mirror which has a flat surface with the dimension of  $20\text{mm} \times 40\text{mm}$ . Figure 1 shows a layout of the CHS MLSX. The total number of layers is about 200 and the thickness  $2d$  is  $67.4 \pm 1.4$  [Å]. The 20ch. Silicon surface barrier detectors are arranged horizontally, and positions correspond to X-ray energy in Bragg condition. The reflectivity and energy resolution of the mirror has been calibrated in photon factory in KEK (Tsukuba, Japan) for the energy range of  $300 \sim 1200\text{eV}$ . The reflectivity increases from  $3\% \sim 25\%$  with the photon energy. Although, each detector views the different toroidal observation chords, the toroidal spread length is totally about 5 cm at the magnetic axis. In addition, the bremsstrahlung is practically emitted from the plasma core region.

Figure 2 shows an X-ray spectrum from ECH and NBI low temperature plasmas ( $T_e \sim 200$  eV), which exponentially decreases and O VII, O VIII impurity lines are observed[1].

Although it is necessary to take into account the effect of impurity line radiation, 20 channel spectrometer with MLM will permit a more faster time resolution in electron temperature measurement.

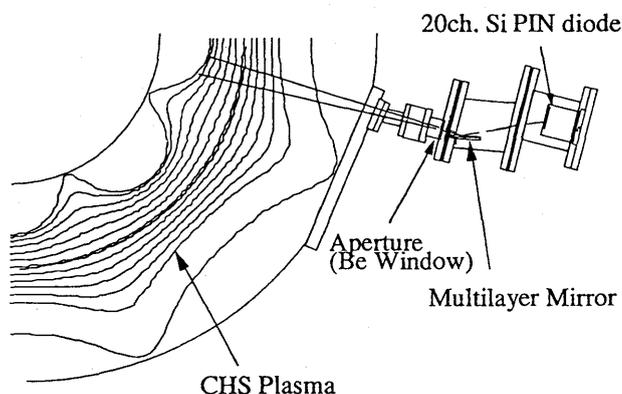


Fig. 1: Schematic view of the soft X-ray spectrometer with multi-layer mirror

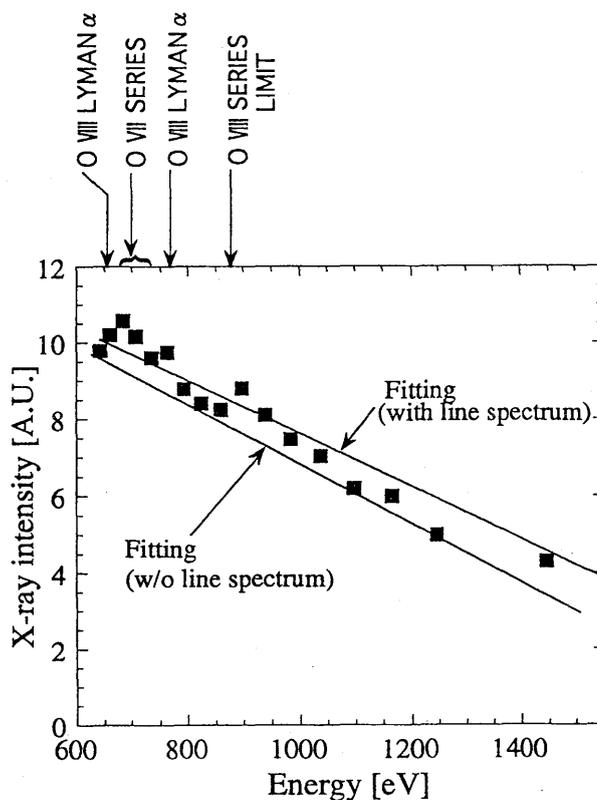


Fig. 2: X-ray spectrum from an ECH and NBI low temperature plasma. Fitting lines show cases with and w/o impurity effect.

1) R.H. Huddlestone, plasma diagnostic techniques, Academic press inc.