§34. Development of a Vacuum Crystal Spectrometer for Measurement of Radial Profiles of Impurity Lines in CHS

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A vacuum crystal spectrometer has been designed and developed to measure the radial dependence of the impurity line intensity in the vicinity of 20 Å. Highly ionized ions, that is, OVII and FeXVII are typical impurities whose line spectra can be obtained using the spectrometer.

While spectroscopy in that wavelength region is technically much more difficult than other wavelength region, the line spectra were successfully observed in CHS. The spectral resolution was estimated to be 610 ($=\lambda/\Delta\lambda$). The spatial resolution was better than 10 mm at the major radius of R980 mm of CHS.

The optics of the crystal spectrometer is illustrated in Fig.1. The spectrometer is of the Johan type with a bent RAP crystal (2d=26.12 Å and a photodiode array with a 2-stage MCP. The radius of curvature of the RAP crystal is 600 mm. The number of channel of the array is 1024. The surface size per channel is 2.5 μm x 2.5 mm. The accumulation time is 15 msec in a normal case.[1]

A piece of polypropylene (^{t}3.3 μm) film was put in front of the crystal. The film is used as a gas shield against CHS. The vacuum of the chamber was held better than 3×10^{-7} torr for normal operation of the detector to avoid increasing back ground noise.

The line-of-sight of the spectrometer can be changed in a range of ±15° by a scannable stand on which the vacuum chamber is fixed. Spatial resolved measurements are available shot by shot. The spatial resolution is adjustable.

Figure 2 shows an observed spectrum. Impurity lines were clearly observed and were assigned to FVIII, FeXVII and OVII lines. The line-of-sight of the spectrometer was on the mid plane of CHS.

A test performance of radial profile measurement was carried out. The experimental result is shown in Fig.3. The angle of the line-of-sight from mid plane was 3.0° in the case of #56640. As is shown in the figure, the radial dependence of each impurity is quite different.

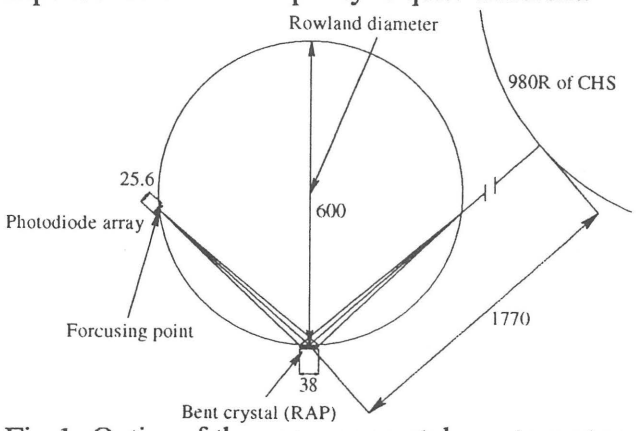

Fig.1 Optics of the vacuum crystal spectrometer. The unit of dimension is millimeter.

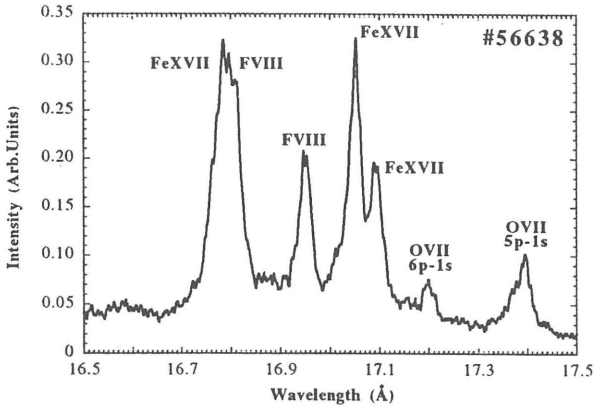

Fig.2 Observed spectrum in CHS by the vacuum crystal spectrometer.

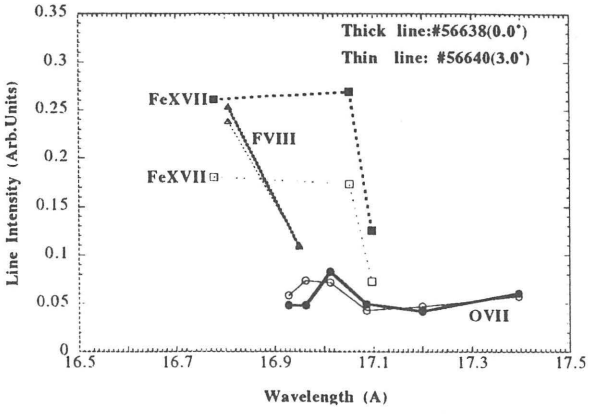

Fig.3 Radial dependence of the assigned lines.

Reference

1) Muto,S., *et al.*, Rev.Sci.Instrum. submitted