§10. Crystal Spectrometer for LHD

Morita,S., Muto,S and Goto,M

A Johann-type crystal spectrometer with a Rowland radius of 2R=3m has been developed for ion temperature measurement in LHD using x-ray lines from intrinsic metallic impurities and externally gas-puffed Ar[1]. The x-ray spectrometer is set at #3-O port of LHD as shown in Fig.1. The line-of-sight of the crystal spectrometer is tilted tangentially with an angle of 22deg. to observe an troidal rotation of the plasmas. The spectrometer is evacuated for the security to the vacuum maintenance of LHD as a superconducting machine, although the vacuum condition is completely separated from the LHD chamber by the Be window.

The spectrometer can be scanned by an external control system in a range of θ_B=61.4-72.1deg, since the length between the detector and the crystal are adjusted by bellows with the Bragg angle. The curved crystals are mounted on the ratable quadrangle crystal holder. We are preparing 4 quartz crystals for measurement of x-ray lines from 4 different elements of impurities. They are also listed in the figure. The vacuum vessel of LHD is made of stainless steel 316 (Fe71/Cr18/Ni8/Mo3). At present only the divertor region of the vacuum vessel is planned to be covered with carbon tiles. Another region of the vacuum vessel, however, is not covered because of some technical difficulties. Then, enough emissions from the intrinsic metal impurities are expected. The H- and He-like ions of Ar, Ti, Cr and Fe are detectable scanning the detector and the crystal holder. Using such the metal impurities as Ti, Cr and Fe we can measure the ion temperature in the central column of the plasma in a range more than 1keV. In a low-temperature case the Ar puffing will be useful.

As a detector of x-rays we plan to use large-area CCD instead of a multi-wire proportional counter. The CCD detector has a good spatial resolution (essentially 25μm) in comparison with the proportional counter (more than 100μm), although the sensitivity becomes low. We expect an increase in the spectral resolution, since in ECH plasmas the electron temperature is very high , but the ion temperature is still low. We are now testing the possibility using a low-grade CCD x-ray detector.

Reference

1) Morita, S.et al.: Fusion Eng. Des. 34-35(1997)165.

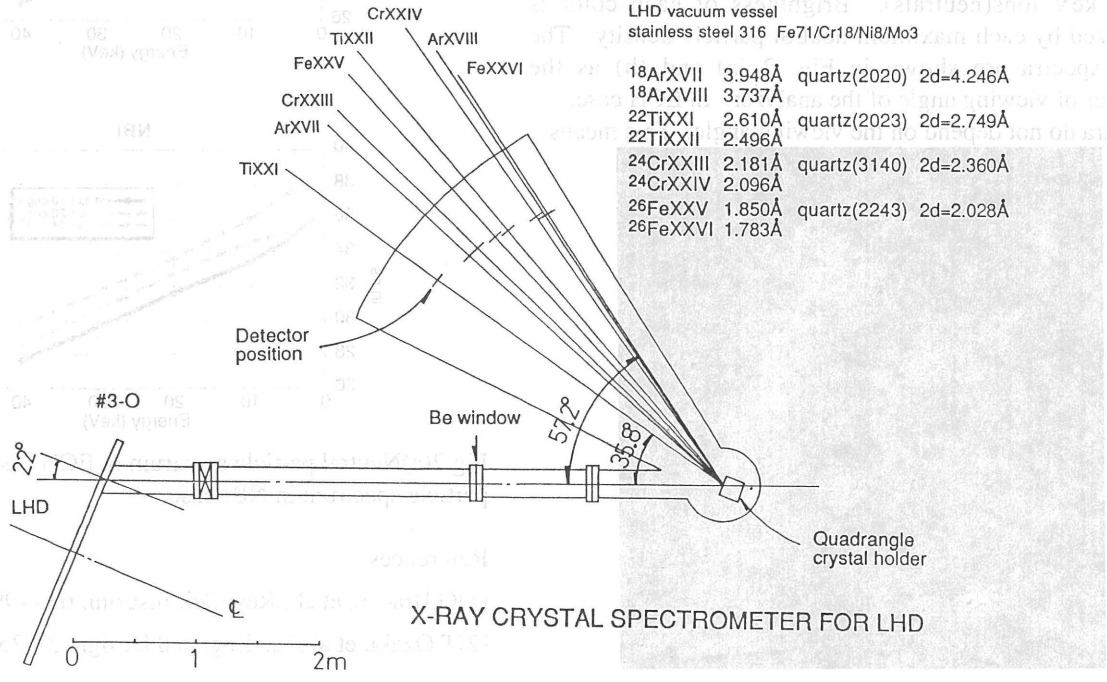

Fig.1 Schematic view of crystal spectrometer for LHD.