

Extension of the energy-resolved soft X-ray imaging system using two CCD cameras in LHD

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In order to obtain soft X-ray emissivity profile of specific photon energy range up to 10 keV, an imaging system using a CCD (Charge Coupled Device) camera and beryllium filters has been installed to the Large Helical Device (LHD). Eight two-dimensional images with different cutoff energies are measured by rotating a filter disk mounting beryllium filters with different thicknesses. Assuming continuum radiation and spatially uniform effective charge, it can possibly be applied to the measurements of line-averaged effective electron temperature and change in soft X-ray profile due to locally distorted electron energy distribution [1]. However, if the measured soft X-ray emissivity contains not only the continuum but also K_{α} spectral lines from impurity ions, they would affect the signal intensity especially in higher energy range. Therefore it would be helpful for further discussions on the results of the imaging if the soft X-ray energy spectra are measured simultaneously.

The CCD camera can also be utilized for the measurements of soft X-ray energy spectra by counting pulse heights in photon counting mode [2,3]. In this study the present diagnostic system has been extended by adding another soft X-ray CCD camera mainly used for the photon counting mode in LHD. Though the setup of the newly added system is basically similar to the existing one, it has been installed in the upper port to observe vertically elongated cross section. Another unique feature is that two mounting disks which rotate independently are equipped in front of the camera. Beryllium filters are mounted on the first disk to control the photon flux, while several slits with various widths are attached to the second disk so as to limit the photon illumination to the specific rows of the CCD chip. The slits are used in the kinetic mode operation of the CCD if temporal resolution is the first priority. This setup enables us to choose any combination of the filter thickness and the slit width according to the amount of photon flux. The details and capability of the simultaneous measurements of the soft X-ray images and spectra will be described and a preliminary results of the photon counting mode in LHD will also be presented.

[1] C. Suzuki, K. Ida, T. Kobuchi, M. Yoshinuma, LHD Experimental Group, to be published in *Rev. Sci. Instrum.* **79** (2008).

[2] Y. Liang, K. Ida, S. Kado, I. Nomura, T. Minami, *Rev. Sci. Instrum.* **71** (2000) 3711.

[3] Y. Liang, K. Ida, S. Kado, T. Minami, S. Okamura, I. Nomura, K. Y. Watanabe, H. Yamada, CHS Group, LHD Group, *Rev. Sci. Instrum.* **72** (2001) 717.