

# Development of Ultrafast Charge-eXchange Recombination Spectroscopy System in Heliotron J

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In magnetically confined fusion plasmas, the reduction of turbulent transport is a critical issue to improve the plasma confinement [1]. Measurement of ion temperature and flow velocity fluctuation provides indispensable information in turbulent research. Charge-eXchange Recombination Spectroscopy (CXRS) [2] is a powerful method that measures the local ion temperature and flow velocity [3]. To measure the fluctuation in Heliotron J, a new ultrafast CXRS system is under development, which is composed of high speed photodiode detectors, high throughput monochromator and optical fiber that can reach microseconds of temporal resolution.

The ultrafast CXRS system in Heliotron J measures the CVI ( $n=8-7$ , 529.05nm) or HeII ( $n=4-3$ , 468.5nm) emissions and estimate the ion temperature and flow velocity from the Doppler broadening and Doppler shift. As shown in fig. 1, two observation ports are used in the NBI region and non-NBI region to subtract the background emission from measured spectra. A high throughput Echell-grating monochromator (Bunkoukeiki, SPL-200P) with 0.185nm/mm dispersion at 529.05nm is being used. The typical spectrum width at the output port of monochromator is about 2.72mm. Considering the element pitch and size of the APD camera detector array (Hamamatsu S8550), a lens set (Nikon AF 50mm f/1.4D and AF DC 135mm f/2D) is used to zoom in the spectrum with a magnification of 2.7 times. The APD camera (Fusion Instruments Kft. APDCAM) with a Nikon F mount is coupled with the lens set.

An experiment to test the APD camera has been carried out. The maximum stable sampling frequency is 0.9MHz within 2 seconds acquisition time, depending on the data transfer rate to the control PC and the sensitivity of intensity fluctuation is up to 0.1%.

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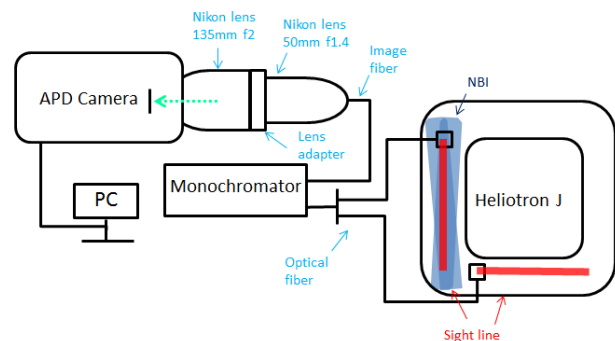


FIG.1. Schematic view of the Ultrafast CXRS system in Heliotron J