§4. TV Thomson Scattering for LHD

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Thomson scattering (TS) is widely used for the measurements of electron temperature and density profiles of plasmas. We are designing a TVTS as well as a main YAGTS [1] for LHD plasma diagnostics. The LHD TVTS observes electron temperature and density profiles along with the LHD major radius at the longitudinal 10.5L-port as shown in Fig.1, while the YAGTS measures them at the transverse 4O-port.

The green, second harmonics of YAG or glass laser is used for the incident laser beam in the TVTS. The laser is introduced vertically through a beam port on the 10.5L-port, and directed to the torus center along with the major radius by a mirror mounted inside the vacuum vessel. Thomson scattered photons are observed at about right angle through a view window on the same 10.5L-port. The scattered photons are collected by a focussing optics and analyzed with an imaging spectrometer, in which selectable three grating mirrors are mounted for changing wavelength (i.e., temperature) region observed. Typical observable temperature region is from 50 eV to 10 keV.

A fast, visible ICCD camera with the pixel format of 576x384 (Princeton Instruments Inc., ICCD-576G) is used for photon detection. As compared with the LHD YAGTS which has about 1000 APD detectors, calibration for the TVTS may be carried out efficiently. In traditional TVTS systems, very fast streak systems are installed for the measurements of Thomson scattered plus background (plasma) lights, and only background light at very short time interval. In the LHD TVTS, ICCD pixel format is divided into two areas. The upper half area is open for signal detection and the rest is masked for signal storage. An image detected on the open area can be transferred onto the storage one within 0.9 msec. In the way, we use the ICCD camera as a slow quasi-streak camera without any expensive streak systems. The transfer rate of 0.9 msec is expected to be enough short for the steady-state LHD plasmas. The temporal resolution of the TVTS is limited to be 1 sec, due to the slow read-out time of the ADC system for the ICCD.

Comparative studies of electron temperature and density profiles measured at different cross sections by the LHD TVTS and YAGTS will provide detail information on the LHD plasma characters arising from the complex helical configuration. In addition, non-Maxwellian electron velocity distributions during local electron cyclotron heatings could be observed owing to the high wavelength resolution of the TVTS system.

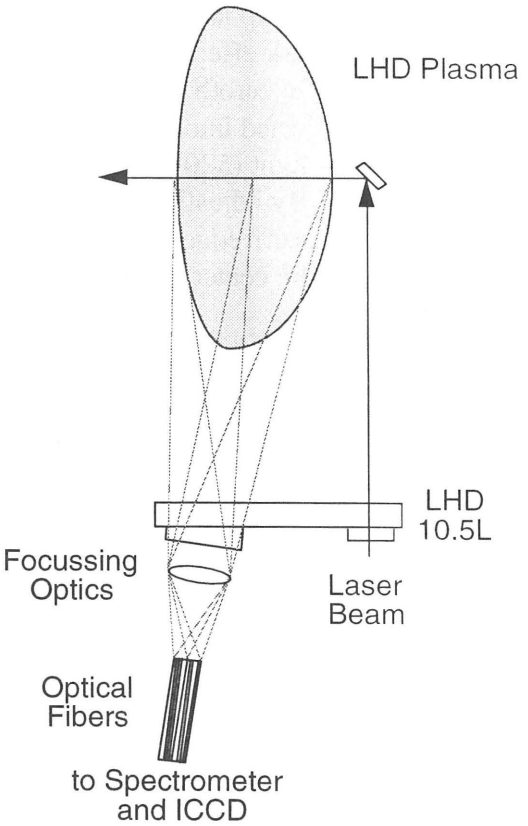

Fig.1: Schematics of the LHD TVTS

Reference

[1] Narihara, K., et al., Ann. Rep. NIFS (1994-1995), 92 (1995).