§49. Lithium Beam Probe System for LHD

Morisaki, T.

A lithium beam probe for the edge plasma measurement has been developed in NIFS. It can measure radial profiles of the electron density and its fluctuations simultaneously in one shot, in addition to advantages of no disturbances to plasmas and no high heat loads from plasmas. In CHS, the thermal beam which is available with a simple oven to evaporate solid lithium was employed for the probe [1]. While a thermal beam probe has a high density beam which is available for fluctuation measurements with a relatively simple setup, the region where it can measure is limited to only a low density peripheral layer because of the beam attenuation.

For LHD, an accelerated beam with an energy up to 30 keV is employed in order to measure the region a few cm inside the LCFS. Practically, the beam with an energy of a few keV will be utilized, taking account of the spatial resolution which is a travel distance of an excited (2p) lithium atom before coming back to its ground state (2s). With this range of the beam energy, the spatial resolution is about 5 mm

Figure 1 shows the lithium beam diagnostic set-up. The system consists of a beam injector and a optical detector. In the injector, lithium ions are extracted from a β-Eucryptite solid emitter with a diameter of 15 mm by a Pierce-type electrode, then accelerated and focused by Einzel lens, and neutralized in a charge-exchange cell filled with lithium vapor. The lithium beam can be deflected two-dimensionally by two sets of deflection plates to correct the beam trajectory. All the components, including turbo molecular pumps, of the beam injector are shielded against the stray magnetic field of LHD. For the optical detector, a fast image intensified CCD camera with an interference filter for Li I line (670.8 nm) is utilized to obtain precise density profiles. Optical fiber array is also installed for fluctuation measurements and spectroscopy.

The system is installed in LHD 6-O port as shown in Fig.2. The beam is horizontally injected 300 mm under the midplane. In this configuration, the probe measures the region near X-point through the divertor leg. The distance between the injector and plasmas is about 5.5 m.

The design of all components has been finished. Then the fabrication, fundamental test of the operation and investigation of the beam performance are about to be performed.

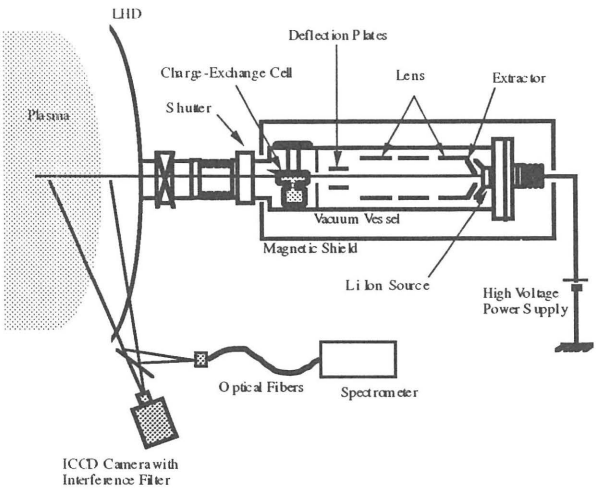

Fig.1 Symplified drawing of the lithium beam probe system.

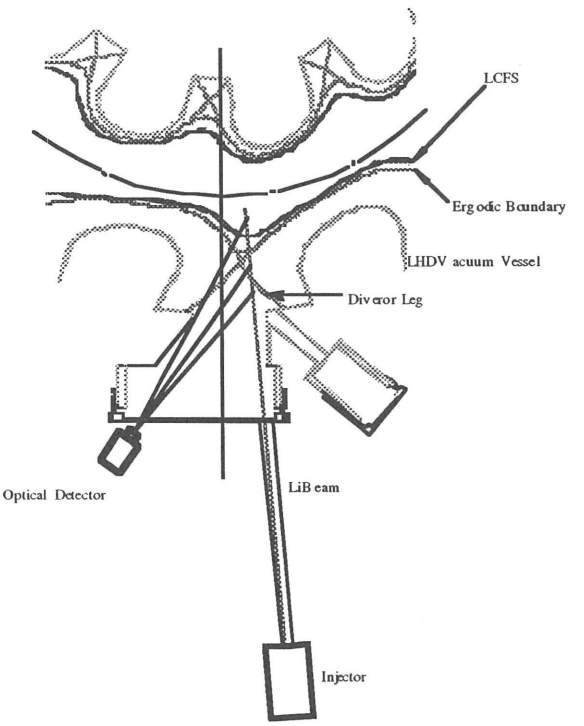

Fig.2 Installation layout in LHD

Reference

1) Morisaki, T., et al., Plasma Phys. Control. Fusion 37 (1995) 787.