§20. Design of a Lithium Neutral Beam Probe for Diagnostic on CHS Edge Stochastic Layer

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Divertor configuration and arrangement is the key issue for magnetic confinement fusion reactor. It also plays an essential role in particle and heat flux control to obtain improved confinement. A heliotron/torsatron type helical device has a natural divertor configuration similar to double null X-points in tokamak divertor region. In toroidal helical devices, however, because of breaking of helical symmetry, separatrix is not clear as in tokamak configuration. There is a thin region of stochastic or chaotic magnetic layer that surrounds core plasma. Particle and heat fluxes diffuse outwards and reach divertor region passing through this edge stochastic layer. The layer plays as a buffer for particle and heat outward fluxes

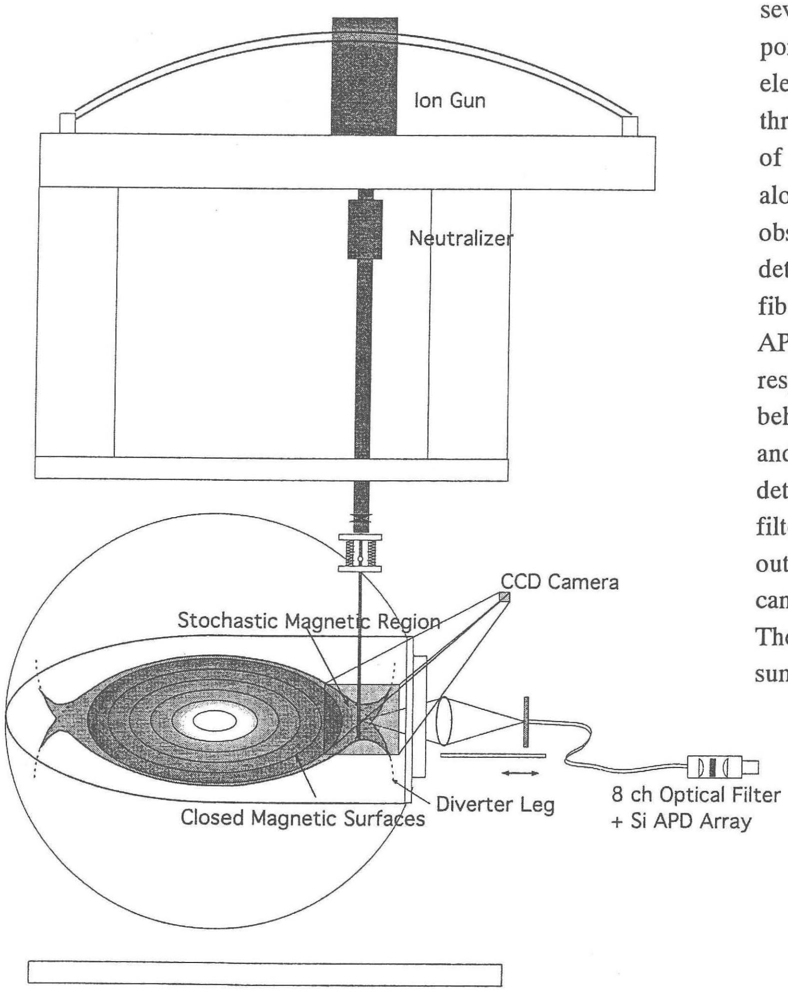

Fig. 1. Schematic arrangement of the lithium neutral beam probing on CHS under design.

in case of MHD activities. Understanding plasma behavior in this region and controlling them is important to design better divertor configuration. There has been little study on it in helical confinement devices.

CHS, which is a low aspect ratio heliotron/torsatron device, is suitable to study on it. Stochastic magnetic layer changes shape and width depending on the magnetic axis position. In addition, with an inward shifted magnetic configuration, the last closed magnetic surface is determined by the inboard wall of the vacuum chamber (limiter configuration), while with an outward shifted magnetic configuration, the last closed magnetic surface is surrounded by the stochastic magnetic layer. Various configurations can be tested. Good accessibility of the diagnostics to the stochastic region is also an advantage.

We have designed a lithium neutral beam probe for two dimesional diagnostic of the stochastic and separatrix layers of the CHS. A schematic arrangement of the beam injector and the optical detection systems is shown in Fig. 1. An accelerated lithium neutral beam with the energy up to 20 keV and with the equivalent beam current of several hundreds microamperes is injected from the M-port (located upside of the torus). Light emission due to electron impact excitation (6708 A) will be collected through a window mounted on the O-port (located outside of the torus). The injection beam line can be scanned along the major radius so that edge stochastic layer can be observed in two dimensional manner. Two types of light detection systems will be prepared. One is an 8-channel fiber optics array with optical band-pass filters and silicon APD (Avalanche Photodiode) detectors. Fast time response up to tens kHz is required to respond to dynamic behaviors associated with MHD activities. Intense beam and bright light collection optics is essential. Another detector is a CCD camera system with an optical band pass filter. Viewing area of the CCD camera covers the whole outboard stochastic layer so that two-dimensional profile can be obtained with beam line scanning in shot by shot. The total system will be installed on the CHS next summer.