§1. Construction of a Movable Electron Gun and Measurement of Magnetic Surfaces in LHD

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After the second experimental campaign, magnetic islands induced by an error field were observed by magnetic surface measurement under high magnetic fields (~3T). The local island divertor (LID) experiment is planned in the fifth experimental campaign by using an m=1 magnetic island formed by perturbation magnetic fields induced by the LID coils and the inherent error field. In order to prevent local concentration of the heat load on an LID limiter head, detailed measurement of the three-dimensional structure of the m=1 magnetic island in various configurations of LID coil currents is necessary for designing the limiter head, and it is also important to confirm the constancy of the position of the magnetic island (the error field) between the second and the forth experimental campaign.

In order to measure the magnetic island in the forth experimental campaign, we newly designed and installed a movable electron gun in 4.5-L port. Figure 1 shows the cross sectional view of the movable electron gun and the LHD vacuum vessel. At the tip of the rod of the electron gun, LaB_6 (lanthanum hexaboride) ceramic cathode which can emit thermal electron under high magnetic fields (~4 Tesla) was mounted. The vertical position of the electron gun can be moved for measuring the radial profiles of magnetic surfaces and islands. The injection angle of an electron beam to the magnetic field line can be changed by rotating the rod. The electron beam (E~200eV, I_{max}=7mA) was extracted through an aperture (ϕ=3mm) on a bias plate of the electron gun. The extracted beam circulates in the LHD vacuum vessel along magnetic field lines, and collides with the fluorescent mesh (Width:1m×Height:2m) installed in 6.5-L port. Fluorescent powder (ZnO:Zn, P15) adhered on the mesh caused fluorescent spots. The spots were detected with a back illuminated Peltier cooled CCD camera mounted on a tangential port (7-T).

Figure 2 shows the image of the spots in the standard magnetic configuration (#1-o, R_{ax}=3.75m, B=2.64T) without LID coil currents. The m=1 magnetic island was clearly observed. It is found that the size and the poloidal position of the magnetic island agree with the experimental results measured just after the second experimental campaign (#1-o, R_{ax}=3.75m, B=2.65T). These experimental results show no observable change of the error field, indicating the availability of analyses of magnetic islands basing on the experimental data in the second experimental campaign for the design of the LID limiter head. The detailed three-dimensional measurement of the island in various configurations of LID coil currents is our future task.

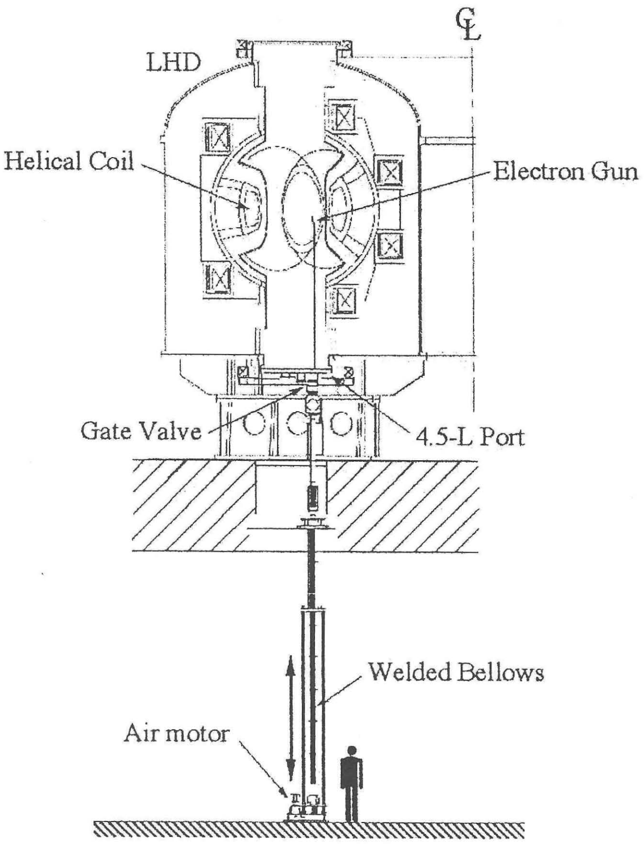

Fig 1. Movable electron gun for magnetic surface measurement installed in the 4.5-L port. The vertical position of the electron gun can be moved for measuring magnetic surfaces at various minor radii.

R_{ax}=3.75m (#1-o), B=2.64Tesla, w/o LID

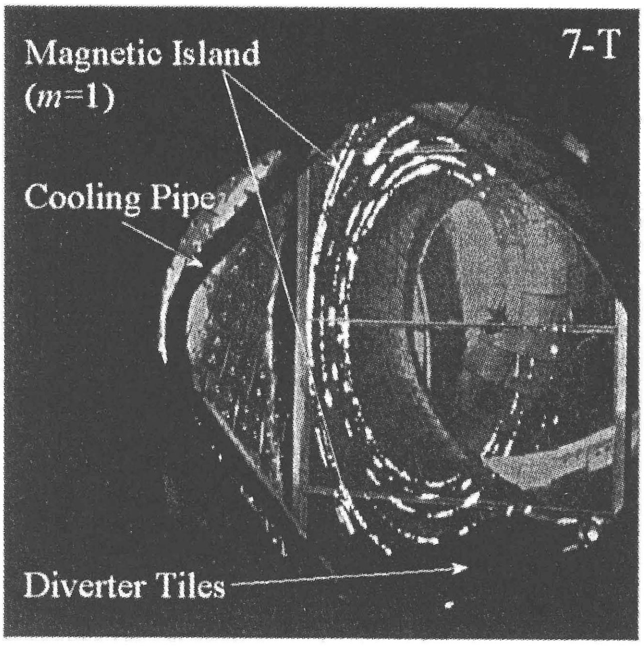

Fig 2. An image of magnetic surfaces measured just after the 4th experimental campaign. An m=1 magnetic island is clearly observed. The fluorescent spots are emphasized in this figure.