§32. Development of a Fluorescent Rod Scanning System for Magnetic Surface Mapping in LHD

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For magnetic surface mapping in helical systems, the so called fluorescent target method has become a standard one. Two kinds of target have been used i.e., (a) transparent mesh and (b) scanning of a rod in a poloidal cross section. The former has an advantage that a magnetic surface can be measured instantaneously. On the other hand, the latter has a merit that mapping experiment can be easily succeeded by plasma experiment without breaking vacuum vessel into atmosphere. Magnetic surfaces are possibly suffered from distortion or destruction as a result of installation of various facilities around the confinement device. Therefore, mapping is necessary many times during a course of experimental program.

We have developed and tested a simple and reliable rod scanning R&D system for magnetic surface mapping in LHD. The LHD is a super conducting machine and the magnetic surface mapping will be done at relatively high magnetic field intensities compared to existing devices. Therefore, the rod driving unit should be placed far away from LHD device so that it works smoothly and does not disturb confining magnetic field. We adopted polyester rope to transfer driving force from the motor to the fluorescent rod.

Figure 1 shows schematically a block diagram of the present R&D system. A copper rod (3mm diameter, 355mm length) is fixed to a vacuum flange which is connected to a vacuum vessel via a flexible bellows. Thus, the rod can be tilted around the pivot point which locates near the bellows. A weight (400-800 g) is suspended from an arm extended from the flange. At first, the rod is placed at a stand-by position i.e., outside the last closed magnetic surface. Then, the torque motor (100V, 3W) which is placed ~3m apart from the rod, is drived by a start signal. It pulls up the weight through the rope (5mm diameter) and drive the rod. The scanning of the rod is stopped by one of the limit switches. The sweep angle is 26°. After a certain time, the motor is reversed and the rod returns to the stand-by position. Oscillating swing mode (for instance f=0.1 Hz) is also possible. The scanning speed is controllable by changing either voltage applied on the torque motor or weight suspended from the arm. The operation is remotely controllable.

Figure 2 is a strobo picture which shows a scanning of the rod. The weight is 800g and sweep time is about 18sec. This R&D system has worked smoothly and reliably. We consider that this scheme can be well adopted to magnetic surface mapping in LHD.

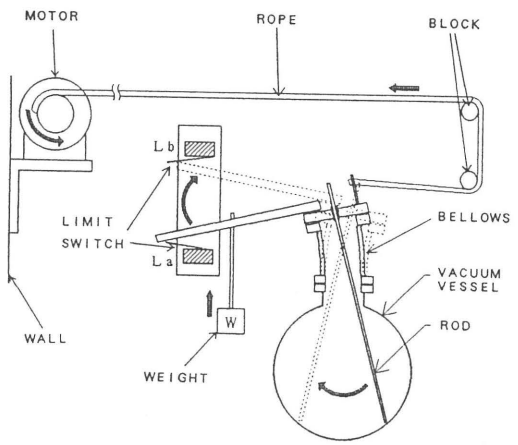

Fig. 1. Rod scanning R&D system for magnetic surface mapping in LHD.

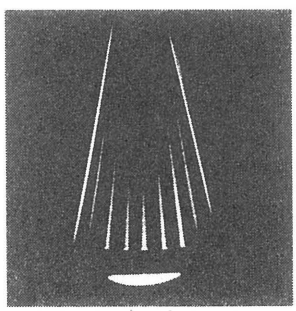

Fig. 2. A strobo picture of the rod scanning