§13. Measurement of Magnetic Field Fluctuations within Last Closed Flux Surface with Movable Magnetic Probe Array

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Magnetic fluctuation may play an important role in plasma transport on high temperature plasmas heated by auxillay heating. However, magnetic fluctuations are usually monitored by so-called Mirnov coils. They were mounted far from the last closed flux surface (LCFS), except that "internal" magnetic fluctuations were only measured for ohmically heated low temperature plasmas in small tokamaks. So, we have developed a new type of movable magnetic probe array to detect magnetic fluctuations inside as well as outside LCFS.

Figure 1 shows the structure of the movable magnetic probe array. There are 3 probes to detect radial magnetic fluctuations with 21 mm radial spacing between each probe, and 7 probes to detect poloidal (toroidal) magnetic fluctuations with 7 mm radial spacing. These probes were installed inside a SUS304-pipe of 13 mm diameter and 1mm thickness. This probe array can be inserted into a plasma beyond LCFS, where the probe position is scanned in the range of r/a = 1.4-0.8. As shown in Fig.1, the SUS-pipe is covered with a cap of Carbon-Carbon composite with 20% Boron, to protect the pipe from plasma bombardment and to reduce impurity efflux from it. Figure 2 shows the effect when the probe is inserted into plasma. Oxygen flux and H_α emission also remain unchanged.

The radial and poloidal components of the fluctuating magnetic field were measured in NBI heated plasmas of ~350 ms duration. The plasma parameters are $T_{e0} \approx 1500$ (eV), $T_{i0} \approx 800$ (eV) and $\bar{n}_e \approx 5 \times 10^{13}$ cm^{-3} during NBI. Figure 3 shows a radial profile of poloidal magnetic fluctuations in various frequency range. The poloidal mode number m is determined from the radial variation of $\tilde{B}_\theta$. We assume $\tilde{B}_\theta \propto r^{-(m+1)}[1-(r/b)^{2m}]$ (wall rasius b=320.0 mm) outside LCFS [2]. Coherent component of f=9.0-20.0 kHz has m=2 and incoherent component of 50.0-60.0 kHz m=12.

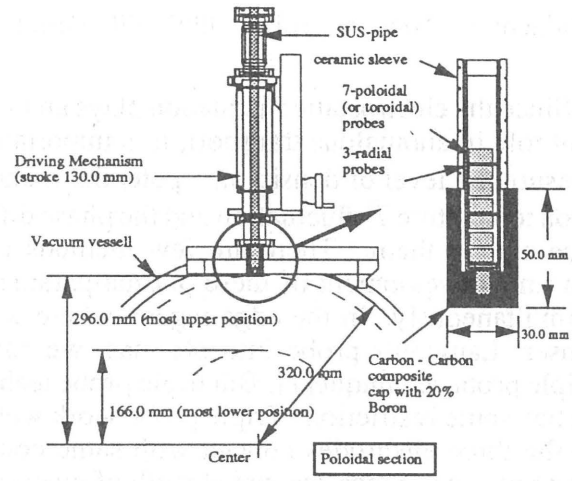

Fig. 1. Schematic of movable magnetic probe

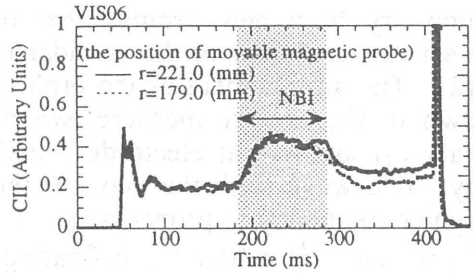

Fig. 2. Time evolution of impurity (CII line) in NBI heated plasma when the probe is inserted.

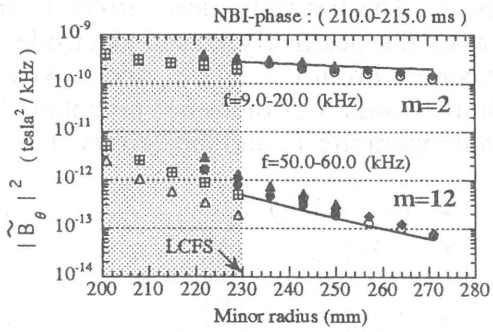

Fig. 3. Radial profile of amplitude of poloidal magnetic fluctuations.

Reference
1) M.Malacarne, P. A. Duperrex, et al., Nucl. Fusion 27, 2113 (1987)
2) Y. J. Kim, K. W. Gentle, Ch. P. Ritz, et al., Phys. Fluids B 3 ,674 (1991)