§18. Half-Turn Loop Antennas for Excitation of Alfven Eigenmodes in CHS

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In a thermonuclear reactor, it is important to clarify interaction between magnetically confined plasmas and fusion generated alpha particles. In particular, it is theoretically predicted that TAE (Toroidicity-Induced Alfven Eigenmodes) excited by alpha particles may increase loss of alpha particles and prevent ignition. Experimental studies on TAE have been carried out by using energetic particles generated by NBI or ICRF heating in tokamaks. It is necessary to investigate exciting and damping mechanisms of these modes experimentally, because these mechanisms are complicated and still unclear.

For this reason, excitation of TAE modes using half-turn loop antennas is being studied in the heliotron/torsatron device CHS. Four antennas are installed in the toroidal direction to determine the toroidal mode number (Fig.1). Two of these antennas are installed 3cm above the plasma, and the other antennas are installed on the outboard side at the different toroidal cross section. These antennas are connected in parallel each other. Mode number of excited fluctuations is determined by changing the polarity of each antenna current. RF oscillator consists of a capacitor bank and SIT (Static Induction Transistor) switching elements. A few hundreds Amperes of RF current can be induced in the above mentioned antennas, having the frequency range of 10～250 kHz. Magnetic fluctuations are detected by fast magnetic probes distributed in the toroidal direction. The current and voltage of these antennas are measured by CTs (Current Transformer) and voltage dividers, respectively.

Figure 2 shows the experimental results on ECH plasmas without any fast ions. In the case of antenna excitation, magnetic fluctuations are enhanced considerably by antenna currents. The driving frequency of the antenna is chosen to be close to the predicted TAE frequencies.

The TAE excitation experiments are being carried out to clarify spatial structures and physics mechanisms of TAE modes in CHS.

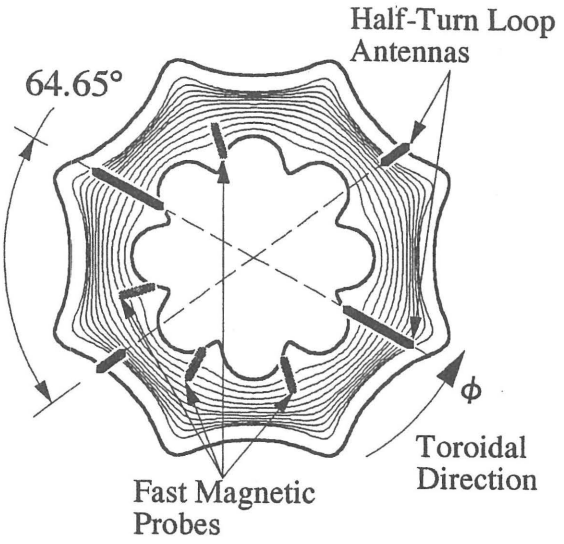

Fig. 1 Toroidal arrangements of antennas and magnetic probes in CHS.

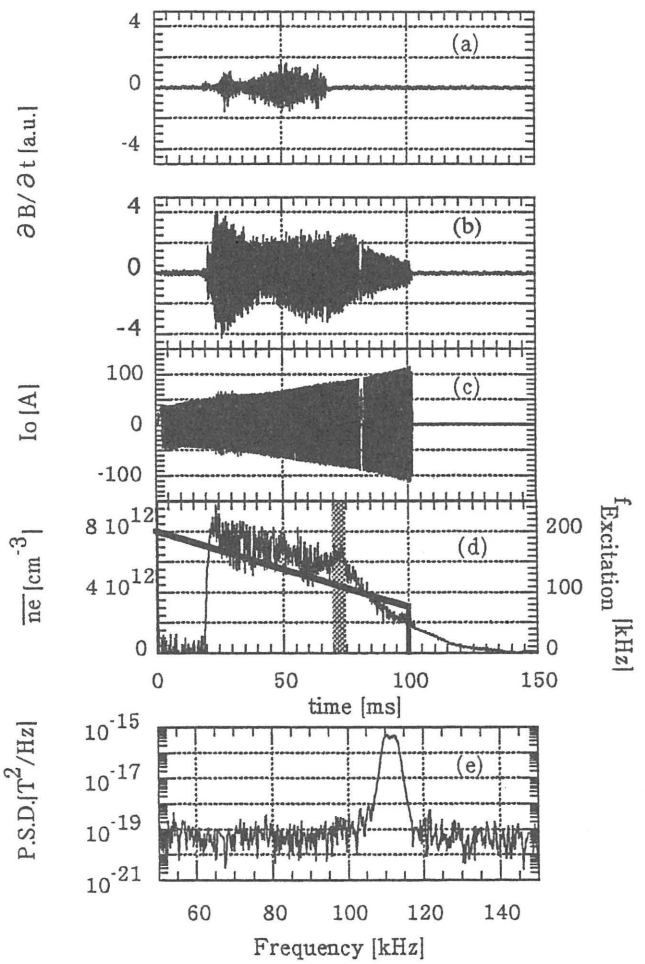

Fig. 2 Experimental results on ECH plasmas without (a) and with antenna excitation (b) - (e), where (a) and (b): magnetic fluctuations, (c): antenna current, (d): electron density and swept frequency of the antenna current, and (e): power spectrum density of (b) at 70-75ms.