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EX/P6-26: Experimental Study of Low Frequency Wave Current Drive in the SUNIST Spherical Tokamak

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Alfven wave is one of the waves that can overcome the density limit and reach the interior of spherical tokamak (ST) plasmas. Therefore, it may be possible to drive plasma current by low frequency waves through Alfven resonance in STs. This method has been tested in the SUNIST spherical tokamak (R/a: 0.3 m/0.23 m; B_T0: 0.15 T; I_P: 30˜50 kA; n_e: ˜1E19 mˆ-3; pulse length: 4˜25 ms). Four pairs of antennas, which are made by poloidal folded stainless steel straps, have been installed in the equatorial plane of the vacuum vessel with a uniform toroidal spacing angle of 90 degree. Two pairs of the antennas are protected by side limiters (consist of boron nitride plates) but the two pairs left are not protected by anything. The antenna system is powered by a four phases outputs radio frequency (RF) generator (0.4 ˜ 1 MHz, <100 kW per output). The most obvious observation after injecting RF waves from bare antennas was the increased intensity of impurity lines (carbon and oxygen). The boron nitride plates protected antennas have better performance on impurities. The experimentally measured impedance of the antenna system has the similar characteristics as theoretical one-dimension MHD calculations (Figure 1). Since the antenna system was fed in pi phasing, both N=1/-1 and M=1/-1 vacuum modes are excited. From the experimental impedance curve, it seems that the plasma may have responded to both two modes. When the RF waves (˜40 kW for each phase) were applied to lower density (n_e < 8E18 mˆ-3) and lower current (I_P ˜ 30 kA) plasmas by bare antennas, we often observe an enhancement of runaway electrons. Hard X ray measurements by CdTe detectors support this observation. However, when the RF waves were applied to the discharges with normal density (n_e > 1E19 mˆ-3) and normal plasma current (I_P ˜ 40 kA), no obvious differences could be found compared to discharges without RF waves.

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