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P1.1061 Rotation coupling of magnetic islands with different toroidal wave-numbers due to plasma viscosity in tokamak

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The rotation of a magnetic island chain in tokamak plasma can be affected by both the electromagnetic and viscous torques applied to the resonant plasma layer that is occupied by the magnetic islands. In the presence of a static Resonant Magnetic Perturbation (RMP), in particular an Error Field, the rotation is irregular that appears as cyclical time variations of the mode Instantaneous Angular Velocity (IAV) [1]. The IAV is defined as time derivative of the mode angular phase. In the case of a single mode, the period of IAV variations in time is equal to the period of the mode oscillations. This sort of rotation irregularity is attributed to oscillations of the electromagnetic torque, applied to the resonant plasma layer from the RMP, along with the island rotation. The electromagnetic coupling of the tearing-modes (see [2]) with different poloidal, m, and equal toroidal, n, numbers occurs because in toroidal geometry each mode has sideband components that differ by the m numbers. On the contrary, the tearing-mode does not have side-band n-harmonics because of the axisymmetric tokamak geometry with respect to the main vertical toroidal axis. Therefore, the electromagnetic coupling of tearing-modes with different toroidal, n, numbers seems impossible. However, rotation of these different-n modes can be coupled via viscous radial transfer of angular momentum in plasma (see [3]).
The simulation and its experimental validation of the rotation coupling between m/n = 2/1 and 3/2 modes in T-10 tokamak are presented. In the specially chosen T-10 regime, the m/n = 2/1 mode and the m/n = 3/2 mode are observed simultaneously. The rotation irregularity (IAV oscillations) of each mode due to the Error Field effect is used as a marker to distinguish this mode presence in the IAV oscillations of the other mode. The admixture of 4 kHz component to the natural 2 kHz oscillations of the m/n = 2/1 mode IAV and the admixture of 2 kHz component to the natural 4 kHz oscillations of the m/n = 3/2 mode IAV are observed in the experiment (see Fig.1).
The nonlinear visco-resistive TEAR-code [1, 4] is used for simulation. The comparison of the simulation results with experimental data confirms the assumption that the observed coupling between m/n = 2/1 and 3/2 modes is attributed to plasma viscosity.

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