An investigation of the plasma response to applied RMPs on TEXTOR

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Resonant magnetic perturbation (RMP) fields are known to cause magnetic reconnection in plasmas, resulting in changes to the magnetic topology and thus influencing magnetohydrodynamic (MHD) instabilities such as edge-localized modes (ELMs). With ELM control being of critical importance for ITER and future tokamak reactors, the plasma response to RMPs is of increasing significance for the physics of magnetized plasmas.

The Fast Movable Magnetic Probe (FMMP) has provided direct measurements of the magnetic topology in the edge of TEXTOR plasmas with applied RMPs from the Dynamic Ergodic Divertor (DED), which had the unique ability to produce an RMP field rotating at frequencies comparable with the plasma rotation or MHD modes, meaning the interaction between the rotation of the RMPs and various plasma parameters could be studied.

Comparing the magnetic field structure in the plasma edge with that in the equivalent vacuum case reveals the effect of the plasma response to the RMPs. The fast rotation of the RMP field also allowed synchronous detection of the plasma response, improving the quality of the experimental data. Shielding currents have been observed to form as a plasma response to applied rotating low-n RMP fields. Multiple shielding currents on neighbouring resonant surfaces have been observed concurrently for perturbation fields of different amplitudes, frequencies and phases [1].

A recent detailed analysis has revealed that even the magnetic field in the vacuum case differs from that predicted by vacuum modelling using the Biot–Savart law. An investigation of the effect of the 3D vessel wall is employed to explain this discrepancy.

A novel method of visualizing the time-varying RMP fields using hodographs has been developed, which allows easy recognition of phase changes in the signal, such as when the FMMP crosses a current sheet in the plasma.

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