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Kinetic properties of edge plasma with 3D magnetic perturbations in RFX-mod

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Three-dimensional magnetic fields are commonly applied to the plasma edge of fusion devices in order to modify the plasma wall interaction, edge-localized modes (ELM) frequency, divertor loads and transport. However, the action of these magnetic perturbations (MPs) on the edge plasma is still not well understood, and to date there is no obvious relationship between the edge pressure gradient and the MP. This is an outstanding issue for control and suppression of (ELMs).

In this work the response of the kinetic properties of the edge plasma to 3D magnetic perturbations is studied in the RFX-mod experiment, characterizing their toroidal and poloidal structure. The RFX-mod experiment is particularly suited for these studies, since it can operate in reversed field pinch (RFP), ultra-low q (ULQ) or tokamak configurations, all characterized by the presence of magnetic modes with different helicity. In RFP configuration different modes with m=1 can develop spontaneously or applied externally; in ultra-low q and tokamak discharges, mode with m/n = 1/2, 1/3 or 2/5 develops in the edge, depending on the value of the safety factor.

A detailed study of the poloidal structure of the floating potential Vf and edge electron pressure Pe has been undertaken. The spatial structures of the floating potential and the Pe have been observed to be modulated according to the dominant magnetic topology. However, along the poloidal angle, the plasma configuration (characterized through Vf, Pe and neutral influxes), does not exactly reflect the helicity of the MP: more poloidal harmonics are present, and the rotation of the dominant m=1 does not always follow the rotation of the MP. In particular, it is shown that in the equatorial midplane Pe and the magnetic deformation oscillate in phase; while at theta=90° there is a finite time shift between the two quantities.

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