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H-mode Achievement and Edge Features in RFX-mod Tokamak Operation

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The RFX-mod experiment is a fusion device designed to operate as a Reversed Field Pinch (RFP), with a major radius R= 2 m and a minor radius a = 0.459 m. Its high versatility recently allowed operating also as an ohmic tokamak allowing comparative studies between the two configurations in the same device. The device is equipped with a state of the art MHD mode feedback control system, providing a magnetic boundary effective control and modulation, by applying resonant or non-resonant magnetic perturbations (MP) both in RFP and in tokamak configurations. In the fusion community the application of MPs is widely studied as a promising tool in particular to limit the impact of plasma filaments and ELMs, in particular on plasma facing components. An important issue is envisaged in the exploitation of the RFX-mod active control system for ELM mitigation studies.

As a first step in this direction, this paper will focus on the most recent achievements in term of RFX-mod tokamak explored scenarios, which allowed the first investigation of the ohmic and edge biasing induced H-mode. In particular the realization of D-shaped tokamak discharges and the design and deployment of an insertable polarized electrode were accomplished. Both operations took advantage of the implementation of a real-time feedback control system of the electron density and of a multivariable shape feedback control system designed on a full model-based approach. Indications of Ohmic H-mode were transiently observed during Single Null shaped plasmas. Stationary H-mode phases were instead obtained with insertable electrode biasing stimulation. The edge biasing is applied in new operation scenarios relatively unexplored with this technique in particular in plasma shaped Single Null discharges and in the very low q circular plasma discharges, q(a)<2, achievable in RFX-mod. Important modification of the edge plasma density and flow properties are observed as well as, in some cases, a complex “dithering”phenomenology, characterized by very fast L-H and H-L transitions. These strong fluctuations appear associated to the onset of MHD activity, whose behavior will be analyzed and discussed in the paper along with the filamentary structures observed in the fast turbulence electromagnetic fluctuations.

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