Contribution ID: **138** Type: **Poster**

Extended scenarios opened by the upgrades of the RFX-mod experiment

Thursday, 20 October 2016 08:30 (4 hours)

RFX-mod is a flexible device capable of operating both as a Reversed Field Pinch and as a Tokamak, both circular and shaped. In both configurations the explored parameter range and the effectiveness in dealing with critical issues for magnetic confinement will be extended by some enhancements aiming at: a) reducing magnetic chaos by improving the performance of MHD control system; b) improving wall recycling and density control; c) favouring the L-H transition; d) developing new diagnostic systems, in particular increasing the number of magnetic sensors. The scientific motivations and perspectives of such upgrades are discussed in the paper.

In the Quasi Single Helicity helical regime, the performance improves when the magnetic chaos is reduced, i.e. at the lowest amplitudes of the m=1 secondary modes and of the m=0 modes. Moreover, operated as a Tokamak, the exploitation of the feedback system allows the investigation of the m/n=2/1 mode control, in particular exploring the q(a) <2 scenario. Therefore, although the advanced MHD active control system allowed a progressive reduction of the field errors, the achievement of an even smoother magnetic boundary remains crucial for the RFP performance and also favours Tokamak operations. Simulations by the RFXLOCKING code show that by removing the inconel vacuum vessel, presently surrounding the plasma, the deformation of the last closed magnetic surface will be reduced (factor about 2).The same modification, combined with the optimisation of the toroidal field winding power supply, will improve the m=0 mode control.

The improvement of density control relies on the change of the graphite tiles presently covering the first wall with higher conductivity ones, featuring lower temperature increase under high power loads. The deposition of a W layer on the graphite is also being evaluated, given the outward pinch observed after W LBO experiments, which prevents W core contamination.

In Tokamak configuration, to robustly exceed the L-H transition power threshold and exploit the feedback control system for ELM control studies, 1MW neutral beam will be installed, whose shine-through has been evaluated to be ≈0.5 in the RFX-mod operational conditions.

Paper Number

EX/P5-23

Country or International Organization

Italy

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Session Classification: Poster 5

Track Classification: EXD - Magnetic Confinement Experiments: Plasma–material interactions; divertors; limiters; scrape-off layer (SOL)