Motivations and perspectives of RFX-mod2, the challenge of the upgraded RFX-mod device

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In recent years the RFX-mod device has been operated as a Reversed Field Pinch (RFP) and as a low-q Tokamak. In both configurations the capability and flexibility of its active control system of MHD instabilities have been exploited to control RWMs and tearing mode wall locking (RFP) and to stabilize the m/n=2/1 mode to operate at $q(a) \leq 2$ (Tokamak). The dynamics of the tearing modes has been fully characterized experimentally and simulated by the RFXLocking code [*Zanca P. 2009 Plasma Phys. Control. Fusion 51 015006*].

At high current, RFP plasmas have been observed to self-organize into quasi single helicity (QSH) states, where a single m=1 modes dominates the spectrum of all the other secondary modes and magnetic chaos is reduced. In particular, in QSH the best plasma performance is observed at the lowest amplitude of the secondary modes, which on the other hand also affect wall recycling and impurity content. The beneficial effect expected from reducing the amplitude of tearing modes and increasing their dynamics, motivated the plasma moving closer to the conductive shell and as a consequence a modification of the device load assembly. The present inner Inconel vacuum vessel, which is surrounded by a copper shell, both enclosed in a stainless steel support structure, will be removed. The support structure will be modified in order to ensure vacuum tightness. In this way, the conductive shell will approach the plasma, whose minor radius will increase from 0.459m to 0.49m. According to RFXLocking simulations, discussed in this contribution, the deformation related to m=1 modes will decrease by a factor ≈3. The expected improvement in confinement will be at least by a factor ≈35%. In addition, the plasma current threshold for tearing mode locking will increase from ≈120 kA to ≈400-600 kA.

This contribution also describes the challenges in the design of the upgraded RFX-mod (RFX-mod2) and the innovative solutions found to solve the main issues, in particular to fulfill vacuum and electrical requirements of the in-vessel components.