

P2.1003 RFX-mod2: a Reversal Field Pinch device with edge transport optimization

Tuesday, 9 July 2019 14:00 (2 hours)

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The edge of magnetically confined plasmas in toroidal configurations is characterized by the presence of various magnetic perturbations (MPs), appearing spontaneously as tearing modes in the Reversed Field Pinch (RFP) [1] or as peeling ballooning modes (ELM) in the tokamak. In the RFX-mod device during high-current discharges ($R=2\text{m}$, $a=0.46\text{m}$, $I_P>1\text{MA}$) an almost monochromatic tearing mode (TM) spectrum spontaneously develops: this is the so-called quasisingle helicity (QSH) [2, 3], characterized by the presence of a single mode with helicity m/n , with ($m=1$, $n=7$) the poloidal and toroidal mode numbers respectively. However, the presence of secondary modes ($m=1, n>7$), with amplitudes one order of magnitude smaller than the dominant one, results in a local pattern of constructive interference (phase locking) and in a radial displacement of the plasma edge surface [4]. The intensity of the deformation can be comparable to that of the dominant mode, appearing as a sharp decrease ("hole") of the connection length to the wall at the locking angle, as shown by simulations with the ORBIT code [5,6]. An upgrade of RFX-mod device, RFX-mod2 [7], will be assembled in the near future. It will be characterized by a copper shell as continuous conductor nearest to the plasma and by a shellplasma proximity reduction from $b/a=1.11$ to $b/a=1.04$, likely improving feedback coils action. 3D MHD non-linear visco-resistive simulations show that secondary TM amplitude and the edge deformation due to phase locking will decrease by a factor 2 [8, 9]. Simulations with ORBIT show that in RFX-mod2 the average parallel connection length to the wall is expected to increase by a factor 8 with respect to RFX-mod, with no "hole" at the locking angle [6]. Having virtually cancelled the effect of TMs at $r=a$ with a front end which behaves like an ideal wall, plasma wall interaction in RFX-mod2 could arise only due to the residual error fields at the gaps [8]: these upgrades are expected to lead to an optimized edge transport, with a well-formed SOL and to an improvement of the global plasma performance.

References [1] N. Vianello et al, Nuclear Fusion 53 (2013) 073025 [2] Escande D. et al, PRL 85 (2000) 1662 [3] Lorenzini R. et al, Nature Physics 5 (2009) 570 [4] P. Zanca and D. Terranova Plasma Phys. Control. Fusion 46 (2004) 1115 [5] R.B. White and M.S. Chance, Phys. Fluids 27 (1984) 2455 [6] P. Scarin et al, to be published in Nuclear Fusion (2019) [7] S. Peruzzo et al, Fusion Eng. Des. 136 (2018) 1605 [8] L. Marrelli et al, to be published on Nuclear Fusion (2019) and this conference [9] D. Bonfiglio et al, this conference

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Session Classification: Poster P2

Track Classification: MCF