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Overview of the RFX-Mod Contribution to the International Fusion Science Program

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The RFX-mod device can be operated both as a Reversed Field Pinch (RFP), where advanced regimes featuring helical shape develop, and as a Tokamak. Due to its flexibility, RFX-mod is contributing to the solution of key issues in the roadmap to ITER and DEMO, including 3D nonlinear MHD modeling, MHD instability control, internal transport barriers, edge transport and turbulence, isotopic effect, high density limit.
In RFP configuration, in the last two years advancements in the understanding of the self-organized helical states, featuring strong electron transport barriers, have been achieved; the role of microtearing modes in driving the residual transport at the barrier has been investigated experimentally and by gyrokinetic simulations. First experiments with deuterium as filling gas showed increased temperature and confinement time. New results on fast ion confinement and on the isotope effect on edge transport and turbulence are reported. RFX-mod contributed to the general issue of the high density limit physics, showing that in the RFP the limit is related to a toroidal particle accumulation due to the onset of a convective cell. The experimental program was accompanied by substantial progress in the theoretical activity: 3D nonlinear visco-resistive MHD and non-local transport modelling have been advanced; resistive wall and fast particle modes have been studied by a toroidal MHD kinetic hybrid stability code.
In Tokamak configuration, q(a) regimes down to q(a)=1.2 have been pionereed, with (2,1) Tearing Mode (TM) mitigated and (2,1) RWM stabilized: the control of such modes can be obtained both by poloidal and radial sensors with proper control algorithm. Progress has been made in the avoidance of disruptions due to the locking of the (2,1) TM. External 3D fields have been applied to study a variety of physical issues: effect of magnetic perturbations on sawthooth control, plasma flow, runaway electron decorrelation. Probes combining electrostatic and magnetic measurements have been inserted to characterize turbulence and flow pattern at the edge.

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