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EX/P5-38: Development of MHD Active Control in the RFX-mod RFP

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In the last two years many efforts have been dedicated to develop and implement new MHD control approaches in RFX-mod, to optimize the existing schemes based on refined physical models and to design an upgrade of the real-time control system.
In particular the study of the transition to a helical state with m=1, n=-7 helicity has been extended to high plasma currents up to 2MA. These experiments have been performed with a real time version of the modal dynamic decoupler, with significant reduction of m=0,n=7 and m=1,n=7 harmonics.
The control of the edge field due to the Tearing Mode harmonic composing the helical state, namely the m=1,n=7 one, has been simulated by means of the improved RFXlocking code, allowing to perform parametric scans of different feedback schemes based on different magnetic sensors. Experiments with gains determined by the model are on going in order to verify model prediction.
The improved RFXlocking code (including digital feedback) shows that further reduction of the helical field at the plasma edge is possible by reducing significantly the latency of the control system. This motivated the design and realization of a new real-time control system based on a new architecture. The new system, which merges the MHD and equilibrium control, is supervised by the MARTe software framework, developed at JET and currently used for the JET vertical stabilization and in other fusion devices.
As far as the capability of stabilizing Resistive Wall Modes is concerned, an integrated dynamic model of the system was developed integrating the plasma response in the presence of active and passive conducting structures (CarMa model) and a complete representation of the control system. An enriched version of the plasma response model has been developed including multiple RWMs with abs(n)=2, 3, 4, 5, 6. This is required in order to analyse the effect of the a reduced set of coils on stabilization, since it allows the simultaneous study of modes which could be amplified by the low n order sidebands. Dedicated experiments were run by destabilizing otherwise marginally stable modes applying negative proportional gains in the control loop, in order to compare the experimental unstable mode growth rates with the model.

Country or International Organization of Primary Author

italy

Primary author: Mr MARRELLI, Lionello (Italy)

Co-author: RFX-MOD, team (Consorzio RFX - Associazione EURATOM-ENEA sulla Fusione)

Presenter: Mr MARRELLI, Lionello (Italy)

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