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A simulation chain for reflectometry and non-linear MHD – Type-I ELM case

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Properties of magnetized plasmas in fusion devices are widely determined by turbulence and non-linear magneto-hydrodynamic (MHD) instabilities. The evolution of non-linear MHD instabilities can be predicted with increasing accuracy through codes such as JOREK [1]. JOREK simulations are able, for example, to display the behavior of Edge Localized Modes (ELMs) driven by large pressure gradients and current densities at the edge of H-mode plasmas.

In fusion devices, microwave reflectometry has been applied to measure electron density fluctuations and thus characterize turbulence and MHD features, while the technique has also found strong support in modeling activities for quantitative data interpretation. On the modeling side, complete chains from turbulent plasma models using gyro-fluid simulations through full-wave codes simulating conventional reflectometry have been implemented before [2]. In this work, a similar workflow for the case of a MHD-reflectometry chain was established. The two-dimensional full-wave code REFMUL [3] was employed together with MHD descriptions obtained from the JOREK code, and the first results are presented here.

An ELMy plasma scenario with Type-I ELMs leading to a fast collapse of the H-mode pedestal, was taken as case-study [4]. The REFMUL simulations were customized to implement the synthetic reflectometer in the conventional set-up using fixed frequency probing with O-mode waves. The merits and caveats of the technique in these plasma conditions are pointed out in light of the results obtained.

References

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