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TH/P2-05: Modelling of Hybrid Scenario: from Present-day Experiments toward ITER

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An attractive operating scenario for ITER has recently emerged that combines long plasma duration similar to the steady-state scenario, together with the reliability of the reference H-mode regime: the so-called 'hybrid'scenario. Worldwide a significant experimental effort has been devoted to explore the operating space in present day tokamaks. This paper is an overview of the recent European modelling effort carried out within the Integrated Scenario Modelling group which aims at (i) understanding the underlying physics of the hybrid regime in ASDEX-Upgrade and JET, and, (ii) extrapolating them toward ITER.
Six JET and two ASDEX-Upgrade hybrid scenarios performed under different experimental conditions have been simulated in an interpretative and predictive way in order to address the current profile dynamics and its link with core confinement, the relative importance of magnetic shear, s, and ExB flow shear on the core turbulence, pedestal stability and H-L transition. The correlation of the improved confinement with an increased s/q at outer radii observed in JET and ASDEX-Upgrade discharges is consistent with the predictions based on the GLF23 model applied in the simulations of the ion and electron kinetic profiles.
Projections to ITER hybrid scenarios have been carried out focusing on optimization of the heating/current drive schemes to reach and ultimately control the desired q-profile with the ITER actuators and constraints. Firstly, access condition to the hybrid-like q-profiles during the current ramp-up phase has been investigated. Secondly, from the interpreted role of the s/q ratio, ITER hybrid scenario flat-top performance has been optimized through tailoring the q-profile shape and pedestal conditions. EPED predictions of pedestal pressure and width have been used as constraints in the interpretative modelling while the core heat transport is predicted by GLF23. Finally, model based approach for real-time control of advanced tokamak scenarios has been applied to ITER hybrid regime for simultaneous magnetic and kinetic profile control.

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