MF1-I45 AAPPS-DPP2020

4th Asia-Pacific Conference on Plasma Physics, 26-31Oct, 2020, Remote e-conference

Integrated Modeling in the ITER era: taking standard approaches to the next level

Francesca M. Poli[1]
[1] Princeton Plasma Physics Laboratory, USA
e-mail: fpoli@pppl.gov

In ITER, there will be both a high premium for reliable operation to minimize the occurrence of disruptions and runaway electron formation as well the need to push the boundaries of our understanding to achieve the scientific and technology goals of the facility. The ITER plasmas will be dominated by self-heating, external actuators and diagnostics will operate in a nuclear environment, outside of the operational window of our present-day experiments. This raises questions of whether our current physics models are adequate to model burning plasmas, whether our experiments can be projected and whether the control schemes that are used today can be exported. Most importantly, what are the research opportunities in the near-term to prepare for ITER operations? This is an area where modeling can provide guidance and inform ITER. Simulations of ITER scenarios are moving away from semi-empirical models and progressively including models with higher physics fidelity, aiming at answering critical questions like access to H-mode. At PPPL we have started looking at how time-dependent simulations can help designing controllable discharges, by using the free-boundary equilibrium and transport solver TRANSP [1] to model the plasma response to external actuators.

Previous work indicated that Neoclassical Tearing Modes should be controlled pre-emptively on ITER, since the hardware and diagnostics response are not compatible with the fast time scales of growth of the magnetic islands at the (2,1) surface [2].

This talk will discuss simulations that focus on burn control and safe exit from H-mode, to highlight areas where theoretical development is needed and where experiments can contribute filling gaps to inform ITER on safe operation. It will be shown that – by including elements of control in time-dependent simulations – controllable discharges can be designed. Even with a reduced and parametrized model for the Scrape-Off-Layer, important dynamics of the density and temperature can be captured. These simulations indicate that – within the limits of the models that have been used – the exit from H-mode can be controlled in the ITER baseline discharge, even at current of 12.5-14MA.

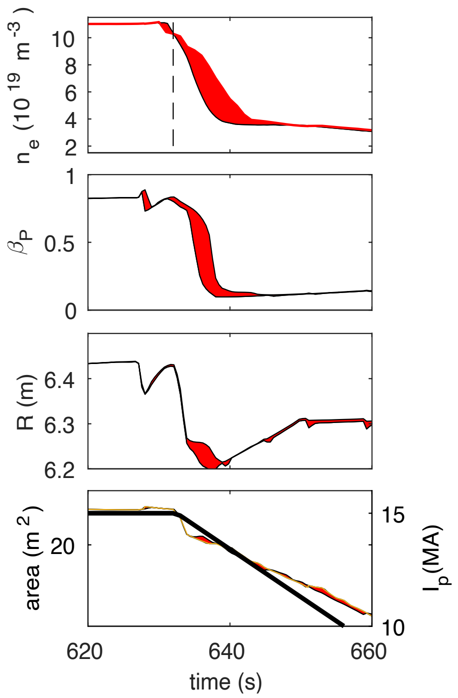

Figure 1: evolution of line averaged density, beta poloidal, plasma radial position, the plasma cross-section and current during the ramp-down phase. The flattop ends at 632s.

References

[1] F.M. Poli, Phys. Plasmas (2018) **25** 055602
[2] F.M. Poli *et al* 2018 *Nucl. Fusion* **58** 016007