First global simulations of ITER 15MA Q=10 baseline scenario with D and T treated separately in the SOL/divertor

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To demonstrate a stable fusion Q of 10 in flat-top operation for 500s in ITER is a challenge that requires extensive core plasma and divertor modelling. In addition to sustaining optimal performance while maintaining density control, the plasma needs to stay within operational limits which requires that the divertor power loads are kept at acceptable levels without the plasma fully detaching. The presented work consists of coupled core/SOL/divertor simulations, performed with the JINTRAC code, studying the flat top and exit phase of the ITER 15MA/5.3T DT Q=10 scenario. The work is built on simulations presented in [1] with the additions of the EC code GRAY to simulate the EC deposition and current drive self-consistently, the first-principle transport model EDWM, the inclusion of Tungsten in the plasma and, most importantly, Deuterium and Tritium are now for the first time treated separately in the whole ITER plasma volume [2]. For the flat top phase of the discharge the aim is to achieve a fusion Q of 10 using DT pellets and pure D SOL gas puff, which is preferential as it allows a more effective use of T, while keeping within operational limits keeping track of Tungsten sputtering and accumulation as well as Ne seeding. The exit phase consists of an initial density ramp down at full auxiliary power and current followed by an H-L transition at full current and a subsequent current ramp down. This ramp down scenario differs from most previous simulations such as [1] where the density is assumed to linearly drop with the current. With the inclusion of the particle transport and a consistent treatment of core/SOL/divertor interactions these simulations have the capability to study how fast the density decreases when the pellet fuelling is changed. Knowing the characteristic time of density decay for a given ITER fuelling system while maintaining H-mode and avoiding full detachment will be important for safe emergency termination scenarios and designing ramp-down simulations with magnetic control.

References

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