Predict–first scenario modelling in support of the design of the Divertor Tokamak Test facility

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Designing a new tokamak requires concerted efforts of engineers and physicists. In order to reduce costs and minimise risks, a first-principle based integrated modelling as comprehensive as possible of plasma discharges in different operational scenarios is an essential tool. Therefore, main baseline scenarios of the future Divertor Tokamak Test facility (DTT) [1] ($R_0 = 2.19$m, $a = 0.70$m, W first wall and divertor, pulse length ≤ 100s, plasma current $I_{\mathrm{pl}} \leq 5.5$MA, vacuum toroidal field $B_{\mathrm{tor}} \leq 5.85$T, total power by auxiliary heating systems $P_{\mathrm{tot}} \leq 45$MW) have been simulated extensively. This modelling work led to the optimisation of the device size and of the reference heating mix, as widely described in [2], and provided reference profiles for diagnostic system design, estimates of neutron yields, calculations of fast particle losses, gas puffing and/or pellet feature requirements for fuelling, MHD evaluations, and other tasks.

The latest simulation results of the DTT scenarios with the Single Null magnetic configuration are presented here. These runs, carried out with the JINTRAC [3] suite or the ASTRA [4] transport solver, make use of theory based quasi-linear transport models (QLK [5] and TGLF SAT2 [6]), ensuring the highest fidelity presently achievable in integrated modelling. A specific attention to the consistency between the control coil system capabilities and plasma profiles has been paid and the edge requirements to have plasma scenarios compatible with divertor and first wall power handling capability and tungsten influx have been taken into account.

References

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