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# Core transport simulations of plasma scenarios for JET and JT-60SA tokamaks: validation and predictions for future JT-60SA experiments

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The use of theoretical models and simulation codes is essential for predicting plasma behaviour in future tokamak experiments, such as ITER and JT-60SA. These tools play a critical role in developing plasma scenarios to achieve the desired experimental goal, and their validation against experimental results enhances confidence in their predictive capabilities. Significant efforts have been dedicated to the integrated modelling of plasma scenarios for the next operational phase of the superconducting tokamak JT-60SA [1], which achieved its first plasma in October 2023. During the next experimental campaign of JT-60SA (OPeration 2 – OP2), the machine will be equipped with enhanced diagnostics and high heating power with respect with what was available in the first plasma operations, with up to 23.5 MW from Neutral Beam Injection (NBI) in Deuterium plasmas and 3 MW from Electron Cyclotron Resonance Heating (ECRH), marking the start of high-power operations. Moreover, in 2023 experiments were conducted at the Joint European Torus (JET) aiming to develop a scenario with dimensionless parameters ($\beta_N, \rho_p^*, \nu^*$) as close as possible to those envisaged for JT-60SA [2]. The aim was to establish a high-$\beta_N$ scenario comparable to the advanced inductive hybrid scenario and the non-inductive steady-state scenario of JT-60SA. This approach makes use of the similarity criterion, which states that plasmas with equivalent dimensionless parameters exhibit similar confinement properties. These pulses provide a testbench to validate the models in similar conditions to the ones envisaged for JT-60SA scenarios. This work presents the first integrated modelling predictions of the ramp-up and flat-top phases of the baseline and hybrid scenarios planned for high-power operations (OP2) of JT-60SA. These are the first applications of a 1.5D integrated modelling suite, JINTRAC [3], to JT-60SA OP2 scenarios, computing transport and sources of heat and particles self-consistently with equilibrium evolution. To reinforce confidence in the predictions, the modelling framework was validated against three JET pulses (#102433, 103116, 105321) at different value of toroidal magnetic field, conducted to support JT-60SA scenario development.

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**References**:

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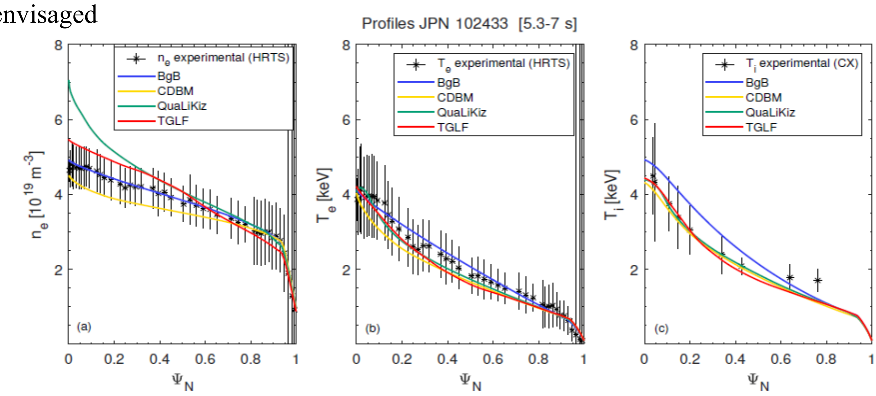


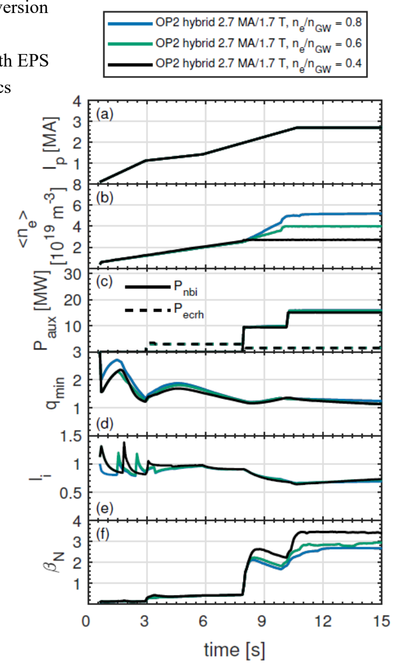


**Figure 1** Left: Validation of the JINTRAC suite of codes, coupled with various transport models (semi-empirical and first-principle), against experimental kinetic profiles from JET high-beta pulse. Right: Time evolution of main plasma parameters for the JT-60SA hybrid scenario planned for Operational Phase 2 (OP2) in 2026, as predicted by JINTRAC simulations, at three different values of the Greenwald density fraction.