Modelling of core confinement in JET Carbon vs. ITER-like wall discharges

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In order to asecertain the influence the type of wall may have on the core confinement of JET baseline and hybrid plasmas, a comparative analysis has been carried out between carbon (C) and ITER-like wall (ILW) discharges using JINTRAC (JETTO and JETTO+SANCO) with either Bohm–gyro-Bohm (BgB) or GLF23 transport models, in combination with the continuous ELM model for the description of transport in the external transport barrier (ETB). Hence, fully predictive simulations have been carried out for comparable C and ILW JET pulses (with equivalent high-performance phases), trying to fit the experimental density and electron and ion temperatures in the plasma core.

Preliminary results obtained using JETTO with BgB to model hybrid discharges show good agreement between experiments and simulations and that there is apparently no dramatic change in the core transport coefficients when going from C to ILW. A couple of checks have also been performed, such as repeating the analysis starting with identical profiles for ion and electron temperaures (given the uncertainties in measuring the former) and re-running the simulations exchanging the ion effective charges between the two types of discharges (to control the effect of changing the plasma composition).

In addition, C and ILW baseline discharges have been studied with JETTO+SANCO, yielding reasonable agreement between measured and modelled core temperature and density, with core transport predicted by either GLF23 or the standard BgB model. Heat conductivities seem to be reduced by 20-25 % with the ILW compared to the C wall. It can be concluded that a lower electron temperature (of typically 1.0 keV) on top of the pedestal with the ILW is caused by a reduction in heat flux due to increased core radiation, enhanced level of heat and particle conductivities in the ETB (which might partly arise from an increased level of inter-ELM transport and a change in MHD conditions leading to an increase in the ELM frequency) and impurity-induced radiation in the pedestal zone.

In another modelling study with JETTO+SANCO, it could be confirmed that the W transport properties and concentration play an important role for the quality and stability of the plasma confinement in JET ILW discharges. The application of strong auxiliary heating power might help to reduce, or at least delay, the W contamination via the increase of the temperature gradient in the core. Modelling results suggest that additional heating during current ramp-up might be helpful in order to reduce the W content in the core at the beginning of the flat-top phase.