Analysis of ITER performance with different heating schemes using predictive integrated plasma modelling

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In order to achieve a suitable fusion performance and reach the H-mode in the Pre-Fusion Power Operation Phase (PFPO) at ITER, auxiliary heating power systems such as Ion Cyclotron Resonance Frequency (ICRF) heating are needed. Although extensive research has gone into ICRF modelling, most of the modelling has been done for heating scenarios relevant for the D, T and D-T plasmas in the Fusion Operation stage of ITER, focusing on second harmonic T heating and fundamental minority ^{3}He resonance heating schemes. There is a need to improve our understanding on the performance of ICRF in H and He in the non-active phase of ITER, and on the most effective heating schemes for this phase.

We use the heating code PION [1] integrated into the European Transport Solver (ETS) [2] to study and predict how the plasma transport will be affected when ICRF heating is applied to ITER non-active plasmas. The integration into a transport modelling workflow is relevant because a transport modelling workflow such as ETS, which has been developed inside the ITER Integrated Modelling & Analysis Suite (IMAS) [3], can calculate the evolution of the plasma discharge and provide the capabilities for self-consistent predictive simulations. In this work, the PION+ETS integration was used to model JET high performance baseline discharge 92436 with D-H plasma composition at full field, and was validated against PION results of this discharge. Synthetic METIS ITER shot 110005 with ^{4}He-H plasma composition was also modelled and validated against results from our earlier PION results in IMAS [4]. In both cases the ICRF heating scheme used was fundamental minority H heating. We present results of time dependent predictive simulations at different H concentrations of the ITER synthetic shot using the PION+ETS integration. Fundamental minority H heating was found to be an effective heating scheme, yielding increasing power absorption with increasing H concentration and reaching a maximum of 80.2% at [H] $\sim$ 5%.

References

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