The impact of the heating mix on DEMO plasmas

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The development of the EU-DEMO reactor is at the pre-conceptual design phase. At this stage, close attention is paid to the heating mix necessary to fulfill all the plasma requirements: breakdown, ramp-up, L-H transition, burn control, NTM stabilization, sawteeth pacing, radiative instability control and ramp-down. Integrated modeling is an effective tool to compare the impact of dominant electron vs. ion heating on turbulence and plasma kinetic profile evolution. Thus, the ability of a given heating mix to meet the aforementioned requirements can be systematically studied. We have utilized the ASTRA [1] transport code, coupled to the TGLF [2] turbulent transport model to compare the plasma response to dominant electron and ion heating mixes representative of ECRH, NBI and ICRF in L- and H-mode conditions. The H-mode pedestal is treated with scaling laws coupled to the core parameters. Suitable boundary conditions are applied at the separatrix via a 0D 2-point model. Initial estimations [3] point to the feasibility of the L-H transition and significant fusion power production even in purely electron-heated plasmas. This work has now been revised and extended through the inclusion of impurities, thus setting a concentration threshold for the L-H transition, and TGLF-predicted electron density profiles. These results are further compared against cases with predominant ion heating to assess differences in performance.

References

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