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Operational domain for the new 3MW/1000s ECRH System on WEST

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The ECRH system formerly used in Tore Supra is being upgraded to start on WEST in 2023, at a power level of 1 MW and frequency of 105 GHz. Its ultimate 3 MW/1000s capability is expected to enlarge the WEST operational domain by increasing margins with respect to H-mode access, and by providing additional flexibility in terms of achievable scenarios using impurity and/or MHD control. This flexibility is made possible using a modified version of the Tore Supra antenna, based on three external steerable mirrors for controlled power injection [1].
In order to determine an appropriate range of EC wave injection angles for WEST scenarios, the fast and reliable ray-tracing code REMA [2] has been interfaced with the WEST IMAS database. This allows the EC power damping rate to be quickly assessed, as well as deposition profiles to be predicted in realistic plasma conditions. Based on a previous WEST discharge [3] at central magnetic field $B_0 \sim 3.6$T, central line-integrated density $n_l \sim 4.2 \times 10^{19}\mathrm{m}^{-2}$ and central electron temperature $T_{e0} \sim 3$keV, ray-tracing calculations have been performed. Comprehensive poloidal and toroidal angle scans, as well as variations of B_0, n_l and T_{e0} with respect to the reference parameters have allowed an adequate range of injection angles to be determined for efficient use of ECRH and or ECCD in typical WEST scenarios, and compared with the mechanical limits set by the antenna mechanical characteristics. In order to further characterize the effect of this new power source in WEST scenarios, EC wave deposition and current profiles computed by REMA have been included in integrated simulation codes such as METIS [4]. Using interpretative simulations of well-documented shots as a basis, it has been shown that this additional power source could allow central electron heating to be achieved, potentially alleviating the issue of radiative collapse caused by impurities observed in some situations [3].

References
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