Integrated physical assessment of DTT reference scenarios

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One of the main issues for tokamak plasmas is power exhaust. ITER device will optimize the operation with a conventional divertor based on detached conditions.

In parallel, DTT (Divertor Test Tokamak) [1] project has been launched to investigate alternative power exhaust solutions for DEMO. DTT has a major radius about one fifth the radius of DEMO (R=2.08 m for DTT, R~9 m for EU DEMO [2]) but is designed to achieve reactor-relevant conditions in the divertor and scrape-off layer (SOL) regions [3], as well as plasma core [4].

A key parameter characterizing these regimes is P^{SEP}/R, whose values should be around 15 MW m^{-1} to be DEMO relevant (where P^{SEP} is the power flowing through the plasma boundary). DTT will be able to reach such values by maintaining dimensionless parameters similar to those foreseen for DEMO [5]. DTT aims at exploring different divertor configurations [6] such as single null (SN), double null (DN), snowflake (SF); and this is challenging, since changing the magnetic topology changes the dimensionless parameters. The desired values of P^{SEP}/R will be reached using a mix of additional heating systems: Electron cyclotron (EC) heating, ion cyclotron (IC) heating and neutral beam injection (NBI) heating [7] that will deliver 45 MW to the plasma at full power (25 MW EC, 10 MW IC, 10 MW NBI) and 25 MW at the beginning of operations (15 MW EC, 3 MW IC, 7 MW NBI).

In this work, the reference SN scenario is studied. Starting from the reference equilibria developed for the SN magnetic configuration, the 0.5D fast tokamak simulator code METIS [8] has been used to develop physically consistent reference plasma. From this scenario, some possible design choices are investigated, such as different characteristics of the foreseen additional heating systems.

A discussion of main differences in the SN scenario with the additional power at beginning of operation (25MW) is presented, together with reference plasma scenarios for DN and SF magnetic configurations.

References

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