Overview of the DTT diagnostic systems

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With the recent publication of the Divertor Tokamak Test (DTT) Research Plan [1], the DTT diagnostic set was updated to support the project objectives, closely following the evolution of the operational phases therein described. DTT is a fully superconducting, compact size (R = 2.19 m, a = 0.70 m) tokamak, currently under construction at the ENEA research center in Frascati, Italy. Thanks to its actively water-cooled W components and high external heating power, provided by a combination of ECRH, NBI and ICRH (up to P = 45 MW), DTT aims at reproducing divertor heat loads comparable to those expected in ITER and DEMO, with the goal of exploring innovative heat exhaust solutions in fusion-relevant conditions [2]. This presentation provides an overview of the DTT tokamak diagnostic set.

According to the planned sequence of DTT operational phases, the First Plasma will be shortly followed by an early experimental phase. Therefore, particular focus was put onto the definition of a full set of systems for machine protection, runaway detection and plasma control, along with diagnostics to probe early phase-scenarios (e.g. scenario “A” described in [3]). Following the upgrades of the external heating systems, DTT will be operated with progressively advanced scenarios, and its diagnostic capabilities evolve accordingly. The commissioning diagnostic set will be upgraded during so-called Phase-1, with additional systems to study transport physics and plasma-wall interactions, eventually reaching its full capabilities during Phase-2, when fast ion and neutronic studies will be performed following the installation of a 10 MW Neutral Beam. Particular focus was put onto the definition of a diagnostic set for detachment studies and control, adapting the systems’ design to the machine geometry and developing a flexible framework that allows for future upgrades.

[1] G. Giruzzi et al 2026 Nucl. Fusion 66 116017
[2] F. Romanelli et al., Nucl. Fusion 64, 112015 (2024).
[3] I. Casiraghi *et al* 2023 *Plasma Phys. Control. Fusion* **65** 035017