Design and development of plasma diagnostics to tackle the DTT Tokamak research objectives

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The Divertor Tokamak Test (DTT) is a compact size (R = 2.19 m, a = 0.70 m), fully superconducting tokamak, presently under construction in the ENEA research centre in Frascati, Italy [1]. With its high field and plasma current (B = 5.85 T, I_p = 5.5 MA), actively cooled in-vessel W components to sustain long pulse duration ($t_{pulse} \approx 100$ s), and a significant amount of external heating provided by a combination of ECRH, NBI and ICRH (up to P = 45 MW), DTT aims at reproducing the level of divertor heat loads expected in ITER and DEMO to explore innovative heat exhaust solutions in fusion-relevant environments [2]. The first version of its Research Plan was recently released [3]. This defines the project objectives, describes DTT plasma scenarios, and sets the basis for the development of diagnostics, closely following the experimental phases of the machine therein described, with a particular focus towards the divertor region for detachment studies. Advanced systems for the investigation of the physics of transport and fast particles are also included. Since DTT First Plasma will be immediately followed by an experimental phase, operations will start with a full set of systems for machine protection and plasma control, as well as diagnostics to probe early-phase plasma scenarios. This presentation provides an overview of the DTT tokamak diagnostic set, focusing on how these systems are designed to address the scientific goals of the project from First Plasma to full power scenarios.

[1] F. Romanelli et al., Nuclear Fusion 64, 112015 (2024).
[2] F. Crisanti et al, Nuclear Fusion 64, 106040 (2024).
[3] F. Crisanti, G. Giruzzi, P. Martin, et al., Tech. Rep. 978-88-8286-474-3 (2025).

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