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Mechanical Design of the new Bolometric and Soft-X ray diagnostics for DTT

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In the European roadmap towards nuclear fusion, the new Italian project DTT (Divertor Tokamak Test) [1], currently under construction at the ENEA Frascati Research Centre, aims at exploring alternative solutions for the divertor and optimizing the divertor configuration foreseen for DEMO.

A dedicated set of diagnostics are planned to measure the radiated power by integrated emission detection and to monitor plasma processes by means of Soft-X emission measures. The measurement of the total radiated power will rely on commercial metal resistor bolometers [2], while for the SXR range of energies a new technology based on custom Chemical Vapor Deposition diamonds (CVD) will be adopted [3].

This work focuses on the mechanical layout design of these integrated diagnostics, respecting geometrical and functional constraints of DTT and minimizing the diagnostics encumbrance inside the access pipe. An integrated and compact solution, allowing flexible positioning and easy maintenance of the two systems has been pursued, with a structural layout based on a modular approach. The detectors of the two diagnostics are mounted on a common frame, with adjustable mounts for an independent fine-tuning of their alignment.

The high heat load from the plasma is coped with by means of a custom designed active water-cooling system, to protect the sensors while ensuring stable and reliable operations.

To allow a good physical exploitation of the collected data, i.e. with tomographic reconstructions, the lines of sight of both systems must be properly arranged on the poloidal section of the plasma. The proposed mechanical design foresees a customized chassis for each of the four poloidal ports of the DTT vacuum vessel, assuring a suitable coverage of the plasma's poloidal section.

[1] F. Romanelli 2024 Nuclear Fusion. IOP Publishing on behalf of the IAEA

[2] G.M. Apruzzese et al. Accepted EPS Conference proceeding 2024

[3] S. Palomba et al. ECPD Conference proceeding 2023

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