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Conceptual studies on optical diagnostic systems for plasma control on DEMO

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The roadmap to the realization of fusion energy describes a path towards the development of a DEMO tokamak reactor, which is supposed to provide electricity into the grid by the mid of the century [1]. The DEMO diagnostic and control (D&C) system must provide measurements with high reliability and accuracy, constrained by space restrictions in the blanket under the adverse effects induced by neutron, gamma radiation and particle fluxes. As a consequence an initial selection of suitable diagnostics has been obtained [2]. This initial group of diagnostic consists in 15 different systems classified in 6 methods, microwave diagnostics, thermocurrent measurements, magnetic diagnostics, neutron/gamma diagnostics, IR interferometry/polarimetry, and a variety of spectroscopic and radiation measurement systems.

The key aspect for the implementation, performance and lifetime assessment of these systems on DEMO is mainly attributable to their suitable location, that must be well protected against neutrons, and meet their own set of specific requirements. Within this paper, we concentrate on spectroscopic and radiation measurement systems that require sightlines over a large range of plasma regions and inner reactor surfaces. In this context, sightline analysis, the space consumption and the evaluation of optical systems are the main assessment tools to obtain a high level of integration, reliability and robustness of all this instrumentation, essential features in future commercial fusion power nuclear plants. This paper summaries the main results and strategies adopted in this early stage of DEMO conceptual design, to assess the feasibility of this initial set of diagnostic methods based on sightlines and the integration of the total number of these needed for DEMO D&C.

List of references:

[1] F. Romanelli, “Fusion Electricity – A roadmap to the realization of fusion energy,” 2013
[2] W. Biel et al., “Diagnostics for plasma control - from ITER to DEMO”, SOFT Conference 2018

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