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Oral_73: Nuclear diagnostics for assessing the performance of the DT burning plasma experiment SPARC

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Various private investors have recently shown their interest into nuclear fusion as a source of clean energy. One of the most challenging project is SPARC, a DT tokamak under development by Commonwealth Fusion Systems in collaboration with the Massachusetts Institute of Technology and contribution from investors among which the Italian ENI. The SPARC [1] tokamak is at present under design and has the main features of being superconducting, of compact size (major radius ~1.9 m, minor radius ~0.6 m) with very high magnetic field (toroidal field>12 T). External heating to achieve these plasma conditions will be provided by ICRH. Despite being of compact size, SPARC aims to reach the conditions of a burning plasma with a fusion gain Q~2 and Pfus~55 MW in the most conservative extrapolations, and Q>10, Pfus~140 MW in the most favorable one, with high power density (Pfusion/Vplasma~7 MWm-3) relevant for fusion power plants. This will open up the possibility to study the alpha particle physics and their of interactions with high-frequency MHD modes. In this work, starting from the last two decade experience on JET, we will present a preliminary study of the nuclear (neutron and gamma ray) diagnostics that could be installed on SPARC. Focus will be given to the alpha particle diagnostic capabilities offered by gamma ray diagnostic and to the assessment of the effectiveness of ICRH heating scheme with high resolution neutron and gamma ray spectroscopy.

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