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Neutron diagnostics

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Abstract

Neutrons are generated in most high-performance magnetic confinement fusion devices, and their measurements is considered as a main diagnostic approach for tokamak plasma. Neutron diagnostics play a crucial role in offering essential insights into plasma physics, machine protection, and control. Key parameters such as fusion power, power density, ion temperature, fast ion energy, and their spatial distributions in the plasma core can be measured using neutron diagnostic techniques. Significant experience has been gained in last several years in the operated research fusion tokamaks. The implementation of these systems in high performance fusion machines, such as ITER and future fusion reactor, poses several challenges related to the harsh environment, machine and operation complexity, accuracy and reliability requirements, as well as calibration approaches. This lecture provides an overview of the principles of neutron diagnostics, the main experimental techniques employed in tokamaks, and the key physical quantities derived from these measurements. Furthermore, the lecture highlights the challenges and issues in high-performance fusion machines, with an emphasis on the requirements and constraints associated with diagnostic systems and their calibration. It also provides an outlook on current and future studies.