

P1.1028 Quantitative investigation of the neutron production in ASDEX Upgrade

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See the full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1028.pdf>

Accurate measurements of the neutron emission in fusion plasmas are a prerequisite for the performance of present and future fusion devices mainly due to the role neutrons play in the fusion rate estimation. In addition, neutrons serve as an imprint of the fast ions content and dynamics, which can be detrimental to the plasma facing components.

Recent comparisons between the experimental neutron rate in JET and the neutron rate expected from TRANSP show discrepancies referred to as “neutron deficit”, interpretation of which is still a challenging task. Based on this study, the deficit is concluded to originate from more than one process in the plasma [1]. Given the importance of accurate measurements, the physical understanding and minimization of these discrepancies is necessary for reliable fast ion studies.

In this work the absolute calibration technique of the neutron detectors is proposed as an additional candidate affecting the “neutron deficit”. Thereby, a new calibration procedure has been performed in ASDEX Upgrade. A toy train carrying a radioactive source was run over two poloidal positions inside the tokamak vessel, thus allowing longer calibration time, better reproducibility and improved spatial precision than previous calibrations at ASDEX Upgrade. The calibration results are compared with the calculations of Serpent, a Monte Carlo particle transport code developed at the VTT Technical Research Centre of Finland [2].

The code allows the description of two- and three-dimensional reactor configurations and has the advantage of allowing the direct import of CAD geometries in the form of STL files. This gives a lot of freedom to manipulate the geometry inside any CAD-based program. Cross sections can be both taken from standard data libraries or generated by the user which broadens the scope of reliable neutron analysis. Moreover, the material compositions can be easily exchanged leaving some space for the investigation of possible physics scenarios.

Future goal of this work is the installation of a new scintillating detector designed to have better statistics, time resolution and therefore less uncertainty, which will contribute to the analysis of fast ion physics as a part of this research activity. Last but not least, the simulation of fusion reactions using Serpent will make further fusion related studies available in this project.

References

- [1] H. Weisen, Hyun-Tae Kim, J. Strachan, S. Scott, Y. Baranov et al., The ‘neutron deficit’ in the JET tokamak, Nuclear Fusion (2017)
- [2] J. Leppanen, M. Pusa, T. Viitanen, V. Valtavirta, and T. Kaltiaisenaho. “The Serpent Monte Carlo code: Status, development and applications in 2013.” Ann. Nucl. Energy, 82 (2015) 142-150

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