

Predictive neutron source modelling for the ITER 15MA/5.3T D-T baseline scenario

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In the contribution we present a framework for computing realistic plasma neutron source models for ITER, based on coupling between the plasma transport code JINTRAC and the fusion kinematics code DRESS, and demonstrate its application to the MCNP neutron transport code. This allows capturing plasma events throughout the whole predicted scenario trajectory, including transients, and their direct effect on neutron emissivity properties and nuclear detector response. The ITER 15MA/5.3T D-T baseline scenario is modelled throughout the beginning of the flat-top operational point, in which $n_T/(n_D+n_T)$, P_{fus} and Q_{fus} are ramped-up from negligible levels to steady-state operation values at ≈ 0.5 , 500 MW and 10, respectively. Four trajectory points within the fusion power ramp-up phase are modelled, with different plasma heating configurations and D-T composition ratios. For each snapshot the plasma state is modelled with state-of-the-art core-edge-SOL coupled JINTRAC simulations in IMAS, and the distribution of energetic beams ions calculated with ASCOT4. Large differences between the core and edge D-T ratio are found at the beginning of the ramp-up phase, affecting fusion reactivity profiles and limiting the operational domain of nuclear diagnostics, which arise due to an interplay of D gas puffing, D-T pellet fueling, and inward fuel transport. DRESS-computed emissivity profiles and neutron energy spectra are compiled into a bespoke MCNP SDEF source and launched within the ITER C-lite neutronics model. A neutron detector sensitivity is presented to address the significant differences in shape and spectra observed between the standard and new ITER source models. The JINTRAC-DRESS-MCNP workflow is being made compatible with the IMAS infrastructure to facilitate a seamless exchange of data in IDS format and routine creation of neutron source models for arbitrary ITER scenario plasma simulations, aligned with the new research plan.

Acknowledgments: This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion) and from the EPSRC [grant number EP/W006839/1]. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them. The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

Type of contribution:	Poster session	<input type="checkbox"/>
	Oral Contribution	<input checked="" type="checkbox"/>