E-lite 360º neutronics model of the ITER Tokamak

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ITER is the flagship fusion project, conceived as an experiment to select and develop the technologies for the first demonstration reactor, DEMO. Nuclear analysis is a core discipline in support of the design, commissioning and operation of the machine. To date, ITER nuclear analysis has been conducted with increasingly detailed partial MCNP models, which represented toroidal segments of the tokamak. These models have successfully allowed to address most of the questions regarding ITER nuclear analyses until now. However, the limitations of using partial models became evident as estimates of quantities relevant to design, safety and operation showed unquantifiable uncertainties, which is a risk. Thanks to increasing high-performance computing capabilities and improvements in the memory management by the codes over the years [1], it is now feasible to overcome such limitations. We will present a 360° MCNP model of the ITER tokamak, called E-lite [2]. This model reflects the most faithful, realistic and up-to-date MCNP representation of the complete machine configuration ever achieved. We demonstrate the model's usability and practicality. Two examples are used to illustrate qualitatively and quantitatively how it solves previously intractable problems with marked benefits for the future nuclear analysis of ITER, with applications to DEMO and future reactors. E-lite constitutes a milestone in the field of ITER nuclear analysis in terms of realism in the evaluation of key quantities and has already been adopted as a reference model of the ITER tokamak by the ITER project.

References

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