ATLAS: accelerated torus-like angular source for fusion neutronics applications

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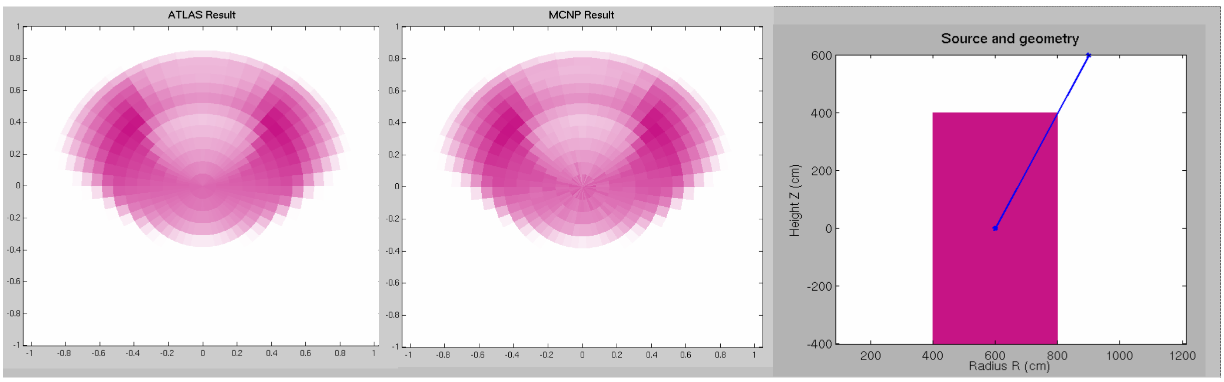
As the ITER project gains momentum, the demand for fast and accurate neutronic analyses is rapidly increasing. These analyses are traditionally undertaken using MCNP, ATTILA or other 3D codes which simulate the transport of neutrons throughout the entire geometry and, in large and complex models such as ITER, are very computationally demanding. In some studies, neutronics parameters are only required for localised components and transporting particles throughout the full model is slow and wasteful. In such cases, however, it is possible to model only the region of interest and, by capturing the angular distribution of the uncollided neutron current, construct a simplified source representation which enables relatively accurate estimations to be performed at a local level whilst significantly reducing computational effort.

An algorithm has been devised and implemented to produce an accelerated neutron source for modelling localised toroidal geometry in MCNP and ATTILA. Given a location of interest, the 'ATLAS' algorithm (accelerated torus-like angular source) integrates a volumetric neutron source over a series of angular bins and generates an equivalent boundary source for MCNP and Attila. The implementation has been made in the form of a FORTRAN programme with user-friendly input and output, supported by a MATLAB graphic interface. The approach is appropriate for locations where the neutron response is dominated by the uncollided neutron flux, such as those close to the first wall or within penetrations or ducts. The method is anticipated to be well suited for parameter scan studies of such components, where calculation turn-over time is more important than very high levels of accuracy. In this paper, we describe the ATLAS algorithm and present results from thorough testing and validation exercises. It is estimated that, for a given statistical uncertainty, a factor of 5 speed-up can be achieved compared with full 3D source representations whilst maintaining reasonable accuracy.



Example of ATLAS vs MCNP unscattered neutron current at first wall.

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