ID de Contribution: **42** Type: **Poster**

Polynomial axial expansion in the Method of Characteristics for neutron transport in 3D extruded geometries

mercredi 11 mai 2016 14:30 (20 minutes)

In the recent years a solver based on the Method of Characteristics (MOC) allowing the treatment of 3D extruded geometries has been developed inside the TDT module of APOLLO3. The standard Step Constant (SC) approximation is used and results show an excellent agreement with Monte-Carlo simulations. However a fine mesh refinement is needed to converge, due to strong flux gradients. An improvement of this method is proposed: the results of the previous work show that the flux gradients are likely to be represented by a polynomial base along the vertical direction. Since most of the geometrical and physical heterogeneities are radially located, the Step Constant approach is preserved to represent the solution over the radial plane. As a matter of fact the strong irregularities in the geometrical meshes prevent from an efficient use of a polynomial expansion. On the contrary along the axial direction the computational meshes assume a Cartesian shape, well suited for a polynomial representation of sources and fluxes. A suitable polynomial development in this direction allows us to approximate the strong flux gradients without the help of a large number of axial meshes.

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Classification de Session: Poster session

Classification de thématique: Nuclear Physics