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Interfacing MCNP/MCNPX and McStas for Cold Neutron Moderator Calculations

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In the target-moderator-beam extraction system such as the European Spallation Source (ESS) facility in Lund, Sweden, neutrons are slowed down from being fast at formation in the spallation target to thermal or cold neutrons in the beam extraction guides. Simulation of this neutron moderation and of the neutron scattering instruments play a central role in the design update phase of ESS, where the aim is to optimize neutron fluxes for the scattering experiments.

For describing models of spallation target and moderators, the MCNP/MCNPX code is a standard of its field. Since mainly being developed for high energy applications such as nuclear reactor cores and weapons, the MCNP/MCNPX code does however lack in description of coherent scattering applicable to the cold/thermal range, e.g., reflectivity and Bragg scattering, plus inelastic scattering arising from phonons etc.

The transport through neutron guides and optics and the scattering instruments on the other hand are well described using the cold/thermal neutron ray-tracing code McStas, where Risø DTU has been the main development centre. To bridge the gap between MCNP/MCNPX and McStas, the approach has generally been to use analytical formulae fitted to MCNP/MCNPX event spectra, using these as input for the McStas simulation. This approach has strong limitations, however, as it in general does not allow the re-entry of cold neutrons into the thermal regime.

We will present our ideas for developing codes to implement a more direct coupling of the MCNP/MCNPX and McStas simulation codes, without storing event files on disk. We foresee that the combination of MCNP/MCNPX and McStas will become a new standard in simulation efforts for cold neutron moderators. Further, this interface may allow use of McStas-based descriptions of e.g. reflecting material and crystals to optimize neutron moderator designs beyond what is possible with the MCNP/MCNPX codes alone.