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Nested Mirror Optics –Towards a New Generation of Neutron Transport Systems?

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The advent of high-brilliance neutron moderators has raised the question how to efficiently extract and transport neutrons from such compact sources while maximizing the brilliance transfer to an instrument. Nested mirror optics (NMO) offer a viable and flexible solution for this task by circumventing the under-illumination associated with long neutron guides. A basic version, consisting of an assembly of short elliptic mirrors, is able to image a well-defined volume of beam phase space from the moderator surface onto a target, e.g., a sample or a virtual source. In contrast to neutron guides, each of the NMO's individual mirrors reflects neutrons only within a narrow range of finite angles. Due to its geometrically well-defined reflection kinematics, one can tailor the divergence and spectrum of the transported beam to the needs of an experiment by design of the NMO. The device thus provides a clean beam without depending on optical elements close to the source or the target, which leads to a number of practical advantages.
Besides a presentation of the concept, we will report on experimental results obtained at the multi-purpose instrument MIRA at FRM2 with an elliptic NMO prototype. We will further present results from recent experiments at the BOA beamline at PSI, which included, among others, the imaging of two-dimensional structures. Supported by McStas simulations, we will highlight various potential applications of NMO for neutron scattering and fundamental physics.

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