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How To Design a Focusing Guide: The Large Moderator Case

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As continuously shaped super-mirrors are becoming more available, the conceptual design of focusing guides should explore a wider range of possibilities to accomplish an efficient neutron beam extraction. Starting from a desired phase-space volume at the sample position and using an upstream ray-tracing approach, the acceptance diagram of any focusing guide can be calculated at the moderator position. To ensure high brilliance transfer and homogeneous coverage, the acceptance diagram should be fully included in the neutron source emission phase-space volume within the entire wavelength band of interest. Following this idea, the guide system can be scaled into dimensionless geometric figures that convey performance limits for a desired cross-section reduction. Moreover, if we impose a monotonic increase of the reflection angle with divergence angle at the sample position, the optimal shape of the mirror is analytically determined. This approach was applied in the design of SNAP and DISCOVER instruments at SNS-FTS, located at ORNL, USA. The results of McStas simulations are presented with different options included.

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