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Nested Optic for Neutron Focusing

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The investigation of small samples by neutron scattering is usually very time consuming due to the low available neutron flux density of neutron beams and small signals from the sample. Originally, neutron guides have been used to transport neutrons over large distances to make room for additional beamlines and for improving the signal-to-noise ratio. While being originally proposed to reduce the number of reflections and therefore the losses, elliptic neutron guides are enjoying an increasing popularity also for focusing neutron beams. However, elliptic guides do not image objects properly due to very strong coma aberrations which should be avoided. In order to overcome the aberrations, we propose using nested arrays of short elliptic mirrors.

In our contribution, we report on the investigation of a nested mirror optic at the beamline MIRA. The key properties of the optic are a large brilliance transfer of approximately 75% and the possibility of adjusting the beam size and the divergence of the neutron beam at the sample position by apertures placed before the nested mirror optic. Therefore, no beam shaping devices are required close to the sample position thus reducing the background significantly. Nested mirrors will also be particularly useful for the efficient extraction of neutrons from highly brilliant moderators such as at the ESS, because the common illumination losses associated with using neutron guides are avoided.

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