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Development of a Nested Mirror Optic Array for the Thermal TAS PUMA at MLZ

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A persistent challenge for the inelastic neutron scattering technique has been the low scattering cross-section of neutrons, necessitating large sample sizes compared to elastic neutron scattering or inelastic x-ray scattering. Focusing the neutron beam is a viable technique to increase the flux reaching the sample, but previous techniques suffer from limitations to beam size, beam quality or an excessively close distance to the sample which interferes with sample environments. The nested mirror optic (NMO) is an ideal solution in many ways to overcome these challenges and provide a small, well-behaved beam at the sample position while keeping the optical components a reasonable distance to make room for the sample environment equipment. An ongoing project has led to the development of an NMO prototype for the cold triple-axis spectrometer (TAS) MIRA at MLZ, but with a limited energy transfer range. The development of supermirror coatings with large m-values has opened up the possibility to apply this technique to the thermal TAS instrument PUMA at MLZ. While current focusing techniques on PUMA yield a cross section of 20mm x 20mm, the current NMO project seeks to develop, install and commission an NMO setup that will reduce the beam size to 5 mm x 5 mm while preserving 50% of the incoming neutrons, for an 8-fold increase in flux on small samples. It will do this while also providing space for the sample environment and preserving the beam characteristics, and will be straightforward to mount and dismount to adjust for the needs of each user. I will discuss the planned setup and our current progress in designing the NMO setup for PUMA, as well as the scientific case for such a device with several planned use cases.

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