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Flexible SANS for small samples and in-situ experiments at ESS

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Abstract

SANS instruments with neutron beam cross sections in the range of 2 x 2 mm^2 or down to a few 10 x 10 μm^2 are strongly requested in biology as well as in soft matter research and material science. The small cross sections enable new SANS measurements which are generally only be performed at synchrotron source (SAXS), e.g. the scanning of domains in microstructured materials or the analysis of smallest sample volumes. A challenge of the small dimensions is the neutron flux. For a sample size of about 50 x 50 μm^2 the scattering volume and associated with it the intensity would be reduced by an order of about 5 compared to conventional samples sizes. To compensate the reduction of the neutron flux and to increase the signal to noise ratio the incoming flux has to be focused on the sample. At the same time the backround has to be minimized. Not only a small sample size would profit from the optimized signal to noise ratio but it would also reduce the measurement times for conventional samples and enable in-situ measurements.

Here we present a conceptual design for an optimized small sample SANS instrument at the long pulsed spallation source ESS. McStas simulations have been used to compare the performance of different SANS concepts. In particular the focusing options and devices as, for example, parabolic and elliptical neutron guides have been analyzed.