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AMPLIFY; a grazing incidence instrument concept for SINQ

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Grazing incidence small angle neutron scattering (GISANS) is a powerful techniqu to investigate surface-near lateral structures on the nanometer scale. It is particulary useful in soft-matter experiments to disentangle surface near structures from bulk effects. But even in hard-matter magnetism the technique can be used to improve the signal when scattering from magnetic particles on or near surfaces.

One chellange of the technique is the need for SANS-like angular resolution while the sample geometry is more similar to reflectometers and wavelength resolution requirements can vary strongly in dependence of the science case. When investigating effects on the surface of liquids, the additional need for changing of reflection angle on a horizontal sample surface arises.
To tackle these challenges we have started to develop a novel instrument concept as part of an investigation into a new guide hall at the PSI SINQ neutron source. The Adjustable Monochromator to Perform Liquid grazing Incidence, Focused or magnetic Yoneda scattering (AMPLIFY) makes use of two parabolic multilayer monochromators to provide a tunable wavelength resolution between 2% and 10% Delta Lambda/Lambda. The neutron optics deflect the beam by 24° and end at 10 m from the sample, leading to low background and flexible collimation. The sample stage can be moved vertically to change the incident angle with the collimation system tilting down to follow. A fixed detector vessel with large entrance window evacuuates the flight path after the sample.
With 10 Å wavelength, 10 m collimation and 20 mm sample width the GISANS resolution would be moderate compared to typical SANS machines. Replacement of the second monochromator mirror with a different shape will allow to focus the beam onto the detector for high resolution experiments on sample width up to 50mm.

We have compared the expectec instrument performance with a SANS-like configuration. For collimations in the range of 5m to 20m AMPLIFY can reach similar or better angular resolution with slightly higher intensity and more homogenous beam profile. When increasing the wavelength resolution, a SANS-like instrument would require an additional chopper which would further decrease the efficiency.

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