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Refurbishement of the optics at REFSANS, the TOF-reflectometer with GISANS option

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In a wide variety of fields, the properties of a system are controlled by the structure of interfaces: e.g. electrochemical systems, corrosion, bio-membranes, catalysts. Neutron reflectometry is a fundamental tool for the investigation and characterization of those interfaces: this technique is nondestructive; its resolution is well adapted to the length-scales of interest; it probes a large surface of the sample thereby providing a statistically relevant information in a single measurement. Beside the classical specular reflectivity mode of operation, modern 2D detectors make it easy to collect the diffuse off-specular scattering characteristic of long range in-plane correlations. Grazing incidence small angle scattering pushes the limits of off-specular reflectometry by drastically improving its resolution. Those aspects and the broad scientific community potentially interested by this technique are the reasons for which neutron facilities typically offer several reflectometers. Among those, the instruments with horizontal sample geometry based on the time of flight mode of operation occupy a specific niche and are recognized as an indispensable component of an instrument suite. Initially developed to perform measurements on liquid-air interfaces for which angular scanning is not practical, they have widened their use case by making it easy to perform in situ time-resolved experiments. Moreover, they constitute a natural and ideal test bench for the development of techniques to be used at pulsed sources. REFSANS is the horizontal TOF reflectometer at MLZ, offering a unique GISANS option.
This improvement project consists of two independent work packages, both aiming to increase the flux at the sample position, reducing the measurement time and improving the time resolution; the first one being the refurbishment of the instrument's primary neutron delivery system whose performance has declined over time. Extensive simulations and measurements have demonstrated that the already implemented technical solution should still be used in the future. The second work package aims at optimizing the secondary optics for smaller samples, thereby answering the modern needs of the whole user community. On the one hand a modification of the collimation will enable a wider range of accessible vertical divergences and, on the other hand, an in-plane focusing solution reducing the beam width by half will be implemented by using parabolic nested mirror optical devices.
The refurbishment of the primary delivery system should improve the intensity by a factor 2 while together, the in-plane focusing and increased vertical divergent option would bring an additional factor 2 to 4 thereby positioning the MLZ horizontal TOF reflectometer on par with its international competitors.

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