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## Development of a “Newton shutter” prototype for use in Neutron Scattering

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The scientific case of the FREIA instrument at ESS is partly based on the measurement of reflectivity with very fast time-resolution. The novel elliptical guide design delivers up to 3 collimated beams onto the sample position and thereby enables the possibility of quickly changing the incidence angle without moving the sample. However, it remains technically challenging to achieve sequential selection between beams at a speed that will allow the full potential of the instrument to be achieved.

The ZOOM instrument at ISIS is intended to measure scattering from very large-scale structures, something that will only be possible by using focusing optics: a system of CRLs coupled with a fast aperture. This aperture has strikingly similar requirements to the FREIA shutters since it will need to be able to close to create a small aperture as the neutron pulse reaches the focal wavelength of the lenses.

Here we present the design and testing of a prototype shutter system that is capable of opening and closing in between or during beam pulses. The shutters are able to select which pulses to accept in any arbitrary pattern and open or close within a few milliseconds. By incorporating a slit into the shutter, it is also able to generate a change in aperture size mid-pulse. Testing has been performed on the ZOOM beamline demonstrating that the performance meets the requirements of both instruments.

To illustrate the potential application of these shutters on the FREIA instrument we also report on recent experiments examining the digestion of triolein films. While this complex process can be followed using existing reflectometers, the Q-range available at the required time resolution severely limits our ability to interpret the development of the digestion process.

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