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Spectroscopic binning of event mode neutron data: Sub-second time resolution for the study of soft matter

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Neutron scattering methods enable a broad range of material studies that are difficult to carry out with other experimental methods. One specific example is the study of soft condensed matter, which includes polymeric systems. Under certain temperatures and concentrations, these polymers may crystallize into crystalline structures. This results in interesting viscoelastic properties of the material, such as gelation or shear thinning. We use Large Amplitude Oscillatory Shear (LAOS) to exert strain on a polymeric sample with a rheometer. Small Angle Neutron Scattering (SANS) is used to probe the periodically assembling crystal structures in the bulk of the material and address unanswered questions about nonlinear effects, such as shear bands and stress-overshoots which could be linked to non-uniform structures. To access the time scales necessary for analyzing an excitation with e.g. a frequency of 1 Hz, we take the neutron data in event mode, capturing every neutron event with a precise time stamp. Via a time-of-flight measurement, the detector data can then be linked to the stress-strain curve of the rheometer at the same synchronized time. Developing a corresponding data reduction pipeline based on the ESS software scipp is a core component of the project. This method also enables improved post processing and rebinning of the data at a later stage.

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