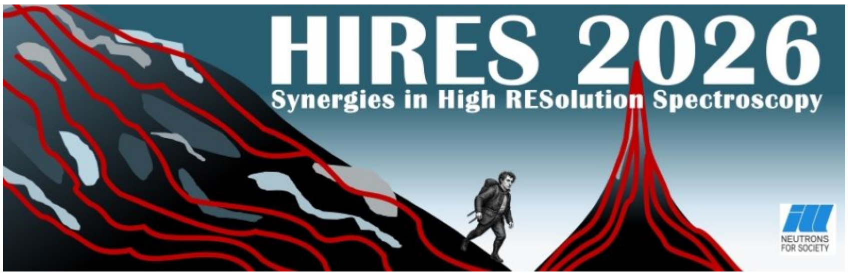


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# Rheo-NSE: Probing dynamics of entangled polymer blends under shear.

Polymeric fluids are one of the most fascinating areas in soft matter physics. Entangled polymer systems exhibit complex, non-Newtonian viscoelastic behaviour arising from topological constraints that restrict chain motion. These entanglements result in characteristic plateau moduli and long relaxation times. To directly access molecular relaxation under shear, we used an updated cone–plate shear cell compatible with in-situ Rheology–Neutron Spin Echo (Rheo-NSE) and Rheology–Small Angle Neutron Scattering (Rheo-SANS). The cell features a non-magnetic design, an improved motor enabling precise speed control, and a dedicated filling protocol for highly viscous samples. In addition, enhanced sealing for operation at high shear rates.

A key challenge in Rheo-NSE is Doppler-induced phase shift arising from velocity gradients that project onto the scattering vector ($\vec{Q}$), causing beam depolarization and restricting the accessible Fourier time. To address Doppler shift, we performed extensive simulations to optimize instrument settings and quantify operational limits in accessible Fourier times, shear rates, and Weissenberg numbers. Using these simulations to take into account Doppler scattering on a pixel-by-pixel basis will significantly increased the effective measurable dynamic range or the available intensity depending the experiment's requirements. We optimized the experimental parameters by analysing static NSE data of the entangled polybutadiene (PBD) melt.

This integrated approach establishes Rheo-NSE as a quantitative probe for polymer dynamics, providing molecular insight into non-linear visco-elasticity in polymer blends, melts, and wormlike micelles, critical for understanding fundamental polymer physics, polymer processing, and material design.

## Session

Soft Condensed Matter

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