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Combining Neutron Spin Echo and Polarization Analysis

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Neutron Spin Echo (NSE) spectroscopy uses polarized neutrons; however, it was never used for performing polarization analysis at the same time, which can offer a very promising extension. In NSE experiments one requires a polarizer for preparing the precessing polarization of the incoming neutron beam and a polarization analyzer for observing the precessing polarization of the scattered beam. For a mixture of coherent and nuclear spin incoherent scattering in conventional NSE analysis the directly measured signal $S(q,t)$ is the difference of the intermediate scattering function of the coherent scattering minus $1/3$ of the same for the incoherent scattering. We have used the inherent polarization analysis capability of NSE spectrometers to identify the individual magnitudes of the coherent and incoherent scattering intensities within the energy transfer window of the NSE set-up with effective FWHM width in energy E , as primarily determined by the energy transmission function of the NSE polarization analyzer. This information can be very efficiently made use of as powerful evidence and constraint for the models used in the interpretation of a mix of coherent and incoherent scattering. These intensities can be considered as the $S(q,t=T)$ points of the NSE spectra at the NSE time value T about \hbar/E . The method has been successfully used for the first time in the study of quasielastic scattering processes in ordinary and heavy water on the WASP multiangle NSE spectrometer at ILL.

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