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The new high-resolution neutron spin-echo spectrometer at MLZ: J-NSE Phoenix

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The neutron spin echo spectrometer provides the ultimate energy resolution in quasi-elastic cold neutron scattering spectroscopy. High-resolution means the extension of Fourier-time (τ) up to the regime of μs, which depends on the reduction of the field-integral inhomogeneity down to the some ppm. The limiting factor is the performance of the present correction coils. We could mitigate this hardship by optimizing the shape of the precession magnetic field - and thus reducing the intrinsic inhomogeneity introduced by the cylindrical main solenoids - guided by the original idea of Zeyen [1] and by a new semi-analytical approach [2]. Following this strategy we numerically optimized and realized a set of new superconducting, fringe-field compensated solenoids with zero net dipole moment for the neutron spin-echo spectrometer J-NSE at MLZ. Due to the lower intrinsic field inhomogeneity the amount of required correction is reduced by over a factor 2, as expected from numerical calculations. After the installation of the new precession coils the performance of the new J-NSE Phoenix already allowed us to use a magnetic field integral of 1.0 Tm for a Fourier-time of 100 ns at 8 Å, 190 ns at 10 Å and 350 ns at 12.5 Å. Together with an increased wavelength-band from 10% to 20% we will strive for 500 ns at 15 Å. The improved resolution may be used to reach larger Fourier-times and/or to benefit from significant intensity gains by the use of shorter neutron wavelength from a given τ. Thus the new J-NSE will meet the needs to look into the microscopic dynamics of functional polymers thanks to new and more enhanced qualities.
[1] Zeyen C.M.E. and Rem P.C., 1996 Meas. Sci. Technol. 7 782–91, [2] Pasini S. and Monkenbusch M., 2015 Meas. Sci. Technol. 26 035501

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