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Optimized signal deduction procedure for the MIEZE spectroscopy technique

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A method is reported to determine the phase and amplitude of sinusoidally modulated event rates, binned into four bins per oscillation, based on data generated at the resonant neutron spin-echo spectrometer RESEDA at FRM-II. The presented algorithm relies on a reconstruction of the unknown parameters. It omits a calculation-intensive fitting procedure and avoids contrast reduction due to averaging effects. It allows the current data acquisition bottleneck at RESEDA to be relaxed by a factor of four and thus increases the potential time resolution of the detector by the same factor. The approach will be compared with the established fitting procedures of time series having four and 16 time bins per oscillation. In addition the empirical estimates of the errors of the three methods are presented and compared with each other. The reconstruction is shown to be unbiased, asymptotic and efficient for estimating the phase. Reconstructing the contrast increases the error bars by roughly 10% as compared with fitting 16 time-binned oscillations. Finally, we present heuristic, analytical equations to estimate the error for phase and contrast as a function of their initial values and counting statistics.

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