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GHz-Bandwidth Signal Processing for Time-Resolved Faraday/Kerr Rotation Experiments[1] YANJUN MA, PATRICK IRVIN, JEREMY LEVY — Faraday/Kerr rotation is a sensitive measurement of the electron spin and its dynamics in semiconductor nanostructures such as GaAs quantum dots. The Kerr rotation angle from a single spin, however, can be as small as 10^{-6} rad, which requires massive averaging of the Kerr signal in order to maximize the signal-to-noise ratio. By replacing the mechanical delay line typically found in time resolved Kerr rotation (TRKR) measurements with a continuous wave probe and high-speed electronics, the signal and noise can be sampled more often which results in a higher SNR. However, real-time methods for data collection are typically limited by available memory, resulting in unavoidable dead time for which data cannot be collected and averaged. The approach we have developed integrates a field-programmable gate array (FPGA) with a high-speed digitizer, thus allowing high-speed on-board averaging to overcome these technical limitations. We will demonstrate the performance of this instrument by comparing the results of this system with traditional pump-probe (sampling) techniques and discuss its applicability for a variety of dynamical spin-sensitive experiments in the solid state.

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