Orbital Angular Momentum Imprints Studied Using Optical Vortex Pump-probe Spectroscopy\textsuperscript{1} M. A. NOYAN, A. L. EXARHOS, J. M. KIKKAWA, Department of Physics and Astronomy, University of Pennsylvania — We introduce a second generation magneto-optical spectroscopy based on orbital angular momentum of light. Our technique is analogous to methods such as time resolved Faraday/Kerr rotation, but instead of utilizing photon spin, we use holographic gratings to pump and probe materials using photons carrying orbital angular momentum (OAM). We will discuss our first time resolved experiments studying pump-induced OAM dichroism in bulk semiconductors. 100 fs pump pulses with alternating orbital angular momentum $\pm \hbar$ create OAM imprints whose momentum distributions resemble right- or left-handed “whirlpools” or vortices. The OAM memory of the sample is then measured using a probe beam whose $\pm \hbar$ OAM components are detected in a balanced photodiode bridge. We find that in n-GaAs, the dynamical OAM signal shows a unique timescale when compared to population and spin dynamics and, surprisingly, lasts considerably longer than the momentum scattering time. This method should be of further interest for studying non-equilibrium dynamics in a variety of orbitally coherent systems.

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