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Atomic-Lifetime-Timescale Development of Birefringence in an Ultracold Gas JONATHAN GILBERT, MARK WATKINS, JACOB ROBERTS, Colorado State University — For near-resonance light incident on an optically thick gas of atoms, the light is strongly absorbed leading to an opaque gas in steady state. However, when the light is turned on over a time shorter than the excited state lifetime of the atoms, the gas is nearly transparent, and a large fraction of the initial light intensity is transmitted through the gas. This initial light peak is known as an optical precursor. In the presence of a magnetic field, a gas of multi-level atoms becomes birefringent, and at short times the light undergoes a time-dependent polarization rotation. This time-dependent birefringence influences the initially transmitted light signal as the atoms emit radiation in response to the local driving field. We have performed measurements of the optical precursor and the time-dependent phase difference between orthogonal components of the transmitted electric field in an optically thick gas of ultracold ^{85}Rb atoms in the presence of different magnetic field strengths. We have also developed a model based on the optical Bloch equations that includes the relevant magnetic sub-levels of the ground state and excited state to compare to our experimental measurements.

Jonathan Gilbert
Colorado State University

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