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Spectral and time-dependent multiple light scattering in ultracold atomic ^{85}Rb[1] S. BALIK, R.G. OLAVE, C.I. SUKENIK, M.D. HAVEY, Department of Physics, Old Dominion University, Norfolk, VA 23529, V.M. DATSYUK, D.V. KUPRIYANOV, I.M. SOKOLOV, Department of Theoretical Physics, State Polytechnic University, St.-Petersburg, Russia — Multiple light scattering can generate distributed coherences in an optically dense ultracold atomic gas. An intriguing possibility is that at high enough atom densities, the coherences collapse into spatially localized subradiant excitations. Theories of strong light localization in condensed samples show that diffusive transport is strongly suppressed; in atomic samples, this would be reflected in the time dependence of emergence of light from the ultracold gas samples. At lower densities, light transport is approximately diffusive, and can be effectively modelled by, for example, Monte Carlo simulations of the multiple scattering process. We present in this paper experimental data on the spectral and time dependence of light emerging from a sample of ultracold and dense (peak optical depth b = 8(1)) ^{85}Rb atoms. For off-resonance excitation, the time-dependence measurements show transient beats upon turn-on of the pulsed excitation. Surprisingly, the transient decay of the intensity shows a nearly constant decay rate at longer times, independent of the detuning of the excitation pulse frequency from resonance. Monte-Carlo simulations of the process successfully describe the full temporal behavior of the fluorescence intensity, and support physical interpretations of the observations.

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