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A 3-photon process for producing degenerate gases of metastable alkaline-earth atoms DANIEL S. BARKER, NEAL C. PISENTI, BENJAMIN J. RESCHOVSKY, GRETCHEN K. CAMPBELL, JQI, University of Maryland and NIST, College Park, MD 20742 — We present a method for creating quantum degenerate gases of metastable alkaline-earth atoms. A degenerate gas in any of the ^3P metastable states has not previously been obtained due to large inelastic collision rates, which are unfavorable for evaporative cooling. Samples prepared in the $^1S_0$ ground state can be rapidly transferred to either the $^3P_2$ or $^3P_0$ state via a coherent 3-photon process. Numerical integration of the density matrix evolution for the fine structure of bosonic alkaline-earth atoms shows that transfer efficiencies of $\simeq 90\%$ can be achieved with experimentally feasible laser parameters in both Sr and Yb. Importantly, the 3-photon process does not impart momentum to the degenerate gas during excitation, which allows studies of these metastable samples outside the Lamb-Dicke regime. We discuss several experimental challenges to the successful realization of our scheme, including the minimization of differential AC Stark shifts between the four states connected by the 3-photon transition.

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