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Simulations of a multi-level atom interferometer[1] B. BARRETT, I. CHAN, C. MOK, A. CAREW, R. BERTHIAUME, A. KUMARAKRISHNAN, York University, I. YAVIN, New York University — We present numerical simulations to understand a multi-level atom interferometer used for precision measurements with laser cooled atoms. In the experiment, a standing wave pulse (swp) is applied at $t = 0$ which creates a superposition of momentum states. At $t = T$, a second swp diffracts the momentum states again so that a density grating is formed in the vicinity of $t = 2T$. This grating is associated with the interference of p-states differing by multiples of the 2-photon recoil momentum ($n\hbar q = 2n\hbar k$). A traveling wave readout pulse Bragg scatters light only from the grating with spatial periodicity $\lambda/2$ (associated with interfering p-states differing by $\hbar q$). Coherent backscatter due to the readout pulse is detected as the signal. A model of the experiment is realized by numerically solving the Schrödinger equation for a multi-level atomic wave packet subject to a time-dependent standing wave potential. The simulation models several aspects of the experiment, such as the dependence of the signal on pulse duration, intensity and detuning. It is also used to explain the effect of spontaneous emission and magnetic sub-level populations on the experiment. A comparison of the simulations to experimental data is presented.

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