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Simulations of the Spatial Dependence of Populations in High Field Optical Pumping[1] BEN OLSEN, WILL HAPPER, Princeton University — Optical pumping of alkali atoms forms the basis for many modern experiments including atomic clocks, magnetometers, and hyperpolarization of noble gases and solids. The alkali atoms in these experiments interact with other alkali atoms, the optical pumping laser, buffer gas or noble gas targets, and the glass cell walls or a coating. Recent experimental results at high magnetic fields have shown that ground-state sublevel populations in a cesium vapor exhibit spatial diffusion, each with a different effective diffusion length. At high magnetic fields, each ground-state sublevel can be individually probed with a weak $D1$ ($S_{1/2} \to P_{1/2}$) laser while a stronger $D2$ ($S_{1/2} \to P_{3/2}$) laser depopulates a single sublevel. The probe beam is physically translated to measure the populations at different positions in the vapor cell. To try and understand some unexpected features observed in the sublevel populations undergoing optical pumping, we present a numerical model of the density matrix of alkali atoms as a function of position within the vapor cell. Steady-state sublevel populations are shown for atoms undergoing optical pumping, alkali-alkali collisions, alkali-buffer gas collisions, and depolarization at the cell walls, and these results are compared to experimental observations.

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