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Optical phase dependence and formation time for superlattice density patterns in a 6-beam $\sigma+$-$\sigma-$ optical lattice. TIMOTHY ROACH, WILBER ALFARO CASTRO, College of the Holy Cross — We have been studying superlattice density variations in a 6-beam $\sigma+$-$\sigma-$ optical lattice (optical molasses). These density patterns, seen also in magneto-optic traps, are caused by slight beam misalignments that produce a gradient in the time phases of the optical lattice across the interaction region. The resulting superlattice has regions with different polarization character and hence different potential wells and damping forces. For example, one region has primarily circular polarization and Sisyphus cooling while another has linear polarization and an induced-orientation friction force. We impose a phase-gradated optical lattice on an initially uniform (Gaussian distributed) atomic cloud and observe the diffusion of atoms into a periodic structure over times $\sim 10^{-2}$ sec. We also induce gradients of the two independent optical time phases each in a different spatial direction. This creates a mapping of the 2D optical phase space onto real space, where we see a density distribution with atoms localized in islands arranged in a 2D pattern. While this gradient method itself does not allow unambiguous determination of optical phases, there is a particular symmetry and topography in the experimental distribution and in the calculated light field ellipticity that allows us to infer that atoms are accumulating at points of minimum ellipticity, where the optical time phases are equal. The diffusion rate within the superlattice can be explored as a function of intensity and detuning which will be useful for comparison with theoretical models.

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