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Structuring spin domains in a BEC with spin-dependent light

MARK BAKER, ALEXANDER PRITCHARD, THOMAS BELL, DAVID COLAS, TYLER NEELY, HALINA RUBINSZTEIN-DUNLOP, MATTHEW DAVIS, School of Mathematics and Physics, The University of Queensland — We present our work on spatially structuring magnetic domains in multi-component Bose-Einstein condensates of ^{87}Rb, using spin-dependent optical potentials. For this, we make use of light at the tune-out wavelength (between the D1 and D2 line, for ^{87}Rb at 790.018 nm) to create optical barriers and potential wells sensitive to the hyperfine state of the atom. Using a focused Gaussian beam, and with appropriate circular polarization, this results in a repulsive barrier for (F,m_F) =(1,-1), and attractive well for the (1,+1) state, with the (1,0) state unaffected. We initially load a pure (1,-1) BEC into a flat-bottom line trap formed from a painted optical dipole potential. Using RF pulses, we drive spin transitions and prepare mixtures of (1,-1) with a tunable population of (1,0) or (1,+1) states. Using a 2D acousto-optical deflector, the spin-dependent light beam is steered and focused onto the BEC, resulting in localised repulsive barriers for the (1,-1) state. Through mean-field effects, the other hyperfine states fill in the resulting density dips in the (1,-1) condensate. Removing the light, we observe the formation of stable immiscible domains of (1,+1) embedded in the (1,-1) bulk.

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