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Designer Spatial Control of Interactions in Ultracold Gases[1]
NITHYA ARUNKUMAR, North Carolina State University, ARUNKUMAR JAGANNATHAN, Duke University, North Carolina State University, JOHN THOMAS, North Carolina State University — Optical control of scattering interactions can achieve high-resolution spatial and ultrafast temporal control of interactions in ultracold gases. We report on experiments that uses electromagnetically induced transparency near the energy-dependent narrow Feshbach resonance in ^{6}Li Fermi gas to tune the interactions by 12 background scattering lengths. We achieve this tunability by changing the frequency of the laser light by merely a few MHz, thereby not altering the effective potential experienced by the atoms. By measuring mean field shifts from radio frequency spectra, we show that our method achieves the same level of tunability as magnetically tuning the scattering length. We further illustrate the versatility of our technique by creating spatially dependent interactions, where the central interacting region of the atomic cloud is "sandwiched" between two weakly interacting regions or vice versa.

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