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High Fidelity Preparation of a Single Atom in Its 2D Center of Mass Ground State PIMONPAN SOMPET, YIN HSIEN FUNG, EYAL SCHWARTZ, MATTHEW D. J. HUNTER, JINDARATSAMEE PHROMPAO, MIKKEL F. ANDERSEN, The Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, University of Otago, Dunedin, New Zealand — Complete control over quantum states of individual atoms is important for the study of the microscopic world. Here, we present a push button method for high fidelity preparation of a single ^{85}Rb atom in the vibrational ground state of tightly focused optical tweezers. The method combines near-deterministic preparation of a single atom with magnetically-insensitive Raman sideband cooling. We achieve 2D cooling in the radial plane with a ground state population of 0.85, which provides a fidelity of $\sim$0.7 for the entire procedure (loading and cooling). The Raman beams couple two sublevels ($|F = 3, m = 0\rangle$ and $|F = 2, m = 0\rangle$) that are indifferent to magnetic noise to first order. This leads to long atomic coherence times, and allows us to implement the cooling in an environment where magnetic field fluctuations prohibit previously demonstrated variations. Additionally, we implement the trapping and manipulation of two atoms confined in separate dynamically reconfigurable optical tweezers, to study few-body dynamics.

Pimonpan Sompet
University of Otago

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