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Atom Chip Radio-Frequency Traps for Neutral Atoms[1] ANDREW ROTUNNO, SHUANGLI DU, DOUG BERINGER, SETH AUBIN, William Mary — We report on theoretical and experimental progress in the development of spin-dependent traps based on radio frequency (RF) atom chip near-field potentials using the AC Zeeman effect. The ability to trap and spatially control atoms based on their internal spin state has applications in atom interferometry, qubit logic gates, novel many-body systems, and sympathetic evaporative cooling. In recent work, we have shown the ability to push or pull individual atomic spin states of rubidium-87 using a single RF current of roughly 10 mA at a few MHz on an atom chip. With the use of two or three RF currents with controlled phase and amplitude, trapping of specific spin states should be possible, and we explore the effectiveness of this trapping scheme experimentally. Simulations show that 2 W of power in each of three parallel chip wires can produce a trap depth of 60-80 μK, without impedance matching. Other trapping schemes employ a ground plane, multiple RF frequencies, and different combinations of amplitude and phase parameters to alter trap geometry while targeting specific spin states. We also report on equipment development for this trapping method, as well as preliminary tests of state mixing over time.

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