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Progress towards optically trapping 2d ion crystals[1] MATT GRAU, OLIVER WIPFLI, CHRISTOPH FISCHER, JONATHAN HOME, ETH Zurich —

Arrays of trapped ions and Rydberg atoms are both attractive platforms for quantum simulation due to high-level single particle of control and the presence of long-range interactions. However, current techniques for trapped ions are limited by micromotion and lattice geometry, while Rydberg atoms remain challenging to trap in attractive potentials. We are developing a new apparatus to trap arrays of ions in optical lattices, which combine the flexible geometry found in neutral atom experiments with the high degree of control and large interaction strengths found in ion experiments. Two-dimensional arrays of around 40 ions could be trapped with inter-ion distances of under 10 microns, and also with low residual heating rates due to off-resonant scattering and laser fluctuations. This will be made possible by using a deep lattice potential formed by the large optical intensity in a high-finesse optical cavity. In a complementary effort, the polarizability of the alkali-like ion core of an alkaline earth atom could be used to trap neutral atoms excited to Rydberg states. Sufficiently high angular momentum Rydberg states should suppress loss of atoms from the trap by autoionization. Experimental progress towards these goals will be described.

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