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Towards optically trapped 2d ion crystals for quantum simulation MATT GRAU, CHRISTOPH FISCHER, OLIVER WIPFLI, JONATHAN P. HOME, Institute for Quantum Electronics, ETH Zürich, Otto-Stern-Weg 1, 8093 Züurich, Switzerland — Quantum simulation using atomic systems has the potential to overcome the limitations of classical computers when calculating many-body spin Hamiltonians. Arrays of trapped ions are attractive platform for quantum simulation due to the high level of single particle control combined with the intrinsic long range Coulomb interaction that can be used to engineer tunable spin-spin couplings. However, varying lattice geometry is challenging with current trapping techniques. 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. 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. Operating the optical lattice at a wavelength that traps both neutral atom and ions will allow us to deterministically load neutral atoms in a designed geometry before photoionizing in-situ. Experimental progress towards these goals will be described.

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