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Holographic optical manipulation of trapped ions for quantum simulation[1] CHUNG-YOU SHIH, SAINATH MOTLAKUNTA, MANAS SAJJAN, NIKHIL KOTIBHASKAR, IQC and Dept. of Physics and Astronomy, University of Waterloo, THIAGO BERGAMASCHI, IQC and MIT, Cambridge, MA, ROLAND HABLUTZEL, RAJIBUL ISLAM, IQC and Dept. of Physics and Astronomy, University of Waterloo — Trapped ions are an ideal experimental platform for quantum simulation of interacting many-body Hamiltonians. Arbitrary and programmable control over individual ions is needed for maximum versatility in simulation. In this talk, we will present progress towards developing a holographic optical ion addressing system using Digital Micromirror Devices. The technique uses reprogrammable holograms to modulate the wavefront of the addressing beam to control the amplitude and phase of light at each ion. We implement a novel iterative Fourier transform algorithm to compute holograms that compensate for optical aberrations and produce minimal cross-talk error between ions. Individual ions can be used as aberration sensors for ultimate precision. Such high-precision optical control will enable quantum simulation of dynamical and higher dimensional lattice geometry of spins in a 1D chain of ions, such as to investigate quantum quenches and phase transitions and topological phases.

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