Abstract Submitted
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Experimental apparatus for quantum simulation with two-dimensional 9Be+ Coulomb crystals KARSTEN PYKA, HARRISON BALL, TERRY MCRAE, CLAIRE EDMUNDS, MICHAEL W. LEE, SAMUEL HENDERSON, MICHAEL J. BIERCUK, The University of Sydney, QUANTUM CONTROL LAB TEAM — We report on the development of a new experimental setup designed for Quantum Simulation studies at a computationally relevant scale using laser-cooled 9Be+ ion-crystals in a Penning trap. The trap geometry is optimized using numerical calculations for trapping large ion crystals with enhanced optical access and reduced anharmonic perturbations. Separate loading and spectroscopy zones prevent long term drifts of the trapping parameters due to contamination of the trap electrodes with Be deposits. Our customized superconducting magnet provides a homogenous (dB/B <10-6) magnetic field at 3T required for ion trapping. Laser frequencies required for cooling/detection and spin-motion entanglement are generated from telecom wavelength fiber laser systems in the IR via nonlinear conversion. Our new approach employs high-efficiency telecom modulators and mode-selecting cavities to generate multiple beamlines from a single Sum-frequency-Generation step. Ultimately, this newly developed setup will allow for studies of many-body spin systems with tuneable interaction strength from infinite-range to nearest-neighbour type interaction.

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