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Quantum simulation of 2D and 3D spin systems in a linear chain of trapped ions

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Trapped ions are a leading hardware platform for quantum information processing, in particular quantum simulation. Qubits or (pseudo-)spin states encoded in the internal electronic structure of ions can be precisely controlled, and quantum coherence for individual qubits can last for several minutes. Phonon-mediated programmable long range inter-spin interactions can be engineered by shining the ions with suitable laser beams, enabling the simulation of a many types of spin Hamiltonians such as long range quantum Ising and XY models. In this talk, I will give an overview of trapped ions as a versatile platform for quantum simulation. The interaction graph between spins can be engineered to study spin Hamiltonians on dynamically reprogrammable lattice geometries, enabling the investigation of a wide range of quantum many-body physics problems in 1D, 2D and 3D, such as geometrically frustrated spin systems, quantum transport, and dynamical phase transitions in a linear chain of ions.

Author: Dr ISLAM, Rajibul (University of Waterloo)

Presenter: Dr ISLAM, Rajibul (University of Waterloo)

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