Day 4

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Title:From Quantum Algorithms to Out-of-Equilibrium Phenomena in Interacting Spin Chains

Abstract:
Laser cooled trapped ions offer unprecedented control over both internal and external degrees of freedom at the single-particle level. They are considered among the foremost candidates for realizing quantum simulation and computation platforms that can outperform classical computers at specific tasks. In this talk I will show how linear arrays of trapped 171Yb+ ions can be used as a versatile platform for studying out-of-equilibrium many-body quantum systems and to implement quantum variational algorithms. In particular I will show how a cryogenic trapped-ion quantum simulator allowed the implementation of a Quantum Approximate Optimization algorithm (QAOA) used to approximate the ground state energy of a long-range transverse field Ising model of up to 40 qubits. The reliable production and lifetime of large linear ion chains also enabled us to investigate how confinement can suppress information propagation and thermalization of meson-like quasi-particles in a many-body system. Finally，I will report on the observation of a time crystalline behaviour in a disorder-free system，where high frequency drive suppresses Floquet heating，allowing the realization of a prethermal discrete time crystal.