Contribution ID: **88** Type: **Talk**

【17】Trapped-ion interfaces for quantum networks

Friday 25 August 2017 09:40 (40 minutes)

Laser-cooled trapped ions are among the most promising candidates for quantum computing platforms. Quantum information can be encoded in ions'electronic states, where it can be processed with high-fidelity gate operations and read out deterministically. An outstanding challenge, not only for ion-trap computers but for all experimental realizations, is how to link together remote quantum computers. Such quantum networks would enable distributed quantum computing as well as secure long-distance communication over quantum channels.
By coupling an ion to the mode of an optical resonator, we can construct an interface between single ions and single photons, allowing us to transfer quantum information from ions onto photons for distribution over optical channels. I will present probabilistic and deterministic realizations of an ion-photon interface, based on ion-photon entanglement and ion-photon state transfer. Finally, I will discuss approaches to link up future networks and the challenges that we face on the road to scalability.

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Session Classification: Plenary Session