



Contribution ID: 65

Type: **Poster**

Telecom-Wavelength Quantum Repeater Node Based on a Trapped-Ion Processor

Tuesday, 26 September 2023 19:30 (2 hours)

A quantum repeater node is presented based on trapped ions that act as single-photon emitters, quantum memories, and an elementary quantum processor. The node's ability to establish entanglement across two 25-km-long optical fibers independently, then to swap that entanglement efficiently to extend it over both fibers, is demonstrated. The resultant entanglement is established between telecom-wavelength photons at either end of the 50 km channel. Finally, the system improvements to allow for repeater-node chains to establish stored entanglement over 800 km at hertz rates are calculated, revealing a near-term path to distributed networks of entangled sensors, atomic clocks, and quantum processors.

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Session Classification: Tuesday Poster