

2008 DAMOP Thesis Prize Session

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Remote Entanglement and Quantum Networks with Trapped Atomic Ions*

The recent developments of quantum information science and its potential applications have brought many of the fundamental questions of quantum physics to the mainstream of not only theoretical but also experimental physics. I discuss a system at the heart of these questions – quantum entanglement of two individual massive particles at a distance. I present a theoretical and experimental realization for the entanglement of two trapped atomic ions. Trapped ions are among the most attractive systems for scalable quantum information because they can be well isolated from the environment and manipulated easily with lasers. In particular, I discuss our results including the first explicit demonstration of both the quantum entanglement between a single trapped ion and its single emitted photon, as well as the entanglement between two macroscopically separated trapped ions. The entanglement protocols used in these experiments, together with the recent developments of trapped ion quantum computing, can be used to create a platform for a scalable quantum information network, and perhaps confront some of the strangest features of quantum mechanics.

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