APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

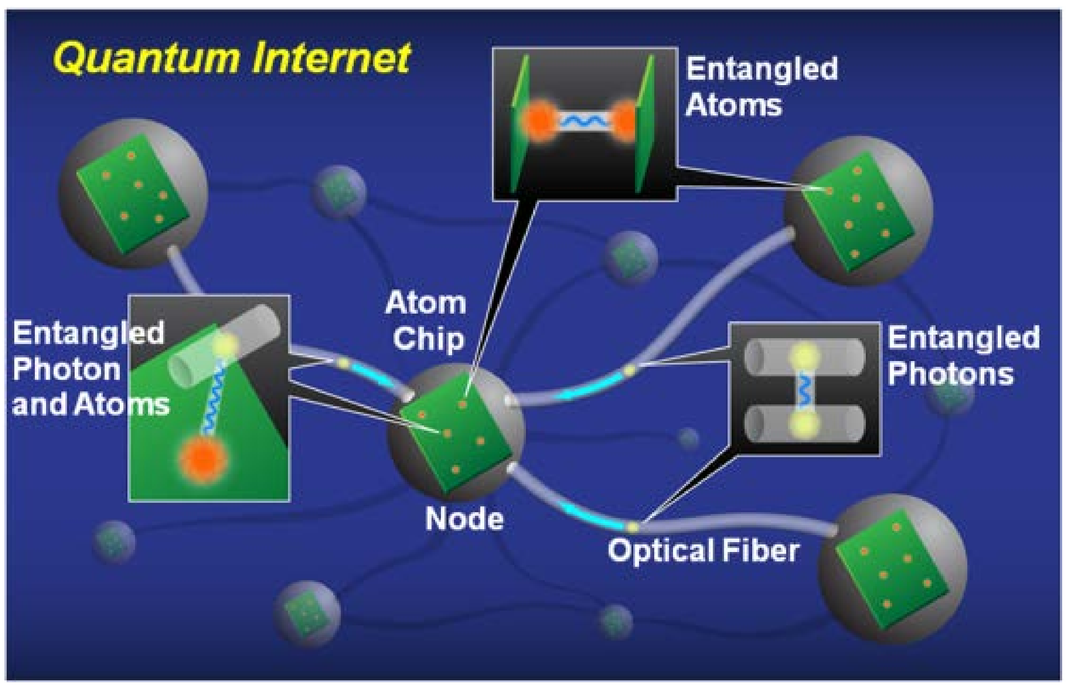
Quantum Sciences

S&T Campaign: Materials Research
Tier 2 Subtopics: Photonics

Dr. Mike Wraback, (301) 394-1459
michael.wraback.civ@mail.mil

Research Objective

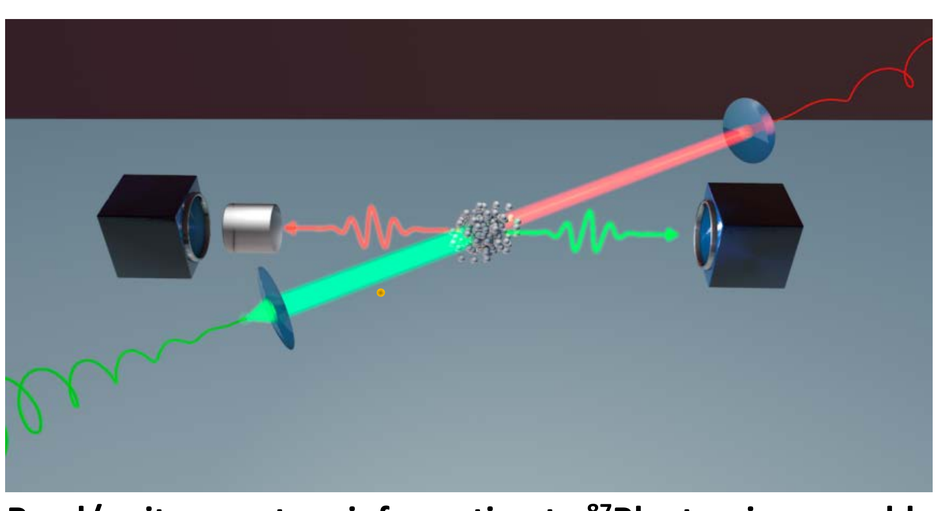
Develop the physical layer of a multi-node modular integrated quantum network based on resilient distributed quantum entanglement preserved by quantum memory and quantum error correction to provide game-changing capabilities for Command, Control, Communications, Intelligence, Surveillance and Reconnaissance for stationary and mobile Army elements.



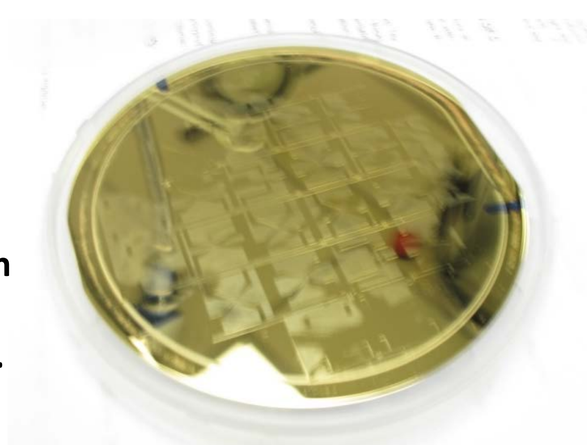
Multi-node distributed quantum network.

Challenges

- Implementation of efficient light-matter interfaces that preserve quantum information.
- Distributing entanglement over large distances.
- Protecting entanglement from decoherence.



Read/write quantum information to ^{87}Rb atomic ensemble.

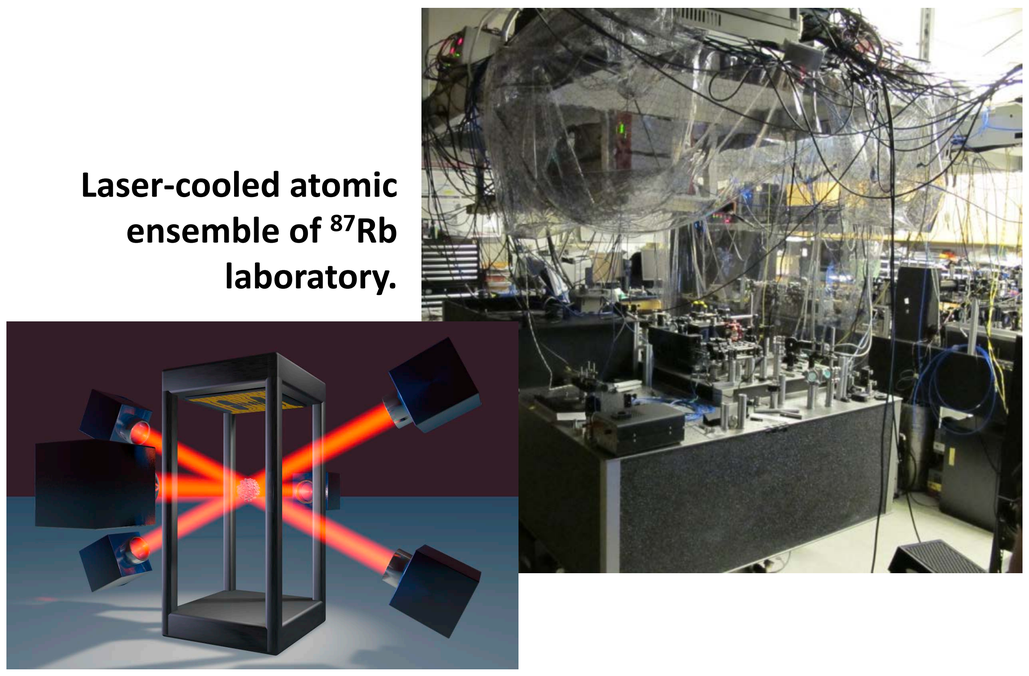


ARL-microfabricated ion trap for quantum information processing.

ARL Facilities and Capabilities Available to Support Collaborative Research

- Centrally-located researchers with wide breadth of knowledge in: materials, optics, characterization, processing, fabrication and modeling & simulation
- Unique expertise in optical characterization and analysis of materials using ultrafast spectroscopy and modeling & simulation of optical processes in materials
- Multiple tunable ultrafast lasers covering the deep UV to long-wave IR for coherent nonlinear spectroscopy studies
- Exclusive technique for *in situ* doping of rare-earth ions into semiconductors for scalable modular quantum memories
- World-class expertise and cleanroom for advanced micro- and nano-fabrication of numerous diverse materials, including complex ion-traps.
- Rapid expansion of skills in quantum information science including laser-cooling of atomic ensembles, ion-trapping, quantum optics, coherent control and quantum information, and coherent nonlinear spectroscopy
- New state-of-the-art laser-cooled neutral atoms and ion-trap laboratories

Laser-cooled atomic ensemble of ^{87}Rb laboratory.



Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Collaborative development and linking of quantum nodes to distribute quantum information across a quantum network
- Expertise in quantum information processing, storage, and distribution

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED