Research Spotlight Forum

6.4.19 Quantum Information Sciences

Trapped Ions for Quantum Computing and Atomic Clocks

PRESENTED BY:

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ABOUT THE PHOTONICS MICROSYSTEMS TECHNOLOGY DEPARTMENT

History

- Fabricating traps for quantum computing since 2005
- Leverage MESA and packaging facilities
- Trapping experiments since 2009
- >12 collaborations, >20 different designs

Experimental capabilities

- Calcium and Ytterbium ion trapping
- High fidelity single and two qubit gate operations
- Room temperature and cryogenic operation
- Custom electronic control system for qubit manipulation

Personnel

- Primarily AMO experimentalists, computer scientists, & fabrication/packaging engineers in department [25 people total]
- Strong collaborations with electrical engineers, QC theorists, & AMO theorists

Keywords

- Ion traps, quantum computing, high voltage device fabrication, atomic clocks, heterogeneous integration, photonics

Trap design and fabrication
Matthew Blain
Ed Heller
Corrie Herrmann
Becky Loviza
John Rembetski
Paul Resnick
MESA team

Trap design and experimental work
Peter Maunz
Craig Hogle
Daniel Lobser
Melissa Revelle
Dan Stick
Christopher Yale

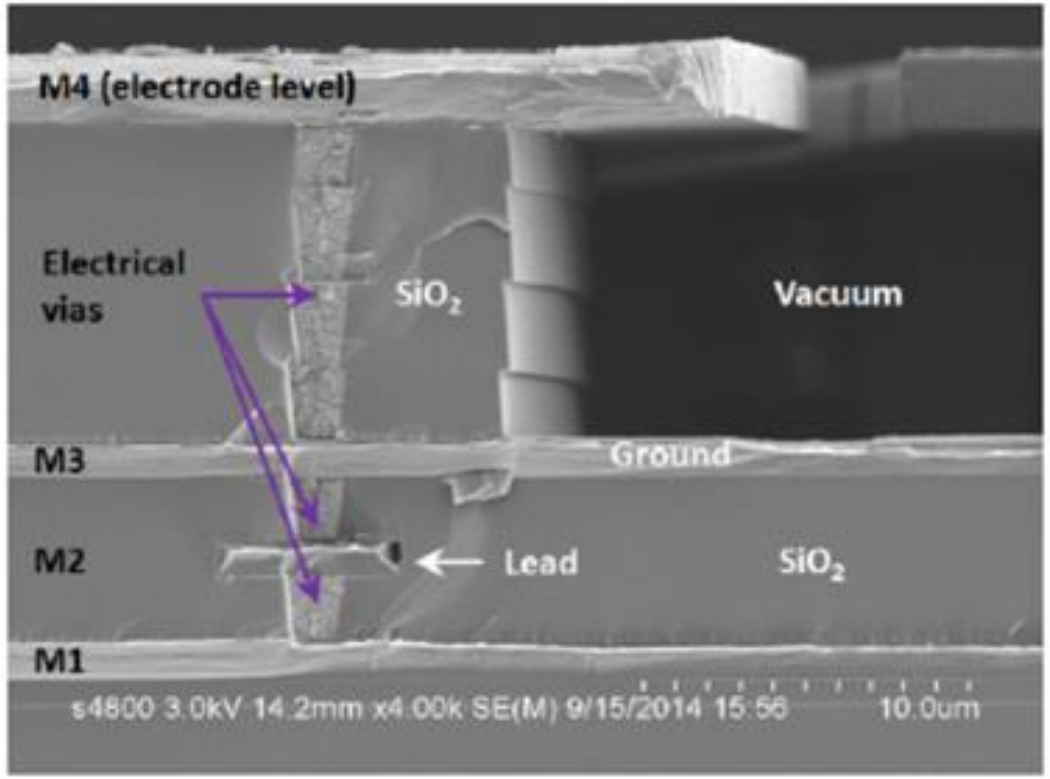
RF Engineering
Christopher Nordquist
Stefan Lepkowski

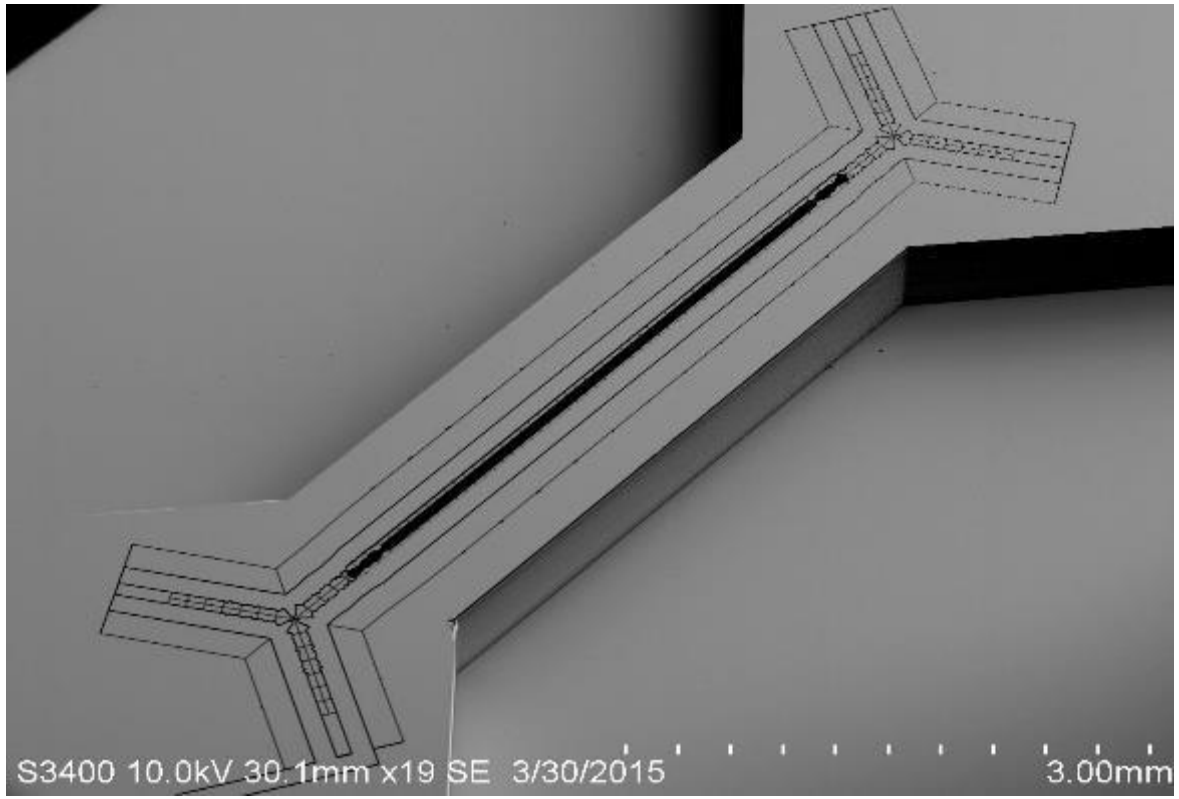
Trap packaging
Ray Haltli
Drew Hollowell
Anathea Ortega
Tipp Jennings

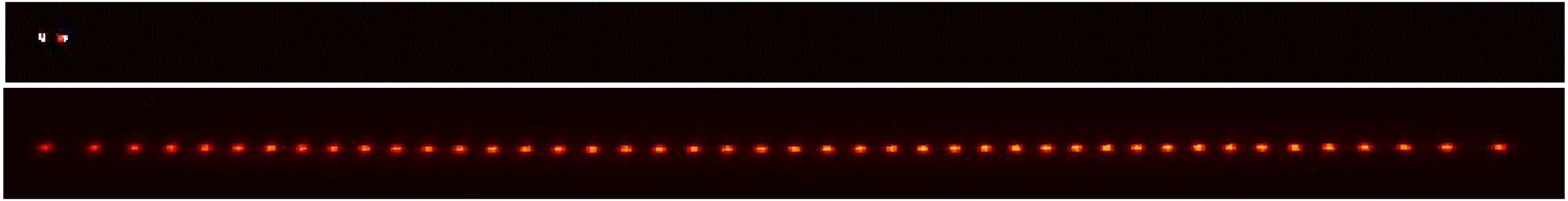
GST protocols
Robin Blume-Kohout
Kenneth Rudinger
Eric Nielsen

Theory Support
Brandon Ruzic
Kevin Young
Setso Metodi

INFORMATION SCIENCES

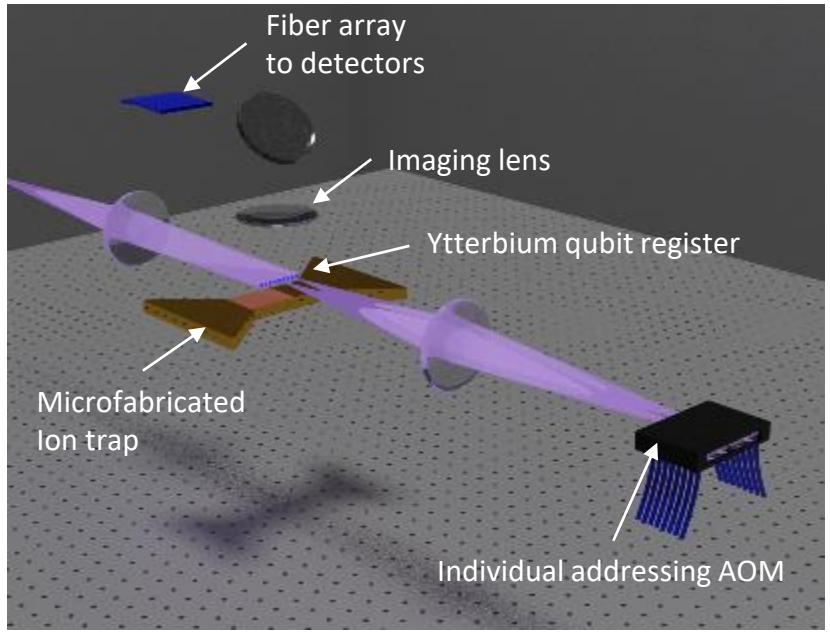


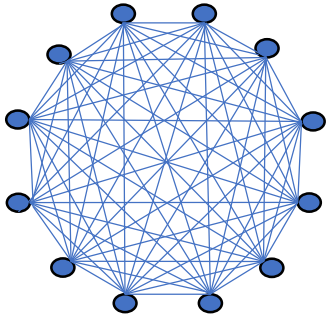




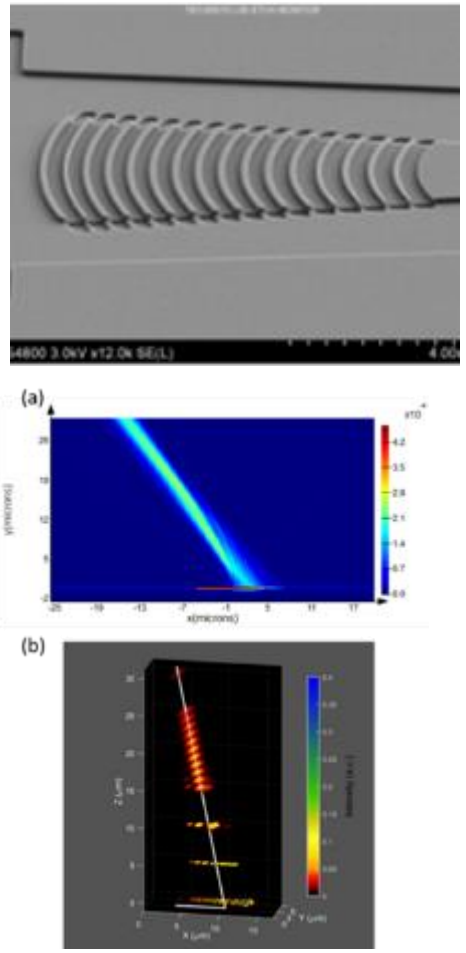
INFORMATION SCIENCES

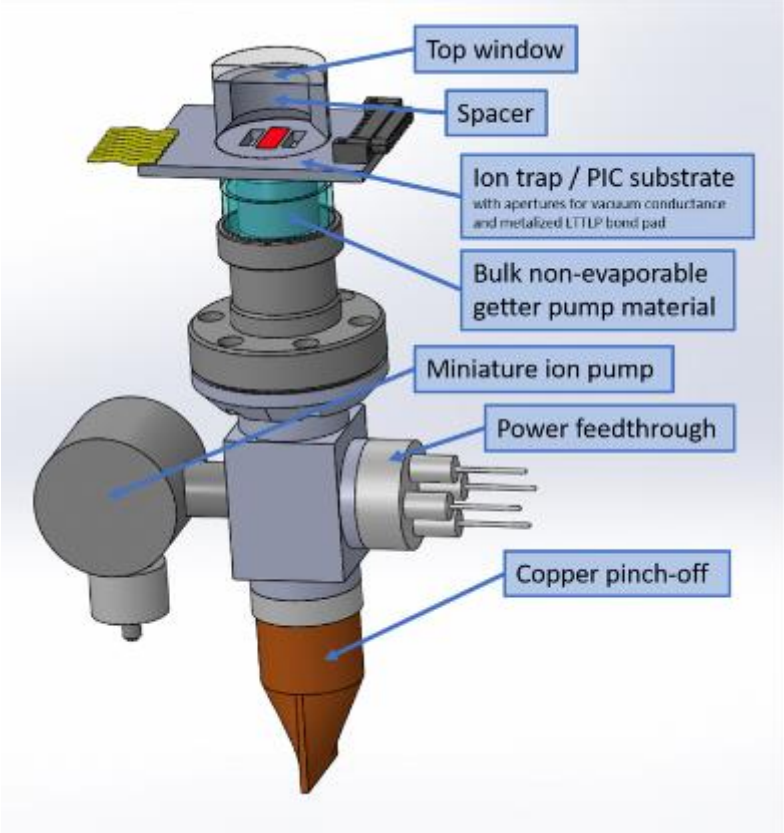
- **QSCOUT** *Quantum Science Open User Testbed*





TICTOC *Trapped Ion Clock using Technology On Chip*





FUNDING SOURCES

- **Sponsors**

U.S. DEPARTMENT OF ENERGY
Office of Science

DARPA

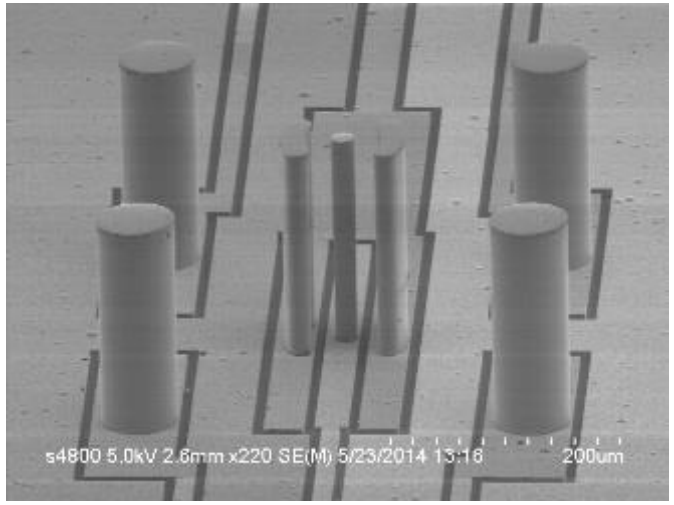
Sandia National Laboratories

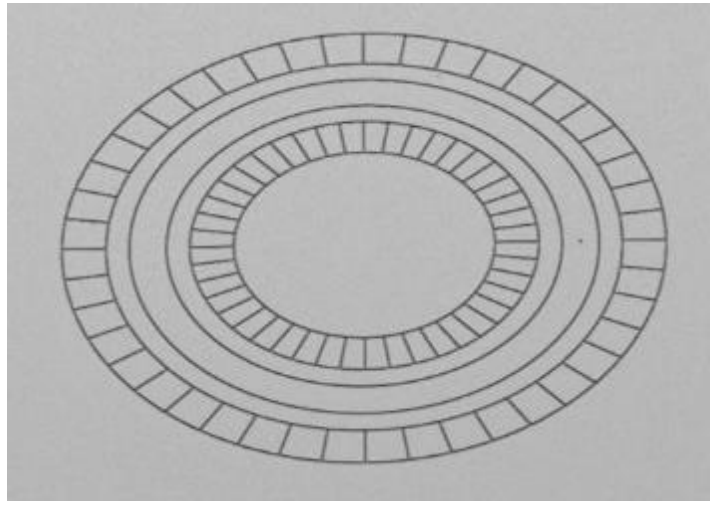
Collaborators

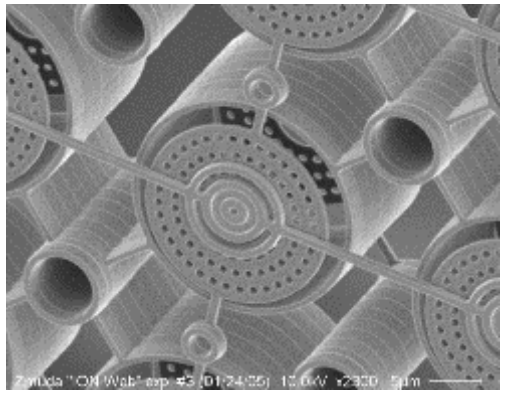
Sandia National Laboratories
University of Maryland
Duke University
Purdue
Universität Innsbruck
NIST National Institute of Standards and Technology U.S. Department of Commerce
Georgia Tech
MIT Massachusetts Institute of Technology
University of Oxford
The University of Sydney
MIT Lincoln Laboratory
AFRL
IONQ
ETH zürich
Honeywell
Albert-Ludwigs-Universität Freiburg
ARL
JG|U Johannes Gutenberg Universität Mainz
University of Washington
The University of New Mexico

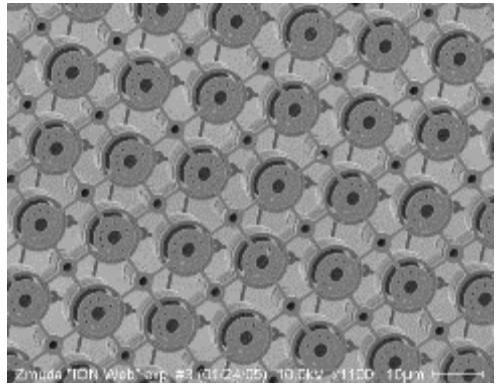
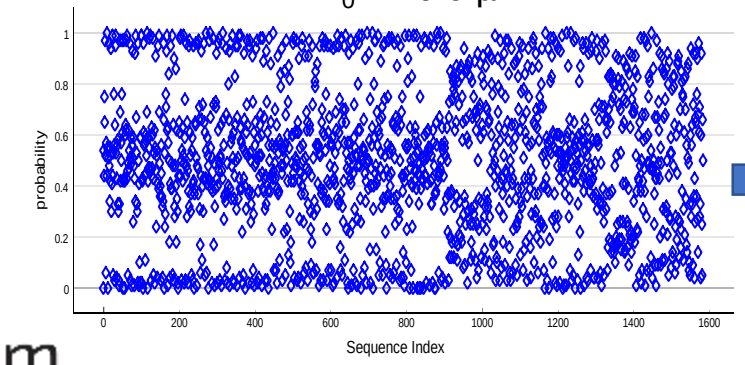
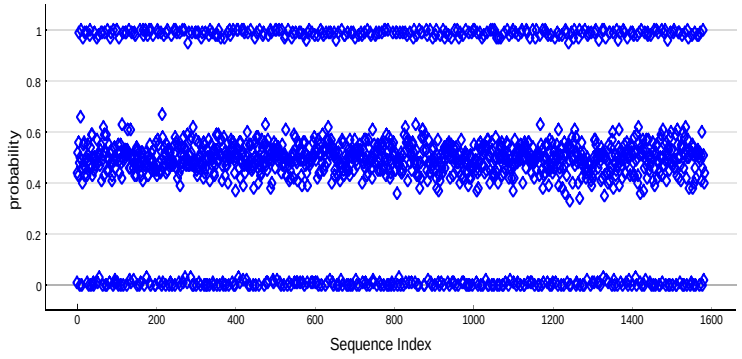
RESEARCH NEEDS

- **Collaboration opportunities**
  - Trap operation and characterization, e.g. material studies of electric field noise
  - Novel uses of ion traps
  - Incorporation of enabling technologies
  - Mass spectrometry
  - QSCOUT algorithm proposals
  - Postdocs!





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