JULES MICHAEL STUART

EDUCATION

Massachusetts Institute of Technology August 2014 - June 2021
Ph.D. in Physics
Thesis: "Integrated Technologies and Techniques for Trapped Ion Array Architectures"
Overall GPA: 4.8

The University of Texas at Austin September 2010 - June 2014
B.S. in Honors Physics
Dean's Scholars Program
Overall GPA: 3.88

HONORS AND AWARDS

NRC Postdoctroal Research Associateship	August 2021
Praecis Presidential Graduate Fellowship	August 2014
Dean's Honored Graduate	June 2014
Eva Stevenson Woods Unrestricted Endowed Presidential Scholarship	August 2013
Kevin E. Underhill Memorial Endowed Presidential Scholarship	September 2012
National Merit Scholarship	September 2010

RESEARCH EXPERIENCE

National Institute of Standards and Technology August 2021 - Present
Postdoctoral Research Associate *Boulder, CO*

· Building an experiment for quantum networking research using trapped atomic ions in surface electrode traps with integrated fiber Fabry–Pérot cavities.

MIT Lincoln Laboratory Janurary 2016 - June 2021
Research Assistant *Lexington, MA*

· Demonstrated the first trapping of ions using only (DC) voltages generated on-chip. Measured the voltage noise in these circuits using trapped-ions and compared results with bench measurements.

· Constructed a new experiment in the ion lab for trapping calcium atoms for testing future rounds of integrated electronics chips. Led an effort to implement a new Python-based software and hardware control system across all of the experiments in the ion-trapping lab.

· Developed ion traps and voltage sources for rapid transport, splitting and merging of chains of trapped ions. Mentored a student to help develop voltage waveforms for doing these operations in the presence of low-pass filters.

· Co-led an experiment to develop a trapped ion atomic clock using a fiber-based stimulated Brillouin scattering laser, operating in a new regime of stability for fiber lasers.

· Co-led the experimental effort to address a trapped ion using a trap with integrated photonics at multiple wavelengths. Engineered a mounting system for attaching fiber-optic arrays to the edge of ion trap chips. Characterized photoelectric charging due to ionization lasers and improved the finite-element simulations of electrostatic potentials.

· Helped to develop a general method for determining the technical noise contribution to heating rates in ion traps.

· Investigated surface preparation methods for reducing motional decoherence of trapped ions. Employed in situ plasma cleaning capability with an ex situ ion mill to determine the effects of surface reconstruction and hydrocarbon removal on the heating rate of trapped ions. Compared milling results with x-ray photoelectron spectroscopy analysis.

Massachusetts Institute of Technology August 2014 - September 2016
Research Assistant *Cambridge, MA*

- Wrote FPGA firmware for an ADC/DAC board to control feedback systems. Addressed high-resolution analog controllers using the maximum possible bandwidth to minimize the frequency noise on lasers locked with PID loops. Created a system of flexible IIR filter stages that can be dynamically switched to obtain an ad hoc balance between the speed of the loop and the complexity of the transfer function.
- Designed and tested a custom circuit for Pound-Drever-Hall locks on lasers. Assembled analog control boards that have been used for such various things as modulating a high-finesse laser lock and driving fixed-frequency AOMs.
- Helped to maintain web-enabled software for laboratory control. Developed front ends written in Javascript and Python to control low-level device function and communicate with a host server for the main experiment.

The University of Texas at Austin May 2012 - July 2014
Research Assistant *Austin, TX*

- Constructed a lock-in amplifier for Auger spectroscopy. Developed LabVIEW software for controlling the high-voltage bias field and performing the signal acquisition and processing.
- Designed and constructed a digital delay generator with 1 ns precision. Replicated the function of a discontinued IC with a custom circuit and created a means for USB control with an Arduino.
- Participated in an experiment to probe the surface of amorphous water with a helium beam. Used a pulsed beam of helium incident on a thin foil with a few layers of adsorbed water, which could be brought quickly into the amorphous state using a wet liquid nitrogen cooling stage.

ACADEMIC PAPERS

D. Reens, M. Collins, J. Ciampi, D. Kharas, B. F. Aull, K. Donlon, C. D. Bruzewicz, B. Felton, **J. Stuart**, R. J. Niffenegger, P. Rich, D. Braje, K. K. Ryu, J. Chiaverini, and R. McConnell, "High-fidelity ion state detection using trap-integrated avalanche photodiodes", Physical Review Letters **129**, 100502 (2022).

W. Loh*, **J. Stuart***, D. Reens, C.D. Bruzewicz, D. Braje, J. Chiaverini, P.W. Juodawlkis, J.M. Sage, and R. McConnell, "Operation of an optical atomic clock with a Brillouin laser subsystem", Nature **588**, 244-249 (2020).

* - *equal contribution*

R.J. Niffenegger, **J. Stuart**, C. Sorace-Agaskar, D. Kharas, S. Bramhavar, C.D. Bruzewicz, W. Loh, R.T. Maxson, R. McConnell, D. Reens, G.N. West, J.M. Sage, and J. Chiaverini, "Integrated multi-wavelength control of an ion qubit", Nature **586**, 538-542 (2020).

C.D. Bruzewicz, R. McConnell, **J. Stuart**, J.M. Sage, and J. Chiaverini, "Dual-species, multi-qubit logic primitives for Ca^+/Sr^+ trapped-ion crystals", npj Quantum Information 5, 1-10 (2019).

J. Stuart, R. Panock, C.D. Bruzewicz, J.A. Sedlacek, R. McConnell, I.L. Chuang, J.M. Sage, and J. Chiaverini, "Chip-integrated voltage sources for control of trapped ions", Physical Review Applied **11**, 024010 (2019).

J.A. Sedlacek, **J. Stuart**, D.H. Slichter, C.D. Bruzewicz, R. McConnell, J.M. Sage, and J. Chiaverini, "Evidence for multiple mechanisms underlying surface electric-field noise in ion traps", Physical Review A **98**, 063430 (2018).

J.A. Sedlacek, **J. Stuart**, W. Loh, R. McConnell, C.D. Bruzewicz, J.M. Sage, and J. Chiaverini, "Method of determination of technical noise contributions to ion motional heating", Journal of Applied Physics **124**, 214904 (2018).

J.A. Sedlacek, A. Greene, **J. Stuart**, R. McConnell, C.D. Bruzewicz, J.M. Sage, and J. Chiaverini, "Distance scaling of electric-field noise in a surface-electrode ion trap", Physical Review A **97**, 020302 (2018).

C.D. Bruzewicz, R. McConnell, J.A. Sedlacek, **J. Stuart**, W. Loh, J. Sage, and J. Chiaverini, "High-fidelity, single-shot, quantum-logic assisted readout in a mixed-species ion chain", arXiv:1709.05102 (2017).

H. Zhang, M. Gutierrez, G.H. Low, R. Rines, **J. Stuart**, T. Wu, and I. Chuang, "Iterative precision measurement of branching ratios applied to 5P states in $88Sr^{+}$", New Journal of Physics **18**, 123021 (2016).

PRESENTATIONS

Poster - **J. Stuart**, L. Sonderhouse, K. David, A. Wilson, D. Slichter and D. Leibfried "Progress towards a quantum network of $^{40}Ca^{+}$ ions trapped in a fiber-based optical cavity", APS DAMOP Meeting 2022.

Talk - **J. Stuart**, "Integrated Photonics and Electronics for Chip-Scale Quantum Control of Trapped Ions", MIT nano Explorations seminar, March 2021.

Poster - **J. Stuart**, R. Panock, C.D. Bruzewicz, R. McConnell, R. Niffenegger, G. Simon, I. Chuang, J.M. Sage and J. Chiaverini, "Integrated Electronics for Chip-Scale Trapped-Ion Quantum Control", North American Conference on Trapped Ions 2019.

Talk - **J. Stuart**, "Go, Go Gadget Ion Trap: Integrated Technology for Scaling to Future Trapped-Ion Array Architectures", NIST visit 2019.

Talk - **J. Stuart**, W. Loh, C.D. Bruzewicz, R. McConnell, R. Niffenegger, G. West, G. Simon, J. Sage, and J. Chiaverini, "Quantum Control of a Trapped Ion using a Stimulated Brillouin Scattering Laser", APS March Meeting 2019.

Talk - **J. Stuart**, R. Panock, C. Bruzewicz, J. Sedlacek, R. McConnell, J. Sage, and J. Chiaverini, "Integrated Electronics for Chip-Scale Trapped-Ion Quantum Control", APS DAMOP Meeting 2018.

Poster - **J. Stuart**, C. Bruzewicz, R. McConnell, R. Panock, J. Sedlacek, J. Chiaverini, J. Sage, "Integrated Electronics for Chip-Scale Trapped-Ion Quantum Control", LogiQ Technical Exchange Meeting 2017.

Poster - **J. Stuart**, J.A. Sedlacek, C.D. Bruzewicz, R. McConnell, J. Sage, and J. Chiaverini, "Investigation of Trapped-Ion Heating Rate with Surface Preparation Techniques", APS March Meeting 2017.

Talk - **J. Stuart**, "The Thrill of the Mill: A Trapped Ion Story", MIT Integrated Quantum Initiative Meeting 2017.