Curriculum vitae

Christopher M. Seck, Ph.D.

A detail-oriented, technical experimental physicist with over eight years of professional experience in matrix research organizations specializing in surface-ion-trap-based quantum information science and quantum computing with wide ranging experience including developing complete diode and solid-state laser, electronics, electro-, acousto-, and free-space-optical systems. Serves as principal investigator (PI) for multi-institution collaborative projects. Technical lead of ion trapping experiments in spectroscopy, precision measurement, quantum information, and quantum computing/simulation as well as optical clock/gate laser development. An effective technical project manager able to lead teams to complete project milestones in an efficient and robust, yet versatile manner while effectively communicating team progress to a technical and/or general audience.

Research Scientist
Quantum Sensing and Computing Group
Quantum Information Science Section
Computational Sciences & Engineering Division
Computing and Computational Sciences Directorate
1 Bethel Valley Road
P.O Box 2008, MS-6129
Oak Ridge, TN 37831-6129

Desk: (865) 341-0583
Mobile: (818) 585-8600
Email: seckcm@ornl.gov
chris.m.seck@gmail.com
Web: linkedin.com/in/chrismseck
Citizenship: USA

Education

Northwestern University, Evanston, Illinois
Doctor of Philosophy in Physics, September 2016
Dissertation: Quantum state control of trapped atomic and molecular ions
Areas of specialization: experimental atomic and molecular ion trapping and cooling, external cavity diode lasers and electronics
Advisor: Brian C. Odom
GPA: 3.515

California Polytechnic State University, San Luis Obispo, California
Bachelor of Science Magna cum Laude in Physics, Minor in Mathematics, June 2009
GPA: 3.823

Research Interests

- Quantum computing/simulation and quantum information processing
- Quantum characterization, verification, and validation
- Laser system design, electronics, and frequency stabilization
- Precision measurement, spectroscopy, and remote sensing
- Physics of trapped, cold atomic and molecular ions and neutrals
- Public policy regarding advanced technologies, energy, and sustainability
- National security and global affairs

Experience

Research Scientist for Quantum Information Science, Band 3 January 2021 – Present
Quantum Computing and Sensing Group, Oak Ridge National Laboratory, Oak Ridge, TN

Research Scientist for Quantum Information Science, Band 2 January 2020 – December 2021
Quantum Information Science Group, Oak Ridge National Laboratory, Oak Ridge, TN

- Technical lead of Oak Ridge National Lab's (ORNL's) first ion trapping apparatus. Oversees all aspects of ORNL's ion trapping experimental efforts including control electronics, optics, dipole-transition lasers, optical-qubit gate laser, and laser modulator subsystems while planning, justifying, and managing project budget.

- Experimentally achieved many firsts at ORNL within the first 9 months of effort: $^{40}Ca^{+}$ trapping, observation of spectroscopy and Rabi oscillations on the $^{40}Ca^{+}$ optical qubit, performing single qubit gates with fidelity of >0.999, and performing two qubit gates with fidelity of >0.98. Achievements resulted in winning a laboratory-wide team award.

- Contributed ion-trap technical ideas and milestones for multiple whitepapers and the Quantum Science Center (QSC) proposal for the Department of Energy's National Quantum Initiative (NQI) call, which was funded. Serves as PI for ion-trapping work under the QSC ($3.65M) targeting analog quantum simulation and cryogenic integrated electronics development in collaboration with Fermi National Accelerator Lab (FNAL).

- Led a funded $2.86M internal project as PI to codesign an ultra-low vibration cryogenic 4 K ion trap apparatus leveraging ColdQuanta's ion trap packaging and ultra-high vacuum (UHV) experience, ORNL's cyrogenic and mechanical engineering expertise, and a Montana Instruments cryogenic station.

- Leads a funded $1.30M internal project as PI to provide an artificial intelligence/machine learning (AI/ML)-optimized trapped ion quantum resource to serve as an HPC accelerator for natively quantum problems within an integrated ecosystem. The project includes acquisition of experiment control hardware from Riverlane and development of a software environment.

- Leads a funded $271k internal project as PI to contract with the Georgia Tech Research Institute (GTRI) to measure the $^{40}Ca^{+}$ $D_{5/2}$ electronic state g-factor and both low and high magnetic field.

Research Scientist II September 2016 – January 2020
Quantum Systems Division, GTRI, Atlanta, Georgia

- Major contributor to GTRI's quantum information research in trapped-ion systems. Worked extensively with both $^{40}Ca^{+}$ and $^{88}Sr^{+}$ optical qubits in multiple surface ion traps including the GTRI GenIIc, GTRI Gold, Honeywell BGA, and Sandia HOA-2. Key member of a team and leader of a subteam comprised of physicist and engineers tasked to meet challenging project milestones under taxing time constraints and contributed to the technical reporting of such in both writing and presentation.

- Contributed to GTRI's optical transition dipole force (OTDF) 2-qubit entangling gate result (publication 8) that measured an infidelity of 6(3) x 10^{-4} without experimental error subtraction. Designed the optical-qubit gate laser optical layout and stabilization subsystems, multiple free-space optical control subsystems, common/standard experiment control sequences, and enhanced PC control of multiple devices.

- Led a team as PI to assemble a proposal for an external funding opportunity. Led all aspects of proposal assembly from technical volume to budget, resulting in a funded Department of Defense grant ($750k) to demonstrate individual ion addressing in a global qubit-laser beam, quantify the results via randomized benchmarking (RB), and characterize a 2Q gate via quantum process tomography (QPT) using the technique. Oversaw all aspects of project execution including solving technical challenges, fulfilling reporting requirements, and managing project budget. Presented the project to the sponsors and other performers at several mandatory program reviews and in two peer-reviewed publications.

- Assembled multiple ultra-narrow-linewidth semiconductor and solid-state qubit-/clock-laser systems for high fidelity 1 and 2 qubit gates with estimated laser linewidths of $\lesssim$10 Hz.

- Designed, constructed, and optimized multiple experiment optical infrastructure subsystems including electro-, acousto-, and free-space optic assemblies using COTS components. Improved and optimized PC-control of experiments and standard experiment sequences. Assembled multiple new experiments and experimental infrastructure for sponsored projects.

Graduate Research Assistant (Doctoral Research) September 2009 – September 2016
Department of Physics & Astronomy, Northwestern University, Evanston, Illinois

Research advisor: Prof. Brian C. Odom

- Experimentally investigated and demonstrated cooling of the motional mode of a single $^{138}Ba^{+}$ ion to the motional ground state of a macroscopic ion trap as a prerequisite to performing precision molecular quantum logic spectroscopy (mQLS) using near-resonant Raman sideband cooling on a Zeeman interval with a final $\bar{n} = 0.15(6)$. Constructed and operated the custom experimental apparatus including the ultra-high vacuum system; ion trap; stabilized diode laser systems and associate electronics; numerous acousto- and free-space-optical systems; multiple phase-locked, versatile RF sources; and apparatus automation via analog servo loops and LabVIEW/Python integration. Performed data collection and analysis in the Python environment. Presented accomplished work through multiple seminars, peer-reviewed articles, and conference presentations.

- Experimentally investigated and demonstrated cooling of the internal degrees of freedom in trapped diatomic molecular ions to the ground state from room temperature using a single, broadband laser source, extending the quantum toolkit developed for decades in atomics to molecules. Worked with other group members to construct and operate the custom experimental apparatus including the ultra-high vacuum system; ion trap and time-of-flight mass spectrometer; stabilized diode laser systems; high-power pulsed Nd:YAG and dye laser systems;

numerous optical and electro-optical systems; and apparatus automation via LabVIEW. Implemented optical pulse-shaping of a frequency-doubled Ti:sapphire femtosecond laser; designed and fabricated analog, digital, high voltage, and RF circuits and enclosures; designed and constructed the experiment's camera-based imaging system including mechanical design and precision machining; and performed all data analysis including construction of a toy Monte-Carlo model for error analysis. Presented accomplished work through multiple seminars, peer-reviewed articles, and conference presentations.

- Led the development of external cavity diode laser (ECDL) systems including the design and fabrication of electronics and high-bandwidth frequency lock servo loops using a rubidium reference and optical transfer cavities. Managed several students ranging from undergraduate to graduate to design, fabricate, and debug Libbrecht-Hall-based current drivers and analog temperature controllers for diode laser systems. Modeled second-harmonic generation optical cavity efficiencies. Constructed multiple ECDL systems for $^{138}Ba^{+}$ shelving and deshelving including second harmonic generation.

- Designed and integrated direct digital synthesizers (DDS) and RF electronics to coherently drive multiple acousto-optic modulators (AOMs) for continuous, near-resonant Raman sideband cooling, far-off-resonant Raman transfer, and stimulated Raman adiabatic passage (STIRAP) for single-ion quantum measurements and quantum logic spectroscopy.

- Researched multiple molecular systems for optical cooling candidates by calculating molecular levels and transitions using LEVEL and rate-equation-simulating using Octave (MATLAB). Investigated the prospect of spin-orbit-split optical molecular cooling and continuous-wave fluorescence imaging of AlH^{+}. Estimated the hyperfine structure of AlH^{+} and proposed an optical hyperfine pumping scheme for the species.

Undergraduate Research Assistant May 2005 – September 2009
Department of Physics, California Polytechnic State University, San Luis Obispo, California

Research advisor: Robert S. Echols

- Worked with other group members to investigate thin-film bulk heterojunction-based solar cells under various fabrication parameters to boost power conversion efficiency. Construction included hazardous materials handling, thin film deposition techniques, metal cathode evaporation, and device testing in a dry, oxygen-free glove box environment.

Research advisor: Glenn D. Gillen

- Experimentally investigated a theoretical model for the propagation of clipped focused Gaussian (TEM_{00}) beams. Diagnosed and developed an optical system to correct an external cavity diode laser's output beam profile from elliptical ($M^2 = 1.2$) to Gaussian ($M^2 = 1.000$). Integrated multiple positioning and optical devices in the experiment to automate the apparatus using LabVIEW. Presented work through several talks.

Research advisor: Thomas J. Bensky

- Constructed a custom bathymetric light detection and ranging (LIDAR) system consisting of a pulsed Nd:YAG laser at the second harmonic with a single-photon detector and electronics

for remote detection and monitoring of sea floor and water-column boundary layer activity in Morro Bay, California. Integrated sensitive laboratory equipment into a harsh environment (ocean pier). Operated remotely operated underwater vehicle (ROV), verifying LIDAR measurements. Communicated scientific work at several research conferences.

Research advisor: Peter V. Schwartz

- Led a group research effort investigating selective, controllable, and reversible self-assembly of polystyrene latex microspheres via DNA hybridization. Prepared multiple experimental investigations, conducted carboxyl/amine surface chemistry, collected fluorescence-marked DNA density measurements using a flow cytometer, investigated increasing surface group density via carboxyl/amine chemistry in silica and polystyrene microspheres, researched swelling properties of polystyrene in various organic solvents, conducted data analysis, and oversaw experiment budget. Utilized hazardous chemicals and optical transmission microscope with imaging hardware/software. Articulated scientific work through several talks and posters.
- Internship at New York University, New York, NY, July 2006.

Sheet Metal Fabricator 2004 – 2009
MJB Precision Sheet Metal, Canoga Park, California

- Manufactured small-number precision prototypes involving operating heavy machinery including Strippit, press break, and shear; programming, maintenance, and operation of Strippit NC; performing quality control; and TIG welding. Handled materials included steel, stainless steel, brass, copper, aluminum, titanium, and exotic alloys.

Proposals and Funded Awards as PI

	Project	Funded?	Source	Duration (yr)	Funding ($)
5.	Trapped Ion g-factor Research of the Calcium Ion (TIgR-CI)	Y	LDRD*	1.5	271k
4.	Ion Trap AI/ML Quantum Performance & Routine Optimization (ITAQPRO)	Y	LDRD*	3	1.30M
3.	Cryogenic Ion Trap Engineering and Development (CITED)	Y	LDRD*	2.5	2.86M
2.	Quantum Simulations on Trapped-Ion Quantum Computers under the Quantum Science Center	Y	DOE NQI	5	3.65M
1.	Local qubit operations in global fields via potential modulation	Y	ARO/LPS	3	750k

* ORNL/DOE Laboratory Directed Research and Development

Professional Development

4. IOP Peer Review Excellence Training, virtual, April 2024.

3. Oak Ridge National Laboratory Dynamic Laboratory Space Manager Safety Training, Oak Ridge, TN, March 2024.

2. Battelle Laboratory Operation Supervisor Academy, Columbus, OH, July 2023.
    - Focus on leadership skills within the Battelle safety culture framework.

1. GTRI Project Management Workshop

Professional Awards and Honors

14. ORNL/UT-Battelle Supplemental Performance Award (SPA), September 2024.
    - For continued effort on establishing a trapped ion program at ORNL and for facilitating reestablishing connections with GTRI to address ongoing technical challenges. Recognized for exceeding expectations, rising above unforeseen challenges, and going the extra mile to advance our missions.

13. ORNL/UT-Battelle Supplemental Performance Award (SPA), December 2022.
    - Recognized for exceeding expectations, rising above unforeseen challenges, and going the extra mile to advance our missions.

12. GTRI Distinguished Performance Awards 2021, Best Paper Award, June 2022.
    - For Refereed Publication 8.

11. ORNL/UT-Battelle Computational Sciences & Engineering Division Outstanding Early Career Scientist Award, December 2021.
    - "For outstanding technical contributions to develop new ion trapping capabilities: Chris Seck leads a quantum science center project (approximately $3M) and two active LDRD's (over $2M) to give ORNL improved quantum simulation capability using trapped calcium ion qubits. One LDRD focuses on developing low noise cryo trap while the second seeks to develop ML techniques to make ion tap quantum simulator need less domain expert tuning with the goal of making them eventual edge compute resources."

10. ORNL/UT-Battelle Spot Award, Computational Sciences & Engineering Division, 2020.

9. ORNL/UT-Battelle Outstanding Scholarly Output Team Award, 2020.
    - "For exemplary performance in developing state-of-the-art quantum computing capability at ORNL. The ion-trap-based system, which is not commercially available, is

necessary to both support ongoing research at ORNL and to anchor the laboratory's future quantum information science programs. As a result, ORNL has its first matter-based quantum computer on site, joining a handful of elite institutions worldwide."

8. GTRI Team Award, March 2018.
    - Nominated by Alexa Harter, CIPHER Lab Director.
    - Observed behaviors: customer focus and support; initiative and "can do"; innovation and creativity; integrity; teamwork; and customer perspective (customer satisfaction).

7. National Science Foundation (NSF) Integrative Graduate Education and Research Traineeship (IGERT) Fellowship, September 2009 – August 2014.

6. Journal of Applied Physics B Molecular Spectroscopy Poster Prize, International Conference on Laser Spectroscopy (ICOLS) 2013, Berkeley, California, 2013.

5. Certificate of Excellence for Outstanding Academic Achievement, Department of Physics, California Polytechnic State University, San Luis Obispo, California, 2009.

4. Society of Physics Students President Recognition, College of Science and Mathematics, California Polytechnic State University, San Luis Obispo, California, 2009.

3. Outstanding Physics Major, College of Science and Mathematics, California Polytechnic State University, San Luis Obispo, California, 2009

2. Recognition of Exceptional Academic Achievement, College of Science and Mathematics, California Polytechnic State University, San Luis Obispo, California, 2009.

1. California Polytechnic State University Dean's List, California Polytechnic State University, San Luis Obispo, California, 2004 – 2009.

Other Awards and Honors

5. Autocross STS Class Champion, Sports Car Club of America (SCCA), Atlanta Region, 2019.

4. Autocross STS Class Champion, Sports Car Club of America (SCCA), Atlanta Region, 2018.

3. Upper A Winter 2018 Hockey League Champions, The Gentlemen, Atlanta Amateur Hockey Association, 2018.

2. Summer 2015 Hockey League Champions, CGHA Red Liners, American Heartland Ice Arena, 2015.

1. City of Agoura Hills, California Community Service Appreciation, 2004.

Refereed Publications

10. Tyler LeBlond, Justin G. Lietz, Christopher M. Seck, and Ryan S. Bennink, "TISCC: A Surface Code Compiler and Resource Estimator for Trapped-Ion Processors," SC-W '23: Proceedings of the SC '23 Workshops of The International Conference on High Performance Computing, Network, Storage, and Analysis, 1426–1435 (2023). Also available as arXiv preprint 2311.10687. DOI: 10.1145/3624062.3624214 (4 citations).

9. Ali Passian, Gilles Buchs, Christopher M. Seck, Alberto M. Marino, and Nicholas A. Peters, "The Concept of a Quantum Edge Simulator: Edge Computing and Sensing in the Quantum Era," *Sensors* **2023**, 23(1), 115 (2023). DOI: 10.3390/s23010115 (11 citations).

8. Craig R. Clark, Holly N. Tinkey, Brian C. Sawyer, Adam M. Meier, Karl A. Burkhardt, Christopher M. Seck, Christopher M. Shappert, Nicholas D. Guise, Curtis E. Volin, Spencer D. Fallek, Harley T. Hayden, Wade G. Rellergert, and Kenton R. Brown, "High-fidelity Bell-state preparation with $^{40}Ca^{+}$ optical qubits," *Physical Review Letters* **127**, 130505 (2021). Also, available as arXiv preprint 2105.05828. DOI: 10.1103/PhysRevLett.127.130505 (144 citations).

7. Holly N. Tinkey, Adam M. Meier, Craig R. Clark, Christopher M. Seck, and Kenton R. Brown, "Quantum process tomography of a Mølmer-Sørensen gate via a global beam," *Quantum Science and Technology* **6**, 034013 (2021). Also available as arXiv preprint 2101.04648. DOI: 10.1088/2058-9565/ac0543 (11 citations).

6. Christopher M. Seck, Adam M. Meier, J. True Merrill, Harley T. Hayden, Brian C. Sawyer, Curtis E. Volin, and Kenton R. Brown, "Single-ion addressing via trap potential modulation in global optical fields," *New Journal of Physics* **22**, 053024 (2020). Also available as arXiv preprint 1911.04543. DOI: 10.1088/1367-2630/ab8046 (9 citations).

5. Christopher M. Seck, Paul J. Martin, Eryn C. Cook, Brian C. Odom, and Daniel A. Steck, "Noise reduction of a Libbrecht—Hall style current driver," *Review of Scientific Instruments* **87,** 064703 (2016). Also available as arXiv preprint 1604.00374. DOI: 10.1063/1.4953330 (16 citations).

4. Christopher M. Seck, Mark G. Kokish, Matthew R. Dietrich, and Brian C. Odom, "Raman sideband cooling of a $^{138}Ba^{+}$ ion using a Zeeman interval," *Physical Review A* **93**, 053415 (2016). Also available as arXiv preprint 1603.09322. DOI: 10.1103/PhysRevA.93.053415 (12 citations).

3. Chien-Yu Lien, Christopher M. Seck, Yen-Wei Lin, Jason H.V. Nguyen, David A. Tabor, and Brian C. Odom, "Broadband optical cooling of molecular rotors from room temperature to the ground state," *Nature Communications* **5**, 4873 (2014). Also available as arXiv preprint 1402.3918. DOI: 10.1038/ncomms5783 (110 citations).

2. Christopher M. Seck, Edward G. Hohenstein, Chien-Yu Lien, Patrick R. Stollenwerk, and Brian C. Odom, "Rotational state analysis of AlH^{+} by two-photon dissociation," *Journal of Molecular Spectroscopy* **300**, 108 (2014). Also available as arXiv preprint 1402.0123. DOI: 10.1016/j.jms.2014.03.023 (34 citations).

1. Glen D. Gillen, Christopher M. Seck, and Shekhar Guha, "Analytical beam propagation model for clipped focused-Gaussian beams using vector diffraction theory," *Optics Express* **18**, 4023-4040 (2010). DOI: 10.1364/OE.18.004023 (30 citations).

Additional Publications

7. Travis S. Humble, Andrea Delgado, Raphael Pooser, Christopher Seck, Ryan Bennink, VicenteLeyton-Ortega, C.-C. Joseph Wang, Eugene Dumitrescu, Titus Morris, Kathleen Hamilton, DmitryLyakh, Prasanna Date, Yan Wang, Nicholas A. Peters, Katherine J. Evans, and Marcel Demarteau, "Snowmass White Paper: Quantum Computing Systems and Software for High-energy Physics Research," March 2022. Available as arXiv preprint 2203.07091 (conference proceeding, 17 citations).

6. Eugene Dumitrescu, Yan Wang, Ryan Bennink, Chris Seck, Raphael Pooser, and Lex Kemper, "The demand for programmable analog simulators," December 2021 (whitepaper).

5. Kathleen E. Hamilton, Dmitry Lyakh, Chris Seck, Andrea Delgado, Kevin Young, Timothy Proctor, and Nouamane Laanait, "Opportunities for Classical Machine Learning in Quantum Testbeds," December 2021 (whitepaper).

4. Eugene Dumitrescu, Yan Wang, Ryan Bennink, Christopher Seck, Raphael Pooser, and Lex Kemper, "The demand for programmable analog simulators," November 2021 (whitepaper).

3. Ryan Bennink, George Siopsis, Creston Herold, and Christopher Seck, "Scalable Characterization of Correlated Faults in Quantum Computing Architectures," January 2020 (whitepaper).

2. "Quantum state control of trapped atomic and molecular ions," Ph.D. Dissertation, Northwestern University, Evanston, Illinois (2016) (1 citation).

1. "Quantitative Effects of Apertures of Gaussian Beam Propagation Qualities," Undergraduate Thesis, California Polytechnic State University, San Luis Obispo (2009).

Conference Publications and Presentations

31. Christopher M. Seck, Gilles Buchs, and Jiafeng Cui, "ORNL Ion Trap Program Overview," 2024 North American Conference on Trapped Ions (NACTI), University of California Lo Angeles, Los Angeles, California, 13 August 2024 (abstract and poster).

30. Craig R. Clark, Creston D. Herold, James T. Merrill, Holly N. Tinkey, Wade G. Rellergert, Robert Clark, Wesley Robertson, Curtis E. Volin, Kara Maller, Christopher M. Shappert, Brian J. McMahon, Brian C. Sawyer, Christopher M. Seck, and Kenton R. Brown, "Characterization of Fast Ion Transport via Position-Dependent Optical Deshelving," 2021 Annual Meeting of the American Physical Society (APS) Division of Atomic, Molecular, and Optical Physics (DAMOP), Virtual, 4 June 2021, paper X10.00008. Published in *Bulletin of the American Physical Society* (talk).

29. Kenton R. Brown, Craig R. Clark, Holly N. Tinkey, Brian C. Sawyer, Karl A. Burkhardt, Adam M. Meier, Christopher M. Seck, Christopher M. Shappert, Nicholas D. Guise, Harley T. Hayden,

Wade G. Rellergert, and Curtis E. Volin, "Demonstration of a Wavelength-Insensitive Entangling Gate for Group-2 Atomic Ions," 2021 APS DAMOP, Virtual, 3 June 2021, paper Q09.00005. Published in *Bulletin of the American Physical Society* (talk).

28. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Ion-trap Potential Modulation as an Optical Phase Control," 2019 Army Research Office (ARO) Quantum Computing Program Review (QCPR), Annapolis, Maryland, 2 August 2019 (poster).

27. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Ion-trap Potential Modulation as an Optical Phase Control," 2019 ARO QCPR, Annapolis, Maryland, 2 August 2019 (invited talk).

26. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Ion-trap Potential Modulation as an Optical Phase Control," 2019 North American Conference on Trapped Ions (NACTI), University of Maryland, College Park, Maryland, 23 July 2019 (abstract and poster).

25. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Single ion addressing via potential modulation (SIAPM)," Seminar, Honeywell Quantum Solutions, Broomfield, Colorado, 12 July 2019 (invited talk).

24. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Single ion addressing via potential modulation (SIAPM)," Quantum Information Science Group Seminar, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 27 June 2019 (invited talk).

23. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Ion-trap Potential Modulation as an Optical Phase Control," 2018 ARO QCPR, Denver, Colorado, 3 August 2018 (poster).

22. Christopher M. Seck, Adam M. Meier, J. True Merrill, Brian C. Sawyer, and Kenton R. Brown, "Ion-trap Potential Modulation as an Optical Phase Control," 2018 ARO QCPR, Denver, Colorado, 3 August 2018 (invited talk).

21. Christopher M. Seck, Mark Kokish, Matthew Dietrich, and Brian C. Odom, "Raman sideband cooling of $^{138}Ba^{+}$ on a Zeeman transition," 2016 APS DAMOP, Providence, Rhode Island, 26 May 2016, paper Q1.00186. Published in *Bulletin of the American Physical Society* (poster).

20. Christopher M. Seck and Brian C. Odom, "Recent developments in trapped molecular ion technology at Northwestern," Midwestern Cold Atom Workshop (MCAW), University of Wisconsin, Madison, Wisconsin, 14 November 2015 (talk).

19. Christopher M. Seck, Mark Kokish, Matthew Dietrich, and Brian C. Odom, "Toward quantum logic spectroscopy of a rotationally cold molecular ion," 2015 MCAW, University of Wisconsin, Madison, Wisconsin, 14 November 2015 (poster).

18. Mark Kokish, Christopher M. Seck, Matthew Dietrich, and Brian C. Odom, "Toward Quantum Logic Spectroscopy of Molecular Ions," 2015 APS DAMOP, Columbus, Ohio, 8–12 June 2015, paper U3.00009. Published in *Bulletin of the American Physical Society* (poster).

17. Christopher M. Seck, Mark Kokish, Matthew Dietrich, and Brian C. Odom, "Quantum Logic Spectroscopy of State Prepared AlH^+: Current Progress," 2015 APS DAMOP, Columbus, Ohio, 8–12 June 2015, paper Q1.00022. Published in *Bulletin of the American Physical Society* (poster).

16. Christopher M. Seck and Brian C. Odom, "Broadband rotational optical cooling of AlH+ to the rotational ground state," SPIE Photonics West, San Francisco, California, 7 – 12 February 2015, presentation 9378-8 (invited talk).

15. Christopher M. Seck, Matthew R. Dietrich, Mark G. Kokish, Chien-Yu Lien, and Brian C. Odom, "Broadband Rotational Cooling of Molecular Rotors to the Ground State," 2014 MCAW, Argonne National Laboratory, Lemont, Illinois, 14–15 November 2014 (poster).

14. Christopher M. Seck, Chien-Yu Lien, and Brian C. Odom, "Broadband Optical Cooling of AlH^+ to the Rotational Ground State," 69th International Symposium on Molecular Spectroscopy (ISMS), University of Illinois Urbana-Champaign, Champaign-Urbana, Illinois, 19 June 2014 (talk). Published in *Proceedings of the International Symposium on Molecular Spectroscopy* (talk).

13. Chien-Yu Lien, Christopher M. Seck, and Brian C. Odom, "Optical cooling of AlH^+ to the rotational ground state," 2014 APS DAMOP, Madison, Wisconsin, 2–6 June 2014, paper D1.00037. Published in *Bulletin of the American Physical Society* (poster).

12. Christopher M. Seck, Chien-Yu Lien, and Brian C. Odom, "Internal Cooling of AlH+ Using Optical Pulse-shaping," 2013 MCAW, Purdue University, West Lafayette, Indiana, 16 November 2013 (poster).

11. Christopher M. Seck, Chien-Yu Lien, and Brian C. Odom, "Optical pulse-shaping for internal cooling of AlH^+," 21^{st} International Conference on Laser Spectroscopy (ICOLS), Berkeley, California, 9–14 June 2013 (poster).

10. Chien-Yu Lien, Christopher M. Seck, Scott R. Williams, and Brian C. Odom, "Optical pulse-shaping for internal cooling of molecules," 2012 MCAW, University of Illinois Urbana-Champaign, Champaign-Urbana, Illinois, 3 November 2012 (poster).

9. Chien-Yu Lien, Christopher M. Seck, Scott R. Williams, and Brian C. Odom, "Optical pulse-shaping for internal cooling of molecules," 2012 APS DAMOP, Orange County, California, 4–8 June 2012, paper K1.00094. Published in *Bulletin of the American Physical Society* (poster).

8. David A. Tabor, Jason H.V. Nguyen, Christopher M. Seck, Chien-Yu Lien, Marc Bourgeois, Scott R. Williams, and Brian C. Odom, "Towards Doppler Cooling of SiO^+ and Internal Cooling of AlH^+," 2011 MCAW, Northwestern University, Evanston, Illinois, 4–5 November 2011 (poster).

7. Vaishnavi Rajagopal, Joan P. Marler, Lauren C. Ruth, Christopher M. Seck, and Brian C. Odom, "Toward internal cooling of trapped molecular ions using a spin-orbit split ground state," 2011 APS DAMOP, Atlanta, Georgia, 13–17 June 2011, paper Q1.00015. Published in *Bulletin of the American Physical Society* (poster).

6. Chien-Yu Lien, Yen-Wei Lin, Joan P. Marler, Jason H.V. Nguyen, Vaishnavi Rajagopal, Christopher M. Seck, David A. Tabor, and Brian C. Odom, "Cooling of Molecular Ions," 2010 MCAW, University of Michigan, Ann Arbor, Michigan, 13 November 2010 (poster).

5. Joan P. Marler, Jason H.V. Nguyen, Chien-Yu Lien, Yen-Wei Lin, Vaishnavi Rajagopal, Christopher M. Seck, David A. Tabor, and Brian C. Odom, "Internal State Cooling of Molecular Ions," 1st European Conference on Trapped Ions (ECTI), Redworth, County Durham, United Kingdom, 19–24 September 2010 (poster).

4. Joan P. Marler, Jason H.V. Nguyen, Chien-Yu Lien, Yen-Wei Lin, Vaishnavi Rajagopal, Christopher M. Seck, David A. Tabor, Greg McGlynn, Lauren C. Ruth, and Brian C. Odom, "Towards Trapping of Ba Ions for Heavy Molecule Spectroscopy," 2010 APS DAMOP, Houston, Texas, 25–29 May 2010, paper E1.00137. Published in *Bulletin of the American Physical Society* (poster).

3. Chien-Yu Lien, Yen-Wei Lin, Joan P. Marler, Greg McGlynn, Jason H.V. Nguyen, Vaishnavi Rajagopal, Lauren C. Ruth, Christopher M. Seck, David A. Tabor, Scott R. Williams, and Brian C. Odom, "Towards Trapping of Barium Ions for Heavy Molecule Quantum Logic Spectroscopy," 2009 MCAW, University of Chicago, Chicago, Illinois, 21 November 2009 (poster).

2. Thomas J. Bensky, Christopher M. Seck, and Derek Smith, "High Resolution Bathymetric LIDAR Measurements at San Luis Obispo Bay, CA," 2007 Fall Meeting of the American Geophysical Union (AGU), San Francisco, California, 10–14 December 2007, paper OS41A-0167. Published in *Eos, Transactions American Geophysical Union* (poster).

1. Christopher M. Seck, Derek Smith, and Thomas J. Bensky, "High Resolution Bathymetric LIDAR Measurements at San Luis Obispo Bay, CA," 2007 California APS Meeting, Lawrence Berkeley National Laboratory, Berkeley, California, 26–27 October 2007 (talk).

Additional Presentations

21. Christopher M. Seck, Gilles Buchs, and Jiafeng Cui, "ORNL Ion Trap Program Overview," Quantum Science Center All-hands Meeting, 7 May 2024 (poster).

20. Christopher M. Seck, Gilles Buchs, and Jiafeng Cui, "ORNL Ion Trap Program Overview," Quantum on the Quad, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1 November 2023 (poster).

19. Christopher M. Seck, Gilles Buchs, John Comish, Jiafeng Cui, Robby Hicks, Gary Lynn, Nicholas Peters, Raphael Pooser, and Christopher Redmon, "Cryogenic Ion Trap Engineering & Development (CITED)," LDRD Poster Fair, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 27 September 2023 (poster).

18. "Single ion addressing via potential modulation (SIAPM)," Sandia National Laboratory Collaboration Workshop, Georgia Institute of Technology, Atlanta, Georgia, 18 June 2019 (talk).

17. “Novel Individual Ion Addressing,” Georgia Tech Quantum Faculty Workshop, Georgia Institute of Technology, Atlanta, Georgia, 25 January 2019 (talk).

16. “Building the foundation for quantum logic spectroscopy at Northwestern University,” Seminar, National Institute of Standards and Technology, Boulder, Colorado, 17 May 2016 (talk).

15. “Building the foundation for quantum logic spectroscopy at Northwestern University,” Seminar, Georgia Institute of Technology, Atlanta, Georgia, 28 April 2016 (talk).

14. “Building the foundation for quantum logic spectroscopy at Northwestern University,” Seminar, Sandia National Laboratory, Albuquerque, New Mexico, 26 April 2016 (talk).

13. “Quantum State Control of Trapped Atomic and Molecular Ions,” Ph.D. Defense, Northwestern University, Evanston, Illinois, 12 July 2016 (talk).

12. “AlH^+ CW Fluorescence Imaging,” Ph.D. Prospectus, Northwestern University, Evanston, Illinois, 28 May 2013 (talk).

11. “Progress Toward AlH^+ Cooling and Fluorescence Imaging,” Integrative Graduate Education and Research Traineeship (IGERT) Seminar, Northwestern University, Evanston, Illinois, 8 May 2013 (talk).

10. “Rovibrational Cooling of AlH^+: Scheme and Current Progress,” IGERT Seminar, Northwestern University, Evanston, Illinois, 9 May 2012 (talk).

9. David A. Tabor, Christopher M. Seck, and Brian C. Odom, “Towards Doppler Cooling of SiO^+ and Internal Cooling of AlH^+,” presented at IGERT poster session, Northwestern University, Evanston, Illinois, 25 May 2011 (poster).

8. “Resonant 2-photon Photoionization of Barium with In-house Diode Laser System,” IGERT Seminar, Northwestern University, Evanston, Illinois, 26 January 2011 (talk).

7. “State-of-the-art in Molecular Internal Cooling/ Status of Diode Laser Construction,” IGERT Seminar, Northwestern University, Evanston, Illinois, 19 May 2010 (talk).

6. Christopher M. Seck, Steven A. Hawks, and Robert S. Echols, “Optimization of Organic Solar Cell Performance Using Toluene/THF as the Active Layer Solvent,” College of Science and Mathematics Research (COSAM) Conference, California Polytechnic State University, San Luis Obispo, California 16 May 2009 (poster).

5. Christopher M. Seck and Glen D. Gillen, “Quantitative Effects of Apertures on Gaussian Beam Propagation,” COSAM Research Conference, California Polytechnic State University, San Luis Obispo, California, 16 May 2009 (talk).

4. Christopher M. Seck and Glen D. Gillen, “Quantitative Effects of Apertures on Gaussian Beam Quality,” Physics Department Colloquium, California Polytechnic State University, San Luis Obispo, California, 12 December 2008 (talk).

3. Christopher M. Seck, Derek Smith, and Thomas J. Bensky, “High Resolution Bathymetric LIDAR Measurements at San Luis Obispo Bay, CA,” Physics Department Colloquium, California Polytechnic State University, San Luis Obispo, California, 6 November 2007 (talk).

2. Christopher M. Seck, Amber J. Bowen, Michael Fischer, and Peter V. Schwartz, “Microspheres, DNA Guided Aggregation, Surface Modification Through Carboxyl Dendrimers,” Soft Condensed Matter Colloquium, University of California, Santa Barbara, California, 14 July, 2006 (talk).

1. Christopher M. Seck, Amber J. Bowen, Michael Fischer, G. Tucker, B. Brasseur, B. Anthony, David J. Pine, and Peter V. Schwartz, “Selective, Controllable, and Reversible Aggregation of Polystyrene Latex Microspheres via DNA Hybridization,” COSAM Research Conference, California Polytechnic State University, San Luis Obispo, California, 18 May 2006 (poster).

Workshop Contributions

2. Quantum Sensing for PNT Use Cases Workshop, The Quantum Economic Development Consortium, May 2024.

1. DOE Quantum Computing Testbeds Stakeholder Workshop (QCTSW), December 2021.

Community Involvement

- Member, Institute of Electrical and Electronics Engineers (IEEE) 2023 – present
- Member, American Motorcycle Association (AMA) 2017 – present
- Member, American Physical Society (APS) 2011 – present
- Member, Sports Car Club of America (SCCA) 2017 – present
- Member, The International Society for Optics and Photonics (SPIE) 2015 – present
- Member, Optica (Formerly The Optical Society [OSA]) 2015 – present
- Member, Society of Physics Students (SPS) 2004 – 2009

Community Service & Workshop Participation

2. Breakout Session Scribe, Quantum on the Quad, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1 November 2023.

1. Breakout Session Host, DOE Quantum Computing Testbeds Stakeholder Workshop (QCTSW), December 15, 2021.

Additional Leadership Experience

Team Captain September 2014 – September 2016

CGHA Red Liners, American Heartland recreational hockey team, Chicago, Illinois

- Managed more than 25 team players including game rosters and setting lines for weekly games.
- Addressed conflicts proactively to maintain a healthy learning environment and positive team atmosphere resulting in league championship from last place over two 10-week seasons.

Chapter President June 2008 – July 2009

Society of Physics Students (SPS), California Polytechnic State University, San Luis Obispo, California

- Represented the physics student body to the department staff and faculty.
- Interviewed prospective new faculty providing the department with valuably student-body feedback.

Teaching

Northwestern University

Department of Physics & Astronomy, Northwestern University, Evanston, Illinois

Academic Year 2012 – 13: General Physics Laboratory instructor (PHYS 135-3, Winter 2012).

- Instructed multiple hands-on laboratory sections in the non-Calculus-based physics series to a total of 34 students. Tasks included preparation of and defining course metrics and objectives, lectures on class topics, preparation of weekly quizzes, overseeing and assisting students with lab tasks, grading reports, and holding office hours for both laboratory and lecture discussion.
- Topics included waves, optics, interference and diffraction, and the electron charge-to-mass ratio.

Students mentored (graduate):

3. Pinrui Shen (February 2016 – August 2016)
2. Mark Kokish (October 2015 – September 2016)
1. Patrick Collins (July 2012 – January 2013)

Students mentored (post baccalaureate):

1. Joseph Samaniego-Evans (January 2014 – April 2014)

Students mentored (undergraduate):

3. Michelle Lis (August 2012 – December 2012)
2. Shaival Vipul Buch (May 2011 – August 2011)
1. Mason Marshall (June 2010 – September 2010)

Skills

Technical

Ultra-high vacuum (UHV) systems
Ion traps (macroscopic and surface)
Spectroscopy (Raman, EIT, quadrupole)
National Instruments PXI(e) platforms
Positioning devices and actuators
Single-board Computers (Raspberry Pi 4)
Analog, digital, high-voltage, and RF electronics
Precision machining
Data and error analysis
Monte Carlo methods
Software Defined Radios (SDRs)

Laser systems

Diode (unstabilized and external cavity)
Tapered amplifier
Solid state (vanadate and Ti:sapphire)
Femtosecond Ti:sapphire and pulse-shaping
High-power pulsed including Nd:YAG and dye
Ultra-narrow linewidth

Optics

UV, visible, and NIR
Polarization
Electro-, acousto-, and free-space optics
Optical fiber (SM, MM, PM, and PC)
Imaging systems
Cameras (EMCCD, CCD, CMOS)
Detectors (diode, avalanche diode, PMT)
Nonlinear optics and resonant optical cavities

Technical software

MATLAB and Octave
Maple
Mathematica
Python and Jupyter
Autodesk
LabVIEW
IGOR
Zeemax
LEVEL
BCONT
Origin
QtiPlot
Cadsoft EAGLE
PSpice/LTspice
Altium
Visual Studio Code

Computer software

Microsoft Office Suite
AutoDesk
Linux (Debian, Raspberry Pi OS, Ubuntu, WSL)
Adobe Illustrator
Unity

24 September 2024