

R. Tyler Sutherland

Position **Principal Theoretical Scientist**

Contact **Phone:** (256) 684-3640
E-mail: tyler.sutherland@oxionics.com

Oxford Ionics
Unit 1, Oxford Technology Park, Technology Drive
Kidlington OX5 1GN, United Kingdom

Education **Purdue University**, West Lafayette, Indiana
Ph.D. in Physics, 2017
Advisor: Francis Robicheaux
Thesis: Coherent Radiation in Atomic Systems
Auburn University, Auburn, Alabama
B.S. in Physics, 2014
Summa cum Laude

- Publications**
- **Sutherland R. T.**, Erickson S. D. (2024) Passive dynamical decoupling of trapped-ion qubits and qudits. *Phys. Rev. A* **109**, 022620.
 - **Sutherland R. T.**, Foss-Feig M. (2023) Laser-free trapped ion entangling gates with AESE: Adiabatic Elimination of Spin-motion Entanglement. *New Journal of Physics* **26**, 013013.
 - **Sutherland R. T.**, Allcock D. T. C., Srinivas R. (2023) Individual addressing of trapped ion qubits with geometric phase gates. *Physical Review A* **107**, 032604.
 - Băzăvan O., Saner S., Minder M., Hughes A. C., **Sutherland R. T.**, Lucas D. M., Srinivas R., Ballance C. J. (2023) Synthesizing a $\hat{\sigma}_z$ spin-dependent force for optical, metastable, and ground-state trapped-ion qubits. *Physical Review A* **107**, 022617.
 - **Sutherland R. T.**, Yu Q., Beck K. M., Häffner H. (2022) One- and two-qubit gate infidelities due to motional errors in trapped ions and electrons. *Physical Review A* **105**, 022437.
 - Yu Q., Alonso A. M., Caminiti C., Beck K. M., **Sutherland R. T.**, Leibfried D., Rodriguez K. J., Madhav D., Hemmerling B., Häffner H. (2022) Feasibility study of quantum computing using trapped electrons. *Physical Review A* **105**, 022420.
 - G. Ferioli, Glicenstein A., Robicheaux F., **Sutherland R. T.**, Browaeys A., Ferrier-Barbut I. (2021) Laser driven superradiant ensembles of two-level atoms near Dicke's regime. *Physical Review Letters* **127**, 243602.
 - **Sutherland R. T.**, Srinivas R. (2021) Universal hybrid quantum computing in trapped ions. *Physical Review A* **104**, 032609.
 - **Sutherland R. T.**, Burd S. C., Slichter D. H., Libby S. B., Leibfried D. (2021) Motional squeezing for trapped ion transport and separation. *Physical Review Letters* **127**, 083201.
 - Srinivas R., Burd S. C., Knaack H. M., **Sutherland R. T.**, Kwiatkowski, A., Glancy S., Knill E., Wineland D. J., Wilson A. C., Allcock D. T. C., Slichter D. H. (2021) High-fidelity laser-free universal control of trapped ion qubits. *Nature* **597**, 209-213.
 - **Sutherland R. T.**, Srinivas R., Burd S. C., Leibfried D., Wilson A. C., H.M. Knaack, Wineland D. J., Allcock D. T. C., Slichter D. H., Libby S. B. (2019) Laser-free trapped-ion entangling gates with simultaneous insensitivity to qubit and motional decoherence. *Physical Review A* **101**, 042334.
 - Robicheaux F., **Sutherland R. T.** (2020) Photon scattering from a cold, Gaussian atom cloud. *Physical Review A* **101**, 013805.
 - **Sutherland R. T.** (2019) Analog quantum simulation of superradiance and subradiance in trapped-ions. *Physical Review A* **100**, 061405. *Rapid Communication*

- Srinivas R., Burd S. C., **Sutherland R. T.**, Wilson A. C., Wineland D. J., Liebfried D., Allcock D. T. C., Slichter D. H. (2019). Trapped-ion spin-motion coupling with microwaves and a near-motional oscillating magnetic field gradient. *Physical Review Letters* **122**, 163201.
Editors Suggestion
- **Sutherland R. T.**, Srinivas R., Burd S. C., Liebfried D., Wilson A. C., Wineland D. J., Allcock D. T. C., Slichter D. H., Libby S. B. (2019). Versatile laser-free trapped-ion entangling gates. *New Journal of Physics* **21**, 033033.
- **Sutherland R. T.**, Robicheaux F. (2017). Degenerate Zeeman ground states in the single-excitation regime. *Physical Review A* **96**, 053840.
- **Sutherland R. T.**, Robicheaux F. (2017). Superradiance in inverted multilevel atomic clouds. *Physical Review A* **95**, 033839.
- **Sutherland R. T.**, Robicheaux F. (2016). Collective dipole-dipole interactions in an atomic array. *Physical Review A* **94**, 013847.
- **Sutherland R. T.**, Robicheaux F. (2016). Coherent forward broadening in cold atom clouds. *Physical Review A* **93**, 023407.

Patents

- **Sutherland R. T.** (2019). Intrinsic dynamically decoupled gates. U.S. Patent Application 16/783875.
- **Sutherland R. T.** (2023). Transport assisted geometric phase gate using a static magnetic field gradient. U.S. Patent Application 18/449967.
- **Sutherland R. T.**, Foss-Feig M. (2023). Rapid adiabatic passage to magnetic field sensitive states for adiabatic elimination of spin-motion coupling in waveless geometric phase gates. U.S. Patent Application 63/487076.
- **Sutherland R. T.**, Burton W.C., Gilbreth C.N., Madjarov I., Fabrikant M., Lauria P.L. (2023). Phonon adiabatic rapid passage:phARP. U.S. Patent Application 63/513379 and 63/589433.
- **Sutherland R. T.** (2023). Eliminating linear dependence of 0G clock state frequency on Bz using a microwave dressing field. U.S. Patent Application 63/581017.
- **Sutherland R. T.**, Erickson S.D. (2023). Temporarily changing the quantization field of a trapped ion chain using an integrated circuit. U.S. Patent Application 63/525300.
- **Sutherland R. T.** (2023). Laser-free one qubit gate using a microwave dressing field. U.S. Patent Application 63/581019.
- **Sutherland R. T.** (2023). Passive dynamical decoupling. U.S. Patent Application 63/600861.
- **Sutherland R. T.** (2024). Mode engineering for quantum logic spectroscopy 63/174460.
- **Sutherland R. T.** (2024). Quantum object shelving using adiaatic rapid passage 63/624428.
- **Sutherland R. T.** (2024). Frequency selected shelving in low quantization fields using microwave dressing fields 63/635228.

Google Scholar:

https://scholar.google.com/citations?user=leoyPoAAAAJ&hl=en&user=leoyP_oAAAAJ

Awarded Grants

Quantum computing with trapped electrons (2021) - joint proposal with UC Berkeley Ion Trap Group, Berkeley, CA.

- **Agency:** Lawrence Livermore National Laboratory LDRD
- **Result:** \$125,000 - 1 year

All-electronic ion qubits (2019) - joint proposal with NIST Ion Storage Group, Boulder, CO.

- **Agency:** U.S. Army Research Office
- **Result:** \$1,000,000/year - 3 years

Research Experience

Atomic Molecular and Optical Theory Group Leader, Quantinuum, 2022 - present

Assistant Professor, Electrical and Computer Engineering/Physics and Astronomy Departments, The University of Texas at San Antonio, 2020 - present

Research Scientist, Physics Division, Theory and Modeling Group, Lawrence Livermore National Lab, 2020

Postdoctoral Researcher, Physics Division, Theory and Modeling Group, Lawrence Livermore National Lab, 2017 - 2020

Graduate Research Assistant, Robicheaux Group, Purdue University Physics and Astronomy, 2014 - 2017

Undergraduate Research Assistant, Loch Group, Auburn University College of Sciences and Mathematics, 2012-2014

REU Intern, Smith Group, Harvard-Smithsonian Center for Astrophysics, Summer 2013

Presentations

- March, 2024. “Indirect cooling of trapped ions through phonon rapid adiabatic passage”. **Invited talk**, APS March Meeting, Minneapolis, MN.
- November, 2023. “Cooling trapped ions with phonon rapid adiabatic passage: phRAP”. **Invited talk**, Stony Brook, NY.
- June, 2023. “Individual addressing of trapped ion qubits with geometric phase gates”. Oral presentation, DAMOP, Spokane, WA.
- January, 2022. “Trapped ion quantum computing with microwaves”. **Invited talk**, ICONIQ workshop, Imperial College, London, UK.
- October, 2021. “Panel: Convergence of machine learning and quantum computing”. Moderator, AI and quantum computing symposium, Columbia, MD.
- October, 2021. “Panel: Quantum computing Today”. Panelist, AI and quantum computing symposium, Columbia, MD.
- June, 2021. “Motional squeezing for trapped ion transport and separation”. Virtual oral presentation, DAMOP.
- June, 2021. “Non-linear trapped-ion spin-motion coupling with orthogonal geometric phase gates”. Virtual poster presentation, DAMOP.
- September, 2020. “Improving how we use quantum computing platforms”. **Invited talk** (virtual), Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.
- June, 2020. “Analog quantum simulation of superradiance and subradiance in trapped ions”. Virtual Oral presentation, DAMOP, Portland, OR.
- June, 2020. “Laser-free trapped-ion entangling gates with simultaneous insensitivity to qubit and motional decoherence”. Poster presentation, DAMOP, Portland, OR.
- February, 2020. “Trapped-ion entangling gates that are insensitive to qubit and motional decoherence”. Poster presentation, Southwest Quantum Information and Technology Workshop, Eugene, OR. (Poster award)
- July, 2019. “Trapped-ion entangling gates that are insensitive to qubit and motional decoherence”. Poster presentation, Annual LPS conference, Annapolis, MD.
- July, 2019. “Trapped-ion entangling gates that are insensitive to qubit and motional decoherence”. Poster presentation, NACTI, College Park, MD.
- May, 2019. “Trapped-ion entangling gates that are insensitive to qubit and motional decoherence”. Poster presentation, DAMOP, Milwaukee, WI.
- May, 2019. “Versatile laser-free trapped-ion entangling gates”. Oral presentation, DAMOP, Milwaukee, WI.
- September, 2018. “Keeping Livermore’s ion quantum computing”. Oral presentation, LLNL Research Slam, Livermore, CA.
- June, 2018. “Microwave-driven entangling gates in the bichromatic interaction picture”. Poster presentation, Annual LPS conference, Denver, CO.
- June 7, 2017. “Superradiance in Inverted Multi-level Atomic Clouds”. Oral presentation, DAMOP, Sacramento, CA.
- September 2016. “Collective Photon Scattering in Atomic Ensembles”. Poster presentation,

Physique Mésoscopique des Ondes pour Imagerie en Milieux Complexes, Corsica, France.

- October 2016. “Collective Photon Scattering in Atomic Arrays and Clouds”. Poster presentation, MCAW, Chicago IL.
- June 2016. “Collective Photon Scattering in Atomic Arrays and Clouds”. Poster presentation, DAMOP, Providence RI.
- November 2015. “Superradiance in the Single Photon Regime”. Poster presentation, MCAW, Madison WI.
- October 2015. “Superradiance in the Single Photon Regime”. Poster presentation, PQC Kickoff Workshop, West Lafayette IN.

Teaching Experience

Past Students

- Master’s advisor, Gabriel Maldonado (UTSA 2020)

Courses Taught

- Spring 2022, Introduction to machine learning (UTSA, EE-3533)
- Fall 2021, Quantum Mechanics II (UTSA, PHY-4423)
- Spring 2021, Electromagnetic engineering (UTSA, EE-3213)

TA Experience

- Summer 2014, Laboratory Teaching Assistant (Purdue University, PHYS 172).
- Fall 2013, Laboratory Teaching Assistant (Auburn University, PHYS 1610)
- Spring 2013, Laboratory Teaching Assistant (Auburn University, PHYS 1600)
- Fall 2012, Laboratory Teaching Assistant (Auburn University, PHYS 1500)

Awards

Auburn University Physics Senior of the Year
Auburn University Physics Junior of the Year
Phi Kappa Phi Honor Society
Auburn University Dean’s List (all semesters)
Barry M. Goldwater Scholarship (Honorable Mention)
Auburn University University Founder’s Scholar (Full Tuition)
Auburn University College of Sciences and Mathematics Research Fellowship

Leadership Experience

Quantinum AMO theory group leader 2022-present
UTSA Electrical and Computer Engineering, Faculty Evaluation Committee Member
UTSA Physics and Astronomy, Quantum Group Leader
Graduate Student Association Representative 2015
Auburn University Society of Physics Students, President (2013-2014)
Loachapoka Elementary Outreach Program, Founder/Organizer (2013-2014)
Auburn University Undergraduate Research Board (2013-2014)

Programming Languages

C/C++, Fortran 95/2003, Python, Mathematica, Tensorflow