Nathan Kenneth Lysne

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EDUCATION

PhD, Physics 2013 – 2020
The University of Arizona, Tucson AZ
Advisor - Dr. Poul S Jessen
Thesis - *Sensitivity to imperfections of analog quantum simulation on atomic qudits*

BA, Physics 2007 – 2011
Carleton College, Northfield MN
Advisors - Dr. Joel Weisberg, Dr. Elizabeth Martha Baylor
Thesis - *Branching out: on the relationship between physics and biology as investigated through trees*
Honors - *Graduated with distinction (thesis exercises), Sigma Xi*

RESEARCH POSITIONS

Postdoctoral Research Associate 2020 – *Present*
2-D Ion Arrays in Surface-Electrode Traps
National Institute of Standards and Technology, Boulder CO
Principal Investigators - Dr. Dietrich Leibfried, Dr. Daniel H Slichter

- Developed new toolbox for control of multiple individually-trapped ions in 2-D surface trap arrays including the integration of ionic micromotion as a control resource
- Demonstrated control over individually trapped ions in a 2-D array to the level of a single shared motional quantum
- Performed complete redesign of control system software using ARTIQ and assembled new hardware to improve its capabilities

Graduate Research Associate 2014 – 2020
Quantum Tomography and Simulation with Cold-Atom Qudits
The University of Arizona, Tucson AZ
Research Advisor - Dr. Poul S Jessen

- Designed optimal control techniques for quantum control of d-dimensional quantum systems and implemented them on an ultracold atom testbed resulting in the highest-fidelity arbitrary SU(16) operations reported to date
- Developed laser, rf & μw systems to precisely control atomic spins of ultracold neutral atoms
- Utilized high-performance computing resources for modeling, design, and analysis

Undergraduate Research Assistant 2010
LIGO Stochastic Pipeline Analysis
Carleton College, Northfield MN
Research Advisor - Dr. Nelson Christensen

- Analyzed LIGO interferometer data to identify noise channels for screening candidate gravity wave signals

Undergraduate Research Assistant 2009
Friction-Assisted Quantum Tunneling
Carleton College, Northfield MN
Research Advisor - Dr. Arjendu Pattanayak

- Modeled open quantum systems to study the effects of environmental coupling on quantum phenomena such as tunneling

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FELLOWSHIPS

Research Faculty Fellow, *NIST Professional Research Experience Program (PREP)*

- Awarded by the University of Colorado Boulder 2020 – *Present*

TEACHING & CURRICULUM DEVELOPMENT

Instructor of Record 2015 – 2019
LASC&SCI 397B&C, 'Entering Research I&II'
The University of Arizona, Tucson AZ

- Facilitated small group learner-centered discussion of research experiences to foster reflection and deepen investment
- Developed curriculum to scaffold professional development for underrepresented and non-traditional students
- Piloted and workshopped lessons for second edition of *Entering Research: A Curriculum to Support Undergraduate & Graduate Research Trainees* (L Branchaw *et al*, 2019)

Member, Faculty Learning Circle Fall 2019
The University of Arizona, Tucson AZ

- Worked with faculty peers to develop and refine specific activites and areas of concerns in undergraduate coursework

Graduate Teaching Assistant, Lecturer Spring 2014
PHYS 102, 'Intro to Physics'
The University of Arizona, Tucson AZ

- Lectured general education course in introductory mechanics to 150 non-majors
- Integrated modern pair-sharing and active learning activities into curriculum to increase engagement and solidify understanding
- Engaged with students in one-on-one and small group problem solving sessions

Graduate Teaching Assistant, Lab Instructor Fall 2013
PHYS 141L, 'Introductory Mechanics'
The University of Arizona, Tucson AZ

- Created new materials to aid students in honing their scientific and argumentative writing
- Focused prescribed laboratory activities around evidential reasoning

Assistant Language Teacher 2011 – 2013
Amakusa City Board of Education, Amakusa Kumamoto JPN

- Led and assisted EFL classes at public middle and elementary schools
- Developed lesson plans to engage learners across a wide range of capabilities
- Presented teaching methods at prefectural professional development conferences for educators as a member of the Japan Exchange and Teaching (JET) Programme

Student Training Supervisor 2010 – 2011
Carleton College Information Technology Services, Northfield MN
- Created and implemented training sequence for 50 student employees on technical communication and troubleshooting

Teaching Assistant Spring 2011
PHYS 235, 'Electricity & Magnetism'
CS 321, 'Artificial Intelligence'
Carleton College, Northfield MN

SERVICE & OUTREACH

Referee for Nature Communications

Organizer, NIST/NICT Virtual Seminar 2022 – 2023
National Institute of Standards and Technology, Boulder CO
- Co-organized seminar series to exchange research progress and ideas on quantum information science research between standards laboratories in the US and Japan

Session Chair, 54th APS DAMOP Meeting Jun 2023
The American Physical Society, Spokane WA
- Conducted Session Q10: *Advances in Quantum Gates*

Pen Pal, Letters to a Pre-Scientist 2023 – *Present*
Letters to a Pre-Scientist, Boulder CO
- Built personal connection through exchange of letters with US middle school students to explore interest and worries about future scientific careers

Outreach Coordinator, UA Women in Physics 2014 – 2016
The University of Arizona, Tucson AZ
- Elected position responsible for coordinating public outreach
- Pursued recurring engagement with underserved student populations in Tucson
- Authored hands-on demonstrations for on- and off-campus visits

REU Student Mentor, NSF Research in Optics REU Program 2014 – 2016
The University of Arizona, Tucson AZ
- Designed and supervised research programs for three undergraduate students working with the Jessen QuIC lab through this NSF REU program

Legislative Policy Advocate 2015 – 2016
The American Physical Society, Tucson AZ
- Worked with congressional outreach experts in the APS and with local congressional staff of the chair of the House Committee on Natural Resources to recommend policy solutions to address the national helium crisis

Mentor, Technical Consultant, Racing the Sun 2013 – 2015
Tech Parks Arizona, Tucson AZ
- Technical advisor for electronic design of solar-powered go-karts
- Created workshops on basic electronic design for high-school students

Outreach Presenter, Tucson Festival of Books - Science City 2014 – 2017
The University of Arizona, Tucson AZ

Graduate Student Mentor, Physics Department 2014 – 2020
The University of Arizona, Tucson AZ

PUBLICATIONS

(4) *NKL*, J Niedermeyer, AC Wilson, DH Slichter, D Leibfried. Single-ion readout and addressing in a 2-D lattice via induced micromotion. *In preparation.*

(3) P Poggi, *NKL*, K Kuper, I Deutsch, PS Jessen. Quantifying the sensitivity to errors in analog quantum simulation. *PRX Quantum* 1, 020308 (2020).

(2) *NKL*, K Kuper, P Poggi, I Deutsch, PS Jessen. A small, highly accurate quantum processor for intermediate-depth quantum simulation. *Physical Review Letters* 124, 230501 (2020).

(1) H Sosa Martinez, *NKL*, C Baldwin, A Kalev, I Deutsch, PS Jessen. Experimental study of optimal measures for quantum state tomography. *Physical Review Letters* 119, 150401 (2017).

PRESENTATIONS

Invited Talks

(4) National Institute of Information and Communications Technology, Koganei Tokyo JPN (Aug 2022, Virtual)
"*Control over a single shared motional quantum between ions in a 2D array.*"

(3) Honeywell Quantum Solutions, Longmont CO (Sep 2021)
"*Control of Ions in Cryogenic 2-D Arrays for Quantum Simulation.*"

(2) Air Force Research Laboratory, Albuquerque NM (Nov 2019)
"*Analog quantum simulation with cold-atom qudits.*"

(1) Optics and Photonics Winter School and Workshop, Tucson AZ (Jan 2018)
"*Analog quantum simulation: quantum computing in the near term.*"

Contributed Talks

(6) 24th Annual Southwest Quantum Information and Technology Workshop (Oct 2022) "*Control over a single shared motional quantum between ions in a 2D array.*" *NKL*, J Niedermeyer, J Keller, K McCormick, S Todaro, AC Wilson, DH Slichter, D Leibfried

(5) 52nd Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics (Jun 2021) "*Control of Ions in Cryogenic Two-Dimensional Arrays for Quantum Simulation.*" *NKL*, J Niedermeyer, J Keller, K McCormick, S Todaro, AC Wilson, DH Slichter, D Leibfried

(4) 21st Annual Southwest Quantum Information and Technology Workshop (Feb 2019) "*What a small-scale, highly-accurate quantum processor can teach us about analog quantum simulation.*" *NKL*, K Kuper, PS Jessen, P Poggi, K Chinni, I Deutsch

(3) 48th Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics (Jun 2017) "*Analog quantum simulation of complex dynamics.*" *NKL*, K Kuper, PS Jessen

(2) 19th Annual Southwest Quantum Information and Technology Workshop (Feb 2016) "*Quantum simulation of complex dynamics in a quantum kicked top.*" *NKL*, K Kuper, HM Knaack, PS Jessen

(1) 47th Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics, (May 2016) "*Quantum tomography of near-unitary processes in high-dimensional systems.*" *NKL*, H Sosa Martinez, PS Jessen, C Baldwin, A Kalev, I Deutsch

Posters

(9) Quantum Innovation 2023 International Symposium (Nov 2023) "*Control over a shared phonon between three ions in a two-dimensional array for quantum simulation*" *NKL*, J Niedermeyer, AC Wilson, DH Slichter, D Leibfried

(8) 25th Annual Southwest Quantum Information and Technology Workshop (Oct 2023) "*Control over a shared phonon between three ions in a two-dimensional array*" *NKL*, J Niedermeyer, AC Wilson, DH Slichter, D Leibfried

(7) 54th Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics (Jun 2023) "*Control over phonons shared between three trapped ions in a two-dimensional microtrap array*" *NKL*, J Niedermeyer, AC Wilson, DH Slichter, D Leibfried

(6) 53rd Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics (Jun 2022) "*Exchange of a single motional quantum between trapped ions in a 2D RF microtrap array.*" *NKL*, J Niedermeyer, J Keller, K McCormick, S Todaro, AC Wilson, DH Slichter, D Leibfried

(5) 22nd Annual Southwest Quantum Information and Technology Workshop (Feb 2020) "*The impact of errors in the operation of a small, highly-accurate quantum simulator.*" *NKL*, K Kuper, P Poggi, I Deutsch, PS Jessen, *awarded 'Top Poster'*

(4) Aspen Many-Body Quantum Chaos Workshop (Mar 2019) "*A general-purpose highly-accurate analog quantum simulator using cold-atom qudits.*" *NKL*, K Kuper, P Poggi, K Chinni, I Deutsch, PS Jessen

(3) 20th Annual Southwest Quantum Information and Technology Workshop (Feb 2018) "*Building a general-purpose analog quantum simulator from cold-atom qudits.*" *NKL*, K Kuper, PS Jessen, K Chinni, I Deutsch, *awarded 'Top Poster'*

(2) NSF Council for Undergraduate Research REU Symposium (Oct 2016) "*Analog simulation of the kicked top.*" HM Knaack*, *NKL*, K Kuper, PS Jessen
**supervised student, selected to represent REU program for NSF CUR Symposium*

(1) 18th Annual Southwest Quantum Information and Technology Workshop (Feb 2016) "*Comparison of strategies for quantum state and process tomography.*" *NKL*, H Sosa Martinez, PS Jessen, C Baldwin, A Kalev, I Deutsch

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PROFESSIONAL AFFILIATIONS

The American Physical Society
Sigma Xi Scientific Research Society