JACOB L. BECKEY

CURRICULUM VITAE

JILA 440 UCB Boulder, CO 80309 United States

Jacob.Beckey@colorado.edu
Twitter
LinkedIn
Webpage

HIGHLIGHTS

Research

- Areas of interest: entanglement theory, quantum learning theory and property testing, quantum metrology
- 9 peer-reviewed publications (Google Scholar Page)(Papers on arXiv)

Fellowships

- U.S. DOE Office of Science Graduate Research Award (SCGSR)
- Los Alamos National Lab Quantum Computing Summer School Fellowship
- National Science Foundation Graduate Research Fellowship (NSF GRFP)
- Fulbright University of Birmingham Postgraduate Award

Teaching and outreach

- Co-founder and vice president of the Idealized Science Institute, an educational non-profit
- Lecturer for PHYS 3090: Introduction to Quantum Computing at CU Boulder
- Instructor for PHYS 1400: Fundamentals of Scientific Inquiry at CU Boulder

EDUCATION

University of Colorado, Boulder, Boulder, CO M.S. (May 2022), PhD Physics (expected May 2024)	2019-PRESENT
 Advisor: Graeme Smith Thesis topics: estimation of multipartite entanglement from local measurements, Gaussian bound entangled states with secure key, and various topics in quantum metrology 	
University of Birmingham, Birmingham, UK Master of Research, Translational Quantum Technology	2018-2019
 Advisors: Haixing Miao and Vincent Boyer Thesis title: Broadband Quantum Noise Reduction in Future Long Baseline Gravitational- wave Detectors via EPR Entanglement and The Quantum Limits of Beam Displacement Mea- surements 	
Clarion University of Pennsylvania, Clarion, PA Bachelor of Science, Physics and Mathematics	2015-2018
RESEARCH	
Graduate Researcher, JILA/University of Colorado, Boulder <i>Quantum information theory under Graeme Smith</i>	2019-PRESENT
• Working primarily on hardware-efficient entanglement quantification (e.g. [PR9]), and topics	

 Working primarily on hardware-efficient entanglement quantification (e.g. [PR9]), and t in quantum metrology (e.g. [PR8])

Graduate Researcher, Los Alamos National Lab <i>Quantum algorithms and quantum info theory under Patrick Coles</i>	2020-2021
• Developed a near-term quantum algorithm for estimating the mixed state quantum Fisher information (see [PR6])	
• Introduced a generalized measure of quantum Fisher information (see [PR5])	
 Proved several properties of computable lower bound on QFI (see [PR3]) 	
• Defined a general family of multipartite entanglement measures computable on current quantum hardware (see [PR4])	
Graduate Researcher, University of Birmingham Quantum optics theory under Haixing Miao and Vincent Boyer	2018-2019
• Worked on the theory and simulation of EPR-based quantum noise reduction for future gravitational-wave detectors (see [PR1] and thesis on LinkedIn)	
DOE SULI Student, Oak Ridge National Lab <i>Quantum optics theory under Raphael Pooser</i>	Summer 2018
• Explored the theory of truncated nonlinear interferometers and their ability to surpass the standard quantum limit (see [PR2])	
NSF REU Student, University of Birmingham <i>Quantum optics theory under Haixing Miao and Andreas Freise</i>	Summer 2017
 Worked within LIGO theory group to model ponderomotive squeezing – a method of sur- passing the standard quantum limit of an interferometer 	
Undergrad Researcher, Clarion University of Pennsylvania	2016
Undergrad Researcher, Clarion University of Pennsylvania <i>Physics education research under advisor Vasudeva Aravind</i>	2015-2016

PUBLICATIONS (GOOGLE SCHOLAR PAGE) (PAPERS ON ARXIV)

PEER-REVIEWED ARTICLES

- [PR9] Jacob L. Beckey, Gregory Pelegrí, Steph Foulds, Natalie J. Pearson. Multipartite entanglement measures via Bell basis measurements. Phys. Rev. A 107, 062425, Jun 2023
- [PR8] Anthony M. Polloreno, Jacob L. Beckey, Joshua Levin, Ariel Shlosberg, James K. Thompson, Michael Foss-Feig, David Hayes, Graeme Smith. Opportunities and Limitations in Broadband Sensing. Phys. Rev. Applied 19, 014029, Jan 2023.
- [PR7] E. Fradgley, C. French, L. Rushton, Y. Dieudonné, L. Harrison, J. L. Beckey, H. Miao, C. Gill, P.G. Petrov, V. Boyer. Quantum limits of position-sensitive photodiodes. Optics Express, Vol. 30, Issue 22, pp. 39374-39381 (2022).
- [PR6] Jacob L. Beckey, Akira Sone, M. Cerezo, Patrick J. Coles. Variational Quantum Algorithm for Estimating the Quantum Fisher Information. Phys. Rev. Research 4, 013083, Feb 2022.

- [PR5] Akira Sone, M. Cerezo, Jacob L. Beckey, Patrick J. Coles. A Generalized Measure of Quantum Fisher Information. Phys. Rev. A 104, 062602, Dec 2021
- [PP4] Jacob L. Beckey, N. Gigena, Patrick J. Coles, and M. Cerezo. Computable and operationally meaningful multipartite entanglement measures. Phys. Rev. Lett., 127:140501, Sept 2021.
- [PR3] M. Cerezo, Akira Sone, Jacob L. Beckey, Patrick J. Coles. Sub-Quantum Fisher Information. Quantum Sci. Technol. 6 035008, Jun 2021
- [PR2] R. C. Pooser, N. Savino, E. Batson, J. L. Beckey, J. Garcia, and B. J. Lawrie. Truncated nonlinear interferometry for quantum-enhanced atomic force microscopy. Phys. Rev. Lett., 124:230504, Jun 2020.
- [PR1] Jacob L. Beckey, Yiqiu Ma, Vincent Boyer, and Haixing Miao. Broadband quantum noise reduction in future long baseline gravitational-wave detectors via EPR entanglement. Phys. Rev. D, 100:083011, Oct 2019.

PRESENTATIONS

INVITED TALKS

- QOQMS Group Seminar, University of Strathclyde, 2022
 - "Controlled-SWAP Test and Entanglement Monotones"
- Quantum Light and Matter Group Seminar, Durham University, 2022
 - "Controlled-SWAP Test and Entanglement Monotones"
- QuFITS Seminar, University of York, 2022
 - "Controlled-SWAP Test and Entanglement Monotones"
- Quantum Information Group Seminar, Universitat Autònoma de Barcelona, 2022
 - "Controlled-SWAP Test and Entanglement Monotones"
- Aliro Technologies Seminar, 2021
 - "Near-term Quantum Algorithm for Quantum Sensor Evaluation"

CONTRIBUTED TALKS

- American Physical Society's March Meeting, 2021
 - "Near-term Quantum Algorithm for Quantum Sensor Evaluation"
- American Physical Society's March Meeting, 2016
 - "First-order Error Corrections in Introductory Physics Lab"

POSTERS

- Theory of Quantum Computation, Cryptography, and Communication (TQC), 2023
 - "Local strategies for multipartite entanglement quantification"
- Quantum Information Processing (QIP), 2023
 - "Multipartite entanglement measures via Bell basis measurements"
- Quantum Information Processing (QIP), 2022
 - "Computable and operationally meaningful multipartite entanglement measures"

- Quantum Science Center's Postdoctoral and Graduate Student Association Inaugural Poster Session, 2021
 "Near-term Quantum Algorithm for Quantum Sensor Evaluation"
- Quantum Information Processing (QIP), 2021
 - "Variational Quantum Algorithim for Quantum Sensor Evaluation"
- Les Houches Ecole des Physique Pre-doctoral School, 2019
 - "Broadband Quantum Noise Reduction in Einstein Telescope via EPR Entanglement"
- ORNL Summer Research Participant Poster Session, 2018
 - "Generalization of Interferometry and Beam Position Measurement Equivalence"
- American Astronomical Society's 231st Meeting, 2018
 - "Modeling Ponderomotive Squeezed Light in Gravitational-wave Interferometers"
- American Astronomical Society's 229th Meeting, 2017
 - "Mapping the Heiles Supershell GSH 90-28-17"

TEACHING

Lecturer, PHYS/CSCI 3090: Introduction to Quantum Computing	SPRING 2022
University of Colorado, Boulder	
Instructor, PHYS1400: The Fundamentals of Scientific Inquiry	Fall 2022
University of Colorado, Boulder	

ACADEMIC SERVICE

- Reviewer for the following journals/conferences:
 - Quantum (3 articles)
 - QIP (3 submissions)

TECHNICAL SKILLS

- Programming languages: Mathematica and Python
- Quantum computing packages: Qiskit, QuTip, Quantum Mathematica

SCHOOLS AND WORKSHOPS

University of Colorado, Boulder, Boulder, Colorado	
Meeting of the Simons Collaboration on Ultra-Quantum Matter	

University of Illinois, Urbana-Champagne, Chicago, Illinois

Quantitative Linear Algebra meets Quantum Info Theory II

2023

2022

AWARDS

Title	Duration
CU Physics Award for TA Excellence	Spring 2023
U.S. DOE Office of Science Graduate Research Award (SCGSR)	Spring 2023
LANL Quantum Computing Summer School Fellowship	Summer 2020
NSF Graduate Research Fellowship	2019-2021
Fulbright - University of Birmingham Postgraduate Award	2018-2019
France-Allison Honors Scholarship	2017-2018
Clarion International Scholar Award	Summer 2017
William and Elizabeth Hart STEM Scholarship	2017-2018
Helen and Lawrence Smith STEM Scholarship	2017-2018
Clarion Honors Foundation Scholarship	2015-2018
Clarion Academic Scholarship	2015-2018
Board of Governors Full Tuition Scholarship	2015-2018
David C. Smith Honors Scholarship	2015-2018
Karl Sendler Freshman Physics Award	2015-2016

OUTREACH

Co-founder and Vice President, Idealized Science Institute McKees Rocks, PA	2023-Present
• Educational non-profit empowering physics educators across the country to engage in research-backed educational practices	
Mentor, Graduate Association of Students in Physics (GASP) Boulder, CO	2021-PRESENT
 Closely mentoring graduate students to help them transition to graduate physics education and research 	
Lecturer, Freedom Area Senior High School <i>Virtual</i>	2020-2021
• Lecturing once per week to advance students on topics in theoretical physics and providing mentorship on college applications, life in physics, etc.	
Mentor, CU Prime Boulder, CO	2019-Present
 Mentor undergraduate physics students on a monthly basis 	
• Mentored a small group of students in an introductory nature of science course (Fall 2019).	

Presenter, Pierce Planetarium2016-2018Clarion, PANarrated monthly educational planetarium shows for students and community members2016-2017Tutor, Community Learning Workshop
Clarion, PA2016-2017• Assisted young students from surrounding schools learn math and physics multiple times
per week2016-2017