Jacob L. Beckey

Curriculum Vitae

JILA
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United States

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Twitter
LinkedIn
Webpage

Highlights

Research

- Areas of interests: quantum metrology, quantum entanglement, quantum information theory
- 8 peer-reviewed publications, 1 pre-print article (Google Scholar Page)(Papers on arXiv)

Fellowships

- Los Alamos National Lab Quantum Computing Summer School Fellowship
- National Science Foundation Graduate Research Fellowship
- 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 (80 students)
- Instructor for PHYS 1400: Fundamentals of Scientific Inquiry at CU Boulder (18 students)

Education

University of Colorado, Boulder, Boulder, CO 2019-Present

M.S. (May 2022), PhD Physics (expected May 2024)

- Advisor: Graeme Smith
- Thesis: Hardware-efficient entanglement quantification, and topics in quantum metrology

University of Birmingham, Birmingham, UK 2018-2019

Master of Research, Translational Quantum Technology

- 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 Measurements

Clarion University of Pennsylvania, Clarion, PA 2015-2018

Bachelor of Science, Physics and Mathematics

Research

Graduate Researcher, JILA/University of Colorado, Boulder 2019-Present

Quantum information theory under Graeme Smith

- Working on various projects at the intersection of information theory and quantum metrology

Graduate Researcher, Los Alamos National Lab 2020-2021

Near-term quantum algorithms and quantum info theory under Patrick Coles

- Developed a variational quantum algorithm for estimating the mixed state quantum Fisher information (see [PR6])
- Introduced a generalized measure of quantum Fisher information (see [PR5])
- Proved important novel properties of lower bound on QFI (see [PR3])
- Introduced method of constructing multipartite entanglement measures computable on a quantum computer (see [PR4])

Graduate Researcher, University of Birmingham 2018-2019
Quantum optics theory under Haixing Miao and Vincent Boyer

- 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 SUMMER 2018
Quantum optics theory under Raphael Pooser

- Explored the theory of truncated nonlinear interferometers and their ability to surpass the standard quantum limit (see [PR2])

NSF REU Student, University of Birmingham SUMMER 2017
Quantum optics theory under Haixing Miao and Andreas Freise

- Worked within LIGO theory group to model ponderomotive squeezing – a method of surpassing the standard quantum limit of an interferometer

Undergrad Researcher, Clarion University of Pennsylvania 2016
Observational astronomy under advisor Sharon Montgomery

Undergrad Researcher, Clarion University of Pennsylvania 2015-2016
Physics education research under advisor Vasudeva Aravind

PUBLICATIONS (GOOGLE SCHOLAR PAGE) (PAPERS ON ARXIV)

PEER-REVIEWED ARTICLES

[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.

Pre-Print Articles

[PP2] **Jacob L. Beckey**, Gregory Pelegrí, Steph Foulds, Natalie J. Pearson. Multipartite entanglement measures via Bell basis measurements. https://arxiv.org/abs/2210.02575. Submitted to Physical Review Letters.

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

- 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

Les Houches Ecole des Physique, Les Houches, France — 2019
Light-matter interaction in dilute media and individual quantum systems

AWARDS

Title	Duration
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

Mentor, Graduate Association of Students in Physics (GASP) 2021-PRESENT
Boulder, CO

- Closely mentoring graduate students to help them transition to graduate physics education and research

Lecturer, Freedom Area Senior High School 2020-2021
Virtual

- Lecturing once per week to advance students on topics in theoretical physics
- Providing mentorship on college applications, life in physics, etc.
- Fostering STEM alumni network

Mentor, CU Prime 2019-PRESENT
Boulder, CO

- 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 Planetarium 2016-2018
Clarion, PA

- Narrated monthly educational planetarium shows for students and community members

Tutor, Community Learning Workshop 2016-2017
Clarion, PA

- Assisted young students from surrounding schools learn math and physics multiple times per week