Huan Q. Bui

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Education

PhD in Experimental Atomic, Molecular, and Optical Physics
Massachusetts Institute of Technology 2021–

B.A., Summa Cum Laude, Honors in Physics, Honors in Mathematics, minor in Statistics
Colby College (GPA: 4.19/4.30, Class Marshal) 2017–2021

- Honors Thesis in Physics (advisor: Professor Charles Conover)
  MOT-based lifetime measurements of $5P_{1/2}$ *and* $5P_{3/2}$ *in* ^{39}K (view)
- Honors Thesis in Mathematics (advisor: Professor Evan Randles)
  A Generalized Polar-coordinate Integration Formula, Oscillatory Integral Techniques, and Applications to Convolution Powers of Complex-valued Functions on $\mathbb{Z}^d$ (view)

Summer school, Perimeter Institute for Theoretical Physics Jun 2020

Research Interests

Ultracold atom experiments, Mathematical analysis/differential equations

Research Experience

Ph.D. Student, Ultracold Quantum Gases Group, Massachusetts Institute of Technology Jun 2021–
PI: Martin Zwierlein
Area(s): ultracold quantum gases, experimental atomic physics

- Studying strongly interacting homogeneous Fermi gases trapped in a box potential

Undergraduate Researcher, Perimeter Institute for Theoretical Physics May 2020–Dec 2020
PI: Timothy Hsieh
Area(s): quantum information, condensed matter physics

- Variational simulation of non-trivial quantum states (QAOA-based, $O(L)$ time)
- Measurement-assisted algorithms as a candidate for sublinear depth simulation
- Found numerically that ground states of the quantum Ising model with nonuniform field and couplings can be simulated exactly by a depth $O(L)$ QAOA ansatz

Research Assistant, Colby College Dept. of Mathematics & Statistics Oct 2019–May 2021
PI: Evan Randles
Area(s): applied mathematics, analysis, ODEs

- Computed convolution powers & associated attractors that are highly oscillatory integrals; generated results indicative of a new local limit theorem
- Constructed a generalized polar-coordinate integration formula with applications to sup-norm-type estimates of convolution powers of complex functions on $\mathbb{Z}^d$
- Contributed to the proof of a new decay estimate for convolution powers (paper)

Research Assistant, Joint Quantum Institute, College Park Summer 2019, Jan 2020
PI: Steven Rolston
Area(s): experimental atomic physics

- Measured collective decay of ultracold Rb atoms trapped around an optical nanofiber
- Contributed to an observation of vacuum-induced collective quantum beats (paper)

Research Assistant, Colby College Dept. of Physics & Astronomy Nov 2017–May 2021
PI: Charles Conover
Area(s): experimental atomic physics

- Precision measurements on ultracold ^{39}K in Rydberg states 2017–2019
- Lifetime measurement of $5P_{1/2}$ and $5P_{3/2}$ in ^{39}K 2019–2021

Teaching Experience

Teaching Assistant, Colby College Dept. of Physics & Astronomy Sep 2017–May 2021

- Grade weekly problem sets
- Past courses: Thermodynamics and Statistical Mechanics, Quantum Mechanics, Electricity and Magnetism, 2×Modern Physics II, 2×Modern Physics I (relativity & early quantum physics), Introduction to Electricity-Magnetism & Optics, Introduction to Mechanics

Teaching Assistant, Colby College Dept. of Mathematics & Statistics Sep 2018–May 2021

- Grade problem sets & hold weekly TA sessions
- Past courses: Partial Differential Equations, 2×Linear Algebra, Ordinary Differential Equations

Mathematics & Physics Tutor, Colby College Deans of Studies Sep 2018–May 2020

Publications/Preprint

1. **Bui, H.Q.**, Randles, E. A Generalized Polar-Coordinate Integration Formula with Applications to the Study of Convolution Powers of Complex-Valued Functions on $\mathbb{Z}^d$. Journal of Fourier Analysis and Applications **28**, 19 (2022). arXiv:2103.04161, SpringerLink

Presentations

1. **Huan Q. Bui**, Evan Randles (2021), *A generalized polar-coordinate integration formula with applications to convolution powers and local (central) limit theorems* (pdf), Joint Mathematics Meetings 2021
2. **Huan Q. Bui** (Jun 2020), *Measurement-assisted variational simulation of non-trivial quantum states* (pdf), Perimeter Institute Undergrad Intern Symposium 2020
3. C. Conover, A. Hill, **HQ Bui** (May 2020), *Measurements of f-, g-, and h-state quantum defects in Rydberg states of potassium* (abstract), DAMOP 20
4. C. Conover, **HQ Bui** (May 2019), *Measurements of p-state fine structure and quantum defects for Rydberg states of potassium* (abstract), DAMOP 19
5. C. Conover, **HQ Bui** (May 2019), *Millimeter-wave precision spectroscopy of d-d transitions in ^{39}K Rydberg states* (pdf), DAMOP 19
6. **Huan Q. Bui** (May 2019), *Matrices in Quantum Computing: A 2-qubit entanglement circuit* (pdf), CLAS 2019
7. **Huan Q. Bui** (Jul 2018), *Precision measurement of potassium energy levels at highly excited states* (pdf), CUSRR 2018

Awards & Honors

1. Class Marshal (graduated with the highest GPA), Colby College, 2021
2. Senior Prize in Physics and Astronomy, Colby College, 2021
3. Marston Morse Prize in Mathematics, Colby College, 2021
4. Sigma Pi Sigma NHS, 2021
5. Williams A. Rogers Prize in Physics and Astronomy, Colby College, 2020
6. Phi Beta Kappa, 2020
7. Mu Sigma Rho, 2020
8. Honorable Mention, COMAP Mathematical Contest in Modeling, 2020
9. Linda K. Cotter Internship Fund, 2020
   for Jan 2020 internship at the Joint Quantum Institute (JQI), College Park, MD
10. Phi Beta Kappa Scholastic Achievement Award, 2019
11. Julius Seelye Bixler Scholar, 2018, 2019, 2020
12. Meritorious Winner (top 8% of 10,000 teams), COMAP Mathematical Contest in Modeling, 2019
13. Dean's List, F'17, S'18, F'18, S'19, F'19, (S'20, F'20 – canceled due to COVID-19), S'21

Projects

1. *Personal Website/Archive*, huanqbui.com Oct 2019–Present
   Notes from class, independent readings, and research projects.