

Joshuah Heath

Postdoctoral Research Associate
Many-body physics & quantum information science
Department of Physics & Astronomy
Dartmouth College
17 Fayerweather Hill Road
Hanover, NH
USA

802-922-1291
ORCID: 0000-0003-2627-9858
Joshuah.T.Heath@dartmouth.edu
[Google Sites](#)
[Google Scholar](#)
[ResearchGate](#)
[Twitter](#)

EDUCATION

- JUNE 2021 Ph.D. in PHYSICS,
Boston College, Chestnut Hill, MA, USA
Field: Theoretical Condensed Matter Physics | Advisor: Kevin S. BEDELL
Thesis: *Novel metallic behavior in topologically non-trivial,
quantum critical, and low-dimensional matter*
Committee: Kevin S. BEDELL, Fazel TAFTI, Jan ENGELBRECHT,
Xiao CHEN
- MAY 2017 M.Sc. in PHYSICS,
Boston College, Chestnut Hill, MA, USA
- MAY 2015 B.Sc. in MATHEMATICS, with honors, *cum laude*
University of Vermont, Burlington, VT, USA
- MAY 2015 B.Sc. in PHYSICS, with honors
University of Vermont, Burlington, VT, USA

EMPLOYMENT

- AUG 2021–PRESENT **Postdoctoral Research Associate**
Dartmouth College, Dept. of Physics and Astronomy, Hanover, NH, USA
Research Groups of Lorenza VIOLA & James WHITFIELD
- AUG 2015–JULY 2021 **Graduate Research & Teaching Assistant**
Boston College, Dept. of Physics, Chestnut Hill, MA, USA
Research Group of Kevin S. BEDELL

SCHOLARSHIPS, AWARDS, & RECOGNITIONS

- MARCH 2021 IOP Outstanding Reviewer for Physica Scripta for 2020
OCT 2020 IOP Trusted Reviewer Status (top 15% of referees for IOP Publishing in terms of quality, insightfulness, and timeliness of reviews)
APRIL 2017 Donald J. White Teaching Excellence Award
MAY 2013/14/15 UVM Mathematics Sophomore, Junior, & Senior Awards
MAY 2014 Mortar Board Senior Honors Society
MAY 2013 Sigma Pi Sigma Physics Honor Society
JUNE 2011 Vermont Scholar's Award

SCIENTIFIC BACKGROUND & INTERESTS

GENERAL

- Condensed matter theory, quantum information, quantum statistical mechanics

PRESENT

- Strongly correlated fermionic liquids, collective behavior of itinerant Majorana fermions, unconventional Kitaev magnets, quantum phase transitions, Luttinger's theorem

PAST

- Floquet-engineered superconductivity, low-dimensional dipolar bosons, non-equilibrium classical plasmas

TEACHING BACKGROUND

PAST

- Graduate teaching assistant for non-physics major and physics major undergraduate classes; duties include recitations, homework grading, test grading, quiz administration, homework help, and occasionally substitute lecturer for classes of up to 100+ students
- Graduate teaching assistant for graduate-level physics classes; duties include homework grading, test grading, and homework help
- Graduate teaching assistant for undergraduate physics and non-physics major laboratory; duties include lab report grading, lab quiz grading, and setting up labs
- Undergraduate teaching assistant for undergraduate physics, math, and philosophy courses; duties ranged from general assistance and coding help to grading of homework sets and exams.

OUTREACH

- NOV. 2018, MARCH 2021 Volunteer Lecturer for BC Splash | Mini-courses on special and general relativity & quantum computing for high school students
Boston College, Chestnut Hill, MA, USA
- APRIL 2017 "Bridging the Gap between Research and Education" | Public lecture for the Graduate Teaching Recognition Ceremony
Boston College, Chestnut Hill, MA, USA
- NOV. 2011–APRIL 2015 Volunteer Science Educator | Physics demos to K-12 students and professionals
ECHO Lake Aquarium and Science Center, Burlington, VT, USA

PROFESSIONAL ACTIVITIES AND SERVICE

2021	ORGANIZER Quantum Computation in Isolation Virtual Seminar Series
2020-PRESENT	REFEREE Physica Scripta
2020-2021	ORGANIZER Quantum Fluids in Isolation Virtual Seminar Series
2018–2019	ORGANIZER Emerging Results Seminar Series, Boston College Physics Dept.
2016–2017	REPRESENTATIVE BC Physics Dept. Grad Affairs & Teaching Committees
2015–PRESENT	MEMBER International Society for Relativistic Quantum Information
2013–PRESENT	MEMBER American Physical Society

MENTORING

PAST

- Roy FORESTANO | Undergrad researcher, Boston College. Jan. 2019–April 2021
 - Project: Unconventional superconductivity in itinerant ferromagnets
 - Current Position: Ph.D. student at University of Florida
- Luke MARTIN | Undergrad researcher, Boston College. Jan. 2019–April 2021
 - Project: KSS viscosity bound in ultra-massive hairy black holes
 - Current Position: Ph.D. student at University of New Hampshire
- Adeyemi LAWAL | Undergrad researcher, Boston College. July–Aug. 2018
 - Project: Basics of quantum statistical mechanics
 - Current Position: Software engineer
- Paul MENKER | Undergrad researcher, Boston College. Jan.–April 2018
 - Project: Basics of conformal field theory and its relation to holography
 - Current Position: Ph.D. student at University of Southern California

TECHNICAL SKILLS

FLUENCY: Julia, Python, Mathematica, Linux, MacOS, \LaTeX
BASIC KNOWLEDGE: BASH, MATLAB, HTML, C++

PUBLICATIONS & PREPRINTS

IN PROGRESS

- **Joshuah T. Heath**, Faranak Bahrami, Roman Movshovich, Xiao Chen, Fazel Tafti, & Kevin S. Bedell | "Evidence of a Majorana-Fermi surface in the Kitaev magnet $\text{Ag}_3\text{LiIr}_2\text{O}_6$ "
[Manuscript in preparation](#) | [arXiv TBA](#)
- **Joshuah T. Heath** | "Fermi liquids in the absence of charge quantization"
[Manuscript in preparation](#) | [arXiv TBA](#)

2021

- **Joshuah T. Heath** & Kevin S. Bedell | "Gauging away the Stoner model: Engineering unconventional metallic ferromagnetism with artificial gauge fields"
[Submitted to SciPost Physics](#) | [arXiv:2008.07535](#)

2020

- **Joshuah T. Heath** & Kevin S. Bedell | "Universal Signatures of Majorana-like Quasiparticles in Strongly Correlated Landau-Fermi Liquids"
[J. Phys.: Condens. Matter](#) **32** 485602 (2020) | [arXiv:1903.00619](#)
- **Joshuah T. Heath** | "Landau Quasiparticles in Weak Power-Law Liquids"
[J. Low Temp. Phys.](#) **201**, 200-212 (2020) | [arXiv:2001.08230](#)
- **Joshuah T. Heath** & Kevin S. Bedell | "Necessary and Sufficient Conditions for the Validity of Luttinger's Theorem"
[New J. Phys.](#) **22** 06301 (2020) | [arXiv:1906.00929](#)
- **Joshuah T. Heath**, Matthew P. Gochan, and Kevin S. Bedell | "Chebyshev polynomial expansion of two-dimensional Landau-Fermi liquid parameters"
[J. Phys. A: Math. Theor.](#) **53** 225203 (2020) | [arXiv:1912.03427](#)
- Matthew P. Gochan, **Joshuah T. Heath**, & Kevin S. Bedell | "Atypical Behavior of Collective Modes in Two-Dimensional Fermi Liquids"
[J. Phys.: Condens. Matter](#) **32** 345602 (2020) | [arXiv:1912.02699](#)

2019

- **Joshuah T. Heath** & Kevin S. Bedell | "Exotic quantum statistics and thermodynamics from a number-conserving theory of Majorana fermions"
[J. Phys. A: Math. Theor.](#) **52** 315001 (2019) | [arXiv:1709.04483](#)

2016

- Kenneth I. Golden & **Joshuah T. Heath** | "Generalized Nonlinear Fluctuation-Dissipation Relation for the One-Component Plasma"
[J. Stat. Phys.](#) **162**, 199-217 (2016)

2014

- Kenneth I. Golden & **Joshuah T. Heath** | "Hierarchy of Fluctuation-Dissipation Theorems for the Classical One-Component Plasma"
[Contributions to Plasma Physics](#), **X**, 1-7 (2014) | [arXiv:1410.4889](#)

PRESENTATIONS

2021

- "Novel metallic behavior in topologically non-trivial, quantum critical, and low-dimensional matter" (includes work done w/Faranak Bahrami, Kevin Bedell, Xiao Chen, Matthew Gochan, Sangyun Lee, Roman Movshovich, & Fazel Tafti)
 - (hybrid virtual/in-person presentation) Doctoral Thesis Defense, Boston College, Chestnut Hill, MA. June 16th, 2021
- "Luttinger's Theorem-Violating Fermi Liquids and Power-law Green's Functions" (includes work done w/Kevin Bedell)
 - (virtual) Contributed talk, 2021 Princeton Summer School on Condensed Matter Physics, Princeton University. June 10th, 2021
- "How useful are quantum computers? Quantum advantage for high school students"
 - (virtual) Presentation for BC Splash outreach to local high school and middle school students. March 28th, 2021
- "Gauging away the Stoner model: Engineering unconventional metallic ferromagnetism with artificial gauge fields" (work done w/Kevin Bedell)
 - (virtual poster) Contributed talk, APS March Meeting, March 18, 2021
- "Evidence of a weakly-correlated Majorana liquid in the Kitaev magnet $\text{Ag}_3\text{LiIr}_2\text{O}_6$ " (work done w/Faranak Bahrami, Sangyun Lee, Roman Movshovich, Xiao Chen, Kevin Bedell, & Fazel Tafti)
 - (virtual) Contributed talk, APS March Meeting, March 16, 2021
- "The Marriage of Heaven and Hell: Kitaev Materials at the Crossroads of Theory and Experiment" (work done w/Faranak Bahrami, Sangyun Lee, Roman Movshovich, Xiao Chen, Fazel Tafti, & Kevin Bedell)
 - (virtual) Invited talk, Quantum/Nano seminar at Dartmouth College. Feb. 25th, 2021
- "Evidence of a Majorana-Fermi surface in the Kitaev magnet $\text{Ag}_3\text{LiIr}_2\text{O}_6$ " (work done w/Faranak Bahrami, Roman Movshovich, Xiao Chen, Fazel Tafti, & Kevin Bedell)
 - (virtual) Contributed talk, waiting for the conference on Highly Frustrated Magnetism, Max Planck Institute for the Physics of Complex Systems. Jan. 27th, 2021
 - (virtual) Contributed talk, MagLab Theory Winter School, National High Magnetic Field Laboratory. Jan. 12th, 2021

2020

- "Landau quasiparticles in weak power-law liquids" (includes work done w/Kevin Bedell)
 - (virtual) Contributed talk, Speakers' Corner seminar, Virtual Science Forum. November 17th, 2020
- "Luttinger's Theorem: The first 60 years" (work done w/Kevin Bedell)
 - (virtual) Invited talk, group seminar of K. Hazzard's Condensed Matter Theory group, Rice University. July 20th, 2020
- "Observation of a weakly-correlated Majorana liquid in the silver-lithium iridate $\text{Ag}_3\text{LiIr}_2\text{O}_6$ " (work done w/Faranak Bahrami, Fazel Tafti, Roman Movshovich, and Kevin Bedell)
 - (virtual) Contributed talk, 2020 Princeton Summer School on Condensed Matter Physics, Princeton University. June 12th, 2020
- "The Hunting of the Snark: Generic Conditions for Luttinger's Theorem in Strongly Correlated Systems" (work done w/Kevin Bedell)
 - (presentation) Contributed talk, Boston College Mini-March Meeting, Boston College, Chestnut Hill, MA. March 4th, 2020

2019

- "The Hunting of the Snark: Generic Conditions for Luttinger's Theorem in Strongly Correlated Systems" (work done w/Kevin Bedell)
 - (presentation) Contributed talk, 21st Annual Greater Boston Area Statistical Mechanics Meeting (GBASM), Brandeis University, Waltham, MA. Oct. 19th, 2019
- "Exotic quantum statistics from a many-body theory of Majorana fermions" (work done w/Kevin Bedell)
 - (poster) Contributed talk, APS March Meeting, Boston, MA, March 6th, 2019
- "Collective Excitations in a Landau-Majorana Liquid" (work done w/Kevin Bedell)
 - (presentation) Contributed talk, APS March Meeting, Boston, MA, March 6th, 2019

2018

- "Fermi Liquids from Spin Liquids" (work done w/Kevin Bedell)
 - (presentation) Contributed talk, Emerging Results Seminar, Boston College, Chestnut Hill, MA. Nov. 28th, 2018
- "Majorana Lives! Many-body Majorana physics beyond the anyonic paradigm" (work done w/Kevin Bedell)
 - (presentation) Contributed talk, 20th Annual Greater Boston Area Statistical Mechanics Meeting (GBASM), Brandeis University, Waltham, MA. Oct. 27th, 2018
 - (presentation) Invited talk, Condensed Matter Theory Kids Seminar, Harvard University, Cambridge, MA. Oct. 10th, 2018
- "Majorana Physics beyond the anyonic paradigm: Towards a Landau-Majorana liquid theory" (work done w/Kevin Bedell)
 - (poster) Contributed talk, Gordon Research Seminar and Conference on Correlated Electron Systems, Mount Holyoke College, South Hadley, MA. June 23th–June 29th, 2018

2017

- "Exotic quantum statistics from a many-body theory of Majorana fermions" (work done w/Kevin Bedell)
 - (poster) Contributed talk, Majorana Fermions & Beyond Workshop, Yale Quantum Institute, Yale University, Hartford, CT. Oct. 27th, 2017
 - (presentation) Contributed talk, 19th Annual Greater Boston Area Statistical Mechanics Meeting (GBASM), Massachusetts Institute of Technology, Cambridge, MA. Oct. 21st, 2017

2015

- "Pressure-energy relation in canonical 2D dipolar bosons: A path integral Monte Carlo study" (work done w/Adrian Del Maestro)
 - (presentation) Contributed talk, New England APS Spring Meeting, Boston University, Boston, MA. April 24th, 2015
 - (presentation) Contributed talk, Student Research Conference, University of Vermont, Burlington, VT. April 23rd, 2015
- "Suppression of conventional pairing in Floquet engineered fermionic systems" (work done w/Marin Bukov & Anatoli Polkovnikov)
 - (presentation) Invited talk, Condensed Matter Theory Seminar, University of Vermont, Burlington, VT, March 12th, 2015

2014

- "Floquet realization of unconventional superconductivity in periodically driven fermionic systems" (work done w/Marin Bukov & Anatoli Pokovnikov)
 - (presentation) Invited talk, group seminar of A. Polkovnikov's Condensed Matter Theory group, Boston University, Boston, MA. Nov. 3rd, 2014
- "Hierarchy of fluctuation-dissipation theorems for the classical one-component plasma" (work done w/Kenneth Golden)
 - (poster given by Kenneth Golden) Contributed talk, International Conference on Strongly Coupled Coulomb Systems, Santa Fe, NM. July 29th, 2014
- "Hierarchy in the static fluctuation-dissipation theorem of one-component plasmas" (work done w/Kenneth Golden)
 - (poster) Contributed talk, Student Research Conference, University of Vermont, Burlington, VT. April 16th, 2014
 - (poster) Contributed talk, New England APS Spring Meeting, Boston College, Chestnut Hill, MA. April 4th, 2014

2013

- "Computational study of ferromagnetic phase transitions in the Ising and XY models via the Monte Carlo method" (work done w/Adrian Del Maestro)
 - (poster) Contributed talk, Student Research Conference, University of Vermont, Burlington, VT. April 23rd, 2013
- "The Kosterlitz-Thouless transition: Complexity in the XY-Model" (work done w/Adrian Del Maestro)
 - (presentation) Contributed talk, Student Complexity Research and Pizza Seminar, University of Vermont, Burlington, VT, Feb. 4th, 2013