Viva R. Horowitz

Hamilton College
198 College Hill Road
Clinton, NY 13323

Phone: 607-205-8482
Email: vhorowit@hamilton.edu

RESEARCH INTERESTS

Condensed matter experiment and optics, including:
Quantum emitters, resonance, anomalous diffusion, microfluidics, and sensing

EDUCATION

University of California Santa Barbara, Santa Barbara, CA 2012
PhD in Physics
Dissertation: "Optically trapped fluorescent nanodiamonds"
Advisor: Prof. David D. Awschalom

Swarthmore College, Swarthmore, PA 2005
BA in Physics, with honors
Thesis: "Fundamental measurements on an aggregated dye liquid crystal"
Advisor: Prof. Peter J. Collings

PROFESSIONAL EXPERIENCE

Hamilton College, Clinton, NY 2016–ongoing
Assistant Professor, Physics Department
Providing opportunities for students through active learning strategies and a vibrant research program in optics.

University of Oregon. Eugene, OR 2018–ongoing
Courtesy Research Assistant Professor, Materials Science Institute
Analyzed quantum emitters and exploring nanomechanical resonant systems.

Harvard University. Cambridge, MA. 2013–2016
Postdoctoral Fellow in Physics, Prof. Vinothan N. Manoharan
Built a dynamic artificial cell

California Institute of Technology. Pasadena, CA. 2013
Postdoctoral Research Scholar, Prof. Oskar J. Painter
Designed an optomechanical gyroscope for measuring angular velocity

University of California, Santa Barbara, Santa Barbara, CA 2005–2012
Graduate Student Researcher, Prof. David D. Awschalom
Developed mobile spin-based sensing with optically trapped nanodiamonds in solution

PUBLICATIONS
(804 citations)

Peer-reviewed

1. Validating an algebraic approach to characterizing resonator networks. Viva R. Horowitz, Brittany Carter, Uriel Hernandez, Trevor Scheuing,* & Benjamín J. Alemán. *Scientific Reports*, **14**, 1325 (2024).
   News: hamilton.edu/news/story/resonator-networks-viva-horowitz-trevor-scheuing
2. Coupled Nanomechanical Graphene Resonators: A Promising Platform for Scalable NEMS Networks. Brittany Carter, Uriel Hernandez, David J. Miller, Andrew Blaikie, Viva R. Horowitz, & Benjamín J. Alemán. *Micromachines*, **14**, 2103 (2023).
   News: hamilton.edu/news/story/nanomechanical-resonators-viva-horowitz

3. Deterministic quantum emitter formation in hexagonal boron nitride via controlled edge creation. Josh Ziegler, Rachael Klaiss, Andrew Blaikie, David Miller, Viva R. Horowitz, & Benjamín J. Alemán. *Nano Letters*, **19**, 2121–2127 (2019).
   News: sciencedaily.com/releases/2019/04/190411131557.htm
4. Active colloidal particles in emulsion droplets: A model system for the cytoplasm. Viva R. Horowitz, Zachary C. Chambers*, İrep Gözen, Thomas G. Dimiduk, & Vinothan N. Manoharan. *European Physical Journal Special Topics*, **227**, 2413–2424 (2019).
   News: hamilton.edu/news/story/viva-horowitz-physics-cell-transport-research
5. Electron spin resonance of nitrogen-vacancy centers in optically trapped nanodiamonds. Viva R. Horowitz, Benjamín J. Alemán, David J. Christle, Andrew N. Cleland, & David D. Awschalom. *Proc. Natl. Acad. Sci. USA*, **109**, 13493 (2012).
   News:
   "Nitrogen vacancies detect magnetic fields in fluids," Belle Dumé, physicsworld.com, (4 Sept 2012). physicsworld.com/a/nitrogen-vacancies-detect-magnetic-fields-in-fluids
   "Nanodiamonds make magnetic field sensors", Belle Dumé, *nanotechweb.org*, (3 Sept 2012).
6. Generating spin currents in semiconductors with the spin Hall effect. V. Sih, W. H. Lau, R. C. Myers, V. R. Horowitz, A. C. Gossard, & D. D. Awschalom, *Phys. Rev. Lett.* **97**, 096605 (2006).
7. Mechanical control of spin-orbit splitting in GaAs and $In_{0.04}Ga_{0.96}As$ epilayers. V. Sih, H. Knotz, J. Stephens, V. R. Horowitz, A. C. Gossard, & D. D. Awschalom, *Phys. Rev. B* **73**, 241316 (2006).
8. Aggregation behavior and chromonic liquid crystal properties of an anionic monoazo dye. Viva R. Horowitz, Lauren A. Janowitz, Aaron L. Modic, Paul A. Heiney, & Peter J. Collings, *Phys. Rev. E* **72**, 041710 (2005).

Submitted and in preparation

- Spatial mapping and analysis of graphene nanomechanical resonator networks. Brittany Carter, Viva R. Horowitz, Uriel Hernandez, David J. Miller, Andrew Blaikie, & Benjamín J. Alemán. Submitted. arxiv.org/abs/2302.03680
- Diffusion in a crowding agent. Elisabeth B. Lawrence,* Elizabeth M. Seider,* Ryan G. Smolarsky,* Rebecca Dalphin,* Alexander Axton,* Trevor Scheuing,* Clare Nelle,* Matthew Jankowski,* Mitchell D. Bierman,* Estelle Khairallah,* & Viva R. Horowitz. In preparation.

Student-authored publication

9. Encapsulation of motor particles in vesicles using microfluidic devices. Yue Ren.* *The Nucleus*, **93**, 2 (May 2015).

Review article

10. Optofluidics: field or technique? Viva R. Horowitz, David D. Awschalom, & Sumita Pennathur. *Lab on a Chip*, **8**, 1856 (2008).

* Undergraduate student co-authors
Updated publication information: scholar.google.com/citations?user=723APdEAAAAJ

TEACHING EXPERIENCE

Hamilton College, Clinton, NY

Instructor

Quantum Physics	Physics 290	Fall 2024 (upcoming)
Laboratory: Quantum Physics	Physics 290L	Fall 2024 (upcoming)
Physics II	Physics 205	Spring 2024
Laboratory: Survey of Physics II	Physics 105L	Spring 2024
Quantum Physics	Physics 290	Fall 2023
Laboratory: Quantum Physics	Physics 290L	Fall 2023
Senior Research Project	Physics 550	Fall 2023
Research seminar	Physics 390W	Spring 2023
Laboratory: Waves and fields (×2)	Physics 195L	Spring 2023
Quantum Physics	Physics 290	Fall 2022
Laboratory: Quantum Physics	Physics 290L	Fall 2022
Introduction to Quantum Computing	Physics 207	Spring 2021
New course at Hamilton College		
Electromagnetism	Physics 295	Spring 2021
Laboratory: Survey of Physics (×2)	Physics 100L	Fall 2020
Developed a new curriculum for hands-on remote education.		
Physics I	Physics 200	Fall 2020
Electromagnetism	Physics 295	Spring 201
Laboratory: Waves and fields	Physics 195L	Spring 2019
Physics I	Physics 200	Fall 2018
Laboratory: Quantum Physics (×2)	Physics 290L	Fall 2018
Quantum Theory Seminar	Physics 450	Spring 2018
Electromagnetism	Physics 295	Spring 2018
Laboratory: Waves and fields	Physics 195L	Spring 2018
Physics I	Physics 200	Fall 2017
Laboratory: Survey of Physics	Physics 100L	Fall 2017
Electromagnetism	Physics 295	Spring 2017
Laboratory: Waves and fields	Physics 195L	Spring 2017
Physics I.	Physics 200	Fall 2016
Laboratory: Survey of Physics.	Physics 100L	Fall 2016

University of California, Santa Barbara, Santa Barbara, CA

Guest Lecturer

Engineering Lecture. Nanotechnology. ECE/ME 141A.	Fall 2009

Teaching Assistant

Engineering Lecture. Nanotechnology. ECE/ME 141A.	Winter 2009
Physics Discussion Section. Electricity and Magnetism. Physics 24.	Winter 2008
Developed weekly student-led presentations to foster peer instruction.	
Physics Laboratory. Magnetism, Circuits, and Optics. Physics 4L.	Winter 2007

HONORS AND AWARDS

Sidney Wertimer Award for Teaching	2023
Works-in-Progress, Hamilton College	2023
Innovations in Digital Pedagogy Fellowship, Hamilton College	2019
Society of Sigma Xi Member	2017
CSEP Excellence in Mentoring Award, UCSB	2012
Outstanding Teaching Assistant Nominee, UCSB	2009–2010
GAANN Fellowship, US Dept. of Education (covering tuition and salary)	2006–2009
Graduate Student Fellowship, Spintech III and IV School & Conference	2005, 2007
Ferrando-Fithian Physics Fellowship	2005
Howard and Gertrude Evans Scholarship	2005
Joseph Gillingham Scholarship	2005
Society of Sigma Xi Associate Member	2004
National Merit Scholarship	2001

RESEARCH MENTORING

Hamilton College, Clinton, NY — 2017–ongoing

1. Sam Feldman ’24 (thesis student) — Spr 2024
   Thesis. Comparing NetMAP to nonlinear least squares fitting
2. Kai Haesslein ’24 (thesis student) — Fall 2021–ongoing
   Fabricating a microfluidic sorter using a mini-CNC
3. Mohammed Isa Khan ’26 — Spr 2024
   Fabricating a microfluidic sorter
4. Elizabeth (Pippi) Seider ’24 (thesis student) — 2022–ongoing
   Thesis. Artificial Cytoplasm: Crowding components causing anomalous diffusion — Fall 2023
   Developing a method for studying enhanced diffusion of Janus swimmers — Fall 2022
5. Sara Conti ’27 — Fall 2023–ongoing
   Diffusion in a crowding agent
6. Leah Bell ’24 (thesis student) — Fall 2023
   Thesis. Exploring the fabrication process for PDMS microfluidic sorters
7. Yongwoo Park ’24 (thesis student) — 2022, 2023
   Thesis. Engineering a magnetometer using diamond NV centers — Fall 2023
   3D printing parts for microfluidics. — Summer 2022
8. Rebecca Dalphin ’24 — May 2023
   Measuring and analyzing diffusion and subdiffusion in aqueous polyethylene glycol
9. Alex Axton ’24 — May 2023
   Measuring and analyzing diffusion and subdiffusion in aqueous polyethylene glycol
10. Elisabeth (Bess) Lawrence ’23 (thesis student) — Spr 2023
    Thesis. Artificial Cytoplasm: Observing Anomalous Diffusion & Progress Towards Drift-Reduction
    Developing a method for studying enhanced diffusion of Janus swimmers
    Measuring subdiffusion in aqueous polyethylene glycol
11. Lauren Kuster ’23 (thesis student) — 2022–2023
    Thesis: Characterizing a Microfluidic Device for Sorting Micro and Nanodiamonds — Spr 2023
    Developing a plastic mold using laser etching — Summer 2022
12. Ryan Smolarsky (thesis student) — Fall 2022
    Thesis: Diffusion and drift reduction in artificial cells
13. Greg Bauman ’23 — 2021–2022
    Fabricating a microfluidic sorter.

14. Clare Nelle ’24 — 2021–2022
    Developing a method for studying enhanced diffusion of Janus swimmers.
15. Estelle Khairallah ’23 — Fall 2021
    Studying diffusion in various crowding conditions
16. Trevor Scheuing’23 — May–Dec 2021
    Developing a method for studying enhanced diffusion of Janus swimmers
17. Matt Jankowski ’22 — May–Sept 2021
    Optimizing the analysis of enhanced diffusion of Janus swimmers
18. Connor Feldman ’22 — Spr 2021
    Fabricating a microfluidic sorter
19. Asa Szegvari ’23 — Spr 2021
    Fabricating a microfluidic sorter
20. Lucas Wright ’21 (thesis student) — Fall 2020–Spr 2021
    Thesis: Progress toward microfluidic nanodiamond sorting
21. Mitch Bierman ’21 (thesis student) — Fall 2020
    Thesis: Crowding in active colloidal particle solution: A more optimized model for cellular cytoplasm
22. Sean Conroy ’21 (thesis student)
    Thesis: Ultrasonic transmission through a single layer of bubbles — Fall 2020
    Temperature dependence of amorphous bubble rafts (jointly with K. Burson) — Spr 2019
23. Hongyu Zhang ’24 — Fall 2020
    Assisted with ultrasonic transmission through a single layer of bubbles
24. Mikel Zemborain ’19 (thesis student) — 2017–2019
    Thesis: Developing a microfluidic microdiamond sorter — Spr 2019
    Subsequently received a Master’s in physics at University of Chicago and worked at CERN in Switzerland.
25. Eileen Wilcox ’21 — Fall ’18–Spr ’19
    Fabricating a microfluidic sorter using ShrinkyDink mastermolds.
26. Samantha D’Angelo ’21 — Fall ’18–Spr ’19
    Fabricating a microfluidic sorter using ShrinkyDink mastermolds.
27. Roger Danilek ’21 (jointly with K. Burson) — Spr 2019
    Temperature dependence of amorphous bubble rafts
28. Alexandra Golub ’21 (jointly with K. Burson) — Spr 2019
    Exploring the crystallinity of bubble rafts over time
29. Daniel Wall ’19 (jointly with K. Burson) — Spr 2019
    Exploring the crystallinity of bubble rafts over time
30. Elisabeth Howard ’20 (jointly with K. Burson) — Spr 2019
    Calculating the radial distribution function using Python
31. Lindsay Gearty ’21 (jointly with K. Burson) — Spr 2019
    Calculating the radial distribution function using Excel
32. Matthew Zielezienski ’22 (jointly with K. Burson) — Spr 2019
    Understanding the radial distribution function
33. George Tucker ’19 (at University of Oregon & thesis at Hamilton) — Summer & Fall 2018
    Thesis: A non-linear microfluidic resonator — Fall 2018
34. Jacob Engelman ’19 (thesis student) — Fall 2018
    Thesis: Microfluidic sorting: Design and manufacture of a multilayer microfluidics device to sort nanodiamonds.
35. Lucy Guzzardo — Fall 2018
    Animating the quantum levels of the nitrogen-vacancy center in diamond.

36. Colin May ’21 — 2017–2018
    Progress toward building a confocal microscope
37. Houghton Yonge ’18 (thesis student) — Summer & Fall 2017
    Thesis: Development of microfluidic devices for a particle-sorting apparatus
    Subsequently earned master’s degree at Tufts.
38. Fuming Qiu ’20 — Summer 2017
    Developed code to control a photon counter and tested microfluidic designs.
    digitalcommons.hamilton.edu/cgi/viewcontent.cgi?article=1000&context=posters

Harvard University. Cambridge, MA

39. Zachary Chambers ’18 — 2015–2016, 2018
    Developed high-yield production of Janus particles and investigated their superdiffusive dynamics in artificial cells
40. Yue (Nini) Ren ’16 — 2014
    Encapsulated particles in phospholipid vesicles using microfluidic devices

University of California Santa Barbara, Santa Barbara, CA

41. Erzsebet Vincent ’15, now has PhD from University of Chicago — Summer 2011
    Investigated optical properties of cephalopod skin
    eureka-csep.cnsi.ucsb.edu/scholars/vincent
    Conference presentation: “Optical Properties of Cephalopod Skin” — Oct 2011
    Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) National Conference
42. Daniel Kirby ’11, now has PhD from Dublin City University — Summer 2010
    Developed a device for measuring electron spin resonance in solution
43. Lijuan (Lily) Li ’12 — Summer 2009
    Investigated the surface chemistry of nanodiamonds

SERVICE

Hamilton College, Clinton, NY

- Advisor to Hamilton College students — 2017–ongoing
- APS-IDEA Inclusion, Diversity, and Equity Alliance — 2020–2022
    - Hosted meetings at Hamilton College
    - Networking with other colleges
    - Subcommittee: Inclusive Pedagogies — Spring 2021
- Chemical Physics Committee — 2017–ongoing
    - Program director — Fall 2020–June 2023
- Member, two search committees for tenure-track assistant profs of Physics — Sept 2022–Jan 2023
- Member, search committee for Assistant Professor of Instruction in Physics — Fall 2022–Spr 2023
- Organizer, Physics Colloquium series — 2018–’19, ’21–’22
- Co-organizer, Panel: What I did with my major in physics: Medical careers — Fall 2022
    - Hamilton Alumni Panelists: Ahtesham Khan ’17, Clare Munroe ’18, Spencer Newman ’96
- Member, two search committees for visiting assistant professors of Physics — Spr ’21, Summer ’21
- Honor Court — 2020–2021
- Co-director, Clare Booth Luce grant program — 2020–2021
- Organizer, physics grad school Q&A events

- Hamilton Alumni Panelists: Elise LePage ’18, Alexei Smith ’19, Kenneth Ratliff ’16 — Jan 2021
- Hamilton Alumni Panelists: Joelle (Baer) Corrigan ’16, Mike Verostek ’16, Anya Nugent ’18, Robert [RJ] Taylor ’19 — July 2020

- Presenter, physics demos for 4th graders, Hamilton College — Summer 2019
- Committee member, mass email working group — 2018–2019
- Member, search committee for two visiting assistant professors — 2018–2019
- Presenter, physics demos, Hamilton College Family Weekend, 50 attendees — Oct 2017
- Presenter, physics demos for 2nd graders, Hamilton College — Summer 2017
- Member, search committee for a visiting assistant professor — Spring 2017

American Association of Colleges and Universities
Project Kaleidoscope (PKAL) — Feb 2022
- Moderator, “Incorporating EDI (Equity, Diversity, Inclusion) in Undergraduate Physics Curricula: From Exercises to Full Courses”

University of Technology Sydney, Sydney, Australia — Fall 2020
- External examiner, Doctoral thesis examination of Johannes Froech

Swarthmore College, Swarthmore, PA, honors program — Spr 2020
- External examiner, Statistical Physics

Mentor: Provide advice and support to a disadvantaged student in California — 2019–ongoing

University of Oregon, Eugene, OR
- Presenter, Putting your physics degree to work seminar series — Mar 2020
- Judge of student poster presentations, OMQ Symposium, Bend, OR — Sept 2019

Harvard University, Cambridge, MA
Co-coordinator, Harvard Physics Research Scholar Advisory Committee — 2014–2016
- Moderated faculty panel on grant writing — Apr 2016
- Organized leadership workshop for physicists given by Harvard Business School Prof. Willy Shih — Jan 2015
- Co-organized two Harvard Physics postdoc retreats — 2014 and 2015
  Guest speakers: Alan Guth, Nobel laureate Roy J. Glauber, NY Times deputy science editor Dennis Overbye, NSF program director Krastan B. Blagoev, and DOE program manager Simona Rolli

Referee for *Nano Letters*, *Physical Review E*

Secretary, Caltech Postdoc Association, Pasadena, CA — 2013

Certified first responder for mental health crises — 2012
Certification from Mental Health First Aid USA, Santa Barbara, CA

Co-coordinator, UCSB Women in Science and Engineering — 2011

Recruiter, UCSB Physics
- Visit Day poster presentation, Santa Barbara, CA — Apr 2012
  “Optically trapped fluorescent nanodiamonds for magnetometry”

- Conference for Undergraduate Women in Physics, Los Angeles — Jan 2008
- Joint Annual Meeting of the National Society of Black Physicists and the National Society of Hispanic Physicists (NSBP/NSHP), Boston, MA — Feb 2007

Co-president and mentor, Swarthmore Women in Astronomy and Physics. — 2002–2005
Ran discussion groups, organized mentorship program, organized events, including annual liquid nitrogen ice cream parties and rocket launching, and mentored underclassmen.

PROFESSIONAL DEVELOPMENT

Works-in-Progress group — Spr 2023
Initiator and participant

Faculty Success Program (FSP) Bootcamp, National Center for Faculty Development & Diversity (NCFDD) — Fall 2022
Participant

Statistics and Research Methods in Psychology, Prof. Tara McKee — Fall 2021
Audit student

Change Your World leadership course, Maria Maier — Fall 2021
Participant

American Association of Physics Teachers, Summer Virtual Meeting — July 2020
Attendee
Networked and developed plans for teaching during the pandemic, especially teaching lab remotely

Virtual sessions on teaching in a pandemic, Hamilton College — Summer 2020
Participant
Attended numerous sessions on how to teach during the pandemic

The Physics behind Quantum Computing, Prof. Steven van Enk, University of Oregon — Spring 2020
Audit student

STEM Engaged and Active Learning (SEAL) AHA group, Hamilton College
Participant — 2018–2019
Discussed and implemented active learning strategies, including gallery walks and jigsaw activities.

Physics Faculty Journal Club: Building a More Inclusive Department AHA group
Participant — Spring 2019
Read and discussed articles about increasing inclusivity and diversity in physics

The Council on Undergraduate Research (CUR): Beginning a Research Program
Participant — Nov 2018
Attended three-day workshop to learn techniques for building my research program.

American Association of Physics Teachers, Faculty Online Learning Community — 2017
Participant
Attended twice-monthly meetings to discuss best teaching practices.

American Association of Physics Teachers New Faculty Workshop — Nov 2016
College Park, MD
Attendee
Attended four-day workshop to learn physics education methods and skills

ADDITIONAL TEACHING

Hamilton College. Clinton, NY

Radio show host, Significant Figures, WHCL — Fall 2021
podcasters.spotify.com/pod/show/viva-horowitz

Consulting professor, Quantum Theory study group — Summer 2020
I met weekly with three Hamilton students who studied chapters 7–11 of Townsend's Quantum Mechanics text.

Radio show guest, WHCL — June 2019
soundcloud.com/viva-horowitz/andrew-projansky-interviews-viva-r-horowitz

Harvard University, Cambridge, MA

Judge, Applied Physics 50 Crack-a-thon — Apr 2016
Judged teams of students who had each built a locked safe based on electromagnetic puzzles.

Organizer, Visit day for 9th grade students from Martinique — Mar 2016
Guided 9th grade students from Collège Aimé Césaire on a physics-centered tour of Harvard in French. Each student group also had the opportunity to 3D-print an object and create a hologram of it to keep.

*Guest advisor***,** Physics 15C Waves and optics lab — Nov 2013, 2014
Coached students creating instruments and presentations on holographic imaging and optical tweezers

University of California, Santa Barbara, Santa Barbara, CA

Circus presenter, UCSB Physics Circus — 2008
Presented scientific demos for elementary school students

Private Tutor. Santa Barbara, CA. — 2007
Tutored a Santa Barbara City College student for her Conceptual Physics class

Department of Physics and Astronomy, Swarthmore College, Swarthmore, PA

Clinic Coordinator and Clinician. — 2004–2005
Coordinated 10 clinicians, assisted 40 students weekly with problem sets, and planned funding with department chair

Grader, Mathematical Methods of Physics — Spring 2004

Clinician. Assisted students with problem sets — Fall 2003

Learning for Life, Swarthmore College, Swarthmore, PA — Summer 2004
Instructor. Taught staff at Swarthmore College the basics of using a computer.
Developed my own hands-on course; created a new webpage for the class.

Swarthmore College Tutoring Program, Swarthmore, PA — Fall 2003
Physics Tutor. Reviewed electricity and magnetism subject matter with a student who was going deaf and having trouble following lectures.

Incorporated Research Institutions for Seismology, Washington, DC Jan 2003
Intern. Created an educational experiment in physics and seismology at the college level.

Department of Mathematics and Statistics, Swarthmore College, Swarthmore, PA
Grader, Discrete Mathematics Fall 2002

Norris Square Community House, Philadelphia, PA Fall 2002
Volunteer. Assisted students with homework in an after-school program.

PRESENTATIONS

Invited talks

1. Utica University Society of Physics Students Feb 2023
   Justice Equity Diversity and Inclusion (JEDI) talk: "Charting my path"
   twitter.com/utica_sps/status/1627894174031773701
2. Physics Colloquium, Wesleyan University, Middletown, CT Oct 2019
   "Luminescent colloids and beyond: From dynamic artificial cells to quantum emitters"
3. Sigma Xi Colloquium, Hamilton College, Clinton, NY Jan 2019
   "Luminescent quantum emitters"
4. Ithaca College, Ithaca, NY Nov 2018
   "Confined colloids: From dynamic artificial cells to magnetic sensing with luminescent levitated nanodiamonds"
5. University of Oregon, Eugene, OR March 2018
   "Active colloidal particles in emulsion droplets: A model system for cytoplasm"
6. Union College, Schenectady, NY October 2017
   "Confining colloids: From dynamic artificial cells to luminescent nanodiamond sensors"
7. Syracuse University, Syracuse, NY October 2017
   "Confining colloids: From dynamic artificial cells to luminescent nanodiamond sensors"
8. The Broad Reach of Materials Physics Symposium, Swarthmore College. June 2017
   "Measuring magnetic fields with photoluminescent nanodiamonds"
9. Williams College Physics Seminar, Williamstown, MA Dec 2015
   "Confined Colloids: From dynamic artificial cells to luminescent nanodiamond sensors"
10. Hamilton College Physics Seminar, Clinton, NY Dec 2015
    "Confined Colloids: From dynamic artificial cells to luminescent nanodiamond sensors"
11. Oxford College of Emory University, Oxford, GA Dec 2015
    "Gauss's Law." Teaching presentation.
12. Hendrix College Physics Seminar, Conway, AR Nov 2015
    "Confined colloids: From dynamic artificial cells to luminescent nanodiamond sensors"

13. Mount Holyoke College Physics Seminar, South Hadley, MA Nov 2015
"Confined colloids: From dynamic artificial cells to luminescent nanodiamond sensors"

14. American Physical Society March Meeting, Baltimore, MD Mar 2013
"Mobile quantum sensing with spins in optically trapped nanodiamonds"
Invited speaker, D. D. Awschalom, talk based on my PhD work

15. Physics seminar, Amherst College, Amherst, MA Feb 2013
"Spin-based sensing using optically trapped nanodiamonds in solution"

16. SPIE Photonics West, San Francisco, CA Feb 2013
"Electron spin resonance of nitrogen-vacancy centers in optically trapped nanodiamonds"

17. Applied Physics Seminar, Caltech, Pasadena, CA Jan 2013
"Spin-based sensing using optically trapped nanodiamonds in solution"

18. CRISP Seminar, Yale University, New Haven, CT Dec 2012
"Spin-based sensing using optically trapped nanodiamonds in solution"

Contributed presentations

19. American Physical Society March Meeting, Las Vegas, NV Mar 2023
"Validating an algebraic approach to characterizing resonator networks." Talk.

20. American Physical Society March Meeting, Boston, MA Mar 2019
"Active colloidal particles in emulsion droplets: A model system for the cytoplasm." Talk.

21. American Physical Society March Meeting, New Orleans, LA Mar 2017
"Walking the tightrope: Colloidal surfers mimicking molecular motors" Talk.

22. Active and Smart Matter Workshop, Syracuse, NY June 2016
"Walking the tightrope." Talk.

23. Physics Postdoc Retreat, Dedham, MA. Organizer. Sept 2015
"Superdiffusion in artificial cells." Quick talk and poster.

24. Gordon Research Conference: Soft Condensed Matter, New London, NH Aug 2015
"Enhanced diffusion in an artificial cell." Poster.

25. American Physical Society March Meeting, San Antonio, TX Mar 2015
"Building a dynamic cell from the bottom up." Talk.

26. New England Workshop on Complex Fluids, Cambridge, MA Dec 2014
"Building a dynamic cell from the bottom up." Soundbite.

27. Harvard Physics Postdoc Retreat, North Andover, MA. Organizer. Sept 2014
"Building a cell from the bottom up." Quick talk and poster.

28. Materials Research Society Fall Meeting, Boston, MA Nov 2012
"Electron spin resonance of nitrogen-vacancy centers in optically trapped nanodiamonds." Talk.

29. American Physical Society March Meeting, Boston, MA Feb 2012
"Optically trapped fluorescent nanodiamonds." Talk.

NEWS

1. "Horowitz, Scheuing '23 Co-Author Paper" Feb 2024
   hamilton.edu/news/story/resonator-networks-viva-horowitz-trevor-scheuing
2. "NetMAP Revolutionizes Characterization of Resonator Networks" Jan 2024
   bnnbreaking.com/tech/science-tech/netmap-revolutionizes-characterization-of-resonator-networks/
3. "Horowitz Publishes Research on Nanomechanical Resonators" Nov 2023
   hamilton.edu/news/story/nanomechanical-resonators-viva-horowitz
4. Teaching Award May 2023
   hamilton.edu/news/story/faculty-teaching-students-awards-professors
5. "Horowitz Presents Research at American Physical Society Meeting" Mar 2023
   hamilton.edu/news/story/viva-horowitz-interpret-data-connected-resonators
6. JEDI talk: Society of Physics Students at Utica University Feb 2023
   twitter.com/utica_sps/status/1627894174031773701
7. "Bringing 'Significant Figures' to Podcast" Oct 2021
   hamilton.edu/news/story/science-faculty-significant-figures-horowitz-podcast
8. Student Researchers Building, Analyzing Artificial Cells July 2021
   hamilton.edu/news/story/cell-cytoplasm-replicate-physics
9. "Stressed? Depressed? You are not alone" Mar 2021
   Physics Today 74, 3, 20 (2021); doi.org/10.1063/PT.3.4696
10. "Physics is a Blast!" Sept 2020
    hamilton.edu/news/story/physics-pressure-rockets-test-predictions
11. "Horowitz Interviewed in Physics Podcast" Mar 2020
    hamilton.edu/news/story/physics-world-interview-viva-horowitz
12. "Coronavirus Hits the Conference Calendar" Mar 2020
    blubrry.com/physicsworldweeklypodcast/56967250/coronavirus-hits-the-conference-calendar-physicists-excel-in-deep-tech-start-up-challenge-remembering-freeman-dyson
13. "Horowitz the Speaker in UO Career Seminar" Mar 2020
    hamilton.edu/news/story/physics-teaching-career-viva-horowitz
14. "Horowitz on 'Luminescent Colloids and Beyond'" Nov 2019
    hamilton.edu/news/story/quantum-systems-nanodiamonds-viva-horowitz
15. "Horowitz Talks Physics with Projansky '21" Jul 2019
    hamilton.edu/news/story/viva-horowitz-physics-andrew-projansky-whcl
16. "Scientists Drill Into White Graphene to Create Artificial Atoms" Apr 2019
    sciencedaily.com/releases/2019/04/190411131557.htm
17. "Horowitz Publishes Cell Transport Research" Mar 2019
    hamilton.edu/news/story/viva-horowitz-physics-cell-transport-research
18. "Hamilton Researchers Present at APS Meeting" Mar 2019
    hamilton.edu/news/story/hamilton-researchers-present-at-aps-meeting

19. "Horowitz Conducting Research at University of Oregon" Jun 2018
hamilton.edu/news/story/horowitz-appointed-as-courtesy-faculty-at-the-university-of-oregon

20. "Horowitz Presents Research at Union College" Dec 2017
hamilton.edu/news/story/professor-physics-viva-horowitz-presents-research-at-union-college

21. "The Changing of the Guard" Fall–Winter 2017
hamilton.edu/magazine/winter17/the-changing-of-the-guard

22. Horowitz and Burson Present at APS Meeting Mar 2017
hamilton.edu/news/story/professor-physics-viva-horowitz-and-kristen-burson-present-at-aps-meeting

23. "New Faculty Appointed for 2016-17 Academic Year" Aug 2016
hamilton.edu/news/story/new-faculty-appointed-for-2016-17

24. "Nitrogen Vacancies Detect Magnetic Fields in Fluids" Sept 2012
physicsworld.com/a/nitrogen-vacancies-detect-magnetic-fields-in-fluids

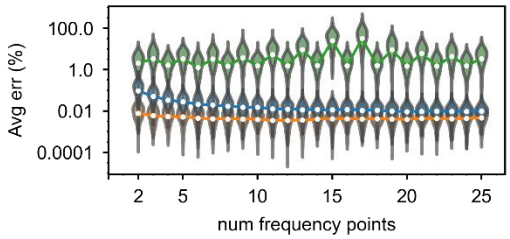
TECHNICAL SKILLS

Materials: colloidal solutions, diamond qubits, water-in-oil emulsions, Janus particles, silicon nitride, silicon
Tool-building: microscope, optical trapping, confocal microscope, microfluidic devices, electrospray for nanoparticle deposition, instrument control/automation
Techniques: photolithography, electron-beam lithography, image analysis, particle tracking, microfluidics, mechanical design, CAD, machining, microwave measurements, fiber optics
Imaging: optical microscopy (brightfield, fluorescence, differential interference contrast, etc.), atomic force microscopy (AFM), scanning electron microscopy (SEM), holographic imaging
Measurement: single photon counting, time-correlated single photon counting, fluorescence spectroscopy, UV/vis spectrophotometry, fluorimetry, automated data acquisition and analysis, pump-probe optical measurements
Programming languages: Python, Labview, Matlab, Mathematica, C, C++

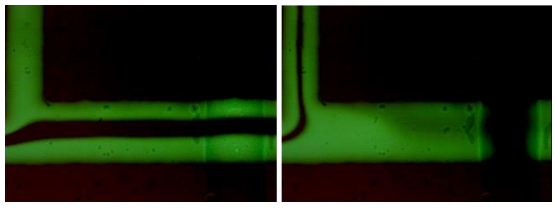
RESEARCH BACKGROUND

(1) Network Mapping and Analysis of Parameters (NetMAP): A new formalism for characterizing resonator networks

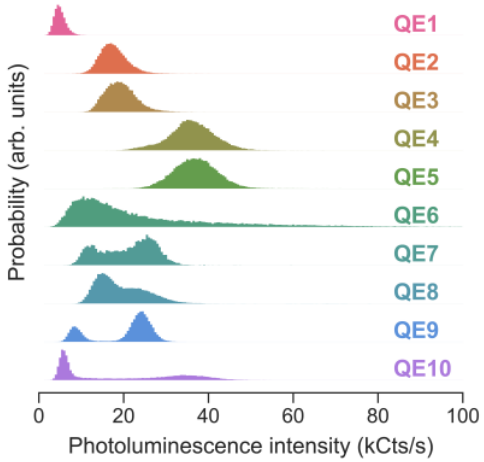
(with Aleman lab, University of Oregon, Sam Feldman and Trevor Scheuing, Hamilton) Resonator networks appear everywhere in natural and engineered systems, and the physicists' view of these is to model such networks as a series of coupled masses on springs. We have developed a new algebraic approach to characterize resonator networks, with applications in diverse fields from physics and engineering to neuroscience and biology. This approach, using Singular Value Decomposition (SVD), is more accurate and scalable than traditional iterative least-squares fitting. We tested this approach with graphene resonators using Scanning Interference Microscopy (SIM) and found promising results, validating the technique through simulations and experiments. Our approach, Network Mapping and Analysis of Parameters (NetMAP), serves as a diagnostic tool for understanding and programming individual nodes and connectivity in resonator networks. In the future, we plan to study larger resonator topologies and further develop the field of large-scale nanoelectromechanical (NEMS) resonator networks.

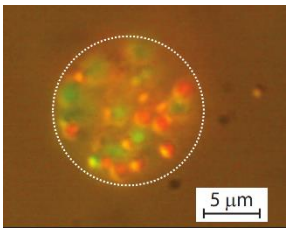


(2) Multilayer microfluidic control (with Kai Haesselein, Mikel Zemborain, Jake Engleman, Lucas Wright, Fuming Qiu, Eileen [Leenie] Wilcox, Leah Bell, Asa Szegvari, Connor Feldman, Lauren Kuster, Greg Bauman, Samantha D'Angelo, Isa Khan, and Yongwoo Park, Hamilton) We control the direction of water flow in a microfluidic channel using a second channel underneath the first. When the second channel pinches the main channel closed, it controllably diverts the water to an alternate channel.



(3) Analyzing quantum emitters in hexagonal Boron Nitride (with Aleman lab, Oregon) Quantum emitters (QEs) in 2D hexagonal boron nitride (hBN) are extremely bright, continue to luminesce under high temperature and harsh chemical conditions, and have the potential for strong coupling to hybrid optoelectromechanical devices due to their 2D host crystal. I analyzed the stability and blinking behavior of quantum emitters that are created when holes are patterned in the hBN material.

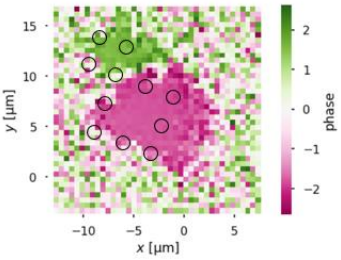


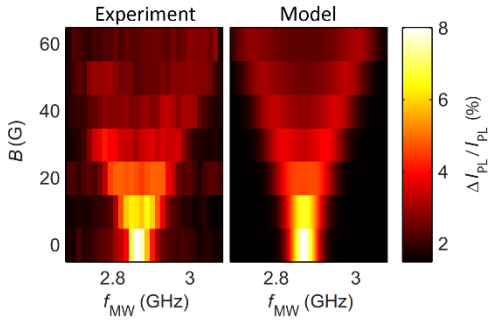


(4) Building a dynamic artificial cell using micro-swimmers in lipid vesicles (with Manoharan lab, Harvard)
Living cells are active, nonequilibrium systems that use active elements (molecular motors) to drive transport in the cytoplasm. Living cells must transport molecules and larger structures through their interior to make precursors available for biochemical reactions and to organize internal material for cell division, among other functions. I encapsulated self-propelled particles in a phospholipid vesicle to introduce an active interior environment. This research will lead to greater understanding of the flow phenomena involved in cytoplasmic streaming in living cells. In addition to providing a way to increase and modulate the rates of chemical reaction in artificial cells, this study may lead to insights into cytoplasmic reaction dynamics in living cells.

(5) Building a platform for studying a dynamic artificial cytoplasm (with Elisabeth [Bess] Lawrence, Ryan Smolarsky, Clare Nelle, Trevor Scheuing, Matt Jankowski, Elizabeth [Pippi] Seider, Sara Conti, Estelle Khairallah, and Mitch Bierman, Hamilton)
Living cellular cytoplasm is both an active and crowded environment. In order to better understand active cytoplasm, we study the trajectories of tracer particles in artificial cytoplasm where we can control the ingredients. However, large-scale currents, or drift, make it difficult to quantify the microscale mixing. We are building a platform for studying active crowded artificial cytoplasm in a chamber where drift is reduced but ingredients can flow in and out through microscopic pores in an agarose hydrogel barrier.

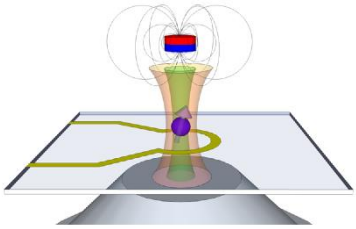
(6) Spatially Resolved Strong and Weak Mechanical Coupling in Graphene Resonators (with Aleman lab, Oregon)
Mechanical resonators provide insight into manipulation of a phononic bandgap, classical Rabi oscillations and Ramsey interferences, and synchronization between two resonators. We mapped and interpreted the shape of the modes of these suspended resonators.



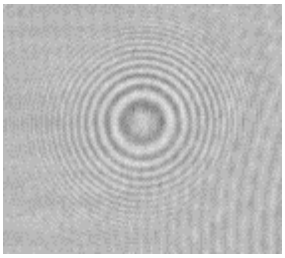


(7) Spin-based sensing with optically trapped nanodiamonds in solution (Awschalom lab, UCSB)
The nitrogen-vacancy (NV) color center in diamond has emerged as a powerful, optically addressable, spin-based probe of electromagnetic fields and temperature. For nanoscale sensing applications, the NV center's atom-like nature enables the close-range interactions necessary for both high spatial resolution and the detection of fields generated by proximal nuclei, electrons, or molecules. Using a custom-designed optical tweezers apparatus, I demonstrated three-dimensional position control of nanodiamonds in solution with simultaneous optical measurement of electron spin resonance

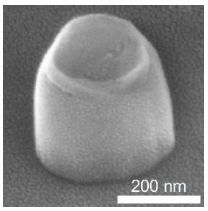
(ESR). It was my own idea to use optically trapped nanodiamonds for measuring magnetic fields. Despite the motion and random orientation of NV centers suspended in the optical trap, I observed distinct peaks in the ESR spectra from the ground-state spin transitions. Accounting for the random dynamics of the trapped nanodiamonds, I modeled the ESR spectra observed in an applied magnetic field and estimated the dc magnetic sensitivity based on the ESR line shapes to be 50 $\mu T/Hz^{1/2}$. I used the optically trapped nanodiamonds to characterize the magnetic field generated by current-carrying wires and ferromagnetic structures in microfluidic circuits. These measurements provide a pathway to spin-based sensing in fluidic environments and biophysical systems that are inaccessible to existing scanning probe techniques, such as the interiors of living cells.



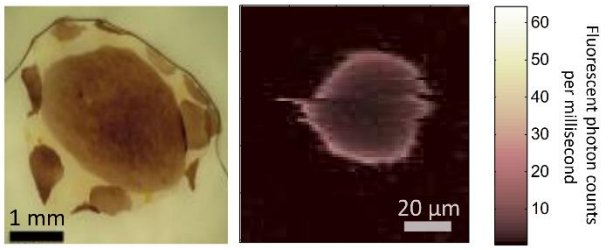
(8) Tool-building: Optical tweezers and confocal microscope
(Awschalom lab)
Optical tweezers are valuable for manipulating particles using light radiation pressure. I designed and built a single-beam optical trapping apparatus for trapping small particles. An infrared beam is tightly focused through a high numerical aperture objective and aligned to create a three-dimensional potential well. By analyzing the interference pattern in the forward-scattered beam, I tracked the confined motion of single particles in the trap. I integrated a customized confocal microscope apparatus with single photon detection for combined confocal fluorescence microscopy and optical trapping.



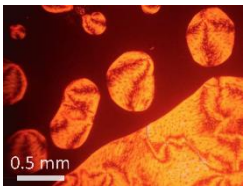
(9) Tool-building for particle tracking: Holographic microscopy
(Manoharan lab)
Holographic images encode the entire three-dimensional volume of a sample. I built a holographic microscope and used the Holopy software package to identify the x, y, and z position of a micro-swimmer as it traversed tens of microns in just a few seconds.



(10) Creating better nanodiamonds through top-down fabrication
(Awschalom lab)
Nanoparticle diamonds vary greatly in quality. In order to create high-quality diamond particles, I used a top-down approach to fabricate nanoparticle diamonds. I reduced diamond membranes to the desired thickness using a nonselective inductively coupled plasma etch and then deposited gold nanoparticles as an etch mask on the diamond membrane. A selective anisotropic oxygen etch removed the membrane except beneath the etch mask, leaving diamond nanoparticles on the substrate. This has paved the way for top-down fabrication of high-quality nanoparticle and nanorod diamonds.

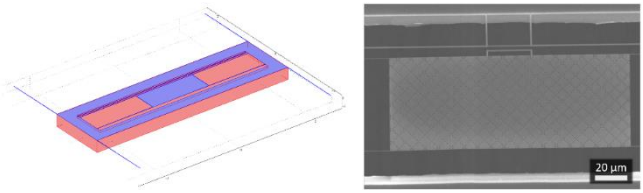


(11) Optical measurements of cephalopod chromatophores (Awschalom lab)
Cephalopods use the controlled expansion and contraction of sacs of pigment called chromatophores in order to alter their appearance for dynamic camouflage. Using the confocal microscope I built, my undergraduate student and I measured and mapped the fluorescence of *Loligo opalescens* squid chromatophores.



(12) Investigating a lyotropic chromonic liquid crystal (Collings Lab)
As an undergraduate at Swarthmore College, I measured the phase diagram, birefringence, and order parameter of aqueous Sunset Yellow, an aggregated dye liquid crystal. The results suggested a model of the aggregation in which the nitrogen-nitrogen double bonds of the Sunset Yellow molecule are perpendicular to the long axis of the aggregate. This work has become a classic in the field.

(13) Fabricating optomechanical gyroscopes for angular velocity detection (Painter lab, Caltech)



We developed a vibrating structure gyroscope based on a photonic zipper cavity for detecting the acceleration of a test mass sensitive to the Coriolis effect. I studied mechanical resonances of the gyroscope using simulations in COMSOL Multiphysics with MATLAB and, in collaboration with graduate students, fabricated silicon nitride devices with a measured mechanical Q of 1 million.