

Dr. Georgios Varnavides

Postdoctoral Research Fellow, Miller Institute for Basic Research in Science, University of California, Berkeley

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Education

Ph.D., Materials Science and Engineering, *Massachusetts Institute of Technology and Harvard University, Cambridge, MA, USA.* 2017-2022

- Co-advisors: Prof. P. Narang (Harvard) and Prof. P. Anikeeva (MIT).
- Thesis: *Electron Hydrodynamics in Crystalline Solids.*

B.S., Materials Science and Engineering, *Massachusetts Institute of Technology, Cambridge, MA, USA.* 2013-2017

B.S., Civil and Environmental Engineering, *Massachusetts Institute of Technology, Cambridge, MA, USA.*

Research Interests

- Spatially-resolved transport of non-equilibrium carriers in materials.
- Functional imaging of charge, heat, and spin using diffractive imaging methods.
- Scanning transmission electron microscopy.
- Materials science pedagogy.

Awards & Honors

Outstanding Ph.D. Thesis Research Award, *Department of Materials Science and Engineering, Massachusetts Institute of Technology.* 2022

Miller Institute Postdoctoral Fellow 2022-2025 (awarded and accepted), *Miller Institute for Basic Research in Science, University of California, Berkeley*

Heising-Simons Postdoctoral Fellow 2022-2024 (awarded), *Kavli Energy NanoScience Institute, University of California, Berkeley*

Kavli Institute at Cornell Postdoctoral Fellow 2022-2024 (awarded), *Kavli Institute at Cornell, Cornell University*

Materials Research Society Graduate Student Gold Award, *MRS Fall 2021 Meeting.* 2021

John Wulff Award for Excellence in Teaching an Undergraduate Subject, *Department of Materials Science and Engineering, Massachusetts Institute of Technology.*

Hugh Hampton Young Fellow, *Massachusetts Institute of Technology.* 2020

Best Paper Award for Second or First Year Student, *Department of Materials Science and Engineering, Massachusetts Institute of Technology.* 2019

Piper Presidential Graduate Fellow, *Massachusetts Institute of Technology.* 2017

Horace A. Lubin Award for Outstanding Service to the DMSE Community, *Department of Materials Science and Engineering, Massachusetts Institute of Technology.*

Juan Hermosilla Prize for exceptional talent and potential at the intersection of mechanics, materials & structures, *Department of Civil and Environmental Engineering, Massachusetts Institute of Technology*.

Julian Szekely Award for the Outstanding Junior, *Department of Materials Science and Engineering, Massachusetts Institute of Technology*.

2016

Undergraduate Student Teaching Award in Teaching an Undergraduate Subject, *Department of Materials Science and Engineering, Massachusetts Institute of Technology*.

Publications

For a complete list of publications, please see my [Google Scholar profile](#). *Denotes equal contribution.

In Preparation

1. G. Varnavides, A. Yacoby, C. Felser, P. Narang, [Charge Transport and Hydrodynamics in Materials](#), **Invited Review**.

2. G. Varnavides, A.S. Jermyn, P. Anikeeva, P. Narang, [SpaRTaNS: Spatially Resolved Transport of Nonequilibrium Species](#).

Prepress

3. G. Varnavides*, A.S. Jermyn*, P. Anikeeva, P. Narang, [Probing carrier interactions using electron hydrodynamics](#), *arXiv:2204.06004* (2022), **Submitted**.

Journal articles

4. R.A. Kowalski, J.R. Nolen, **G. Varnavides**, S.M. Silva, J.E. Allen, C.J. Ciccarino, D.M. Juraschek, S. Law, P. Narang, J.D. Caldwell, [Mid- to Far-Infrared Anisotropic Dielectric Function of HfS₂ and HfSe₂](#), *Adv Optical Mater* (2022).

5. Y. Wang*, **G. Varnavides***, P. Anikeeva, J. Gooth, C. Felser, P. Narang, [Generalized design principles for hydrodynamic electron transport in anisotropic metals](#), *Phys Rev Materials* 6, 083802 (2022).

6. L. Y. Maeng, D. Rosenfeld, G. J. Simandl, F. Koehler, A. W. Senko, J. Moon, **G. Varnavides**, M. F. Murillo, A. E. Reimer, A. Wald, P. Anikeeva, A. S. Widge, [Probing Neuro-Endocrine Interactions Through Wireless Magnetothermal Stimulation of Peripheral Organs](#), *Frontiers in Neuroscience*, 949 (2022).

7. G. Varnavides*, Y. Wang*, P. J.W. Moll, P. Anikeeva, P. Narang, [Mesoscopic finite-size effects of unconventional electron transport in PdCoO₂](#), *Phys Rev Materials*, 6, 045002 (2022).

8. C. A. Garcia, D. M. Nenno, **G. Varnavides**, P. Narang, [Anisotropic phonon-mediated electronic transport in chiral Weyl semimetals](#), *Phys Rev Materials*, 5, L091202 (2021).

9. U. Vool*, A. Hamo*, **G. Varnavides***, Y. Wang*, T. X. Zhou, N. Kumar, Y. Dovzhenko, Z. Qiu, C. A. Garcia, A. T. Pierce, J. Gooth, P. Anikeeva, C. Felser, P. Narang, A. Yacoby, [Imaging phonon-mediated hydrodynamic flow in WTe₂](#), *Nat Phys*, 1745-2481 (2021).

10. X. Tian*, X. Yan*, **G. Varnavides***, Y. Yuan, D. S. Kim, C. J. Ciccarino, P. Anikeeva, M.-Y. Li, L.-J. Li, P. Narang, X. Pan, J. Miao, [Capturing 3D atomic defects and phonon localization at the 2D heterostructure interface](#), *Sci Adv*, 7: eabi6699 (2021).

2022

2021

- 11.** M. R. van Delft, Y. Wang, C. Putzke, J. Oswald, **G. Varnavides**, C. A. C. Garcia, C. Guo, H. Schmid, V. Suss, H. Borrmann, J. Diaz, Y. Sun, C. Felser, B. Gotsmann, P. Narang, P. J.W. Moll, Sondheimer oscillations as a probe of non-ohmic flow in WP2 crystals, *Nat Commun* 12, 4799 (2021).
- 12.** J. Park*, F. Koehler*, **G. Varnavides**, M.-J. Antonini, and P. Anikeeva, Influence of Magnetic Fields on Electrochemical Reactions of Redox Cofactor Solutions. *Angew. Chem. Int. Ed.*. (2021).
- 13.** **G. Varnavides**, A. Mortensen, W.C. Carter, Simulating Infiltration as a Sequence of Pinning and De-pinning Processes, *Acta Materialia* 210, 116831 (2021).
- 14.** K. Reidy*, **G. Varnavides***, J.D. Thomsen, A. Kumar, T. Pham, A. M. Blackburn, P. Anikeeva, P. Narang, J. M. LeBeau, F. M. Ross, Direct imaging and electronic structure modulation of moiré superlattices at the 2D/3D interface, *Nat Commun* 12, 1290 (2021).
- 15.** **G. Varnavides***, A. S. Jermyn*, P. Anikeeva, P. Narang, Electron hydrodynamics in anisotropic materials, *Nat Commun* 11, 4710 (2020).
- 16.** D. Gregurec, A. W. Senko, A. Chuvilin, P. D. Reddy, A. Sankararaman, D. Rosenfeld, P.-H. Chiang, F. Garcia, I. Tefel, **G. Varnavides**, E. Ciocan, P. Anikeeva, Magnetic Vortex Nanodiscs Enable Remote Magnetomechanical Neural Stimulation, *ACS nano* 14, 7 (2020).
- 17.** P. Periwal, J. D. Thomsen, K. Reidy, **G. Varnavides**, D. N. Zakharov, L. Gignac, M. C. Reuter, T. J. Booth, S. Hofmann, F. M. Ross, Catalytically mediated epitaxy of 3D semiconductors on van der Waals substrates, *Applied Physics Reviews* 7, 031402 (2020).
- 18.** J. Moon, M. G. Christiansen, S. Rao, C. Marcus, D. C. Bono, D. Rosenfeld, D. Gregurec, **G. Varnavides**, P.-H. Chiang, S. Park, P. Anikeeva, Magnetothermal Multiplexing for Selective Remote Control of Cell Signaling, *Advanced Functional Materials* 30, 36 (2020).
- 19.** D. Rosenfeld, A. W. Senko, J. Moon, I. Yick, **G. Varnavides**, D. Gregurec, F. Koehler, P.-H. Chiang, M. Christiansen, L. Y. Maeng, A. S. Widge, P. Anikeeva, Transgene-free remote magnetothermal regulation of adrenal hormones, *Science advances* 6, 15 (2020).
- 20.** **G. Varnavides**, A. S. Jermyn, P. Anikeeva, P. Narang, Nonequilibrium phonon transport across nanoscale interfaces, *Phys Rev B*, 100, 115402 (2019).
- 21.** S. Rao, R. Chen, A. A. LaRocca, M. G. Christiansen, A. W. Senko, C. H. Shi, P.-H. Chiang, **G. Varnavides**, J. Xue, Y. Zhou, S. Park, R. Ding, J. Moon, G. Feng, P. Anikeeva, Remotely controlled chemomagnetic modulation of targeted neural circuits, *Nat Nanotechnol* 14, 967 (2019).
- 22.** M. Kanik*, S. Orguc*, **G. Varnavides**, J. Kim, T. Benavides, D. Gonzalez, T. Akintilo, C. C. Tasan, A. P. Chandrakasan, Y. Fink, P. Anikeeva, Strain-programmable fiber-based artificial muscle, *Science* 365, 6449 (2019).
- 23.** J. Vukajlovic-Plestina, W. Kim, L. Ghisalberti, **G. Varnavides**, G. Tutuncuoglu, H. Potts, M. Friedl, L. Guniat, W.C. Carter, V.G. Dubrovskii, A. Fontcuberta i Morral, Fundamental aspects to localize self-catalyzed III-V nanowires on silicon, *Nat Commun* 10, 869 (2019).

2020

2019

Investigating the Role of Microscopic Interactions in Electron Hydrodynamics, Materials Research Society (MRS) Spring 2022, *Honolulu, HI, USA*.

2022

SpaRTaNS: Spatially Resolved Transport of Non-equilibrium Species, American Physical Society (APS) March 2022 Meeting, *Chicago, IL, USA*.

Imaging anisotropic electron fluids with high spatial resolution, KIC Special Seminar, *Virtual Seminar*.

2021

Electron Hydrodynamics: Microscopic Origins and Effects of Macroscale Geometries, Materials Research Society (MRS) Spring 2021, *Virtual Conference*.

Electron Hydrodynamics: Microscopic Origins, American Physical Society (APS) March 2021 Meeting, *Virtual Conference*.

Temperature-Resolved Observations and Predictions of Phonon-Mediated Hydrodynamic Flow of Electrons in WTe₂, Materials Research Society (MRS) Fall 2020, *Virtual Conference*.

2020

Teaching Materials Science using the Wolfram Language, Wolfram Technology Conference 2020, *Virtual Conference*.

Crystal Symmetry and Electron Hydrodynamics: A Group Theory Approach, Materials Research Society (MRS) Fall 2019 Meeting, *Boston, MA, USA*.

2019

Spatially-Resolved Non-equilibrium Phonon Transport Across Nanoscale Interfaces, American Physical Society (APS) March Meeting 2019, *Boston, MA, USA*.

Ab initio Predictions of Spatially-Resolved Non-equilibrium Coherent Transport Phenomena, Materials Research Society (MRS) Fall 2018 Meeting, *Boston, MA, USA*.

2018

Non-Equilibrium Phonon Transport Across Semi-Coherent Interfaces, 16th International Conference on Phonon Scattering in Condensed Matter, *Nanjing, China*.

(De)Generative Art, Wolfram Technology Conference 2017, *Champaign, IL, USA*.

2017

Capillarity in pressure infiltration part I & II: Experiment and modelling, Materials Science & Technology (MS&T16), *Salt Lake City, UT, USA*.

2016

Posters

Finite-size Effects of Electron Transport in Anisotropic Quasi-Two Dimensional Metals, Materials Research Society (MRS) Fall 2021 Meeting, *Boston, MA, USA*.

2021

Darcy-Brinkman multiscale modelling applied on the Mosul Dam, New England Mechanics 2017 Workshop, *Cambridge, MA, USA*.

2017

Simulating capillarity in metal infiltration, Materials Science & Technology (MS&16), *Salt Lake City, UT, USA*.

2016

Teaching

Lead Instructor	Instructor-G , <i>Department of Materials Science and Engineering</i> , Cambridge, MA, USA - <u>Mathematics and Computational Thinking for Materials Scientists and Engineers I (3.029)</u>	2022
Teaching Assistant	Graduate Teaching Assistant , <i>Department of Materials Science and Engineering</i> , Cambridge, MA, USA - Materials Project Laboratory (3.042) Undergraduate Teaching Assistant , <i>Department of Materials Science and Engineering</i> , Cambridge, MA, USA - Mathematics for Materials Science and Engineers (3.016) - Electrical, Optical and Magnetic Properties of Materials (3.024)	2020 2016-2017
Short Courses	Generative Art Workshop , <u>4-day IAP workshop</u> , <i>Massachusetts Institute of Technology</i> , Cambridge, MA, USA. Co-taught with Emma Vargo, Amina Matt, Jovana Andrejevic, and Nina Andrejevic.	2017-2022

Service & Outreach

Teaching multiple short courses to 9th grade Physics and 11th grade Engineering Honors students at the El-Cerrito high school.	2022-present
Graduate Materials Council (GMC) officer on the Departmental Committee on Graduate Studies (DCGS).	2019-2021
Teen Counselor and Teen Advisor for Camp Kesem, a student-run organization helping children through and beyond a parent's cancer.	2015-2021

Memberships

Microscopy Society of America (MSA).	2022-present
Materials Research Society (MRS). American Physical Society (APS).	2018-present
Tau Beta Pi (TBP) - Engineering Honor Society Member. Chi Epsilon (XE) - Civil Engineering Honor Society Member.	2017-present

Last updated: November 2022