

Noah P. Mitchell

Kavli Institute for Theoretical Physics
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Citizenship: USA

Current Appointment

Helen Hay Whitney Foundation Fellow

Kavli Institute for Theoretical Physics & UC Santa Barbara

Mentors: Sebastian Streichan, Boris Shraiman, & Zvonimir Dogic

Collaborators: Dan Needleman (Harvard), Eric Wieschaus (Princeton)

Education & Training

2018 Ph.D. **University of Chicago**, Physics

Advisor: William T. M. Irvine

Other mentors: Vincenzo Vitelli, Heinrich Jaeger, Sid Nagel

Topics: Fracture, topological metamaterials, nanoparticle mechanics, turbulence

Thesis: Geometric Control of Fracture and Topological Metamaterials

2013 M.S. **University of Chicago**, Physics

2011-2012 **University of Minnesota**, undergraduate research assistant, visiting undergraduate

Mentor: Evan Skillman

Topics: Star formation in dwarf galaxies, galactic winds

2012 B.A. **St. Olaf College**, Physics, *summa cum laude, with distinction*

Mentor: David Nitz

Topics: Atomic spectroscopy of neutral Cerium

Awards

Helen Hay Whitney Foundation Fellowship	2020-present
Otis Williams Postdoctoral Fellowship.....	2019-2020
Springer Thesis Award	2019
Yodh Prize, for top experimentalist, University of Chicago	2017
Best poster, Soft Condensed Matter Gordon Research Seminar	2017
Robert A. Millikan Fellow, University of Chicago.....	2015-16
Robert G. Sachs Fellow, University of Chicago	2013
Wentzel Teaching Prize Awardee, University of Chicago.....	2013
NSF GRFP Honorable Mention	2013
McCormick Fellow, University of Chicago.....	2012-14
David B. Fossan Endowed Scholar, for excellence in Physics	2011-12
Buntrock Regent Scholar, highest academic scholarship, St. Olaf College	2008-2012
National Merit Scholarship	2008-2012

Publications

Condensed Matter & Biophysics

- [12] B. Lemma, **N. P. Mitchell**, R. Subramanian, D. J. Needleman, Z. Dogic. “Active microphase separation in mixtures of microtubules and tip-accumulating molecular motors.” arxiv/2107.12281 (2021)

- [11] **N. P. Mitchell**, A. M. Turner, W. T. M. Irvine. “Real-space origin of topological band gaps, localization, and re-entrant phase transitions in gyroscopic metamaterials.” *Physical Review E*, **104**, 025007 (2021)
- [10] **N. P. Mitchell**, “Geometric Control of Fracture and Topological Metamaterials.” Springer Nature Thesis Series (2020).
- [9] **N. P. Mitchell**, R. Carey, J. Hannah, Y. Wang, M. Cortes, S. McBride, H. Jaeger. “Conforming Nanoparticle Sheets to Surfaces with Gaussian Curvature.” *Soft Matter*, **14**, 9107-9117 (2018).
- [8] **N. P. Mitchell**, L. M. Nash, W. T. M. Irvine. “Tunable Band Topology in Gyroscopic Lattices.” *Physical Review B*, **98**, 174301 (2018).
- [7] **N. P. Mitchell**, L. M. Nash, W. T. M. Irvine. “Realization of a Topological Phase Transition in a Gyroscopic Lattice.” *Physical Review B Rapid* **97**, 100302(R) (2018).
- [6] **N. P. Mitchell**, L. M. Nash, D. Hexner, A. Turner, W. T. M. Irvine. “Amorphous Topological Insulators Constructed from Random Point Sets.” *Nature Physics* **14**, 380-385 (2017).
- [5] **N. P. Mitchell**, V. Koning, V. Vitelli, W. T. M. Irvine, “Fracture in Sheets Draped on Curved Surfaces.” *Nature Materials* **16**, 89-93 (2016).

Astrophysics & Atomic Physics

- [4] K. B. W. McQuinn, E. D. Skillman, T. N. Heilman, **N. P. Mitchell**, T. Kelley. “Galactic Outflows, Star Formation Histories, and Timescales in Starburst Dwarf Galaxies from STARBIRDS.” *Monthly Notices of the Royal Astronomical Society* **477**, Issue 3, 1 January 1753, 3164-3177 (2018).
- [3] D. E. Nitz, J. J. Curry, M. Buuck, A. DeMann, **N. P. Mitchell**, W. Shull, “Transition Probabilities of Ce I Obtained from Boltzmann Analysis of Visible and Near-Infrared Emission Spectra.” *Journal of Physics B: Atomic, Molecular and Optical Physics* **51** 045007 (2018).
- [2] K. B. W. McQuinn, E. D. Skillman, A. E. Dolphin, **N. P. Mitchell**. “Calibrating UV Star Formation Rates for Dwarf Galaxies From STARBIRDS.” *The Astrophysical Journal* **808** 109 (2015).
- [1] K. B. W. McQuinn, **N. P. Mitchell**, E. D. Skillman. “The Panchromatic Starburst Irregular Dwarf Survey (STARBIRDS): Observations and Data Archive”, *The Astrophysical Journal Supplement Series* **218** 29 (2015).
Data archive published in the *Mikulski Archive for Space Telescopes (MAST)* (2015).

In preparation

- N. P. Mitchell**, D. J. Cislo, S. Shankar, I. B. Breinyn, Z. Dogic, B. I. Shraiman, S. J. Streichan, “Muscle-driven convergent extension drives folding in organogenesis.”
- N. P. Mitchell**, M. F. Lefebvre, V. Jain-Sharma, B. I. Shraiman, E. F. Wieschaus, S. J. Streichan, “Dynamic atlas for drosophila morphogenesis.”
- N. P. Mitchell**, D. J. Cislo. "TubULAR: an analysis package for morphing tube-like tissues." M. F. Lefebvre, N. Claussen, N. P. Mitchell, B. I. Shraiman, E. F. Wieschaus, S. J. Streichan, “Eulerian sourcing of myosin governs tissue flow in germ band extension.”
- A. Khanra, L. L. Jia, **N. P. Mitchell**, A. Balchunas, R. A. Pelcovits, T. R. Powers, Z. Dogic, P. Sharma. “Topological folding of colloidal membranes through control of the Gaussian curvature modulus”
- T. Matsuzawa, **N. P. Mitchell**, S. Perrard, W. T. M. Irvine. “Realization of Confined Turbulence Through Multiple Vortex Ring Collisions.”

Harvard University WAM Seminar. Cambridge, MA. *Nov 10, 2021*. "Visceral organ morphogenesis via calcium-patterned muscle contractions."

UC Santa Barbara MCDB-BMSE Retreat. Santa Barbara, CA. *October 23, 2021*. "Multi-scale mechanical interactions across layers drive folding morphogenesis in the gut."

GRC Stochastic Physics in Biology. Ventura, CA. *October 11, 2021*. "Active Folding Via Bilayer Morphogenesis In Vivo."

KITP Big Ideas Public Seminar. *Nov 18, 2020*. "Physics of form in living matter."

Emory University YEP colloquium. *July 7, 2020*. "Tissue folding in a developing organ."

ETH Zürich, Switzerland. *April 17, 2018*. "Fracture in sheets draped on curved surfaces."

University of Washington. *August 31, 2018*. "Spinning topology in ordered and amorphous metamaterials."

ETH Zürich, Switzerland. *April 19, 2018*. "Spinning topology in ordered and amorphous metamaterials."

New York University, NY. *April 11, 2018*. "Spinning topology in ordered and amorphous metamaterials."

University of California Santa Barbara, CA. *March 29, 2018*. "Spinning topology in ordered and amorphous metamaterials."

Cornell University LASSP Seminar, NY. *March 22, 2018*. "Spinning topology in ordered and amorphous metamaterials."

Syracuse University, NY. *March 19, 2018*. "Spinning topology in ordered and amorphous metamaterials."

Stanford University, CA. *March 1, 2018*. "Spinning topology in ordered and amorphous metamaterials."

University of Chicago JFI Friday Seminar. *August 25, 2017*. "Chiral waves from spinning tops: topology without long-range order."

University of Chicago JFI Friday Seminar. *May 15, 2015*. "Guiding Cracks with Geometry."

St. Olaf College Physics Colloquium Series, MN. *April 29, 2015*. "Guiding Cracks with Geometry."

Chicago Soft/Meta Matter Conference. *September 30, 2014*. "Geometrically Frustrated Fracture Mechanics."

Conference Talks

N. P. Mitchell, D. Cislo, S. Shankar, Z. Dogic, B. Shraiman, S. Striechan, "Patterned shear drives folding during organogenesis." Virtual APS March Meeting. *March 18, 2021*.

T. Matsuzawa, **N. P. Mitchell**, S. Perrard, W. T. M. Irvine. "Creation of an isolated turbulent blob sustained by vortex ring injection." Virtual APS March Meeting. *March 17, 2021*.

Z. Dogic, B. L. Lemma, **N. P. Mitchell**, R. Subramanian, D. Needleman. "Phase diagram of microtubule and end-directed motor proteins." *March 15, 2021*.

N. P. Mitchell, D. Cislo, S. Shankar, Z. Dogic, B. Shraiman, S. Striechan, "Active folding and coiling *in vivo*." Virtual APS March Meeting. *March 5, 2020*.

T. Matsuzawa, **N. P. Mitchell**, S. Perrard, W. T. M. Irvine. "Realization of Confined Turbulence Through Multiple Vortex Ring Collisions." APS March Meeting. Boston, MA. *March 2019*.

N. P. Mitchell, L. M. Nash, W. T. M. Irvine. "Realization of a Topological Phase Transition in a Gyroscopic Lattice." APS March Meeting. Los Angeles, CA. *March 6, 2018*.

N. P. Mitchell, L. M. Nash, D. Hexner, A. M. Turner, W. T. M. Irvine. "Amorphous Topological Insulators Constructed from Random Point Sets." APS March Meeting. Los Angeles, CA. *March 6, 2018*.

N. P. Mitchell, L. M. Nash, D. Hexner, A. M. Turner, W. T. M. Irvine. "Amorphous Gyroscopic Topological Metamaterials." APS March Meeting. New Orleans, LA. *March 13, 2017*.

- N. P. Mitchell**, V. Koning, V. Vitelli, W. T. M. Irvine. “Fracture in Sheets Draped on Curved Surfaces.” APS March Meeting. Baltimore, MD. *March 15, 2016*.
- N. P. Mitchell**, V. Koning, V. Vitelli, W. T. M. Irvine. “Geometrically Frustrated Fracture Mechanics.” APS March Meeting. San Antonio, TX. *March 3, 2015*.
- N. P. Mitchell**, V. Koning, V. Vitelli, W. T. M. Irvine. “Fracture on Curved Surfaces.” APS March Meeting 2014. Denver, CO. *March 5, 2014*.
- N. P. Mitchell**, K. B. W. McQuinn, E. D. Skillman. “UV-derived Star Formation Rates in Nearby Starburst Dwarf Galaxies.” Physics at University of Minnesota Expo. Minneapolis, MN. *August 10, 2011*.

Poster Presentations (selected)

- N. P. Mitchell**, D. Cislo, S. Shankar, Y. Lin, B. I. Shraiman, S. J. Streichan. "Morphing an organ via calcium signaling in muscles". Gordon Research Seminar & Conference. Ventura, CA. Oct 10-16, 2021.
- N. P. Mitchell**, L. M. Nash, D. Hexner, A. M. Turner, W. T. M. Irvine. “Topological phase transitions in ordered and amorphous gyroscopic metamaterials.” Gordon Research Conference: Soft Condensed Matter Physics. New London, NH. *Aug 11-16, 2019*.
- N. P. Mitchell**, R. L. Carey, J. Hannah, Y. Wang, M. Cortes Ruiz, S. P. McBride, X. Lin, H. M. Jaeger, “Conforming nanoparticle sheets to surfaces with Gaussian curvature.” Gordon Research Seminar & Conference: Complex Active and Adaptive Material Systems. Ventura, CA. *January 23 - February 1, 2019*.
- N. P. Mitchell**, L. M. Nash, D. Hexner, A. M. Turner, W. T. M. Irvine. “Amorphous Gyroscopic Topological Insulators.” Gordon Research Conference. New London, NH. *August 12-18, 2017*. Won prize for **best poster**. Won **Winstein Travel Prize** to attend.
- N. P. Mitchell**, V. Koning, V. Vitelli, W. T. M. Irvine. “Fracture in Sheets Draped on Curved Surfaces.”
- Industry Associates Meeting at the University of Chicago. Chicago, IL. *October 27, 2016*.
 - Physics and Mechanics of Soft Complex Materials, Institut d’Études Scientifiques de Carthage. *August 8-20, 2016*. Won **Winstein Travel Prize** to attend.
- N. P. Mitchell**, K. B. W. McQuinn, E. D. Skillman. “UV derived Star Formation Rates and Emission Timescale in Nearby Starburst Dwarf Galaxies.”
- 79th Annual Meeting of the Minnesota Academy of Science. Northfield, MN. *January 21, 2012*.
 - American Astronomical Society Meeting. Austin, TX. *January 8-12, 2012*.
- N. P. Mitchell**, M. Buuck, D. E. Nitz. “Measurement of Atomic Transition Probabilities for Neutral Cerium.”
- St. Olaf Science Symposium. Northfield, MN. *May 6, 2011*.
 - Midstates Consortium for Math and Science at Washington University in St. Louis. St. Louis, MO. *November 12-14, 2010*.

Teaching

Kavli Institute for Theoretical Physics, UC Santa Barbara

- Instructor Image Analysis for Quantitative Biology, July 24-25, 2019
- Department of Physics, UC Santa Barbara**
- Guest Lecturer Introductory Physics (PHYS 6), Dec. 5, 2019
“Resistor Networks & RC Circuits”
- Guest Lecturer Advanced Classical Mechanics (PHYS 104), March 6, 2019
“Liouville’s Theorem and Poisson Brackets”
- Department of Physics, The University of Chicago**
- Grader Soft Condensed Matter (PHYS 367), Winter 2018
- T.A. Experimental Physics (PHYS 211), Autumn 2016
- T.A. Electronics (PHYS 226), Spring 2016
- Grader Advanced Electrodynamics (PHYS 322), Winter 2016
- T.A. Advanced Electrodynamics (PHYS 322), Winter 2015
- T.A. Experimental Physics (PHYS 211), Spring 2014
- T.A. Optics and Waves (PHYS 133), Spring 2013
- T.A. Electricity and Magnetism (PHYS 132), Winter 2013
- T.A. Mechanics (PHYS 131), Fall 2012
- Department of Physics, St. Olaf College**
- Guest Lecturer Statistical Mechanics (PHYS 379), April 29, 2015
“Entropy-driven self-assembly”
- T.A. Introductory Astronomy (PHYS 112), Spring 2012
- T.A. Principles of Physics I (PHYS 124), Fall 2011
- Grader Principles of Physics II (PHYS 125), Spring 2010

Students Supervised

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| Isaac Breinyn. Undergraduate researcher, 2019-2020. | <i>After:</i> Princeton PhD |
| Jingyang Zheng. REU, 2016. | <i>After:</i> Cornell PhD |
| Maria Cortes Ruiz. REU, 2015. | <i>After:</i> scientist at Corning Glass |
| Jacob Mazor. Undergraduate researcher, 2015. | <i>After:</i> Stony Brook PhD |
| Apostolos Apostolou. Undergraduate researcher, 2014. | <i>After:</i> private sector |

Extended Stays

Princeton University, Wieschaus Lab, September 2019

Workshops

- Symmetry, Thermodynamics, & Topology in Active Matter. KITP. *March-May 2020*. **Discussion Leader.**
- Gordon Research Seminar & Conference: Soft Condensed Matter Physics. New London, NH. *Aug 10-16, 2019*. **Chair** for associated GRS.
- Morphogenesis in Animals and Plants: Search for Principles. *July 22 - Aug 23, 2019*. **Instructor.**
- Gordon Research Seminar & Conference: Complex Active and Adaptive Material Systems. Ventura, CA. *January 23 - February 1, 2019*. **Session Chair** for GRS.
- Illinois Soft Materials Workshop. University of Illinois at Urbana-Champaign. *June 6, 2018*.
- Gordon Research Seminar & Conference: Soft Condensed Matter Physics. New London, NH. *Aug 12-18, 2017*.
- Physics and Mechanics of Soft Complex Materials, Institut d’Études Scientifiques de Cargèse. Cargèse, France. *August 8-20, 2016*.
- Topological Matter at H-Zero, Lorenz Center at University of Leiden. *May 9-13, 2016*.
- Crafting the Lecture: A Student-Centered Approach, UChicago GRAD. *April 14, 2016*.

Dark Matter Detectors Summer School, KICP and Fermilab. *July 2012.*

In the News

Topological Metamaterials

Phys.org, Space Daily, ChemEurope, Science Newslane, Nanowerk Nanotechnology News, AAAS EurekAlert

Fracture

K. Kamrin, “Elastic Sheets: Cracks by Design.” *Nature Materials* **16**, 8-9 (2017)
“Physicists find way to control fractures.” University of Leiden News, October 2016.

Astrophysics

J. Hargis. “High Level Science Products: The STARBurst IRregular Dwarf Survey (STARBIRDS).” *MAST News*, April 2017.

Honor Societies

Phi Beta Kappa 2012

Sigma Pi Sigma (*Society of Physics Students' Honor Society*) 2011

National Merit Finalist 2008

National Honor Society 2007, Saint Louis University High School chapter

Service & Outreach

Reviewer

Soft Matter, Physical Review Letters, Physical Review X, Physical Review E, Physical Review B, Physical Review Research, Physical Review Applied, ACS Nano, New Journal of Physics, Extreme Mechanics Letters, PNAS

Chair / Organizer

Symmetries in Morphogenesis KITP Monthly Seminar *2021*.

Symmetries in Morphogenesis KITP Conference *October 21-22, 2020*.

Gordon Research Seminar: Soft Condensed Matter Physics. *Aug 10-11, 2019*.

Session Chair

APS March Meeting 2020 (Virtual session, held via Zoom). “Active Matter in Living Matter” *March 5, 2020*.

Gordon Research Seminar: Complex Active and Adaptive Material Systems, “Polymers with Personality.” *January 26, 2019*.

APS March Meeting 2014, Session M17: Fracture and Other Problems in Statistical Physics. *March 5, 2014*.

Panelist

Extreme Mechanics Letters Seminar 2021 (Virtual session, held via Zoom). *September 15, 2021*.

KITP Outreach Programs: Big Ideas Talk (Nov 2020), Coffee with a Scientist (July 2, 2020),

Group Leader, Expanding Your Horizons symposium for middle-school girls. *March 2017*.

Instructor, Artifice Tech Education Program, *Fall 2015 – Spring 2016, weekly*.

Co-led after school courses on coding, electronics, and robotics for ages 12-15 at UChicago Woodlawn Charter School.

Instructor, Science and Technology Outreach Mentoring Program, *Oct. 2014-June 2015, weekly*.

STOMP staffs the science component of an after-school program at the North Kenwood Oakland (NKO) and Donoghue elementary schools. Instructors design engaging education science and technology activities for student in K-5th grade.

Organizer and Instructor, Bike Physics With A Bang! *June-July 2015, July 2016*.

Using bicycles as a centerpiece for demonstrating the principles of physics, this program targets underprivileged preteens on Chicago's South Side. Activities explore energy, angular momentum, pressure, and concepts from materials science. (Four sessions / year)

Exhibitor, *The Art of Science*, Second Friday Pilsen Art Show.

Science-based visual art show

Prize Winner, Science Art Show, Feb. 25, 2016.

Finalist in competition of science-based art

Participant, Interdivisional Science-Art Show, June 4, 2015.

Exhibition of science-based art

Demonstrator

- *Physics With A Bang!* at University of Chicago, 2012-present, one day annually.
Annual open house for students, families, and teachers. Lab tours offer participation in hands-on activities related to their research.
- Young Scholar's Program, 2013-2016, one day annually.
The Young Scholars Program offers mathematically talented seventh through twelfth graders an opportunity to explore mathematics that are not generally taught in schools
- Science Night at Lee Elementary, "Fun with Marangoni Flows." October 2, 2014.
- Women in Physics Conference, U. Chicago, January 18, 2014.
- *Science on the Screen* at U. Chicago, April 21, 2013.

Science Fair Judge, Harte Elementary School, Nov 6, 2013.

Volunteer, *Science Club*, Andrew Carnegie Elementary School, 2013-2014, monthly.

Physics Dept. Mentor to first-year physics majors at St. Olaf College, 2011-12.

Research Assistant preparing the manuscript of *The Image in Mind* by Prof. Charles Taliaferro (philosophy of science) St. Olaf College: Northfield, MN. Winter 2010.

Director of the Nature and Astronomy Center at Many Point Scout Camp, Ponsford, MN, June – August 2009.

Non-science

Composer, numerous chamber ensemble performances & albums.

Music performance in venues across the US, including with John Rutter, Nina Nastasia, David Hagedorn, & many others.

Musical accompanist for Dance Department, St Olaf College, 2008-2012.

Music theory & guitar instructor, eight weekly students, 2005-2008.

References

Prof Boris Shraiman

Susan F Gurley Professor of Theoretical Physics and Biology

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