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

Education & Training

2018 Ph.D. **University of Chicago**, Physics
Advisor: William T. M. Irvine
Topics: Fracture mechanics, topological materials, nanoparticle monolayers, and fluid 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
Topic: Star formation in dwarf galaxies, galactic winds

2012 B.A. **St. Olaf College**, Physics, *summa cum laude, with distinction*
Mentor: David Nitz
Topic: 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 ..... summer 2013
Wentzel Teaching Prize, 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, top academic scholarship, St. Olaf College 2008-2012
National Merit Scholarship 2008-2012

Publications

Biophysics & Condensed Matter

[17] **N. P. Mitchell***, M. F. Levebvre*, V. Jain-Sharma*, N. Claussen, M. K. Raich, H. J. Gustafson, A. R. Bausch, S. J. Streichan. "Morphodynamic atlas of Drosophila development." bioRxiv (2022). **equal contribution*

[16] **N. P. Mitchell**, D. J. Cislo. "TubULAR: Tracking deformations of dynamic tissues and

interfaces in 3D." bioRxiv doi.org/10.1101/2022.04.19.488840 (2022).

[15] A. Khanra, L. L. Jia, **N. P. Mitchell**, A. Balchunas, R. A. Pelcovits, T. R. Powers, Z. Dogic, P. Sharma. "Controlling the shape and topology of two-component colloidal membranes" arxiv/2203.07133 (2022).

[14] M. F. Lefebvre*, N. H. Claussen*, **N. P. Mitchell**, H. J. Gustafson, S. J. Streichan, "Geometric control of Myosin-II orientation during axis elongation." bioRxiv doi.org/10.1101/2022.01.12.476069 (2022).

[13] **N. P. Mitchell**, D. J. Cislo, S. Shankar, Y. Lin, B. I. Shraiman, S. J. Streichan. "Visceral organ morphogenesis via calcium-patterned muscle contractions." bioRxiv doi.org/10.1101/2021.11.07.467658 (2021).

[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). **equal contribution*

[8] **N. P. Mitchell**, L. M. Nash, W. T. M. Irvine. "Tunable Band Topology in Gyroscopic Lattices." *Physical Review B* **98**, 174301 (2018).

- *Featured in:* Middleton, C."Topological insulators: from graphene to gyroscopes." *Physics Today* 10.1063/pt.6.3.20181127a (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* **97**, 100302(R) (2018).

- *Featured in:* Middleton, C."Topological insulators: from graphene to gyroscopes." *Physics Today* 10.1063/pt.6.3.20181127a (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).

- *Featured in:* Middleton, C."Topological insulators: from graphene to gyroscopes." *Physics Today* 10.1063/pt.6.3.20181127a (2018)
- *Featured in: Phys.org, Space Daily, ChemEurope, Science Newsline, Nanowerk Nanotechnology News, AAAS EurekAlert*

[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).

- *Featured article:* K. Kamrin, "Elastic Sheets: Cracks by Design." *Nature Materials* **16**, 8-9 (2017).
- *Featured in: University of Leiden News*, October 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, 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).

- *Featured in:* J. Hargis. "High Level Science Products: The STARBurst IRregular Dwarf Survey (STARBIRDS)." *MAST News,* April 2017.

In preparation

N. P. Mitchell, M. F. Lefebvre, V. Jain-Sharma, *et al*., S. J. Streichan, "Dynamic atlas for Drosophila morphogenesis."

T. Matsuzawa, **N. P. Mitchell**, S. Perrard, W. T. M. Irvine. "Creation of an isolated turbulent blob fed by the injection of vortex loops."

Invited Seminars

GSA Drosophila Research Conference. San Diego, CA. *April 9, 202*2. "Visceral organ morphogenesis via calcium-patterned muscle constrictions."

Princeton/CUNY Physics of Life Symposium. New York, NY. *March 25, 202*2. "Visceral organ morphogenesis via calcium-patterned muscle constrictions."

BPPB Seminar. Virtual. *January 21, 202*2. "Visceral organ morphogenesis via calcium-patterned muscle constrictions."

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

UC Santa Barbara MCDB-BMSE. 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."

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."

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

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. Chicago, IL. *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 Cargèse. *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

Rémi Boros. Graduate researcher [UCSB] 2019-present	
Yuzheng Lin. Undergraduate researcher [UCSB] 2019-2022	*After:* Princeton PhD
Bezia Lemma. Graduate researcher [Harvard/UCSB] 2019-2021	*After:* Princeton Pdoc
Isaac Breinyn. Undergraduate researcher [UCSB] 2019-2020	*After:* Princeton PhD
Jingyang Zheng. REU [Chicago] 2016	*After:* Cornell PhD
Maria Cortes Ruiz. REU [Chicago] 2015	*After:* Corning, KTH PhD
Jacob Mazor. Undergraduate researcher [Chicago] 2015	*After:* Stony Brook PhD
Apostolos Apostolou. Undergraduate researcher [Chicago] 2014	*After:* 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*.

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

Reviews of Modern Physics, Cells & Development, 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 & four albums.
Music performance in venues across the US, including with John Rutter, Nina Nastasia, David Hagedorn, & Ellen Fullman.
Musical accompanist for Dance Department, St Olaf College, 2008-2012.
Music theory & guitar instructor, eight weekly students, 2005-2008.

References

Prof Boris Shraiman
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