# Bezia Laderman Lemma

*NSF PRFB Fellow - Princeton*

*BezL@princeton.edu*
*www.bezialemma.com*
*github.com/bezlemma*

## Research Interests

**Biophysics — Active Matter — Tissue Morphogenesis — Energy Metabolism**
My research integrates physical approaches with developmental biology to understand the chemical and mechanical energy landscape of tissues. I combine microscopy, computational modeling, and experimental manipulation to reveal fundamental principles of biological self-organization across scales—from molecular motors to developing organs.

## Academic Appointments

Present **Postdoctoral Fellow**, *Princeton University*, Mentors: Celeste Nelson & Andrej Košmrlj
Department of Chemical & Biological Engineering

## Education

2021 **Ph.D. Physics**, *Harvard*, Advisors: Daniel Needleman & Zvonimir Dogic
*Hierarchical phases of filamentary active matter.*

2015 **M.Sc. Engineering Physics**, *Universiteit Gent*, Advisor: Daniele Del Sarto
*Helicity conservation in the dynamical evolution of magnetic flux tubes.*

2013 **B.S. Physics**, *NYU*, Advisor: Paul Chaikin

## Fellowships

2023 **NSF** PRFB Fellowship, $240,000 for 3 years as postdoc

2015-2017 **Harvard** - Purcell, An Wang, and Wallace-Noyes Fellowships for 3 years as Ph.D.

2013 **European Union** - Erasmus Mundus, €48,000 for 2 years as M.Sc.

## Publications

Patterns of Mitochondrial ATP Predict Tissue Folding.
**Bezia Lemma**, Megan Rothstein, Marcus Kilwein, Pengfei Zhang, Bridget Waas, Anvitha Sudhakar, Safiya Topiwala, Sherry X. Zhang, Katharine Goodwin, Elizabeth R. Gavis, Ricardo Mallarino, Andrej Košmrlj, Celeste M. Nelson, *pre-print available*

Biophysical mechanisms of morphogenesis in lizard lungs.
Kaleb Hill*, Aaron Griffing*, Michael Palmer, **Bezia Lemma**, Aria Lupo, Tony Gamble, Natalia Shylo, Andrej Košmrlj, Paul Trainor, Celeste Nelson, *pre-print available*

Structure and dynamics of motor-driven microtubule bundles
**Bezia Lemma***, Linnea Lemma*, Stephanie Ems-McClung, Claire Walczak, Daniel Needleman, Zvonimir Dogic, *Soft Matter, doi.org/10.1039/D3SM01336G*, 2024

Spatial patterning of energy metabolism during tissue morphogenesis
**Bezia Lemma**, Celeste M. Nelson, *Current Opinion in Cell Biology, doi:10.1016/j.ceb.2023.102235*, 2023

Dissipation and energy propagation across scales of an active cytoskeletal material
Peter Foster*, Jinhye Bae*, **Bezia Lemma**, Juanjuan Zheng, William Ireland, Haitao Zhang, Pooja Chandrakar, Rémi Boros, Zvonimir Dogic, Daniel Needleman, Joost Vlassak, *PNAS, doi:10.1073/pnas.2207662120*, 2023

Plasticity in airway smooth muscle differentiation during mouse lung development
Katharine Goodwin, **Bezia Lemma**, Pengfei Zhang, Adam Boukind, Celeste M. Nelson *Developmental Cell, doi:10.1016/j.devcel.2023.02.002*, 2023

Origins of smooth muscle and evolutionary specializations of the pulmonary mesenchyme in the vertebrate lung
Katharine Goodwin*, Michael Palmer*, **Bezia Lemma**, Celeste M. Nelson *bioRxiv, doi:10.1101/2022.07.13.499952*, 2022

Active microphase separation in mixtures of microtubules and tip-accumulating molecular motors

**Bezia Lemma**, Noah Mitchell, Radhika Subramanian, Daniel Needleman, Zvonimir Dogic, *PRX, doi.org/10.1103/PhysRevX.12.031006*, 2022

Engineering stability, longevity, and miscibility of microtubule-based active fluids
Pooja Chandrakar, John Berezney, **Bezia Lemma**, Bernard Hishamunda, Angela Berry, Kun-Ta Wu, Radhika Subramanian, Johnson Chung, Daniel Needleman, Jeff Gelles, Zvonimir Dogic, *Soft Matter, doi:10.1039/D1SM01289D*, 2020

Self-straining of actively crosslinked microtubule networks
Sebastian Fürthauer, **Bezia Lemma**, Peter Foster, Stephanie Ems-McClung, Che-Hang Yu, Claire Walczak, Zvonimir Dogic, Daniel Needleman, Michael Shelley, *Nature Physics, doi:10.1038/s41567-019-0642-1*, 2019

Re-entrant solidification in polymer–colloid mixtures as a consequence of competing entropic and enthalpic attractions
Lang Feng*, **Bezia Laderman***, Stefano Sacanna, Paul Chaikin, *Nature Materials, doi:10.1038/nmat4109*, 2014

* indicates multiple first authors.

## Teaching

2025 **Guest Lecturer**, *Princeton*, Physical Basis of Disease
2023 **Assistant-in-Instruction**, *Princeton*, Physical Basis of Disease
2020 **Teaching Fellow**, *Harvard*, Science and Cooking - **Teaching Award**
2019 **Derek Bok Center Teaching Certificate**, *Harvard*
2017 **Teaching Fellow**, *Harvard*, Intro to Fluid Mechanics and Transport Processes - **Teaching Award**
2011 - 2013 **Course Tutor**, *NYU*, General Physics I & II

## Invited Presentations

**Hilde Mangold Plenary Session Speaker, SDB Annual Meeting**, Chicago, 2023 - **Presentation Award**
*Coupling energy metabolism to morphogenesis in the developing lung*

**Stower's Avian Meeting**, Kansas City, 2025
*Patterns of Mitochondrial ATP Predict Tissue Folding*

**SDB Northeast Regional Meeting**, Woods Hole, 2024 - **Presentation Award**
*Mitochondrial ATP and Apical Constriction during Tissue Morphogenesis*

**EMBO Workshop on Developmental metabolism**, Heidelberg, 2023
*Connections between energy metabolism and morphogenesis in the developing lung*

**Energy and Metabolism in Time and Space Subgroup, ASCB Annual Meeting**, Boston, 2023
*Patterning of mitochondrial energy metabolism during early avian lung morphogenesis*

## Presentations and Posters

2024 Poster at SDB Northeast Regional Meeting, Woods Hole - **Poster Award**
Coupling mitochondrial energy metabolism to branching morphogenesis in the developing avian lung
2024 Poster at BMSE Annual Meeting, Baltimore
Coupling mitochondrial energy metabolism to branching morphogenesis in the developing avian lung
2019 Poster at Soft Matter Gordon Research Conference, New London, NH
Structure and Dynamics of Polarity Sorting Filamentary Systems
2018 Presentation at Brandeis Bioinspired Soft Materials MRSEC Winter School, Bretton Woods, NH
Structure and Dynamics of Polarity Sorting Filamentary Systems
2018 Poster at Aspen Winter Conference for Active Matter, Aspen
Is the motion of microtubule and kinesin-14 bundles related to polarity?
2015 Poster at SPP-SO Workshop, Florence
Flux Rope Collision And Merging In The Inertial MHD Regime
2013 Presentation at American Physical Society, Baltimore
Temperature dependent depletion interaction from PEO and other polymers
2013 Poster at American Astronomical Society Meeting, Long Beach Time Series Photometry of Two Southern Hemisphere AM CVn Stars

## Mentoring

- Princeton Class of 2027 - **Camille Perez**, Undergraduate Student

- Princeton Class of 2026 - **Madison Draizin**, Undergraduate Student
- Auburn University Class of 2025 - **Jordan Clemmons**, REU Student, now PhD candidate at Princeton CBE
- UCSB PhD 2025 - **Rémi Boros**, Graduate Student
- Princeton Class of 2023 - **Safiya Topiwala**, Undergraduate Student, now MD candidate at Temple
- CSU Northridege Class of 2022 - **Diana Roman**, REU Student

## Outreach and Service

2023 Special Interest Subgroup organizer, American Society for Cellular Biology

2022 Science Day - Día de la Ciencia

2022 Summer research program for high school students - Princeton Learning Lab

2018-2021 Creator of, and writer for, LabOnTheCheap

2017 Lecture at Korea Science Academy of KAIST

2017 Group Discussion Leader for Waltham High School visit to STEM at Brandeis

2017 Nikon Small World In Motion, **Awardee**

2015 Co-Instructor for Science Class at 4th Presbyterian Church in South Boston

2011-2012 Host for 'The Doppler Effect' radio show on WNYU 89.1 FM.

## Employment and Research Experiences

2014 **SPbSPU** - Summer course on fusion technologies

2010 - 2013 **Senior Webmaster**, *Courant Institute*, New York, NY

2012 **NSF REU**, *CTIO*, La Serena, Chile, Advisor: Tim Abbott
Acquired photometry of cataclysmic variable star systems and determined their periodicity.

2012 **DAAD RISE**, *AICES*, RWTH Aachen, Germany, Advisors: Georg May and Aravind Balan
Implemented numerical shock-capturing schemes for a Discontinuous Galerkin fluid simulation.

2011 **U.S. DoE Summer Fellowship**, *INFN, LNS*, Sicilia, Italy, Advisor: Cettina Maiolino
Developed ROOT/GEANT4 code to fit scintillator signals of MEDEA in response to neutrons.

2008 - 2009 **Active Service**, *United States Air Force*, Colorado Springs, CO, USAFA

## References

- **Celeste M. Nelson**, Professor of Bioengineering, Princeton
  *Email: celesten@princeton.edu — Postdoctoral advisor*
- **Andrej Košmrlj**, Associate Professor of Mechanical and Aerospace Engineering, Princeton
  *Email: andrej@princeton.edu — Postdoctoral co-advisor*
- **Zvonimir Dogic**, Professor of Physics, UCSB
  *Email: zdogic@physics.ucsb.edu — PhD co-advisor*
- **Daniel Needleman**, Professor of Applied Physics and Molecular & Cellular Biology, Harvard
  *Email: dneedle@seas.harvard.edu — PhD co-advisor*
- **Radhika Subramanian**, Assistant Professor of Genetics, MGH/HMS
  *Email: radhika@molbio.mgh.harvard.edu — Research collaborator*