Bezia Laderman Lemma

NSF PRFB Fellow - Princeton

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github.com/bezlemma

Research Interests

Biophysics — Active Matter — Dev. Bio — Aging
My research integrates physical approaches with biology to understand organization across scales—from molecular motors to developing organs. I combine microscopy, computational modeling, and experimental manipulation to reveal the fundamental principles of biology

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

Employment

Present **Postdoctoral Fellow**, *Princeton University*, Mentors: Celeste Nelson & Andrej Košmrlj
Spatial patterning of mitochondrial ATP production in development

Present **CEO** - Gallusa, avian tools for rapid research.

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

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

Fellowships

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

2017 **Harvard** - Wallace-Noyes Fellowship

2016 **Harvard** - An Wang Fellowship

2015 **Harvard** - Purcell Fellowship

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

Research Experience

2025 **Postdoctoral Biology of Aging Summer Course**, *MBL*, Mentors: Carrie Adler
Characteriztion of pseudo-aged and immortality restored worms through behavioral assays.

2014 **Masters Fusion Technologies Summer Course**, *SPbSPU*

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

2012 **Undergraduate - German Exchange**, RWTH Aachen, Mentors: Georg May and Aravind Balan
Implemented numerical shock-capturing schemes for a Discontinuous Galerkin fluid simulation.

2011 **Undergraduate - DoE Fellowship**, *INFN, LNS*, Sicilia, Italy, Mentor: Cettina Maiolino
Developed ROOT/GEANT4 code to fit scintillator signals of MEDEA in response to neutrons.

Presentations

2026 **Society of Developmental Biology Ethel Browne Harvey Seminar Series**, Online
Patterns of Mitochondrial ATP Predict Tissue Folding

2026 Simon Fraser University, Colloquium
Patterning of bioenergetics predicts the folding of tissue

2026 Metabolism in Development and Physiology Series, Online Seminar Series
Patterns of Mitochondrial ATP Predict Tissue Folding

2025 Stowers Avian Meeting, Kansas City
Patterns of Mitochondrial ATP Predict Tissue Folding

2025 Cambridge Morphogenesis Seminar Series, Online Seminar Series
Coupling mitochondrial energy metabolism to branching morphogenesis in the developing avian lung

2024 Society of Developmental Biology Northeast Regional Meeting, Woods Hole - **Presentation Award**
Mitochondrial ATP and Apical Constriction during Tissue Morphogenesis

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

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

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

2018 Presentation at Brandeis Bioinspired Soft Materials MRSEC Winter School, Bretton Woods, NH
Structure and Dynamics of Polarity Sorting Filamentary Systems

2013 Presentation at American Physical Society, Baltimore
Temperature dependent depletion interaction from PEO and other polymers

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**
2013 **Course Tutor**, *NYU*, General Physics I & II
2012 **Course Tutor**, *NYU*, General Physics I

Mentoring

Madison Draizin, Undergraduate Student, Princeton ('26)
Anvitha Sudhakar, Graduate Student, Princeton ('25)
Jordan Clemmons, REU Student, now PhD candidate at Princeton
Rémi Boros, Graduate Student, UCSB PhD ('25)
Safiya Topiwala, Undergraduate Student, ('23)
Diana Roman, REU Student, CSU Northridege ('22)

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, *Science Advances, doi.org/10.1126/sciadv.aee6175, 2026*

Biophysical processes 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, *Developmental Dynamics, doi.org/10.1002/dvdy.70097, 2025*

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 *pre-print available:, 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.

Outreach and Service

Present	Creator and host, The Lemma Journal Club
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 and writer, LabOnTheCheap
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
2012	Host for 'The Doppler Effect' radio show on WNYU 89.1 FM.

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