

Daniel A. Beller

Curriculum Vitæ

Assistant Professor

Department of Physics and Astronomy
Johns Hopkins University
3400 N. Charles Street
Baltimore, MD 21218, USA

2022 -

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Prior positions

Assistant Professor Department of Physics, School of Natural Sciences University of California, Merced	2018 - 2021
Postdoctoral Research Associate School of Engineering Brown University Supervisor: Thomas R. Powers	2017 - 2018
Postdoctoral Research Fellow Harvard University Department of Physics Supervisor: David R. Nelson	2016 - 2017
George F. Carrier Post-Doctoral Fellow in Widely Applied Mathematics Harvard University School of Engineering and Applied Sciences	2014 - 2016

Education

Ph.D. in Physics and Astronomy University of Pennsylvania, Philadelphia, PA Advisor: Randall D. Kamien Thesis: "Controlling defects in nematic and smectic liquid crystals through boundary geometry"	2014
B.S. in Physics with highest honors, B.A. in Mathematics Brandeis University, Waltham, MA <i>Summa cum laude</i>	2010

Research Interests

Theory and simulation of soft matter and biological physics, including: liquid crystals, topological defects, active matter, 2D order and elasticity, plasticity, and biological population evolution.

Publications

Peer-Reviewed Publications

(* denotes shared first-author contribution)

35. J. Gonzalez Nuñez, J. Paulose, W. Möbius, D. A. Beller, "Range expansions across landscapes with quenched noise." *Proceedings of the National Academy of Sciences* **121**: e2411487121 (2024).
34. M. G. Athani, D. A. Beller, "Symmetry and stability of orientationally ordered collective motions of self-propelled, semiflexible filaments." *Physical Review Research* **6**: 023319 (2024).
33. A. Zakharov, D. A. Beller, "Sequences of dislocation reactions and helicity transformations in tubular crystals." *Physical Review Materials* **8**: 055601 (2024).

32. K. A. Mitchell, Md M. H. Sabbir, K. Geumhan, S. A. Smith, B. Klein, D. A. Beller. "Maximally mixing active nematics." *Physical Review E* **109**: 014606 (2024).
31. F. J. Schwarzendahl, D. A. Beller, "Do active nematic self-mixing dynamics help growing bacterial colonies to maintain local genetic diversity?" *Frontiers in Physics* **10**: 940980 (2022).
30. A. Zakharov, D. A. Beller, "Shape multistability in flexible tubular crystals through interactions of mobile dislocations." *Proceedings of the National Academy of Sciences* **119**: e2115423119 (2022).
29. S. Ettinger, C. F. Dietrich, C. K. Mishra, C. Miksch, D. A. Beller, P. J. Collings, and A. G. Yodh, "Rods in a lyotropic chromonic liquid crystal: Emergence of chirality, symmetry-breaking alignment, and caged angular diffusion." *Soft Matter* **18**: 487 (2021).
28. F. L. Memarian, J. D. Lopes, F. J. Schwarzendahl, M. G. Athani, N. Sarpangala, A. Gopinathan, D. A. Beller, K. Dasbiswas, L. S. Hirst. "Active nematic order and dynamic lane formation of microtubules driven by membrane bound diffusing motors." *Proceedings of the National Academy of Sciences* **118**: e2117107118 (2021).
27. N. Tanjeem, W. H. Wilkin, D. A. Beller, C. H. Rycroft, V. N. Manoharan, "Geometrical frustration and defect formation in growth of colloidal nanoparticle crystals on a cylinder: Implications for assembly of chiral nanomaterials." *ACS Applied Nano Materials* **4**: 10682 (2021).
26. J. X. Velez, Z. Zheng, D. A. Beller, F. Serra, "Emergence and stabilization of transient twisted defect structures in confined achiral liquid crystals at a phase transition." *Soft Matter* **17**: 3848 (2021).
25. G. Duclos, R. Adkins, D. Banerjee, M. S. E. Peterson, M. Varghese, I. Kolvin, A. Baskaran, R. A. Pelcovits, T. R. Powers, A. Baskaran, F. Toschi, M. F. Hagan, S. J. Streichan, V. Vitelli, D. A. Beller, Z. Dogic, "Topological structure and dynamics of three-dimensional active nematics." *Science* **367**: 1120 (2020).
24. D. M. Sussman, D. A. Beller, "Fast, scalable, and interactive software for Landau-de Gennes numerical modeling of nematic topological defects." *Frontiers in Physics* **7**: 204 (2019).
23. S. Chu, M. Kardar, D. R. Nelson, D. A. Beller, "Evolution in range expansions with competition at rough boundaries." *Journal of Theoretical Biology* **478**: 153 (2019).
22. G. Boniello, Y. Luo, D. A. Beller, F. Serra, K. J. Stebe, "Colloids in confined liquid crystals: a plot twist in the lock-and-key mechanism." *Soft Matter* **15**: 5220 (2019).
21. A. Suh, M.-J. Gim, D. Beller, D. K. Yoon, "Topological defects and geometric memory across the nematic-smectic A liquid crystal phase transition." *Soft Matter* **15**: 5835 (2019).
20. Y. Luo, D. A. Beller, G. Boniello, F. Serra, K. J. Stebe, "Tunable colloid trajectories in nematic liquid crystals near wavy walls." *Nature Communications* **9**: 3841 (2018).
19. D. A. Beller, K. M. J. Alards, F. Tesser, R. A. Mosna, F. Toschi, W. Möbius, "Evolution of populations expanding on curved surfaces." *Europhysics Letters (EPL)* **123**: 58005 (2018).
18. M. A. Gharbi, D. A. Beller, N. Sharifi Mood, R. Gupta, R. D. Kamien, S. Yang, K. J. Stebe, "Elastocapillary driven assembly of particles at free-standing smectic-A films." *Langmuir* **34**: 2006 (2018).
17. M.-J. Gim*, D. A. Beller*, D. K. Yoon, "Morphogenesis of liquid crystal topological defects during the nematic-smectic A phase transition." *Nature Communications* **8**: 15453 (2017).
16. Y. Luo, F. Serra, D. A. Beller, M. A. Gharbi, N. Li, S. Yang, R. D. Kamien, K. J. Stebe, "Around the corner: Colloidal assembly and wiring in groovy nematic cells." *Physical Review E* **93**: 032705 (2016).
15. Y. Xia, E. Lee, H. Hu, M. A. Gharbi, D. A. Beller, E.-K. Fleischmann, R. D. Kamien, R. Zentel, S. Yang, "Better actuation through chemistry: Using surface coatings to create uniform director fields in nematic liquid crystal elastomers." *ACS Applied Materials & Interfaces* **8**: 12466 (2016).
14. L. Tran, M. O. Lavrentovich, D. A. Beller, N. Li, K. J. Stebe, R. D. Kamien, "Lassoing saddle splay and the geometrical control of topological defects." *Proceedings of the National Academy of Sciences* **113**: 7106 (2016).
13. D. A. Beller, D. R. Nelson, "Plastic deformation of tubular crystals by dislocation glide." *Physical Review E* **94**: 033004 (2016).
12. D. A. Beller, M. A. Gharbi, I. B. Liu, "Shape-controlled orientation and assembly of colloids with sharp edges in nematic liquid crystals." *Soft Matter* **11**: 1078 (2015).
11. A. Honglawan, D. S. Kim, D. A. Beller, D. K. Yoon, M. A. Gharbi, K. J. Stebe, R. D. Kamien, S. Yang, "Synergistic assembly of nanoparticles in smectic liquid crystals." *Soft Matter* **11**: 7367 (2015).
10. M. A. Lohr, M. Cavallaro, D. A. Beller, K. J. Stebe, R. D. Kamien, P. J. Collings, A. G. Yodh, "Elasticity-dependent self-assembly of micro-templated chromonic liquid crystal films." *Soft Matter* **10**: 3477 (2014).
9. D. A. Beller, T. Machon, S. Čopar, D. M. Sussman, G. P. Alexander, R. D. Kamien, R. A. Mosna, "Geometry of the cholesteric phase." *Physical Review X* **4**: 031050 (2014).
8. M. Cavallaro*, M. A. Gharbi*, D. A. Beller*, S. Čopar, Z. Shi, T. Baumgart, S. Yang, R. D. Kamien, K. J. Stebe, "Exploiting imperfections in the bulk to direct assembly of surface colloids." *Proceedings of the National Academy of Sciences* **110**: 18804 (2013).

7. D. A. Beller*, M. A. Gharbi*, A. Honglawan*, K. J. Stebe, S. Yang, R. D. Kamien, "Focal conic flower textures at curved interfaces." *Physical Review X* **3**: 041026 (2013).
6. M. A. Gharbi, M. Cavallaro Jr., G. Wu, D. A. Beller, R. D. Kamien, S. Yang, K. J. Stebe, "Microbullet assembly: interactions of oriented dipoles in confined nematic liquid crystal." *Liquid Crystals* **40**: 1619 (2013).
5. M. Cavallaro Jr.*, M. A. Gharbi*, D. A. Beller*, S. Čopar, Z. Shi, R. D. Kamien, S. Yang, T. Baumgart, K. J. Stebe, "Ring around the colloid." *Soft Matter* **9**: 9099 (2013).
4. A. Honglawan*, D. Beller*, M. Cavallaro, R. Kamien, K. Stebe, S. Yang, "Topographically induced hierarchical assembly and geometrical transformation of focal conic domain arrays in smectic liquid crystals." *Proceedings of the National Academy of Sciences* **110**: 34 (2013).
3. R. Mosna, D. Beller, R. Kamien, "Breaking the rules for topological defects: Smectic order on conical substrates." *Physical Review E* **86**: 011707 (2012).
2. A. Honglawan, D. A. Beller, M. Cavallaro, R. D. Kamien, K. J. Stebe, S. Yang, "Pillar-assisted epitaxial assembly of toric focal conic domains of smectic-A liquid crystals." *Advanced Materials* **23**:5519 (2011).
1. E. Barry, D. Beller, Z. Dogic, "A model liquid crystalline system based on rodlike viruses with variable chirality and persistence length." *Soft Matter* **5**:2563 (2009).

Works under review or in revision

1. M. O'Keefe*, J. B. D. M. Garcia*, A. J. Rwakabuba, T. M. Otchy, D. A. Beller, M. A. Gharbi, "Templated self-assembly of gold nanoparticles in smectic liquid crystals confined at 3D printed curved surfaces." [arXiv 2306.01118 \(2023\)](#).
2. J. Gonzalez Nuñez, D. A. Beller, "Geometry-induced competitive release in a meta-population model of range expansions in disordered environments." [bioRxiv 2024.10.07.614155 \(2024\)](#).

Invited Commentaries

1. D.A. Beller, "Symmetry depends on scale in cellular monolayers." *Nature Physics* **19** 1767-1768 (2023).
2. M.A. Gharbi, D.A. Beller, A. Honglawan, K.J. Stebe, S. Yang, and R.D. Kamien, "Controlling liquid crystal defects." *SPIE Newsroom* (2014).

Funding

Active

NSF CAREER Award (8/1/2021 - 7/31/2026)

NSF DMR Condensed Matter and Materials Theory

Award number DMR-2225543 [\[link\]](#)

"*CAREER: Geometries of Topological Defects in 3D Nematics, from Equilibrium Structure to Active Dynamics*"

Past

Doctoral New Investigator Grant (9/1/2022 - 8/31/2024)

American Chemical Society Petroleum Research Fund

Award number: PRF # 65254-DN14 "*Stabilization of Multilamellar Onion Phases by Colloidal Particles*"

Hellman Fellows Award (7/1/2020 - 9/30/2021)

Hellman Fellows Fund

"*Modeling 3D Active Nematics Through their Topological Defects*"

Presentations

Public Science Lectures

Mesophases: The Physics of the In Between, All Around Us

Science for Humanity Series

Center for Cellular and Biomolecular Machines

University of California, Merced

May 12, 2021

Invited Talks since 2018

Time cholesterics and other emergent phenomena in active matter of semiflexible filaments

Brazilian Workshop on Soft Matter

São Paulo, Brazil

April 2025

<p><i>Understanding and visualizing complex topological defects in 3D active and passive nematics</i> APS March Meeting, Session "Liquid Crystals I" Anaheim, CA</p>	<p>March 2025</p>
<p><i>Emergent, decaying, and spinning nematic order in active filaments</i> Mid-Atlantic Soft Matter Workshop Washington, DC</p>	<p>February 2024</p>
<p><i>Evolution of active liquid crystals</i> Institute of Science and Technology Austria (ISTA) SLAM Seminar Vienna, Austria</p>	<p>July 2023</p>
<p><i>Evolution of active nematic order</i> Liquid Crystals Gordon Research Conference Manchester, NH</p>	<p>June 2023</p>
<p><i>The evolution of active matter with nematic order</i> Widely Applied Mathematics Seminar, Harvard University Cambridge, MA</p>	<p>April 2023</p>
<p><i>Order and defects in the dynamics of active soft matter</i> Physics Colloquium, Tufts University Medford, MA</p>	<p>February 2023</p>
<p><i>Liquid crystalline order and defects in 3D active soft matter</i> Materials Science and Engineering Seminar, Johns Hopkins University Baltimore, MD</p>	<p>January 2023</p>
<p><i>Do active nematic self-mixing dynamics help growing bacterial colonies maintain genetic diversity?</i> Biological Physics & Physical Biology Seminar Online</p>	<p>April 2022</p>
<p><i>Liquid crystalline order and defects in 3D active soft matter</i> Physics & Astronomy Colloquium, Johns Hopkins University Baltimore, MD</p>	<p>April 2022</p>
<p><i>Do active nematic self-mixing dynamics offer evolutionary benefits to growing bacterial colonies?</i> APS March Meeting, Focus Session M20 Chicago, IL</p>	<p>March 2022</p>
<p><i>Defect lines and loops in 3D active nematics</i> Active Matter Workshop, Telluride Science Research Center Telluride, CO</p>	<p>July 2021</p>
<p><i>Active Liquid Crystals and their Topological Defect Loops</i> Telluride Science Summer Lecture Series Online</p>	<p>June 2020</p>
<p><i>Topological defect structure and dynamics in 3D active nematics</i> Condensed Matter Seminar, Case Western Reserve University AMLCI/CPIP Seminar, Kent State University Condensed Matter Seminar, Johns Hopkins University</p>	<p>November 2019 November 2019 October 2019</p>
<p><i>Topological defect loops in liquid crystals far from equilibrium</i> Soft/Bio Seminar, University of California, Santa Barbara Physics & Astronomy Colloquium, San Francisco State University</p>	<p>April 2019 April 2019</p>
<p><i>Defect loops in 3D active nematics</i> APS March Meeting, Focus Session E61 Boston, MA</p>	<p>March 2019</p>
<p><i>Topological defect lines and loops in liquid crystals, in and far from equilibrium</i> Physics Colloquium, University of California, Merced</p>	<p>February 2019</p>
<p><i>Topological defect loops in liquid crystals, in and far from equilibrium</i> Physics Theory Seminar, University of Exeter, UK</p>	<p>January 2019</p>
<p><i>Defect loops in 3D active nematics</i> Workshop "Optimal design of complex materials", Isaac Newton Institute University of Cambridge, UK</p>	<p>January 2019</p>

Tubular crystals: How helical motion of defects plastically deforms cylindrical lattices
Fresno State University Physics Colloquium September 2018

Three-dimensional geometries of frustrated and active soft matter
"Geometry of Soft Matter" Workshop, International Institute of Physics
Natal, RN, Brazil May 2018

Frustration, defects, and geometric memory at a liquid crystal phase transition
Workshop on "Liquid Crystals, Soft-matter Packing, and Active Systems: Materials and Biological Applications,"
Institute for Mathematics and its Applications (IMA)
Minneapolis, MN January 2018

Tutorials

Free energy relaxation with finite differences
DSOFT Short Course on "Computing Soft Matter Across Scales", APS March Meeting
Las Vegas, NV March 2023

Liquid crystals in models and in reality
BIRS Workshop "Mathematical Analysis of Soft Matter"
Banff, Alberta, Canada July 2024

A 22.5-minute introduction to liquid crystals
International Soft Matter Conference – Young Investigators Workshop
Raleigh, NC July 2024

Honors and Awards

CAREER Award 2021
National Science Foundation

Brazil-U.S. Physics Ph.D. Student and Post-doc Visitation Program Award 2015, 2017
Sociedade Brasileira de Física and American Physical Society

Glenn H. Brown Prize (Thesis Prize) 2016
International Liquid Crystal Society

"For his outstanding theoretical work to identify the rich possibilities and outcomes of controlling defects in nematic and smectic liquid crystals under a variety of boundary conditions. The demonstration of the well controlled disclinations and focal conics is expected to open up a novel route for self-assembly in soft-ordered materials."

Elias Burstein Prize in Condensed Matter Physics 2013
University of Pennsylvania

Teece Fellowship 2013 - 2014
University of Pennsylvania

Werner B. Teutsch Prize 2011
University of Pennsylvania

Graduate Research Fellowship 2011
National Science Foundation

Stephan Berko Memorial Prize in Physics
Schiff Memorial Award in Science
Undergraduate Departmental Representative Award 2010
Brandeis University

Elihu A. Silver Prize for Undergraduate Research in Science 2009
Brandeis University

Norman S. Rabb Scholar, Justice Brandeis Scholar 2006 - 2010
Brandeis University

Maryland Distinguished Scholar 2006

Teaching

Johns Hopkins University

AS.171.406/622 Condensed Matter II
AS.171.105 Classical Mechanics I

Springs 2023, 2024
Falls 2022, 2023

University of California, Merced

PHYS 116 Mathematical Methods
PHYS 126 Special Relativity Minicourse
PHYS 138 Quantum Mechanics II Core
PHYS 205 Graduate Classical Mechanics

Fall 2021
Spring 2020 - 2021
Spring 2020 - 2021
Fall 2018 - 2020

University of Pennsylvania

Center for Teaching and Learning (CTL) Teaching Certificate

Spring 2014

Professional Activities

Current / Recent

Co-organizer: "Mathematical Analysis of Soft Matter" Workshop, Banff International Research Station June - July, 2024
Co-organizer: Soft, Living, Active, and Adaptive Matter (SLAAM) seminar series 2021 - present
Selection Committee: Soft & Living Matter Exchanges (SLiM-Ex) Awards, Institute for Complex Adaptive Matter 2022 - present
North American Regional Representative to the Board of Directors: International Liquid Crystal Society 2024 - present
Co-Chair (Tutorial Presenter and Mentor): Young Investigator Workshop, International Soft Matter Conference July 2024

Past

Membership Committee: Topical Group on Soft Matter, APS 2015 - 2019
Membership Committee Chair 2018 - 2019
Organizer: Widely Applied Mathematics (WAM) Seminar, Harvard University 2014 - 2016
Co-organizer: Gordon Research Conference on Liquid Crystals Student Session 2014 - 2016

Reviewer

Grant proposals: NSF Condensed Matter and Materials Theory; American Chemical Society Petroleum Research Fund.

Journals: *ACS Nano*; *Computer Physics Communications*; *Frontiers in Physics*; *Journal of Colloid and Interface Science*; *Nature Physics*; *New Journal of Physics*; *Nonlinearity*; *Physical Review E, X, Letters*, and *Research*; *Proceedings of the National Academy of Sciences*; *Proceedings of the Royal Society A*; *Soft Matter*.

STEM Outreach and Education

CCBM Virtual Sessions: "Introduction to computer simulations in physics, from forest fires to salad dressing."
University of California, Merced (online) Summers 2020 - 2024

Office of Undergraduate Research, Scholarly & Creative Activity: "Introduction to Data Science" and "Introduction to Python I & II"
Johns Hopkins University Summers 2022 - 2023

Cal-Bridge: Mentor to CSU Stanislaus undergraduate student 2020 - 2022

CREST Science and Computing Research Summer Program
University of California, Merced July 2019

"Dinner with a Scientist"
University of California, Merced March 2019

Instructor: "Crazy 8s" After-School Math Club
Cambridgeport School, Cambridge, MA 2016 - 2017

Visiting Scientist: "Einstein in the Classroom" (Cambridge Science Festival)
King K-8 School, Dorchester, MA

Spring 2015

Science demonstration leader, "Science at the Sixers" night
Wells Fargo Center, Philadelphia, PA

February 2014