

Zachary Gao Sun

Curriculum Vitae

Department of Physics

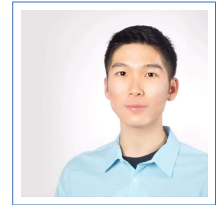
Yale University

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Education

- 2019–2025 **Ph.D., Physics**, *Yale University*, New Haven, CT.
Mechanics and Energetics of Cytoskeletal Assembly
- 2024.8–2025.1 **IvyExchange Ph.D. student**, *Harvard University*, Cambridge, MA.
- 2019–2022 : **Certificate in Yale Physical Engineering & Biology (PEB) program**, *Yale University*, New Haven, CT.
- 2019–2021 : **M.S.**, *Yale University*, New Haven, CT.
- 2019–2021 : **M.Phil.**, *Yale University*, New Haven, CT.
- 2015–2019 : **B.S. Physics Departmental Honors with Great Distinction**, *University of Massachusetts at Amherst*, Amherst, MA.
- 2015–2019 : **B.S. Astronomy Honors, Concentration in Astrophysics with Great Distinction**, *University of Massachusetts at Amherst*, Amherst, MA.
- 2015–2019 : **B.A. Linguistics and Psychology Honors, concentration in Phonology, Cognitive Psychology and Neuroscience with Great Distinction**, *University of Massachusetts at Amherst*, Amherst, MA.
- 2015–2019 : **Certificate in Integrative Concentration of Natural Science, concentration in Renewable Energy**, *University of Massachusetts at Amherst*, Amherst, MA.

Publications

Main areas of research

Physics of Living Systems, Cytoskeleton, Complex Systems, Active Matter, Rheology

Google Scholar: <https://scholar.google.com/citations?user=DkDwpcsAAAAJ&hl=en&oi=ao>

Journal Articles

- 2025.8 **Zachary Gao Sun**, Juanjuan Zheng, Joost Vlassak[†], and Michael Murrell[†]. Non-monotonicity in actomyosin network heat dissipation via F-actin architecture regulation. *(In Prep)*, 2025.8.
- 2025.8 **Zachary Gao Sun**, Juanjuan Zheng, Joost Vlassak[†], and Michael Murrell[†]. Non-monotonicity in actomyosin network heat dissipation via differential regulation and feedback of biological bonds. *(In Prep)*, 2025.8.
- 2025.8 **Zachary Gao Sun**, Mehrzad Sasanpour, Megan T. Valentine, Jennifer L. Ross, Michael Murrell, Ryan McGorty, and Rae M. Robertson-Anderson[†]. Active shearing of cytoskeleton composites is maximized at intermediate motor concentrations. *(In Prep)*, 2025.8.
- 2025.8 **Zachary Gao Sun**, Beatrice Nettuno, Davide Toffenetti, Priyanka Dutta, Bruce Goode, Erwin Frey[†], and Michael Murrell[†]. Synergistic feedback and regulation by cofilin-srv2/cap-profilin cycle creates in vitro actin waves and active nematic solid. *(In Prep)*, 2025.8.
- 2025.3 Sheng Chen[†], Matthew Ricci, A. Pasha Tabatabai, **Zachary Gao Sun**, Suraj Shankar, Mor Nitzan, and Michael P Murrell[†]. Topological control of spontaneous failure in active nematic solids. *(In review at Nature Materials)*, 2025.3.
- 2025.06 **Zachary Gao Sun**, Nathan Zimmerberg, Patrick Kelly, Carlos Floyd, Garegin Papoian, and Michael Murrell[†]. Feedback between F-actin organization and active stress govern criticality and energy localization in the cell cytoskeleton. *Nature Physics*, volume 21, page 1290–1302, 2025.06.
- 2024.11 **Zachary Gao Sun** and Michael Murrell[†]. Cofilin-mediated filament softening and crosslinking counterbalance to enhance actin network flexibility. *Physical Review Letters*, volume 133, page 218402. American Physical Society, 2024.11.

- 2024.10 Srishti Dar, Rubén Tesoro Moreno, Ivan Palaia, Anusha B. Gopalan, **Zachary Gao Sun**, Léanne Strauss, Richard R. Sprenger, Julio M. Belmonte, Sarah K. Foster, Michael Murrell, Christer S. Ejsing, Anđela Šarić, Maria Leptin, and Alba Diz-Muñoz[†]. Caging of membrane-to-cortex attachment proteins can trigger cellular symmetry breaking. (*In review at Cell*), *BioArxiv*: <https://doi.org/10.1101/2024.10.14.618153>, 2024.10.
- 2024.05 MS Yousafzai, S Amiri, **ZG Sun**, AA Pahlavan[†], and M Murrell[†]. Confinement induces internal flows in adherent cell aggregates. *Journal of the Royal Society Interface*, volume 21, page 20240105. The Royal Society, 2024.05.
- 2024.03 **Zachary Gao Sun**, Vikrant Yadav, Sorosh Amiri, Wenxiang Cao, Enrique M. De La Cruz, and Michael Murrell[†]. Cofilin-mediated actin filament network flexibility facilitates 2d to 3d actomyosin shape change. *European Journal of Cell Biology*, volume 103, page 151379. Urban & Fischer, 2024.03.
- 2022.11 Camelia G. Muresan*, **Zachary Gao Sun***, Vikrant Yadav, A. Pasha Tabatabai, Laura Lanier, June Hyung Kim, Taeyoon Kim, and Michael P. Murrell[†]. F-actin architecture determines constraints on myosin thick filament motion. *Nature Communications*, volume 13 (7008). Nature Publishing Group, **F1000 article**, 2022.11.
- 2022.08 Sheng Chen, **Zachary Gao Sun**, and Michael P Murrell. In vitro reconstitution of the actin cytoskeleton inside giant unilamellar vesicles. *JoVE (Journal of Visualized Experiments)*, volume 186, page e64026. MyJove Corp, 2022.08.

*: Equal contribution [†]: Corresponding author

Research Experience

Harvard University

August, 2025 – **Weitz lab: The origin of Liquid-Liquid phase separation in vimentin**, Visiting Postdoc.
December, 2025 In vivo and in vitro experiments on concentration-dependent LLPS and network properties of vimentin.

Advisor : **Dr. David A. Weitz**, Mallinckrodt Professor of Physics and of Applied Physics, Harvard University ([Lab Web-page](#))

Santa Fe Institute

June, 2025 – **Santa Fe Institute Complexity Science Summer School**, Projects 1. Collective Memory in Biological and Social Networks; Project 2: Entropy production and Criticality in Neuro-linguistics (manuscripts in prep).
July, 2025

Harvard University

August, 2024 – **Vlassak lab: Measuring energy dissipation in active matter**, IvyExchange/Collaboration.
January, 2025 Measure heat/energy dissipation in non-equilibrium systems.

Advisor : **Dr. Joost Vlassak**, Abbott and James Lawrence Professor of Materials Engineering, Harvard University ([Lab Web-page](#))

Yale University

June, 2019 – **Murrell lab: In vitro Active Matter & Non-equilibrium Dynamics**.
May, 2025 In vitro reconstituted cytoskeletal systems.

Advisor : **Dr. Michael P. Murrell**, Associate Professor, Department of Biomedical Engineering & Physics, Yale University ([Lab Web-page](#))

UMass Amherst

February, 2018 – **Tuominen's Physics lab on Self-organization**.
May, 2019 Formation patterns and non-equilibrium dynamical dissipative system.

Advisor : **Dr. Mark Tuominen**, Professor, Department of Physics & Associate Dean of College of Natural Science, UMass Amherst

Conferences & Talks

July 2025 **Q-BIO 2025 Conference: Emergent Orders in Living Systems Across Scales, Peking University, Beijing, China** Selected Contributed Talk: Feedback between F-actin organization and active stress govern criticality and energy localization in the cell cytoskeleton

March 2025 **Institute of Physics Physics of Life conference, UK** Early Career Talk: Feedback between F-actin organization and active stress govern criticality and energy localization in the cell cytoskeleton

- March 2025 **American Physical Society (APS) Global Physics Summit** ESME Prized Talk: Feedback between F-actin organization and active stress govern criticality and energy localization in the cell cytoskeleton
- February 2025 **Biophysical Society Annual Meeting** PCB Prized Talk: Feedback between F-actin organization and active stress govern criticality and energy localization in the cell cytoskeleton
- December 2024 **Yale PEB Discussion** Talk: Active Mechanics of the Cell Cytoskeleton
- December 2024 **Yale PEB Retreat** Invited Talk: Active Mechanics of the Cell Cytoskeleton
- November 2024 **MIT PLS Short Talk** Talk: Active Mechanics of the Cell Cytoskeleton
- April 2024 **Max Planck Institute Dresden: Physics of Life (IntCha24 Active Matter Workshop)** Poster: Cytoskeletal geometry and active stress orchestrate self-organized criticality in the cytoskeleton
- March 2024 **American Physical Society (APS) March Meeting** Contributed Talk: Cofilin concentration controls cofilactin gel stress response
- July 2023 **International Physics of Living System conference (iPoLS) Georgia Tech, Atlanta, GA, USA** Contributed Talk: F-actin architecture governs self-organized criticality in the cytoskeleton
- March 2023 **American Physical Society (APS) March Meeting** Contributed Talk: F-actin architecture governs self-organized criticality in the cytoskeleton
- November 2022 **Yale PEB Discussion** Talk: Self-organized criticality in the cytoskeleton
- April 2019 **National Undergraduate Physics Conference** Behavior of a Non-equilibrium Self-Organizing System: A Potential Means to Enhance Energy Efficiency in Systems with Functional Intelligence
- March 2019 **American Physical Society (APS) March Meeting** Poster: Behavior of a Non-equilibrium Self-Organizing System: A Potential Means to Enhance Energy Efficiency in Systems with Functional Intelligence

Fellowships & Awards

- March 2025 **American Physical Society Emerging Soft Matter Excellence Award** Selected to be one of the finalists for the Emerging Soft Matter Excellence (ESME) Award and give prized talk
- March 2025 **American Physical Society GSNP Junior Speaker Award (Declined)**
- February 2025 **Biophysical Society Physical Cell Biology Student Award** Selected to be the recipient for the Physical Cell Biology Student Award at BPS and give prized talk
- March 2024 **APS DBIO Travel Award** Selected to be one of the four students to receive fundings for attending APS conference to present talks
- May 2019 **iCons Honorary Lecture Award** Selected to be one of the four students to give lecture on Honors Thesis
- 2015-2019 **Chancellors Award, UMass Amherst** Awarded to International students with excellent academic standings
- Fall 2017 **Commonwealth Honors College Research Fellowship Award**(with maximum grant)5% Honors students who applied receive full grant
- 2018-2019 **Commonwealth Honors Research Grant** 5% Honors students who applied receive grant, but prioritizes students who work on Honors Thesis

Computer skills

Programming Languages Python, MATLAB, R, JAVA

Teaching fellowship

- Spring, 2022, 2021 & 2020 : **PHY182: Electromagnetism**, Yale University.
- Fall, 2020 & 2019 : **PHY181: Classical Mechanics**, Yale University.