Takumi Matsuzawa

CONTACT INFORMATION

Cornell University, 515 Clark Hall,
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EDUCATION

The University of Chicago, Chicago, IL 2016 - 2023
Ph.D., Physics, Dissertation: *Life, death, and propagation of turbulence*
Advisor: Prof. William T. M. Irvine

M.Sc., Physics, Project title: *Splashing of low-viscosity fluid* 2016 - 2017
Advisor: Prof. Sidney R. Nagel

Kalamazoo College, Kalamazoo, MI 2013 - 2016
B.A., Physics and Chemistry, *summa cum laude with distinction*
Advisor: Prof. Jan Tobochnik

RESEARCH APPOINTMENTS

Postdoctoral Associate, Ithaca, NY 2023 - present
Laboratory of Atomic and Solid State Physics, Cornell University
Supervisor: Prof. Eric R. Dufresne

FELLOWSHIPS AND PRIZES

Schmidt Science Fellowship, Schmidt Futures in partnership with the Rhodes Trust 2024 - 2026
Grainger Foundation Fellowship, The University of Chicago 2022 - 2023
Gallery of Fluid Motion Award, APS Division of Fluid Dynamics 2022
Sidney Nagel Prize for Creativity in Research, The University of Chicago 2020
Robert G. Sachs Fellowship, The University of Chicago 2016
John Wesley Hornbeck Prize for Excellence in Physics, Kalamazoo College 2016
Senior Leadership Recognition Award for Excellence in Teaching, Kalamazoo College 2016
Lee Teng Undergraduate Fellowship in Accelerator Science and Engineering, Fermilab 2015
The 39th Lower Michigan Mathematics Competition, 2nd Place 2015
AWS Fellowship for Science, Kalamazoo College 2014 - 2016

RESEARCH INTERESTS

Turbulence, vortex dynamics, soft condensed matter, biological physics, biomolecular condensate

PUBLICATIONS

Nonlinear diffusion and decay of an expanding turbulent Blob
Matsuzawa, T., Zhu, M., Goldenfeld, N., Irvine, W. T. M., (2025) (submitted)

Self-propulsion, flocking and chiral active phases from particles spinning at intermediate Reynolds numbers
Chen, P., Weady, S., Atis, S., **Matsuzawa, T.**, Shelly, M., Irvine, W. T. M, *Nature Physics*, (2024).[Link]

Turbulence through sustained vortex ring collisions
Matsuzawa, T., Mitchell, N. P., Perrard, S., Irvine, W. T. M., *Physical Review Fluids*, (2023).[Link]

Creation of an isolated turbulent blob fed by vortex rings
Matsuzawa, T., Mitchell, N. P., Perrard, S., Irvine, W. T. M., *Nature Physics*, (2023).[Link]
Featured articles:
"Smash-ups make a tame blob of turbulence" *Nature*, **617**, 655, (2023). [Link]
"An unexpected twist lights up the secrets of turbulence." *Quanta magazine*, (2020). [Link]

Turbulence can be sustained and controlled using coherent vortex rings
Matsuzawa, T., Irvine, W.T.M., *Nature Physics*, (2023). [Link]

Evaluating Machine Learning Models with NERO: Non-Equivariance Revealed on Orbits
Zhao, Z., **Matsuzawa, T.**, Irvine, W.T.M., Maire, M., Kindlmann, G. L. (under review with IEEE Transactions on Visualization and Computer Graphics) [Link]

Multi-scale modeling of altered synaptic plasticity related to amyloid β effects
Matsuzawa, T., Zalányi, L., Kiss, T. and Érdi, P., *Neural Networks*, 93, 230-239 (2017). [Link]

Connecting epilepsy and Alzheimer's disease: Modeling of normal and pathological rhythmicity and synaptic plasticity related to amyloid β effects.
Érdi, P., **Matsuzawa, T.**, John, T., Kiss, T. and Zalányi, L. In *Computational Neurology and Psychiatry*, pp. 93-120. Springer, Cham, (2017). [Link]

Selected Talks

Expanding into Quiescence: How Turbulence Spreads and Decays 2025
Soft Matter and Biological Physics Seminar Series, Syracuse University, Syracuse, NY

Life, death, and propagation of an isolated turbulent blob fed by vortex loops 2023
APS Division of Fluid Dynamics, Washington D.C.
APS March Meeting, Los Angeles, CA

Creation of an isolated turbulent blob sustained by vortex ring injection 2022
APS Division of Fluid Dynamics, Indianapolis, IN
APS March Meeting, Chicago, IL
Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan (Invited)

Confined turbulence through multiple vortex ring collision 2018, 2020-21
APS March Meeting, Virtual, (2021), APS Division of Fluid Dynamics, Virtual, (2020)
APS March Meeting, Boston, MA, (2018)

Selected Poster Presentations

Solutes shift phase equilibria of biomolecular condensates 2024
The 12th Liquid Matter Conference, Mainz, Germany [PDF]

Realization of confined turbulence through multiple vortex ring collision 2019
Simons Foundation workshop: Turbulence across vast scales, New York, NY [PDF]

Teaching Experience

Teaching assistant, The University of Chicago 2016 - 2019
Experimental Physics, Computational Physics with Python, Introductory Physics

Service and Outreach

Peer review: Nature Physics, European Journal of Mechanics - B/Fluids
Science outreach:
- **Special education aide**, private 2021 - 2024
Provide weekly educational support for a 9-year-old student with autistic spectral disorder
- **Physics With A Bang!**, MRSEC at University of Chicago 2019 - 2023
Guided lab tours and conducted scientific demonstrations about fluids in the event with nearly 700 visitors of all ages from all over Chicago
- **SMART science outreach program**, MRSEC at University of Chicago 2022
Communicated cutting-edge research in condensed matter physics to local high school students
Graduate and undergraduate mentor 2018 - present
Trained four graduate students on experimental apparatuses, and supervised three undergraduate students on the projects about 4D flow visualization and machine-learning vortex dynamics.

Technical Skills

Programming: Python (including NumPy, SciPy, Pandas, OpenCV, PyTorch, and Scikit-learn, matplotlib), Java, C, MATLAB, shell scripting, HTML, CSS

Software: Mathematica, Root, LabView, LAMMPS, Blender, Houdini, LaTeX, Git

Data analysis: Image processing, computer vision, machine learning (deep learning to predict an underlying flow field from images), Monte Carlo methods, parallel and distributed computing

Techniques: 2D particle tracking velocimetry, 3D particle tracking velocimetry, high-speed videography, 3D printing, machining, rheometry, electronics, confocal / epifluorescence microscopy, NMR spectroscopy, mass spectrometry, UV/VIS/NIR spectroscopy