
Benjamin A. Hyatt

NSF Graduate Research Fellow | PhD Candidate in Applied Mathematics
Curriculum Vitae

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RESEARCH AREAS

Applied and computational mathematics: numerical analysis | pseudospectral methods | multiscale time-integration and operator-splitting methods (IMEX, multirate, etc.) | high-performance computing | asymptotics and perturbation theory | dynamical systems

Geophysical and astrophysical fluid dynamics: turbulence, convection, waves, and vortices | rotating turbulence | polar regions of giant planets | stellar interiors | Earth systems modeling and simulation | numerical methods for simulating multiscale physics

EDUCATION

Ph.D. in Engineering Sciences and Applied Mathematics 2021–Present

Northwestern University

Advised by Daniel Lecoanet

Expected defense: Dec 2026–Mar 2027

M.S. in Engineering Sciences and Applied Mathematics 2021–2022

Northwestern University

3.96 GPA

B.S. in Mathematics, Minor in Physics, Minor in Philosophy 2017–2021

University of Maryland, Baltimore County (UMBC)

Advised by Muruhan Rathinam

4.00 GPA

FELLOWSHIPS, AWARDS, AND HONORS

NSF Graduate Research Fellowship—Northwestern ESAM 2023–2026

Outstanding Teaching Assistant—Northwestern ESAM 2022–2023

Walter P. Murphy Fellowship—Northwestern 2021–2022

Outstanding Graduating Senior in Mathematics—UMBC Mathematics 2021

Summa Cum Laude—UMBC 2021

Freeman A. Hrabowski President’s Advisory Council Scholarship—UMBC 2020

Undergraduate Research Award—UMBC 2019–2020

Undergraduate Merit Scholarship—UMBC 2017–2021

RESEARCH EXPERIENCE

NSF Graduate Research Fellow 2023–2026

Northwestern University

Graduate Research Intern Summer 2024

Lawrence Livermore National Laboratory: Center for Applied Scientific Computing

Mentored by Chris Vogl

— Benchmarked multiscale process coupling time-integration strategies for the E3SM Atmosphere Model

— Wrote internal technical report shared with PAESCAL SciDAC-5 Collaboration

— Presented results in talks (PAESCAL Collaboration and AGU25)

Undergraduate Research Assistant

Summer 2020

University of Maryland, Baltimore County (UMBC)

Mentored by Jinglai Shen

— Improved analytic stability bounds of autonomous car-following control algorithms

Undergraduate Research Assistant

2019–2020

University of Maryland, Baltimore County (UMBC)

Mentored by Prof. Muruhan Rathinam

— Developed reaction-diffusion model to predict the rate of release of solutes from hydrogels

— Validated model against experimental data using singular perturbation theory and numerical methods

Research Assistant

2018–2019

NASA Intern

Summer 2017, Summer 2018

ASPIRE Intern

2016–2017

Johns Hopkins University, Applied Physics Laboratory: Space Exploration Sector

Mentored by Carolyn Ernst

— Developed digital shape models of small solar system bodies in the Small Body Mapping Tool (SBMT)

— Applied shape models to probe surface morphologies for evidence of impact cratering histories

PEER-REVIEWED PUBLICATIONS

1. **Hyatt, B.A.**, Lecoanet, D., Anders, E.H., Burns, K.J., “Multiple scales analysis of a nonlinear timestepping instability in simulations of solitons”, *Journal of Computational Physics* 513, 113923 (2025). <https://doi.org/10.1016/j.jcp.2025.113923>.
2. Ballouz, R.L., Ernst, C.M., Barnouin, O.S., Daly, R.T., DellaGiustina, D.N., **Hyatt, B.A.**, Martin, A.C. “Seismic resurfacing of 433 Eros indicative of a highly dissipative interior for large near-Earth asteroids”. *Nat Astron* 9, 347–357 (2025). <https://doi.org/10.1038/s41550-024-02411-8>.
3. Anders, E.H., Lecoanet, D., Cantiello, M., Burns, K.J., **Hyatt, B.A.**, Kaufman, E.K., Townsend, R.H.D., Brown, B.P., Vasil, G.M., Oishi, J.S., Jermyn, A.S. “The photometric variability of massive stars due to gravity waves excited by core convection”. *Nat Astron* 7, 1228–1234 (2023). <https://doi.org/10.1038/s41550-023-02040-7>.
4. Ernst, C.M., Daly, R.T., Gaskell, R.W., Barnouin, O.S., Nair, H., **Hyatt, B.A.**, Al Asad, M.M., Hoch, K.K.W. “High-resolution shape models of Phobos and Deimos from stereophotoclinometry”. *Earth Planets Space* 75, 103 (2023). <https://doi.org/10.1186/s40623-023-01814-7>.
5. **Hyatt, B.**, Shen, J. “Stability Analysis of Model Predictive Control-Based Car-Following Control Under Linear Vehicle Dynamics”. *UMBC Review* 22, 161-189 (2021). (*Peer-reviewed article in UMBC journal of undergraduate research*)
6. Sheth, S., Barnard, E., **Hyatt, B.**, Rathinam, M., Zustiak, S.P. “Predicting Drug Release From Degradable Hydrogels Using Fluorescence Correlation Spectroscopy and Mathematical Modeling”. *Front. Bioeng. Biotechnol.* 7, 410 (2019). <https://doi.org/10.3389/fbioe.2019.00410>.

TECHNICAL REPORTS

1. **Hyatt, B.A.**, Vogl, C.J., “Process coupling strategies in a simplified aerosol model” (2024). *Technical report shared with PAESCAL SciDAC-5 Collaboration*.

WORKS IN-PREPARATION

1. **Hyatt, B.A.**, Frishman, A., Lecoanet, D., Das-Ghosh, A. “Circumpolar dynamics of large-scale vortices in rotating forced-dissipative turbulence”. *Planning to submit Fall 2026*.

HPC ALLOCATIONS

NSF ACCESS Discover Allocation — 1,500,000 CPU hours on Anvil (Purdue) “Polar vortices in differentially-rotating turbulence: formation and stability” (PI: B.A. Hyatt , Co-PI: D. Lecoanet)	2025–2026
NSF ACCESS Discover Allocation — 1,500,000 CPU hours on Anvil (Purdue) “Simulating the effects of rotation on convective boundary mixing in massive stars” (PI: B.A. Hyatt , Co-PI: D. Lecoanet)	2025

PRESENTATIONS

1. Friday Lunch Seminar, Dept of Astrophysical and Planetary Science, CU Boulder (Upcoming <u>Invited Talk</u>)	2026
2. AGU25 Annual Meeting — Contributed Talk “Polar vortex formation in differentially-rotating 2D disk turbulence”	2025
3. 78th APS Division of Fluid Dynamics Annual Meeting — Contributed Talk “Polar vortex formation in differentially-rotating 2D disk turbulence”	2025
4. SIAM Journal Club, Northwestern University — Contributed Talk “Polar vortex formation and differential rotation”	2025
5. AGU24 Annual Meeting — Contributed Poster “Error Analysis of Single and Multi-rate Temporal Coupling Approaches in a Simplified Aerosol System”	2024
6. SIAM Journal Club, Northwestern University — Contributed Talk “Process coupling strategies in a simplified aerosol model”	2024
7. PAESCAL SciDAC Group Meeting, LLNL — <u>Invited Talk</u> “Process coupling strategies in a simplified aerosol model”	2024
8. Summer SLAM, LLNL — Contributed Poster “Error Analysis of Single and Multi-rate Temporal Coupling Approaches in a Simplified Aerosol Model”	2024
9. 76th APS Division of Fluid Dynamics Annual Meeting — Contributed Talk “Timestepping stability in pseudospectral methods”	2023
10. 75th APS Division of Fluid Dynamics Annual Meeting — Contributed Talk “Relaxing timestep restrictions for numerical stability in DNS”	2022
11. Summer Undergraduate Research Festival, UMBC — Contributed Talk “Stability Analysis of Car-Following Control of Linear Vehicle Dynamics with General MPC Horizon”	2020
12. Undergraduate Research and Creative Achievement Day, UMBC — Contributed Poster “A Reaction-Diffusion PDE Model for Predicting Solute Release”	2020
13. NASA Intern Presentations, Johns Hopkins University Applied Physics Lab — Talks “Examining the Geologies and Shapes of Small Bodies in the Solar System”	2017, 2018

TEACHING

Graduate Teaching Assistantship Northwestern University 2022–2023, 2026

GEN_ENG 205-4 Engineering Analysis 4 (Fall 2026)

GEN_ENG 206-4 Honors Engineering Analysis 4 (Spring 2023)

ES_APPM 252–2 Honors Multivariable Calculus (Winter 2023)

ES_APPM 252–1 Honors Multivariable Calculus (Fall 2022)

Undergraduate Teaching Assistant UMBC 2019–2021

MATH 225 Differential Equations (Fall 2020 and Spring 2021)

PHYS 224 Vibrations and Waves (Spring 2020)

PHYS 324 Modern Physics (Fall 2019)

MENTORSHIP

1. Undergraduate research — Aishani Das-Ghosh (Northwestern, ESAM) 2025–Present
— Project: Dynamics of large-scale polar vortices in turbulence simulations in spherical geometry
— Student presented poster at 78th APS Division of Fluid Dynamics Annual Meeting (2025)
2. Post-baccalaureate research — Rivkah Moshe (Northwestern, Causeway Program) 2023–2024
— Project: convective adjustment in Rayleigh-Bénard-like convection simulations
— Student enrolled in PhD in Mathematics program at Purdue University
3. High-school research — Chloe Kim (Northwestern CIERA, REACH Program) Summer 2023
— Introduced local Evanston high school student to astrophysics research and Python programming
— Developed 3-week research project on Fourier transforms in Python to sonify asteroseismic data

SERVICE

1. Review sessions and presentations — Northwestern ESAM 2022, 2023, 2025
— Gave presentations to incoming first-year applied math PhD students
— Gave preliminary exam review sessions on multivariable vector calculus
2. Application review — Northwestern CIERA, REACH Program 2024, 2025, 2026
— Each year reviewed 25+ applications from high school students (out of ~ 200 local and international applicants each year) for acceptance into 3-6 week intensive summer program in astronomy, Python, and guided research
3. Committee work — Northwestern CIERA, Climate Action Team 2023–2024
— Served on committee to investigate workplace climate, representing graduate students
— Collaborated with third-party organization, Visceral Change, to conduct a workplace DEI climate survey, analyze results, and discuss the results in CIERA community town halls
— Led production of a final report of survey results and recommended action items, such as: drafting a code of conduct, establishing a social activity fund and an organizing for CIERA social events, and organizing future town halls for discussions between community and leadership