Vrutant V. Mehta

Curriculum Vitae

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Ph.D. Student, Engineering and Applied Sciences | UMass Dartmouth, North Dartmouth, MA

Research Interests

Stellar structure and evolution, thermonuclear (Type Ia) supernovae, nucleosynthesis, gamma-ray bursts, computational fluid dynamics, high-performance computing.

Education

University of Massachusetts Dartmouth, North Dartmouth, MA, USA — Sept. 2024 – Present
Ph.D. in Engineering and Applied Sciences
Advisor: Prof. Robert T. Fisher

University of Massachusetts Dartmouth, North Dartmouth, MA, USA — Jan. 2021 – Aug. 2023
M.S. in Physics
Thesis: *Simulations of Highly Neutronized Ejecta in the Supernova Remnant 3C 397*
Advisor: Prof. Robert T. Fisher

Indus University, Ahmedabad, Gujarat, India — Aug. 2015 – May 2019
B.Tech. in Mechanical Engineering

Publications

Published & Submitted.

1. **V. Mehta**, V. Tiwari, R. Pakmor, D. Singh, & R. Fisher, "Hydrodynamical Simulations of Helium-Ignited Binary White Dwarf Merger," arXiv:2602.23414 (submitted to *ApJ*), 2026.
2. **V. Mehta**, J. Sullivan, R. Fisher, Y. Ohshiro, H. Yamaguchi, K. Bhargava, & S. Neopane, "Hydrodynamical Simulations Reveal a Pure Deflagration Origin of the Near-Chandrasekhar Mass Supernova Remnant 3C 397," *MNRAS* **532**, 1087–1098, 2024.

In Preparation.

3. M. Jones, **V. Mehta**, R. Fisher, & A. Bobrick, "Simulations of Oxygen-Neon and Carbon-Oxygen White Dwarf Mergers in the Double-Degenerate Channel of Type Ia Supernovae," in prep.

Presentations & Invited Talks

247th Meeting of the American Astronomical Society — Jan. 2026
Hydrodynamical Simulations of Helium-Ignited Binary White Dwarf Merger — Phoenix, AZ

University of Connecticut – Astrophysics Seminar (invited) — Apr. 2025
Type Ia Supernovae from Helium-Ignited White Dwarf Mergers — Storrs, CT

American Physical Society – New England Section Fall Meeting — Oct. 2023
Hydrodynamical Simulations of Highly-Neutronized Ejecta in the Near-Chandrasekhar Mass Supernova Remnant 3C 397 — Kingston, RI

242nd Meeting of the American Astronomical Society — June 2023
Simulations of Neutron-Rich Ejecta of Supernova Remnant 3C 397 [iPoster] — Albuquerque, NM

Honors & Awards

- **Chambliss Astronomy Achievement Award** (Honorable Mention), AAS 242 — June 2023
- **Graduate Research Award**, UMass Dartmouth — Apr. 2023

Research Experience

Fisher Computational Astrophysics Group, UMass Dartmouth June 2021 – Present
Graduate Research Assistant — Advisor: Prof. Robert T. Fisher

Project 2: Helium-Ignited Binary White Dwarf Mergers 2024 – Present
Investigating thermonuclear explosion outcomes of helium-ignited sub-Chandrasekhar mass white dwarf mergers in the double-degenerate channel of Type Ia supernovae.

- Performed 3D hydrodynamical simulations of helium-ignited binary WD mergers using FLASH with AMR, mapping merger-phase initial conditions from the moving-mesh code AREPO; developed a custom refinement strategy reducing computational cost by ∼4–5×.
- Demonstrated multiple detonation outcomes across two models: a double detonation (D6) in which the secondary WD survives intact, and a quadruple detonation in which helium and core detonations propagate to the secondary, destroying both WDs — consistent with recent theoretical predictions for the dominant outcome of helium-ignited mergers.
- Computed nucleosynthetic yields for both models; first-authored paper submitted to *ApJ* (arXiv:2602.23414); presented at AAS 247 and invited UConn seminar.

Project 1: Supernova Remnant 3C 397 2021 – 2024
Constraining the progenitor and explosion mechanism of the near-Chandrasekhar mass supernova remnant 3C 397.

- Developed 2D FLASH models of pure deflagration and delayed detonation explosions; computed yields with the Torch nuclear network.
- Showed that a pure deflagration best reproduces the observed neutron-rich X-ray abundances from *Suzaku*.
- Published in *MNRAS* (532, 1087–1098, 2024); presented at AAS 242 and APS New England.

Center for Scientific Computing and Data Research (CSCDR), UMass Dartmouth Nov. 2023 – Present
Student Research Computing Facilitator

- Manage workloads on the CARNiE HPC cluster; support users in optimizing and troubleshooting codes.
- Install libraries and create versioned modules; maintain documentation and wiki pages.
- Provide onboarding demos (SSH, Slurm, Open OnDemand) for new HPC users.

Teaching Experience

Department of Physics, UMass Dartmouth Jan. 2021 – Aug. 2023
Teaching Fellow

- Prepared and delivered lectures for introductory physics classes of 55+ students.
- Designed midterm and final exams, homework sets, and quizzes.

Department of Physics, UMass Dartmouth June 2021 – Aug. 2023
Teaching Assistant

- Conducted entry-level physics laboratories for undergraduate students.
- Managed lab equipment, graded assignments, and maintained grade records.

Technical Skills

Programming	Python, Fortran, MATLAB, Linux shell scripting, Slurm
HPC Systems	CARNiE (CSCDR, UMass Dartmouth), Stampede 3 (TACC, UT Austin), Unity (MGHPCC, UMass Amherst)
Astro Codes	FLASH, Torch, MESA
Libraries	Matplotlib, yt, MPI4py, Pandas, NumPy, h5py, SciPy, Astropy, pynucastro
Tools & Software	Open OnDemand, Slurm Workload Manager, LaTeX, Git, AutoCAD, SolidWorks

Selected Coursework

- Stellar Astrophysics
- High-Energy Astrophysics
- Statistical Thermodynamics
- Computational Physics
- Relativity, Black Holes & Gravity
- Quantum Mechanics I & II
- Advanced Numerical Methods for PDEs
- High-Performance Scientific Computing
- Advanced Linear Algebra
- Scientific Machine Learning

References

Prof. Robert T. Fisher
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Prof. Sigal Gottlieb
Department of Mathematics, UMass Dartmouth, North Dartmouth, MA
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