

VEDANT DHRUV

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RESEARCH INTERESTS

I am a theoretical and computational astrophysicist with broad interests in black hole and plasma physics. I use a multi-scale approach, employing both general relativistic magnetohydrodynamics (GRMHD) and particle-in-cell (PIC) simulations to bridge the gap between kinetic plasma processes and the large-scale dynamics of accretion flows. My work is driven by the need for robust models that can be tested against astronomical observations.

EDUCATION

University of Illinois Urbana-Champaign

Aug 2019 - May 2026

Ph.D. in Physics

GPA: 3.96/4.0

Advisor: Charles F. Gammie

National Institute of Technology Karnataka, Surathkal

July 2014 - May 2018

Bachelor of Technology in Mechanical Engineering

GPA: 9.22/10.0

RESEARCH EXPERIENCE

Graduate Research Assistant | **University of Illinois at Urbana-Champaign** 2020 - 2024; 2025 - Present

Black hole accretion physics

- Implemented a relativistic, weakly collisional plasma model in a performance-portable GPU GRMHD code. Produced the first horizon-scale images and spectra of Sagittarius A* (Sgr A*).
- Contributed toward the Event Horizon Telescope (EHT) theoretical analysis of the first Sgr A* results.
- Developer and maintainer of GRMHD and general relativistic radiative transfer (GRRT) codes at [AFD-Illinois](#).
- Studying potential observational signatures of well-motivated, alternate theories of gravity (dCS and EdGB).

Guest Researcher | **Center for Computational Astrophysics, Flatiron Institute** Aug 2023 - Oct 2023

Particle-in-cell simulations

- Investigating electron dynamics in collisionless, magnetically dominated flows (MADs) through PIC simulations of electron-ion plasmas.

Research Scholar | **Tata Institute of Fundamental Research (TIFR), Mumbai**

2018 - 2019

Helioseismology

- Validated a helioseismic inversion algorithm to recover solar sub-surface flow profile of supergranular flows from surface measurements of synthetic travel times for various separable and a non-separable flow model with realization noise.

Visiting Undergraduate Researcher | **TIFR, Mumbai**

May 2017 - July 2017

Quantum fields in curved space

- Calculated the non-relativistic limit of the Einstein-Dirac and the Einstein-Cartan-Dirac equations using a WKB-like series expansion.

GRANTS, AWARDS, AND SERVICE

Computational Grants

Co-Investigator (PI: C. F. Gammie)

ACCESS Maximize “Event Horizon Telescope and Black Hole Astrophysics”

Oct 2024 - Mar 2026

~ 72k GPU hours, ~ 680k CPU core-hours

Co-Investigator (PI: B. S. Prather)

DOE INCITE “Horizon-scale Variability Modeling for the EHT”

Jan 2024 - Dec 2024

~ 600k Frontier node-hours

Awards

Selected for Doctoral Showcase track at SC25 (Supercomputing Conference), St. Louis	2025
Dissertation Completion Fellowship (one of 21 awardees across 51 departments)	2025 - 2026
Donald C. and F. Shirley Jones Fellowship (~1 student in the department every year)	2025
Selected for ALCF ATPESC HPC Workshop	2023
ICASU-NCSA Graduate Student Fellowship, UIUC	2022 - 2023
Recognized as <i>Excellent Teaching Assistant</i> for all TA appointments, UIUC	2019 - 2020
Visiting Students' Research Programme (VSRP), TIFR Mumbai	2017
Nominated for the OPJEMS Scholarship (top 5% in the department)	2017

Peer review

Astrophysical Journal (ApJ), Astronomy & Astrophysics (A&A)	2025-
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COMPUTING/SOFTWARE EXPERIENCE

Codes: KHARMA (developer), `iharm3d` (developer), `iharm2d_v4` (primary developer), `ipole`(developer), TRISTAN-MP

HPC-related frameworks: Kokkos, [Parthenon](#) OpenMP, MPI, SLURM, PBS, [TACC Launcher](#)

Programming languages: C/C++, Python, Fortran, UNIX Shell Scripting

Numerical-analysis softwares: Mathematica, MATLAB

Other tools: HTML, CSS, PHP, Globus, LaTeX, Git, VS Code, Linux

Supercomputers: Delta (NCSA), Rusty (Flatiron Institute), Ginsburg (Columbia University), Frontier, Summit, Andes (OLCF), Polaris (ALCF)

SCIENTIFIC TALKS

Invited Talks

Astrophysics Seminar, Bar-Ilan University, Ramat Gan, Israel	Mar 2025
Theoretical High Energy Astrophysics (THEA) Group Meeting, Columbia University, NY, USA	Oct 2024
Numerical Series for Fluids and Plasmas, CCA Flatiron Institute, New York, USA	Oct 2024
Astrophysics, Relativity, and Cosmology Seminar, UIUC, IL, USA	Apr 2024
Eliot Quataert's Group Meeting, Princeton University, NJ, USA	Oct 2023
Astroplasma Meeting, CCA Flatiron Institute, NY, USA	Oct 2023

Contributed Talks

Frontiers of Relativistic Plasma Physics in Astrophysics and Laboratory Experiments, KITP, UC Santa Barbara, CA, USA (link)	Aug 2025
Event Horizon Telescope Collaboration 2024 Winter Meeting, Virtual	Dec 2024
NCSA Student Research Conference, NCSA, IL, USA	Apr 2023
Event Horizon Telescope Meeting, University of Arizona, Tuscon, AZ, USA	Nov 2021
International Conference on Mathematical Modelling and Scientific Computing, IIT Indore, India	Jul 2018

MENTORING AND TEACHING EXPERIENCE

Undergraduate Students Mentored

T Thomas (<i>WashU, St. Louis, MO, USA; currently at Univ. of Virgia, VA, USA</i>)	Aug 2024 - May 2025
Implementing Kerr-like metrics in alternate theories of gravity in the radiative transfer code <code>ipole</code> .	
Sam Mason (<i>UIUC, IL, USA; currently at Epic Systems, Madison, WI, USA</i>)	May 2023 - Dec 2024
The importance of radiative cooling in numerical simulations of M87*	
Shreya Majumdar (<i>UIUC, IL, USA; currently at Georgia Tech, Atlanta, GA, USA</i>)	May 2023 - Apr 2024

Testing modified theories of gravity in black hole accretion simulations

César Díaz Blanco (*UIUC, IL, USA; currently at Univ. of Tübingen, Germany*)

May 2021 - Mar 2023

Implemented and tested a passive electron heating scheme in the GPU-accelerated GRMHD code KHARMA

Graduate Teaching Assistant

University of Illinois Urbana-Champaign

Aug 2019 - Jul 2020; Jan - May 2025

Discussion TA: PHYS 225: “Relativity & Math Applications”

Discussion TA: PHYS 101: “College Physics: Mech & Heat”

Discussion TA: PHYS 214/213: “University Physics: Quantum/Thermal Physics”

SELECTED PUBLICATIONS

Full list: [NASA ADS](#) | Total Publications: 34 | Citations: 5004 | h-index: 24

8. **Dhruv, V.**, Sironi, L., Tran, A., Davelaar, J. 2025, *in prep*
PIC Simulations of a Magnetically Dominated Plasma in a Compressing Box: Characterization of Dominant Plasma Instabilities
7. **Dhruv, V.**, Prather, B., Chandra, M. et al. 2025, *ApJL*
[Electromagnetic Observables of Weakly Collisional Black Hole Accretion](#)
6. **Dhruv, V.**, Prather, B., Wong, G. N., & Gammie, C. F. 2025, *ApJS*
[A Survey of General Relativistic Magnetohydrodynamic Models for Black Hole Accretion Systems](#)
5. Conroy, N. S., Bauböck, M., **Dhruv, V.**, et al. 2023, *ApJ*
[Rotation in Event Horizon Telescope Movies](#)
4. Event Horizon Telescope Collaboration et al. 2022, *ApJL*
[First Sagittarius A* Event Horizon Telescope Results. V. Testing Astrophysical Models of the Galactic Center Black Hole](#)
3. Wong, G. N., Prather, B., **Dhruv, V.** et al. 2022, *ApJS*
[PATOKA: Simulating Electromagnetic Observables of Black Hole Accretion](#)
2. **Dhruv, V.**, Bhattacharya, J., & Hanasoge, S. M. 2019, *ApJ*
[Validating Time–Distance Helioseismic Inversions for Nonseparable Subsurface Profiles of an Average Supergranule](#)
1. Khanapurkar, S., Pradhan, A., **Dhruv, V.**, et al. 2018, *PRD*
[Nonrelativistic limit of Einstein-Cartan-Dirac equations](#)