

# VEDANT DHURUV

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## RESEARCH INTERESTS

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I am a theoretical and computational astrophysicist with broad interests in black hole and plasma physics. My research primarily focuses on improving models of black hole accretion, and is guided by observational data. I employ a range of computational techniques to study the influence of dissipative and microphysical plasma processes on the global dynamics of accretion flow.

## PROFESSIONAL APPOINTMENTS

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<b>Graduate Research Assistant</b> <i>University of Illinois at Urbana-Champaign</i>	Aug 2020-
<b>Guest Researcher</b> <i>Center for Computational Astrophysics, Flatiron Institute, New York, USA</i>	Aug 2023 - Oct 2023
<b>Research Scholar</b> <i>Tata Institute of Fundamental Research, Mumbai, India</i>	May 2018 - April 2019
<b>Visiting Undergraduate Researcher</b> <i>Tata Institute of Fundamental Research, Mumbai, India</i>	May 2017 - July 2017

## EDUCATION

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<b>University of Illinois Urbana-Champaign</b> PhD in Physics Advisor: Charles F. Gammie	Aug 2019 - Aug 2025 (Expected) <i>GPA: 3.96/4.0</i>
<b>National Institute of Technology Karnataka, Surathkal</b> Bachelor of Technology in Mechanical Engineering	July 2014 - May 2018 <i>GPA: 9.22/10.0</i>

## RESEARCH EXPERIENCE

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**Black hole accretion physics**  
*University of Illinois at Urbana-Champaign*

Improving global models of collisionless plasmas by incorporating beyond-ideal effects.  
Contributed toward the theoretical analysis of the first Sgr A\* results by the Event Horizon Telescope.  
Developer and maintainer of general relativistic magnetohydrodynamic (GRMHD) codes at [AFD-Illinois](#).

*CCA, Flatiron Institute*  
Conducted particle-in-cell (PIC) simulations of astrophysical plasmas motivated by EHT targets, and investigated the role of kinetic instabilities on ion and electron thermodynamics.

**Alternate theories of gravity**  
*University of Illinois at Urbana-Champaign*

Studying potential observational signatures of well-motivated, alternate theories of gravity (dynamical Chern-Simons and Einstein dilaton Gauss-Bonnet) in event horizon-scale observations of black hole accretion using GRMHD simulations and radiative transfer techniques.

*Tata Institute of Fundamental Research, Mumbai*

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

### Helioseismology

*Tata Institute of Fundamental Research, Mumbai*

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.

## GRANTS AND AWARDS

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### Computational Grants

#### Co-Investigator

*ACCESS Maximize “Event Horizon Telescope and Black Hole Astrophysics”* Oct 2024 - Sep 2025  
~ 72k GPU hours, ~ 680k CPU core-hours

#### Co-Investigator

*DOE INCITE “Horizon-scale Variability Modeling for the EHT”* Jan 2024 - Dec 2024  
~ 600k Frontier node-hours

### Awards

Selected for ALCF ATPESC HPC Workshop 2023  
ICASU-NCSA Graduate Student Fellowship, UIUC 2022 - 2023  
Recognized as *Excellent Teaching Assistant* 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

## COMPUTING/SOFTWARE EXPERIENCE

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**Codes:** KHARMA, iharm3d (current maintainer), iharm2d\_v4 (primary developer), ipole, TRISTAN-MP  
**HPC-related frameworks:** Kokkos, [Parthenon](#) OpenMP, MPI, SLURM, PBS, [TACC Launcher](#)  
**Programming languages:** C/C++, Python, Fortran, UNIX Shell Scripting  
**Supercomputers:** Delta (NCSA), Rusty (Flatiron Institute), Ginsburg (Columbia University), Frontier, Summit, Andes (OLCF), Polaris (ALCF)  
**Numerical-analysis softwares:** Mathematica, MATLAB

## SCIENTIFIC TALKS

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### Invited Talks

Theoretical High Energy Astrophysics (THEA) Group Meeting Oct 2024  
*Columbia University, New York, USA*  
Numerical Series for Fluids and Plasmas Oct 2024  
*CCA Flatiron Institute, New York, USA*  
Astrophysics, Relativity, and Cosmology Seminar April 2024  
*University of Illinois at Urbana-Champaign, Illinois, USA*  
Quataert Group Meeting Oct 2023  
*Princeton University, New Jersey, USA*  
Astroplasma Meeting Oct 2023  
*CCA Flatiron Institute, New York, USA*

## Contributed Talks

NCSA Student Research Conference <i>NCSA, Illinois, USA</i>	April 2023
Event Horizon Telescope Meeting <i>University of Arizona in Tuscon, Arizona, USA</i>	Nov 2021
International Conference on Mathematical Modelling and Scientific Computing <i>IIT Indore, India</i>	July 2018

## MENTORING AND TEACHING EXPERIENCE

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### Undergraduate Students Mentored

*T Thomas (Washington University in St. Louis)* Aug 2024-  
Implementing Kerr-like metrics in alternate theories of gravity in the radiative transfer code `ipole`.

*Sam Mason (University of Illinois at Urbana-Champaign)* May 2023 -  
The importance of radiative cooling in numerical simulations of M87\*

*Shreya Majumdar (University of Illinois at Urbana-Champaign)* May 2023 - April 2024  
Testing modified theories of gravity in black hole accretion simulations

*César Díaz Blanco (University of Illinois at Urbana-Champaign)* May 2021 - March 2023  
Impleted and tested a passive electron heating scheme in the GPU-accelerated GRMHD code KHARMA

### Graduate Teaching Assistant

*University of Illinois Urbana-Champaign* Aug 2019 - July 2020

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

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

Lab TA: PHYS 213: “University Physics: Thermal Physics”

## PUBLICATIONS

### FIRST AUTHOR, SIGNIFICANT CONTRIBUTIONS

- Dhruv, V.**, Prather, B., Wong, G., & Gammie, C. F. 2024, *arXiv e-prints*, arXiv:2411.12647. <https://arxiv.org/abs/2411.12647>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, *ApJL*, 930, L14. <https://doi.org/doi:10.3847/2041-8213/ac6429>
- Wong, G. N., Prather, B. S., **Dhruv, V.**, et al. 2022, *ApJS*, 259, 64. <https://doi.org/doi:10.3847/1538-4365/ac582e>
- Prather, B., Wong, G., **Dhruv, V.**, et al. 2021, *The Journal of Open Source Software*, 6, 3336. <https://doi.org/doi:10.21105/joss.03336>
- Dhruv, V.**, Bhattacharya, J., & Hanasoge, S. M. 2019, *ApJ*, 883, 136. <https://doi.org/doi:10.3847/1538-4357/ab3a95>
- Khanapurkar, S., Pradhan, A., **Dhruv, V.**, et al. 2018, *PhRvD*, 98, 104027. <https://doi.org/doi:10.1103/PhysRevD.98.104027>

### COLLABORATION PAPERS

- Raymond, A. W., Doeleman, S. S., Asada, K., et al. 2024, *AJ*, 168, 130. <https://doi.org/doi:10.3847/1538-3881/ad5bdb>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2024, *ApJL*, 964, L25. <https://doi.org/doi:10.3847/2041-8213/ad2df0>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2024, *ApJL*, 964, L26. <https://doi.org/doi:10.3847/2041-8213/ad2df1>
- Paraschos, G. F., Kim, J.-Y., Wielgus, M., et al. 2024, *A&A*, 682, L3. <https://doi.org/doi:10.1051/0004-6361/202348308>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2024, *A&A*, 681, A79. <https://doi.org/doi:10.1051/0004-6361/202347932>
- Torne, P., Liu, K., Eatough, R. P., et al. 2023, *ApJ*, 959, 14. <https://doi.org/doi:10.3847/1538-4357/acf4f2>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2023, *ApJL*, 957, L20. <https://doi.org/doi:10.3847/2041-8213/acff70>
- Roelofs, F., Johnson, M. D., Chael, A., et al. 2023, *ApJL*, 957, L21. <https://doi.org/doi:10.3847/2041-8213/acff6f>
- Prather, B. S., Dexter, J., Moscibrodzka, M., et al. 2023, *ApJ*, 950, 35. <https://doi.org/doi:10.3847/1538-4357/acc586>

- Jorstad, S., Wielgus, M., Lico, R., et al. 2023, ApJ, 943, 170. <https://doi.org/doi:10.3847/1538-4357/acaea8>
- Issaoun, S., Wielgus, M., Jorstad, S., et al. 2022, ApJ, 934, 145. <https://doi.org/doi:10.3847/1538-4357/ac7a40>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, ApJL, 930, L13. <https://doi.org/doi:10.3847/2041-8213/ac6675>
- Wielgus, M., Marchili, N., Martí-Vidal, I., et al. 2022, ApJL, 930, L19. <https://doi.org/doi:10.3847/2041-8213/ac6428>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, ApJL, 930, L15. <https://doi.org/doi:10.3847/2041-8213/ac6736>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, ApJL, 930, L17. <https://doi.org/doi:10.3847/2041-8213/ac6756>
- Broderick, A. E., Gold, R., Georgiev, B., et al. 2022, ApJL, 930, L21. <https://doi.org/doi:10.3847/2041-8213/ac6584>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, ApJL, 930, L16. <https://doi.org/doi:10.3847/2041-8213/ac6672>
- Event Horizon Telescope Collaboration, Akiyama, K., Alberdi, A., et al. 2022, ApJL, 930, L12. <https://doi.org/doi:10.3847/2041-8213/ac6674>
- Georgiev, B., Pesce, D. W., Broderick, A. E., et al. 2022, ApJL, 930, L20. <https://doi.org/doi:10.3847/2041-8213/ac65eb>