


# HARSHIT TIWARI

PhD Scholar, Department of Physics, IIT Kanpur

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## RESEARCH INTERESTS

Turbulent convection, atmospheric and astrophysical flows, compressible flows, High-Performance Computing (HPC), turbulence and nonlinear dynamics, etc

## EDUCATION



Indian Institute of Technology Kanpur

Kanpur, India

**Doctor of Philosophy in Physics**

*August 2021 - December 2025 (expected)*

- Courses on Tapestry of Field Theory, Physics of Turbulence, High-Performance Computing and Advanced Statistical Physics.
- Current Cumulative Performance Index: 9.56/10



Indian Institute of Technology Kanpur

Kanpur, India

**Master of Science in Physics**

*July 2019 - July 2021*

- Courses on High Energy Astrophysics, Nuclear and Particle Physics and Quantum Field Theory.
- Cumulative Performance Index: 8.30/10



Kumaun University

Nainital, India

**Bachelor of Science**

*July 2016 - June 2019*

- Subjects: Physics, Mathematics, Chemistry
- Percentage: 66.4%, First Class

## RESEARCH EXPERIENCE



**Graduate Researcher, Department of Physics, IIT Kanpur**

*2021 - Present*

**Supervisor:** Prof. Mahendra Verma, Department of Physics, IIT Kanpur

**Co-supervisor:** Prof. Rajesh Ranjan, Department of Aerospace Engineering, IIT Kanpur

**Thesis Title:** *Compressible turbulent convection at extreme Rayleigh numbers*

- Simulated turbulent compressible convection at extreme Rayleigh numbers, revealing classical heat transport scaling laws.
- Developed a scalable Python PDE solver with GPU and MPI support for high-performance simulations.
- Applied advanced numerical methods to study shocks, turbulence, and compressible flows in astrophysics and atmosphere.

**Master's Student, Department of Physics, IIT Kanpur**

*2020 - 2021*



**Supervisor:** Prof. Pankaj Jain, Department of Physics, IIT Kanpur

**Co-supervisor:** Prof. J.S. Yadav, Department of Physics, IIT Kanpur

**Project:** *Theoretical Modelling of Accretion Disk Oscillations*

- Studied acoustic normal modes in thin accretion disks using an effective Kerr potential.
- Derived a dispersion relation valid over a range of black hole spin parameters.

## PUBLICATIONS

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1. **H. Tiwari**, L. Sharma, and M. K. Verma, On the absence of the ultimate regime in turbulent thermal convection, *The Proceedings of the National Academy of Sciences*. 122 (44) e2513474122 (2025). DOI: <https://doi.org/10.1073/pnas.2513474122>
2. **H. Tiwari**, L. Sharma, and M. K. Verma, Compressible turbulent convection at very high Rayleigh numbers, *International Journal of Heat and Mass Transfer*. 242, 126821 (2025). DOI: <https://doi.org/10.1016/j.ijheatmasstransfer.2025.126821>
3. **H. Tiwari** and M. K. Verma, Classical 1/3 Nusselt number scaling in highly turbulent compressible convection, *arxiv:2502.02611* (2025). DOI: <https://doi.org/10.48550/arXiv.2502.02611>
4. D. Singh, **H. Tiwari**, L. Sharma, and M. K. Verma, Mathematical formulation of mode-to-mode energy transfers and energy fluxes in compressible turbulence, *Physical Review Fluids* (2025). (Accepted)
5. D. Singh, **H. Tiwari**, L. Sharma, and M. K. Verma, Scale-by-Scale Energy Transfers and Fluxes in Compressible Turbulence, *Europhysics Letters* (2025). (Under review)
6. L. Sharma, M. Pathak, **H. Tiwari**, and M. K. Verma, Effect of Prandtl number on turbulent compressible convection, *Physical Review Fluids* (2025). (Accepted)
7. L. Sharma, M. Pathak, **H. Tiwari**, and M. K. Verma, Variation of convective heat flux imbalance with Prandtl number, *Center for Turbulence Research Annual Reports Briefs* (2025). (Under review)
8. **H. Tiwari**, D. Singh, M. K. Verma, and R. Ranjan, Energy spectra and fluxes in forced supersonic turbulence using high-order direct numerical simulations. (Under preparation)

## CONFERENCES AND WORKSHOPS

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- Poster presentation titled “Compressible turbulent convection at extreme Rayleigh numbers” at **The Variable Sun: Past, Present, and Future Perspectives** at Thiruvananthapuram, India.
- Talk on “Classical 1/3 Nusselt Scaling in Compressible Convection” at **1st European Fluid Dynamics Conference (EFDC1)** at Aachen, Germany.
- Talk on “Classical 1/3 Nusselt Scaling in Compressible Convection at Extreme Ra” at **ICTS Program on Theoretical and Practical Perspectives in Geophysical Fluid Dynamics**.
- Poster presentation titled “Classical Nusselt 1/3 scaling up to  $Ra = 10^{16}$  in turbulent compressible convection” at **HPC Symposium 2024, IIT Kanpur**.
- Oral presentation on compressible turbulent convection at the **Research Scholar Day** organised by the Department of Physics, IIT Kanpur.
- Participated in **Frontier Hackathon March 2024**. We scaled the compressible finite-difference solver *Dhara* on Frontier up to 8192 AMD MI250X GPUs.
- Attended the **ICTS Program on Field Theory and Turbulence 2023**.
- Attended the **ICTS Program on Turbulence: Problems at the interface of Mathematics and Physics 2023**.
- Participated in **NSM GPU Hackathon 2022**. We ported the Quantum Solver (Gross–Pitaevskii equation) sequential code to run on multiple GPUs and scaled on 64 Nvidia A100 GPUs.
- Attended the **ICTS Summer School on Gravitational-Wave Astronomy 2021**.

## TEACHING EXPERIENCE

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I have assisted in the following courses at the Indian Institute of Technology Kanpur:

- **PHY441A: Electronics** from August 2021 to May 2022.
- **PHY473A: Computational Physics** from August 2022 to November 2022.
- **PHY113A: Classical Electrodynamics** from March 2023 to November 2023.

- **NPTEL: Scientific Computing using Python** from June 2023 to November 2023.
- **NPTEL: Tapestry of Field Theory: Classical Quantum, Equilibrium, Nonequilibrium Perspectives** from January 2024 to January 2025.
- **PHY461A/462A: Experimental Physics I/II** from January 2024 to May 2025.
- **PHY111A: Undergraduate Lab** from August 2025 to Present.

## COMPUTATIONAL SKILLS

- **Advanced:** Python, parallel programming, Numba, Paraview
- **Intermediate:** Matlab, Mathematica, CUDA
- **Basic:** C++, Julia, Fortran, R

## GRANTS AND AWARDS

- Recipient of the **2025 Division of Fluid Dynamics Enabling Award**, American Physical Society, supporting attendance at the 2025 DFD Annual Meeting, Nov 2025.
- Secured an **All India Rank 74** among 15,000 applicants in **IIT Joint Admission Test (JAM) 2019**, for the admission to M.Sc. program at Indian Institute of Technology Kanpur.
- Recipient of **Merit cum Means Scholarship** at Indian Institute of Technology Kanpur, Aug 2019 - May 2021.
- Secured **All India Rank 307** in **Joint Entrance Screening Test (JEST) 2019**.
- Qualified **National Defence Academy (NDA)** entrance exam in 2016.

## OTHER EXPERIENCES

### 1. Coordinator, Adventure Sports Club, IIT Kanpur (2024–25)

- Led club activities, organizing fitness programs, treks, runs, and yoga, boosting participation and visibility.

### 2. Secretary, Adventure Sports Club, IIT Kanpur (2022–23, 2023–24)

- Assisted in organising events and managing logistics for outdoor activities and training sessions.

### 3. Election Officer, Hall 7, HEC Elections 2022

- Managed smooth conduct of hostel elections with a voter turnout of ~85%.

## REFERENCES

1. **Prof. Mahendra K. Verma**, Department of Physics, IIT Kanpur, India.  
✉ [mkv@iitk.ac.in](mailto:mkv@iitk.ac.in)
2. **Prof. Rajesh Ranjan**, Department of Aerospace Engineering, IIT Kanpur, India  
✉ [rajeshr@iitk.ac.in](mailto:rajeshr@iitk.ac.in)
3. **Prof. Shashwat Bhattacharya**, School of Mechanical and Materials Engineering, IIT Mandi, India  
✉ [shashwat@iitmandi.ac.in](mailto:shashwat@iitmandi.ac.in)      📧 [shashwat.mnit@gmail.com](mailto:shashwat.mnit@gmail.com)