

# 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
<b>Doctor of Philosophy in Physics</b>	<i>August 2021 - December 2025 (expected)</i>
<ul style="list-style-type: none"><li>Courses on Tapestry of Field Theory, Physics of Turbulence, High-Performance Computing and Advanced Statistical Physics.</li><li>Current Cumulative Performance Index: 9.56/10</li></ul>	
 Indian Institute of Technology Kanpur	Kanpur, India
<b>Master of Science in Physics</b>	<i>July 2019 - July 2021</i>
<ul style="list-style-type: none"><li>Courses on High Energy Astrophysics, Nuclear and Particle Physics and Quantum Field Theory.</li><li>Cumulative Performance Index: 8.30/10</li></ul>	
 Kumaun University	Nainital, India
<b>Bachelor of Science</b>	<i>July 2016 - June 2019</i>
<ul style="list-style-type: none"><li>Subjects: Physics, Mathematics, Chemistry</li><li>Percentage: 66.4%, First Class</li></ul>	

## RESEARCH EXPERIENCE

 Graduate Researcher, Department of Physics, IIT Kanpur	<i>2021 - Present</i>
<b>Supervisor:</b> Prof. Mahendra Verma, Department of Physics, IIT Kanpur	
<b>Co-supervisor:</b> Prof. Rajesh Ranjan, Department of Aerospace Engineering, IIT Kanpur	
<b>Thesis Title:</b> <i>Compressible turbulent convection at extreme Rayleigh numbers</i>	
<ul style="list-style-type: none"><li>Simulated turbulent compressible convection at extreme Rayleigh numbers, revealing classical heat transport scaling laws.</li><li>Developed a scalable Python PDE solver with GPU and MPI support for high-performance simulations.</li><li>Applied advanced numerical methods to study shocks, turbulence, and compressible flows in astrophysics and atmosphere.</li></ul>	
 Master's Student, Department of Physics, IIT Kanpur	<i>2020 - 2021</i>
<b>Supervisor:</b> Prof. Pankaj Jain, Department of Physics, IIT Kanpur	
<b>Co-supervisor:</b> Prof. J.S. Yadav, Department of Physics, IIT Kanpur	
<b>Project:</b> <i>Theoretical Modelling of Accretion Disk Oscillations</i>	
<ul style="list-style-type: none"><li>Studied acoustic normal modes in thin accretion disks using an effective Kerr potential.</li><li>Derived a dispersion relation valid over a range of black hole spin parameters.</li></ul>	

## 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).
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).
3. 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*. [10](#), 114609 (2025).
4. L. Sharma, M. Pathak, **H. Tiwari**, and M. K. Verma, Effect of Prandtl number on turbulent compressible convection, *Physical Review Fluids*. [10](#), 114611 (2025).
5. **H. Tiwari** and M. K. Verma, Classical 1/3 Nusselt number scaling in highly turbulent compressible convection, [arxiv:2502.02611](#) (2025).
6. 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)
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)
9. N. Kumar, **H. Tiwari**, M. K. Verma, and S. Ravichandran, Heat transfer in moist turbulent convection. (Under preparation)

## CONFERENCES AND WORKSHOPS

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- Talk on “Compressible turbulent convection at very high Rayleigh numbers” at the **APS Division of Fluid Dynamics Annual Meeting 2025** in *Houston, Texas, USA*.
- Poster presentation titled “Compressible turbulent convection at extreme Rayleigh numbers” at **The Variable Sun: Past, Present, and Future Perspectives 2025** at *Thiruvananthapuram, India*.
- Talk on “Classical 1/3 Nusselt Scaling in Compressible Convection” at the **1st European Fluid Dynamics Conference (EFDC1) 2024** 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 2024**.
- Poster presentation titled “Classical Nusselt 1/3 scaling up to  $\text{Ra} = 10^{16}$  in turbulent compressible convection” at **HPC Symposium 2024, IIT Kanpur**.
- Oral presentation on compressible turbulent convection at the **Research Scholar Day 2024**, 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 it 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

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

## GRANTS AND AWARDS

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- Session chair for “Convection and Buoyancy-Driven Flows: Heat Transfer, Instabilities & Turbulence” at **APS Division of Fluid Dynamics Annual Meeting 2025** in *Houston, Texas, USA*.
- 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 the **IIT Joint Admission Test (JAM) 2019**, for admission to the M.Sc. program at the 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

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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

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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@iitmadi.ac.in](mailto:shashwat@iitmadi.ac.in)