HARSHIT TIWARI

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RESEARCH INTERESTS

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

EDUCATION

Indian Institute of Technology Kanpur   Kanpur, India
Doctor of Philosophy in Physics   *August 2021 - February 2026 (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

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. 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.

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. H. Tiwari, D. Singh, M. K. Verma, and R. Ranjan, Scaling in supersonic turbulence: Energy spectra and fluxes using high-fidelity direct numerical simulations, *Journal of Fluid Mechanics* (2025). (Under review)

8. N. Kumar, H. Tiwari, M. K. Verma, and S. Ravichandran, Heat transfer in moist turbulent convection. (Under preparation)

9. A. Pandey, H. Tiwari, K. R. Sreenivasan, Transients depend on the dimensionality of thermal convection. (Under preparation)

CONFERENCES AND WORKSHOPS

- Participated in the **Indo-Japanese Workshop for CFD-based AI and HPC 2025** at **IIT Kanpur.**

- 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 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

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

- 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

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

2. **Prof. Rajesh Ranjan**, Department of Aerospace Engineering, IIT Kanpur, India
   ✉ rajeshr@iitk.ac.in

3. **Prof. Shashwat Bhattacharya**, School of Mechanical and Materials Engineering, IIT Mandi, India
   ✉ shashwat@iitmandi.ac.in