HARSHIT TIWARI

Postdoctoral Associate, New York University

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RESEARCH INTERESTS

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

EDUCATION

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

- Courses on Field Theory, Physics of Turbulence, High-Performance Computing and Advanced Statistical Physics.
- 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

Postdoctoral Associate — **July 2026 - Present**
Department of Mechanical and Aerospace Engineering
Tandon School of Engineering, New York University
Supervisor: Prof. Katepalli R. Sreenivasan, New York University
Project: **Quantum computing for fluid dynamics (QCFD)**

Fellowship for Academic and Research Excellence (FARE) — **March 2026 - June 2026**
Department of Physics, Indian Institute of Technology Kanpur

- High-resolution simulations of moist turbulent convection in Earth's troposphere.
- Thermalisation in quantum and classical Euler turbulence.
- Transients in thermal convection and energy distribution among various scales.

Graduate Researcher — **August 2021 - February 2026**
Department of Physics, Indian Institute of Technology Kanpur
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 — **August 2020 - May 2021**
Department of Physics, Indian Institute of Technology Kanpur
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

Published

1. D. Singh, **H. Tiwari**, L. Sharma, and M. K. Verma, Scale-by-Scale Energy Transfers and Fluxes in Compressible Turbulence, *Europhysics Letters*, 154 53001 (2026).
2. **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).
3. **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).
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*, 10, 114609 (2025).
5. L. Sharma, M. Pathak, **H. Tiwari**, and M. K. Verma, Effect of Prandtl number on turbulent compressible convection, *Physical Review Fluids*, 10, 114611 (2025).
6. 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

1. **H. Tiwari**, D. Singh, M. K. Verma, and R. Ranjan, Scaling in supersonic turbulence: Energy spectra and fluxes using high-fidelity direct numerical simulations, *Physical Review E*.
2. A. Pandey, **H. Tiwari**, K. R. Sreenivasan, Thermal convection in 1, 2, 3 and 4 dimensions, *Journal of Fluid Mechanics*.
3. M. Pathak, L. Sharma, **H. Tiwari**, S. Aseeri, D. Keyes, and M. K. Verma, Prandtl-number dependence of positive and negative heat fluxes in turbulent compressible convection, *Phys. Rev. Fluids*.

Under Preparation

1. **H. Tiwari**, N. Kumar, M. K. Verma, and S. Ravichandran, Direct numerical simulations of moist turbulent compressible convection.
2. **H. Tiwari**, A. Pandey, K. R. Sreenivasan, Scaling laws in four-dimensional turbulent convection.
3. D. Singh, **H. Tiwari**, and M. K. Verma, Thermalization in compressible Euler and quantum turbulence.
4. N. Kumar, **H. Tiwari**, M. K. Verma, and S. Ravichandran, Intermittency in conditionally unstable moist convection.

CONFERENCES AND WORKSHOPS

- Workshop on "Instabilities and transitions in geophysical flows" (Oral) — May 2026
  Mathematical Developments in Geophysical Fluid Dynamics trimester program
  Institut Henri Poincaré, Paris, France
- "High-resolution simulations of dry and moist turbulent convection" (Oral) — May 2026
  Moist Convective Dynamics of Monsoon II
  International Centre for Theoretical Sciences, Bengaluru, India
- **Indo-Japanese Workshop for CFD-based AI and HPC** — December 2025
  Indian Institute of Technology Kanpur, India
- "Compressible turbulent convection at very high Rayleigh numbers" (Oral) — November 2025
  APS Division of Fluid Dynamics Annual Meeting
  Houston, Texas, USA
- "Compressible turbulent convection at extreme Rayleigh numbers" (Poster) — October 2025
  The Variable Sun: Past, Present, and Future Perspectives
  Thiruvananthapuram, India
- "Classical 1/3 Nusselt Scaling in Compressible Convection" (Oral) — September 2024
  1st European Fluid Dynamics Conference (EFDC1)
  Aachen, Germany
- "Classical 1/3 Nusselt Scaling in Compressible Convection at Extreme Ra" (Oral) — June 2024
  Theoretical and Practical Perspectives in Geophysical Fluid Dynamics
  International Centre for Theoretical Sciences, Bengaluru, India
- "Classical Nusselt 1/3 scaling up to Ra $= 10^{16}$ in turbulent compressible convection" (Poster) — March 2024
  HPC Symposium
  Indian Institute of Technology Kanpur, India
- "Compressible turbulent convection" (Oral) — February 2024
  Research Scholar Day
  Department of Physics, Indian Institute of Technology Kanpur, India

- Scaling the Dharа solver on Frontier up to 8192 GPUs (Oral) — March 2024
  Frontier Hackathon
  Oak Ridge National Laboratory, USA
- **Field Theory and Turbulence** — December 2023
  International Centre for Theoretical Sciences, Bengaluru, India
- **Turbulence: Problems at the interface of Mathematics and Physics** — October 2023
  International Centre for Theoretical Sciences, Bengaluru, India
- Porting Gross–Pitaevskii solver to 64 Nvidia A100 GPUs (Oral) — November 2022
  NSM GPU Hackathon
  India
- **Summer School on Gravitational-Wave Astronomy** — June 2021
  International Centre for Theoretical Sciences, Bengaluru, India

TEACHING EXPERIENCE

I have assisted in the following courses at IIT Kanpur:

- PHY111A: Undergraduate Lab — Aug 2025 – Aug 2026
- PHY461A/462A: Experimental Physics I/II — Jan 2024 – May 2025
- NPTEL: Tapestry of Field Theory: Classical Quantum, Equilibrium, Nonequilibrium Perspectives — Jan 2024 – Jan 2025
- NPTEL: Scientific Computing using Python — Jun 2023 – Nov 2023
- PHY113A: Classical Electrodynamics — Mar 2023 – Nov 2023
- PHY473A: Computational Physics — Aug 2022 – Nov 2022
- PHY441A: Electronics — Aug 2021 – May 2022

COMPUTATIONAL SKILLS

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

GRANTS AND AWARDS

- Recipient of the **Outstanding PhD Thesis Award** from IIT Kanpur, 2026.
- Recipient of the **2025 Division of Fluid Dynamics Enabling Award**, American Physical Society, supporting attendance at the 2025 DFD Annual Meeting, Nov 2025.
- 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*.
- 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. Katepalli R. Sreenivasan**
   Professor of Physics, Mathematical Sciences, and Engineering, New York University, USA.
   katepalli.sreenivasan@nyu.edu
2. **Prof. Mahendra K. Verma**
   Department of Physics, IIT Kanpur, India.
   mkv@iitk.ac.in

3. **Prof. Rajesh Ranjan**
Department of Aerospace Engineering, IIT Kanpur, India.
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