

# Kirit D. Makwana

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## Employment Record

Assistant Professor, Department of Physics, IIT Hyderabad, Aug. 2020–present.

Postdoctoral Fellow, Theoretical Astrophysics Group, Deutsches Elektronen-Synchrotron (DESY), Zeuthen, Germany, May 2018–May 2020.

Postdoctoral Scholar, Center for mathematical Plasma Astrophysics, KU Leuven, Belgium, Jan. 2016–April 2018.

Postdoctoral Scholar, Dept. of Astronomy & Astrophysics, University of Chicago, USA, Oct. 2013–Dec. 2015.

Research Assistant, Dept. of Physics, University of Wisconsin-Madison, USA, June 2008–Aug. 2008, June 2009–July 2013.

Teaching Assistant, Dept. of Physics, University of Wisconsin-Madison, USA, Sept. 2007–May 2008, Sept. 2008–May 2009.

Student Intern, IKP Forschungszentrum Jülich, Germany, June 2006–Aug. 2006.

## Education

Ph.D. Physics, University of Wisconsin-Madison, August 2013.

Thesis : Damped Modes in Plasma Microturbulence: Saturation, Regulation, and Energy Partition.

Advisor : Prof. Paul W. Terry

B.Tech. Engineering Physics, Indian Institute of Technology, Bombay, India, May 2007.

## Refereed Research Publications

1. *Kinetic Alfvén wave cascade in sub-ion range plasma turbulence*  
Johan Sharma & Kirit Makwana, under review in *Frontiers in Astronomy and Space Sciences*
2. *Identifying kinetic scale magnetic discontinuity structures in turbulent solar wind*  
Sruti Satyasmita, Popi Das, & Kirit Makwana, *Astrophys. Space Sci.* **369**, 7 (2024)
3. *Linear Dispersion and Nonlinear Interactions in 2.5D Particle-in-Cell Simulations of Kinetic Alfvén Waves*  
Kirit Makwana, Srinikitha Bhagvati, & Johan Sharma, *Plasma Physics Reports* **49**(6), 759-771 (2023)
4. *Cosmic-ray Transport in Magnetohydrodynamic Turbulence*  
Snehanshu Maiti, Kirit Makwana, Heshou Zhang, & Huirong Yan, *Astrophys. J.* **926**(1), 94 (2022).

5. *Role of Parallel Solenoidal Electric Field on Energy Conversion in 2.5D Decaying Turbulence with a Guide Magnetic Field*  
Peera Pongkitiwanchakul, David Ruffolo, Fan Guo, Senbei Du, Piyawat Suetrong, Chutima Yan-nawa, Kirit Makwana, Kittipat Malakit, [Astrophys. J. \*\*923\*\*\(2\), 182 \(2021\)](#).
6. *Properties of magnetohydrodynamic modes in compressively driven plasma turbulence*  
K. D. Makwana, and Huirong Yan, [Physical Review X \*\*10\*\*, Vol. 3, 031021 \(2020\)](#).
7. *Identification of plasma modes in galactic turbulence with synchrotron polarization*  
Heshou Zhang, Alexey Chepurnov, Huirong Yan, Kirit Makwana, Reinaldo Santos-Lima, and Sarah Appleby, [Nature Astronomy \(2020\)](#), doi: [10.1038/s41550-020-1093-4](#).
8. *Ideal MHD instabilities for coronal mass ejections: interacting current channels and particle acceleration*  
Rony Keppens, Yang Guo, K. D. Makwana, Zhixing Mei, Bart Ripperda, Chun Xia, and Xiaozhou Zhao, [Rev. Mod. Plasma Phys. \*\*3\*\*:14 \(2019\)](#).
9. *Study of magnetic reconnection in large-scale magnetic island coalescence via spatially coupled MHD and PIC simulations* (selected as Editor's Pick)  
K. D. Makwana, R. Keppens, and G. Lapenta, [Phys. Plasmas \*\*25\*\*, 082904 \(2018\)](#).
10. *Two way coupled MHD-PIC simulations of magnetic reconnection in magnetic island coalescence*  
K. D. Makwana, R. Keppens, and G. Lapenta, [J. Phys.: Conf. Ser \*\*1031\*\*, 012019 \(2018\)](#).
11. *Driving reconnection in sheared magnetic configurations with forced fluctuations*  
Peera Pongkitiwanchakul, Kirit D. Makwana, and David Ruffolo, [Phys. Plasmas \*\*25\*\*, 022114 \(2018\)](#).
12. *Two-way coupling of magnetohydrodynamic simulations with embedded particle-in-cell simulations*  
K. D. Makwana, R. Keppens, and G. Lapenta, [Comp. Phys. Comm. \*\*221\*\*, 81-94 \(2017\)](#).
13. *Dissipation and particle energization in moderate to low beta turbulent plasma via PIC simulations*  
K. D. Makwana, H. Li, F. Guo, and X. Li, [J. Phys.: Conf. Ser. \*\*837\*\*, 012004 \(2017\)](#).
14. *Energy dynamics and current sheet structure in fluid and kinetic simulations of decaying magnetohydrodynamic turbulence*  
K. D. Makwana, V. Zhdankin, H. Li, W. Daughton, and F. Cattaneo, [Phys. Plasmas \*\*22\*\*, 042902 \(2015\)](#).
15. *Mode-Space Energy Distribution in Instability-Driven Plasma Turbulence*  
P. W. Terry, K. D. Makwana, M. J. Pueschel, D. R. Hatch, F. Jenko, and F. Merz, [Phys. Plasmas \*\*21\*\*, 122303 \(2014\)](#).
16. *Subdominant modes in zonal-flow-regulated turbulence*  
K. D. Makwana, P. W. Terry, M. J. Pueschel, and D. R. Hatch, [Phys. Rev. Lett. \*\*112\*\*, 095002 \(2014\)](#).
17. *Role of stable modes in zonal flow regulated turbulence*  
K. D. Makwana, P. W. Terry, and J.-H. Kim, [Phys. Plasmas \*\*19\*\*, 062310 \(2012\)](#).
18. *Interactions of Stable Modes and Zonal Flows in ITG turbulence*  
P. W. Terry, K. D. Makwana, D. R. Hatch, M. J. Pueschel, J.-H. Kim, W. M. Nevins, F. Jenko, and H. Doerk, in [Fusion Energy 2012, TH-C/P7-08](#) (International Atomic Energy Agency, Vienna, 2012).

19. *Damped eigenmode saturation in plasma fluid turbulence*  
K. D. Makwana, P. W. Terry, J.-H. Kim, and D. R. Hatch, *Phys. Plasmas* **18**, 012302 (2011).
20. *Saturation of Plasma Microturbulence by Damped Eigenmodes*  
P. W. Terry, D. R. Hatch, W. M. Nevins, F. Jenko, F. Merz, J.-H. Kim, and K. D. Makwana, in *Fusion Energy 2010, TH-C/P4-27* (International Atomic Energy Agency, Vienna, 2010).  
Google scholar profile link for citations and metrics - <https://bit.ly/2FvV4jC>

## Teaching

1. EP4210 - Computational Physics (Jan. 2024)
2. MP5070 - Accelerator Physics & Teletherapy Machines (Feb. 2023, 2024)
3. PH6730 - Plasma Physics & MHD (Aug. 2022, 2023)
4. MP5040 - Computational Techniques (Aug. 2022)
5. PH6250 - Plasma Kinetic Theory (Jan. 2022, 2023)
6. EP1108 - Modern Physics (Dec. 2021, Aug. 2022, 2023)
7. PH6589 - Computational Physics-II (Aug. 2021)
8. EP3051 - Physics Lab (Jan. 2021)
9. EP1208 - Electricity & Magnetism (Jan. 2021, Jan. 2022, 2023)
10. EP2017 - Relativity (Sept. 2020)

## Mentoring

### *Research mentees*

1. Harihar Pradhan (Ph.D. student, IIT Hyderabad, 2022–)
2. Sruti Satyasmita (JRF, IIT Hyderabad, 2022-2024, on to Ph.D. at Charles University)
3. Johan Sharma (Ph.D. student, IIT Hyderabad, 2021–)
4. Snehanshu Maiti (Ph.D. student, as co-supervisor at DESY Zeuthen, 2019-2021)

### *Master's students*

1. Kanhea Sabar (2023-2024)
2. Popi Das (2022-2023)
3. Pulkit Mehta (2021-2022)
4. Priya Gupta (2020-2021)

### *Bachelor's students*

1. Vasudev Giduturi (2023-2024)
2. Devananth V (2022-2023)
3. Vatsal Khandelwal (2021-2022)
4. Abhinav Poddar (2021-2022, on to Data Scientist at Sprinklr)
5. Srinikitha Bhagvati (2020-2021, on to Ph.D. at Pennsylvania State University)
6. Abhishek Kumar (2020-2021)
7. Luis Fernando Mejía Jirón (National Autonomous University of Honduras, 2018-19).

### Research grants

1. *Hands on workshop for training on computational fluid dynamics*, co-PI, NSM Workshop, 2023.
2. *Kinetic scale current sheets and wave interactions in space plasma turbulence*, DST-SERB Startup Research Grant (SRG), 2022-2023.
3. *Resolving ion-to-electron scale physics in kinetic Alfvén wave turbulence*, Supercomputer Education and Research Center, IISc Bangalore, National Supercomputing Mission, 2021-2023.
4. *Identifying properties of wave turbulence in space plasmas* - IIT Hyderabad seed grant, 2020-2022.
5. PI for several computing time grants at the Norddeutscher Verbund für Hoch- und Höchstleistungsrechnen (HLRN) supercomputing center, Germany; Vlaams Supercomputer Centrum (VSC) of Belgium, University of Illinois National Center for Supercomputing Applications, Texas Advanced Supercomputing Center (TACC), National Energy Research Scientific Computing Center (NERSC), and San Diego Supercomputer Center for a cumulative computing time of over 30 million CPU-hours.

### Professional Activities

1. Faculty Advisor for Engineering Physics batch of 2020
2. Member of DUGC Physics, IITH
3. Referee for peer-review journals: *Astrophysical Journal Letters*, *Monthly Notifications of Royal Astronomical Society*, *Physics of Plasmas*, *Astrophysics and Space Science*, *Plasma Science and Technology*.

### Professional Talks

1. Astro Seminar, Physical Research Laboratory (PRL), Ahmedabad, Jan. 2024  
*Cosmic ray transport in magnetohydrodynamic turbulence.*
2. 3rd Conference on Plasma Simulation CPS-2022, Raman Science Center, Leh, Ladakh, Jul. 2023  
*Particle and magnetic field line diffusion with adaptive step-size methods (invited).*

3. Plasma Science Society of India (PSSI), PLASMA conference, IIT Jodhpur, Dec. 2022  
*Kinetic Alfvén wave dispersion and nonlinear interactions in 2.5D.*
4. Physics seminar at Sikkim Central University, Oct. 2022  
*Properties of turbulence in space plasmas.*
5. Physics seminar at IIT Kanpur & IIT-BHU, July 2022  
*Wave modes in plasma turbulence from fluid to kinetic scales.*
6. Chandra's contribution in Plasma Astrophysics, Jawaharlal Nehru University, New Delhi, Oct. 2021  
*Diffusion of charged particles in plasma turbulence (invited).*
7. AAPPS-DPP 5th Asia-Pacific Conference on Plasma Physics, 2021  
*Two-fluid kinetic Alfvén wave in particle-in-cell simulations.*
8. International e-Conference on Plasma Theory and Simulations (PTS-2020), Bilaspur, India, 2020  
*Properties of Magnetohydrodynamic Modes in Compressively Driven Plasma Turbulence.*
9. Physical Research Laboratory (PRL), Ahmedabad, India, & TIFR Bombay, 2019  
*Multi-scale physics of turbulence and magnetic reconnection in space plasmas.*
10. European Physical Society (EPS) Conference on Plasma Physics, Milan, Italy, 2019.  
*Properties of magnetohydrodynamic modes in compressively driven plasma turbulence.*
11. Institute for Plasma Research (IPR), Ahmedabad, India & Tata Center for Interdisciplinary Sciences (TIFR-TCIS), Hyderabad, India, 2018.  
*Nature of plasma turbulence and magnetic reconnection going from fluid to kinetic scales.*
12. Arcetri 2018 Workshop on Plasma Astrophysics, Arcetri (Florence), Italy, 2018.  
*Properties of MHD modes in compressible turbulence.*
13. European Geophysical Union (EGU) General Assembly, Vienna, Austria, 2018.  
*Study of reconnection in large-scale magnetic island coalescence via two-way coupling of MHD with PIC.*
14. International Conference on Numerical Simulations of Plasmas, Leuven, Belgium, 2017.  
*Simulating magnetic reconnection in large-scale systems via two-way coupling of MHD with PIC.*
15. Astronom 2017, Saint Malo, France, 2017.  
*Two way coupling of MHD and PIC simulations for multi-scale and multi-physics treatment of magnetic reconnection (invited).*
16. CHARM meeting, Ghent University, Ghent, Belgium, 2016.  
*One-way coupling of the MPI-AMRVAC MHD code with the iPIC3D kinetic code*
17. Astronom 2016, Monterey, CA, USA, 2016.  
*MHD and PIC simulations of decaying plasma turbulence (invited).*
18. Theory Seminar, Princeton Plasma Physics Laboratory, Princeton, USA, 2015.  
*Current sheets and particle energization in Alfvénic plasma turbulence.*
19. 8th Festivale de Theorie, Aix-en-Provence, France, 2015.  
*Mode space energy distribution in gyro-kinetic turbulence.*
20. Astro Seminar, Indian Institute of Science (IISc), Bengaluru, India, 2015.  
*Turbulence in space and astrophysical plasmas - from fluid to kinetic scales.*

21. Physics Seminar, Indian Institute of Science Education and Research (IISER), Pune, India, 2015.  
*Turbulence in space and astrophysical plasmas - from fluid to kinetic scales.*
22. 56th Annual Meeting of APS-DPP, New Orleans, LA, USA, 2014.  
*Comparing fluid and kinetic simulations of decaying MHD turbulence.*
23. Meso-scale Plasma Dynamics and Energetic Particles, Los Alamos, NM, USA, 2014.  
*Comparing fluid and kinetic simulations of decaying MHD turbulence (invited).*
24. Midwest Magnetic Fields Workshop, Madison, WI, USA, 2014.  
*Comparing spectra of MHD turbulence from fluid and kinetic simulations.*
25. US Transport Taskforce Workshop TTF 2012: Annapolis, MD, USA, 2012.  
*Role of stable modes in zonal flow regulated turbulence.*

## Awards

1. UW-Madison Physics department Emanuel R. Piore award for outstanding performance in the Physics qualifying examination (May 2008).