

M. Hasan Barbhuiya

Postdoctoral Fellow - Department of Physics and Astronomy, West Virginia University, Morgantown, WV 26506, USA

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Research Interests

Dissipation and energy conversion in weakly collisional plasmas; Non-equilibrium thermodynamics of collisionless plasma; Non-equilibrium plasma phenomena such as magnetic reconnection, decaying plasma turbulence and collisionless shocks.

Skills

1. Analytical kinetic theory and Magnetohydrodynamic (MHD) theory.
2. Kinetic simulation using FORTRAN based particle-in-cell code p3d.
3. Data analysis using IDL, MATLAB, MATHEMATICA, PYTHON (basic) programming languages.

Education

Ph.D., Physics WEST VIRGINIA UNIVERSITY

Morgantown, WV, USA 2016-2023

Dissertation: [Energy Conversion in Plasmas out of Local Thermodynamic Equilibrium: A Kinetic Theory Perspective](#).

Dissertation advisor: Prof. Paul Cassak

B.Tech., ECE NATIONAL INSTITUTE OF TECHNOLOGY

Silchar, Assam, India 2008-2012

Work Experience

Postdoctoral Fellow WEST VIRGINIA UNIVERSITY

Morgantown, WV 08/2023 - present

- Research responsibilities - theoretical and computational plasma physics, with a focus on understanding energy conversion channels in collisionless plasma and studying non-equilibrium thermodynamics of collisionless plasmas by using analytical theory and particle-in-cell simulations of magnetic reconnection and turbulence.
- Graduate student mentorship and grant application assistance.

Graduate Assistant WEST VIRGINIA UNIVERSITY

Morgantown, WV 2018 - 2023

- Research responsibilities - theoretical and computational plasma physics, with a focus on understanding dissipation and energy conversion in nearly collisionless plasmas using analytical theory and particle-in-cell simulations of magnetic reconnection.
- Graduate student mentorship and grant application assistance.

Teaching Assistant WEST VIRGINIA UNIVERSITY

Morgantown, WV 2016 - 2018

- Responsibilities - teaching Algebra-based Mechanics Lab (Phys 101), Algebra-based Electromagnetism Lab (Phys 102) and Calculus-based Electromagnetism Lab (Phys 112), covering the theory behind the lab work, grading the student responses, preparing quizzes and proctoring and grading the final exams.

Publications

1. **M. Hasan Barbhuiya**, Paul A. Cassak, Subash Adhikari, Tulasi N. Parashar, Haoming Liang, and Matthew R. Argall, "Higher-order nonequilibrium term: Effective power density quantifying evolution towards or away from local thermodynamic equilibrium", [Phys. Rev. E](#) **109**, 015205 (2024).
2. Peiyun Shi, Earl E. Scime, **M. Hasan Barbhuiya**, Paul A. Cassak, Subash Adhikari, M. Swisdak, and Julia E. Stawarz, "Using Direct Laboratory Measurements of Electron Temperature Anisotropy to Identify the Heating Mechanism in Electron-Only Guide Field Magnetic Reconnection", [Phys. Rev. Lett.](#) **131**, 155101 (2023).
3. Paul A. Cassak, **M. Hasan Barbhuiya**, Haoming Liang, and Matthew R. Argall, "Quantifying Energy Conversion in Higher Order Phase Space Density Moments in Plasmas", [Phys. Rev. Lett.](#) **130**, 085201 (2023).
4. Paul A. Cassak and **M. Hasan Barbhuiya**, "Pressure-strain interaction. I. On Compression, Deformation, and Implications for Pi-D", [Phys. Plasmas](#), **29**, 122306 (2022).
5. Paul A. Cassak, **M. Hasan Barbhuiya**, and Arthur Weldon, "Pressure-Strain Interaction: II. Decomposition in Magnetic Field-Aligned Coordinates", [Phys. Plasmas](#), **29**, 122307 (2022).
6. **M. Hasan Barbhuiya** and Paul A. Cassak, "Pressure-Strain Interaction: III. Particle-in-Cell Simulations of Magnetic Reconnection", [Phys. Plasmas](#), **29**, 122308 (2022).
7. **M. Hasan Barbhuiya**, P. A. Cassak, M.A. Shay, Vadim Roytershteyn, M. Swisdak, Amir Caspi, Andrei Runov, Haoming Liang, "Scaling of electron heating by magnetization during reconnection and applications to dipolarization

- fronts and super-hot solar flares”, [Journal of Geophysical Research: Space Physics](#), **127** (2022).
8. Peiyun Shi, Prabhakar Srivastav, **M. Hasan Barbhuiya**, Paul A. Cassak, Earl E. Scime, M. Swisdak, Cuyler Beatty, Tyler Gilbert, Regis John, Matthew Lazo, Ripudaman Singh Nirwan, Mitchell Paul, Ethan E. Scime, Katey Stevenson, and Thomas Steinberger, “Electron-Only Reconnection and Associated Electron Heating and Acceleration in PHASMA”, [Phys. Plasmas](#), **29**, 032101 (2022).
 9. M. R. Argall, **M. H. Barbhuiya**, P. A. Cassak, S. Wang, J. Shuster, H. Liang, D. J. Gershman, R. B. Torbert, and J. L. Burch, “Theory, Observations, and Simulations of Kinetic Entropy in a Magnetotail Electron Diffusion Region”, [Phys. Plasmas](#), **29**, 022902 (2022).
 10. Peiyun Shi, Prabhakar Srivastav, **M. Hasan Barbhuiya**, Paul A. Cassak, Earl E. Scime, and M. Swisdak, “Laboratory Observations of Electron Heating and non-Maxwellian Distributions at the Kinetic Scale During Electron-Only Magnetic Reconnection”, [Phys. Rev. Lett.](#) **128**, 025002 (2022).
 11. Haoming Liang, **M. Hasan Barbhuiya**, P. A. Cassak, O. Pezzi, S. Servidio, F. Valentini, G. P. Zank, “Kinetic Entropy-Based Measures of Distribution Function Non-Maxwellianity: Theory and Simulations”, [J. Plasma Phys.](#), **86**, 825860502 (2020).

Invited Talks

1. “Higher-order nonequilibrium term (HORNET): An effective power density quantifying evolution towards or away from local thermodynamic equilibrium”, UMD Plasma Physics Seminar Spring 2024, University of Maryland College Park, College Park, MD, 1st May 2024.
2. “Insights from Pressure-Strain Interaction about Magnetic Reconnection”, Magnetospheric Multiscale (MMS) Fall 2023 Science Working Team Meeting, College Park, MD, 24 - 27th Oct 2023.
3. “Theoretical Advancements in Studying Energy Conversion in Collisionless Plasmas”, Solar Heliospheric and INterplanetary Environment (SHINE) Workshop, Stowe, VT, 8th Aug 2023.
4. “HORNET - A New Measure of Non-Equilibrium Energy Conversion”, LASP Turbulence Discussion, University of Colorado, Boulder, CO, *Presented Virtually*, 7th Dec 2022.
5. “New Developments on Energy Conversion via Pressure-Strain Interaction and Applications to Magnetic Reconnection”, Engineering-Physics Space Plasma Seminar Fall 2022, Dartmouth College, Hanover, NH, 11th Oct 2022.
6. “Generalized First law of Thermodynamics: Theory and Applications to Reconnection”, US-Japan Workshop on Magnetic Reconnection 2022, Monterey, CA, 16 - 20th May 2022.

Contributed Talks

1. “Identifying The Stages of Magnetic Reconnection using Energy Conversion Metrics”, WVU Center for KINETIC Plasma Physics Workshop, Morgantown, WV, 25 - 26th Sep 2023.
2. “HORNET - A New Measure of Kinetic-Scale Energy Conversion and its Application to Reconnection”, WVU Center for KINETIC Plasma Physics Workshop, Morgantown, WV, 18 - 19th July 2022.
3. “Physics of Pressure-Strain Interaction in Simulations of Magnetic Reconnection”
Magnetospheric Multiscale (MMS) Fall 2022 Science Working Team Meeting, *Attended Virtually*, 4 - 6th Oct 2022.
4. “HORNET - A New Measure of Kinetic-Scale Energy Conversion”, 8th Magnetospheric Multiscale (MMS) community workshop, *Attended Virtually*, 9 - 13th May 2022

Contributed Posters

1. “Identifying The Stages of Magnetic Reconnection using Energy Conversion Metrics”, American Geophysical Union meeting, San Francisco, CA, 11 - 15th December 2023.
2. “Generalized First Law of Thermodynamics: A New Theory of Kinetic-Scale Energy Conversion”, Solar Heliospheric and INterplanetary Environment (SHINE) Workshop, Honolulu, HI, 25th June - 1st Jul 2022.
3. “HORNET - A New Measure of Kinetic-Scale Energy Conversion”, Geospace Environment Modeling (GEM) Workshop, Honolulu, HI, 19 - 24th June 2022.
4. “Electron heating by magnetization and its application to dipolarization fronts in Earth’s magnetotail –Theory, Simulations, and Observations”, American Geophysical Union meeting, New Orleans, LA, 13 - 17th Dec 2021.
5. “Electron heating by remagnetization of demagnetized electron beams produced by magnetic reconnection: Theory, simulations, and observations”, APS-Division of Plasma Physics meeting, Pittsburgh, PA, 8 - 12th Nov 2021.
6. “Electron heating by magnetization in dipolarization fronts in Earth’s magnetotail: Theory, Simulations, and Observations”, Geospace Environment Modeling (GEM) Workshop, Virtual Meeting, 29th Jul 2021.
7. “Using kinetic entropy to identify regions with adiabatic or non-adiabatic processes in antiparallel reconnection”,

American Geophysical Union meeting, *Attended virtually*, 7 - 16th Dec 2020.

8. "Dependence of Kinetic Entropy on Plasma Temperature and Density in Particle-In-Cell Simulations of Antiparallel Reconnection", APS-Division of Plasma Physics meeting, *Attended Virtually*, 9 - 13th Nov 2020.
9. "Dependence of Kinetic Entropy on Plasma Temperature in Particle-In-Cell Simulations of Antiparallel Reconnection", American Geophysical Union meeting, San Francisco, CA, 9 - 13th December 2019.

Awards

1. **Research Trust Fund Seehra Research Award**, Department of Physics and Astronomy, West Virginia University, Fall 2023

Online Courses & Certificate

- Honor code certificates from Physics and Math MOOCs primarily on EDX and COURSERA; please see Licenses & certifications in [LinkedIn profile](#) for a complete list
- **National Programme on Technology Enhanced Learning (NPTEL)** grad-level Quantum Mechanics course

Peer Review

- Geophysical research letters (3)