UCLA

Plasma Physics Seminar

Physics & Astronomy Building (PAB) Room 4-330
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11:00AM

Non-Linear Ion Acceleration in Collisionless Plasma Shocks: New Perspectives from Kinetic Simulations

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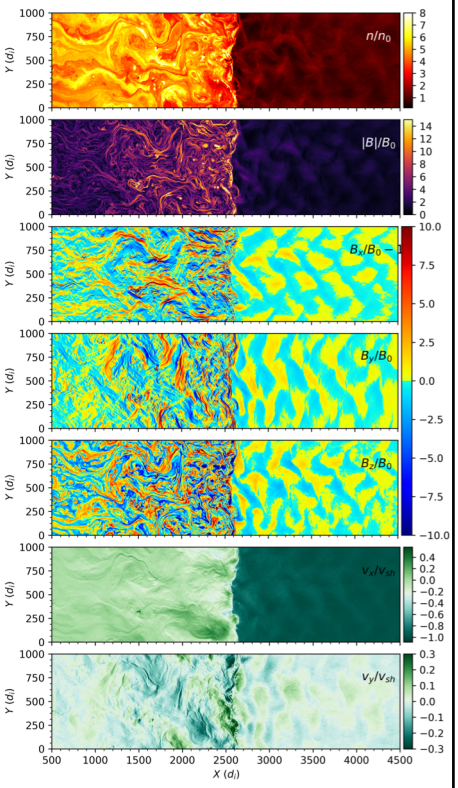

High-energy particles, or cosmic rays (CRs), fill the universe and in the interstellar medium are in energetic equilibrium with both thermal plasma and magnetic fields. CRs can transport and deposit energy over considerable length scales and affect many different astrophysical processes, such as galaxy formation and the evolution of supernova remnants. To detail the ab-initio generation and transport of CRs, I perform simulations of collisionless plasmas with the first-of-its-kind relativistic hybrid code, dHybridR. In collisionless shocks as much as 10-15% of the shock kinetic energy is channeled into CRs. The energized CRs escape upstream of the shock and amplify the background magnetic field. This ultimately slows down the shock and results in a non-linear feedback process which limits the fraction of shock energy deposited into CRs and changes the shape of the CR distribution. These results bring the theory of CR acceleration in collisionless shocks in better agreement with observations of both CRs and supernova remnants and shows the importance of kinetic plasma physics for understanding large scale astrophysical systems.

Colby Haggerty is a plasma physicist who uses theory and computational simulations to study space and astrophysical systems. Currently, he works as a Postdoctoral Scholar in the Astronomy and Astrophysics Department at the University of Chicago studying collisionless plasma shocks, cosmic ray streaming instabilities and relativistic asymmetric magnetic reconnection. He received his PhD in Plasma Physics from the University of Delaware in December 2016. His graduate work focused on studying heating in heliospheric magnetic reconnection as well as kinetic plasma turbulence. His research interests include galactic cosmic ray acceleration and transport, collisionless plasma shocks and diffusive shock acceleration, magnetic reconnection in heliospheric and astrophysical systems and kinetic and MHD plasma turbulence.