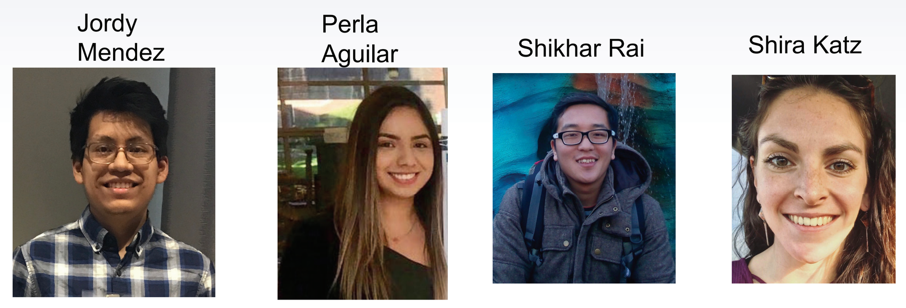
Complex and Turbulent Flows
in fusion, geophysics, astrophysics, and engineering

Hussein Aluie (hussein@rochester.edu)

Students & Postdocs

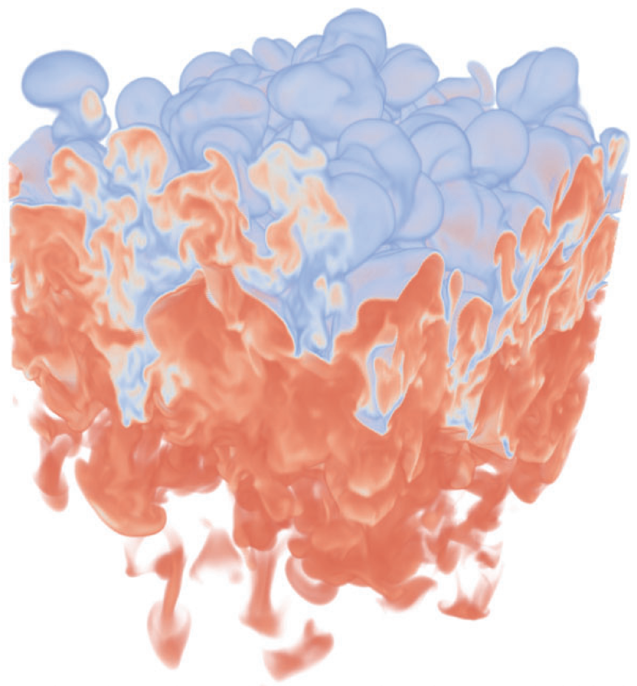
Students

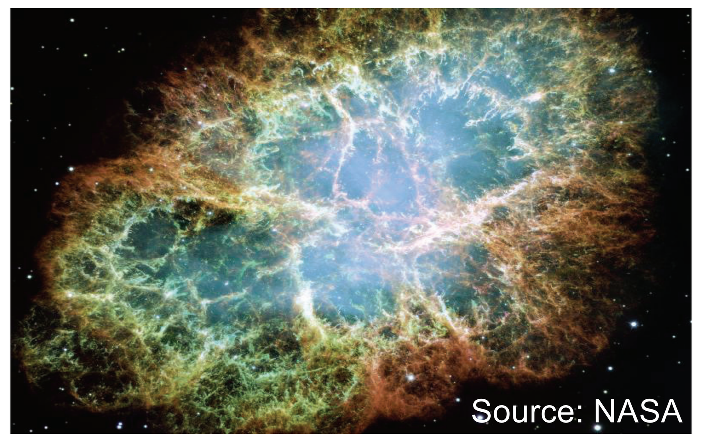


UofR Faculty Collaborators

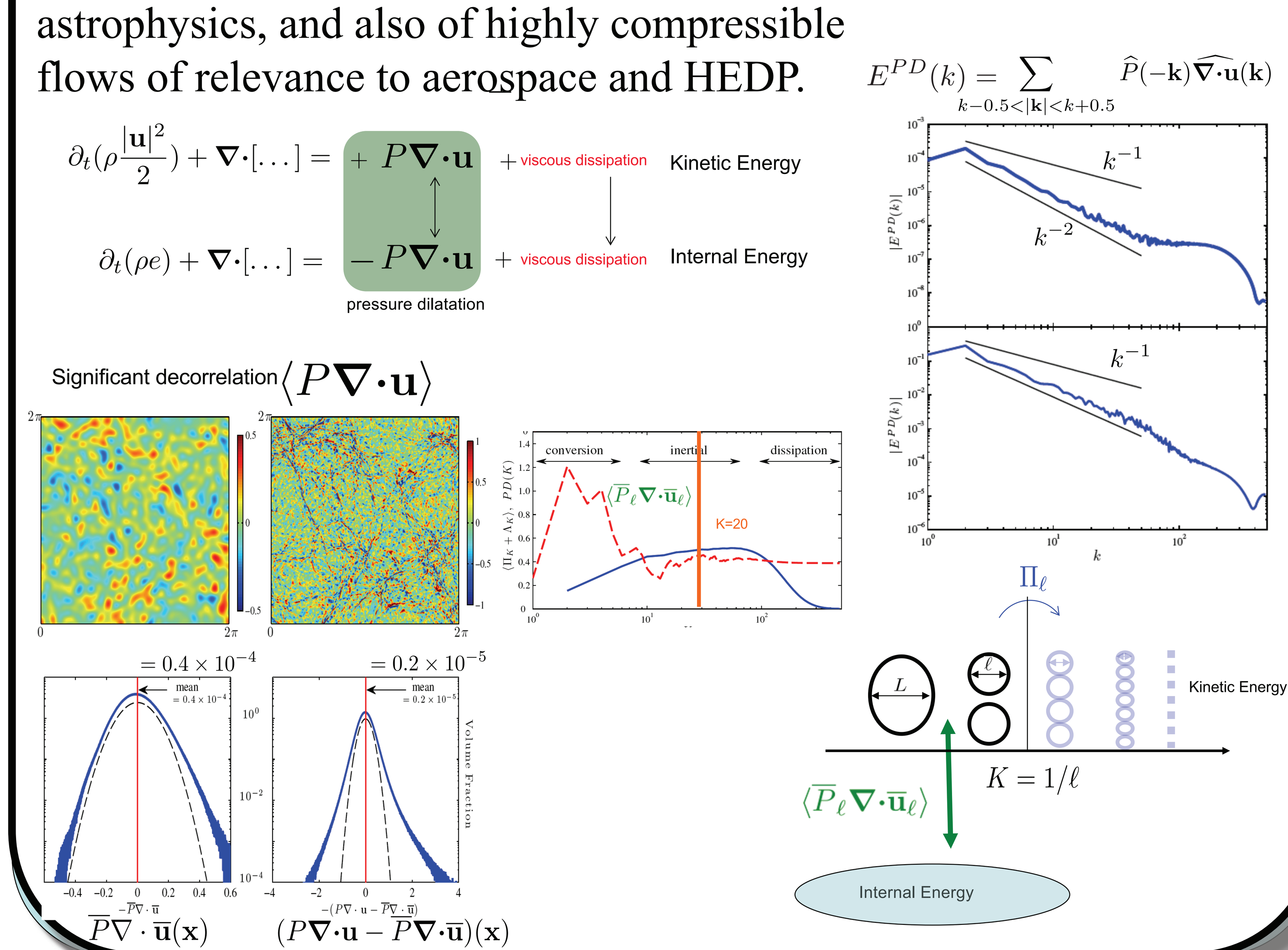
- Riccardo Betti
- Jessica Shang
- Doug Kelley
- Adam Sefkow
- Chuang Ren

Compressible Turbulence and Hydrdynamic Instablities in HEDP

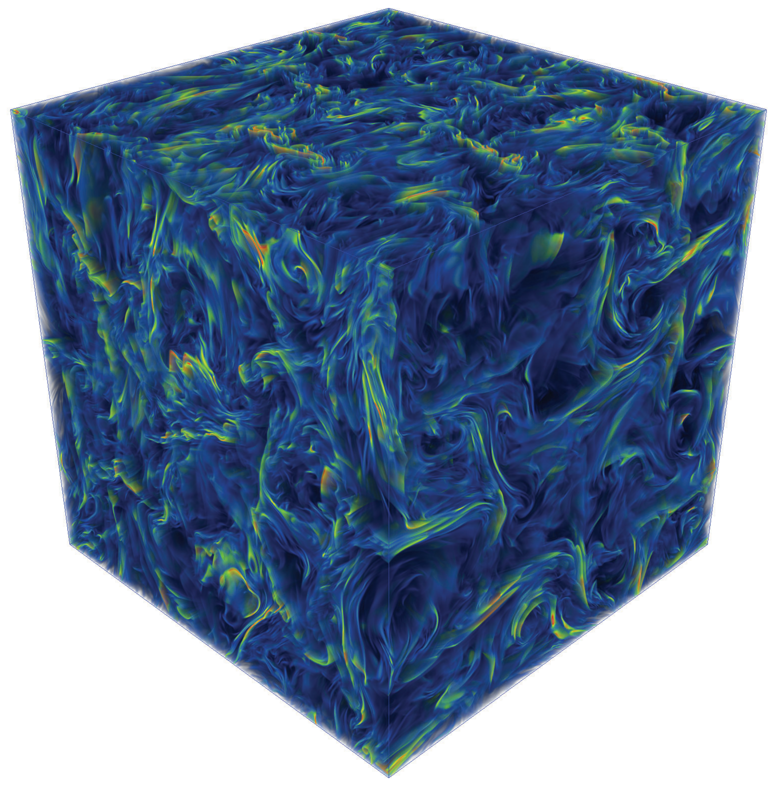


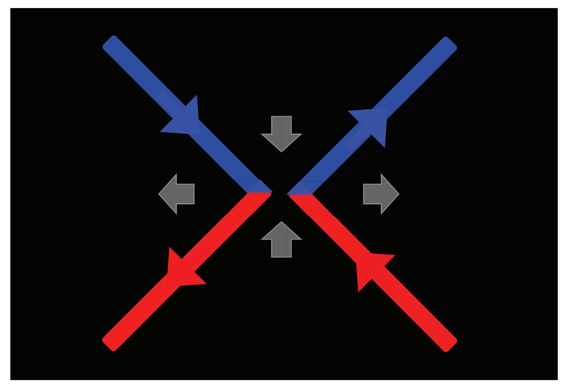


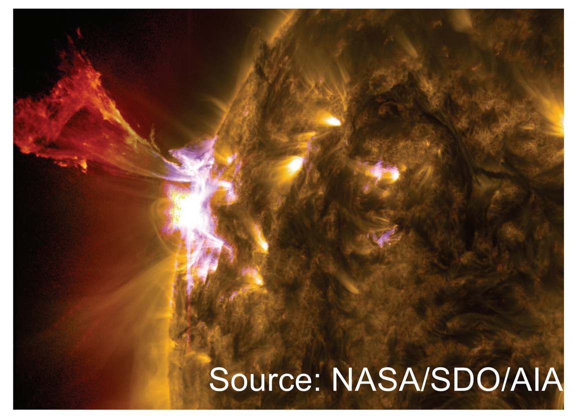
We study hydrodynamic instabilities, such as those in inertial confinement fusion (ICF) and in astrophysics, and also of highly compressible flows of relevance to aerospace and HEDP.



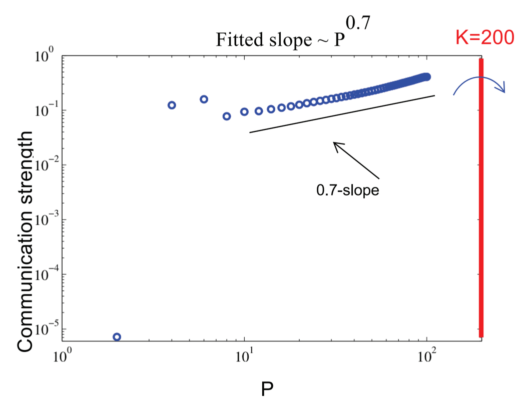
Magnetohydrodynamics and Plasma turbulence



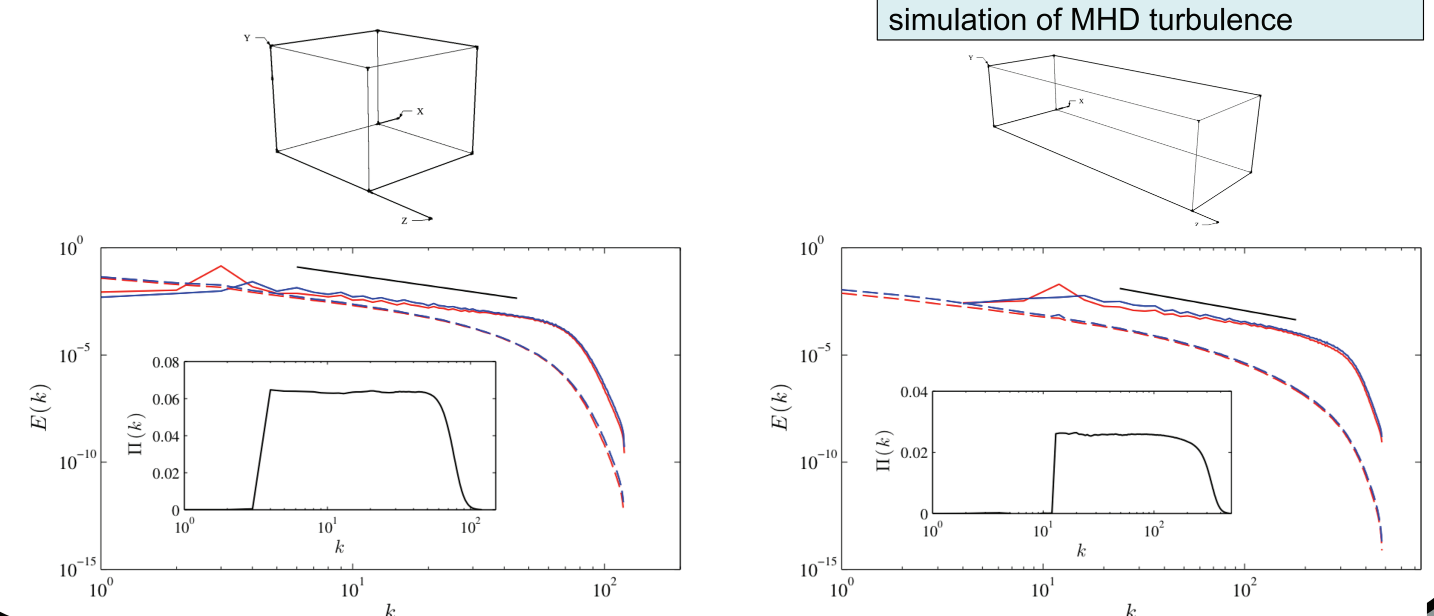




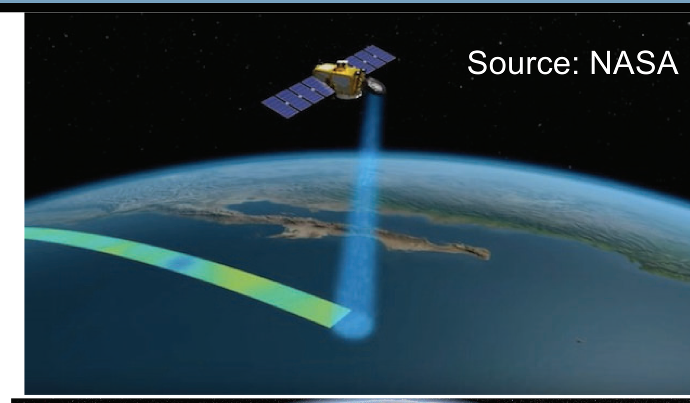
We carry out a massively parallel simulations of MHD turbulence to analyze reconnection between magnetic field lines. Reconnection is manifested in solar flares, in many astrophysical systems, and in HEDP plasmas.

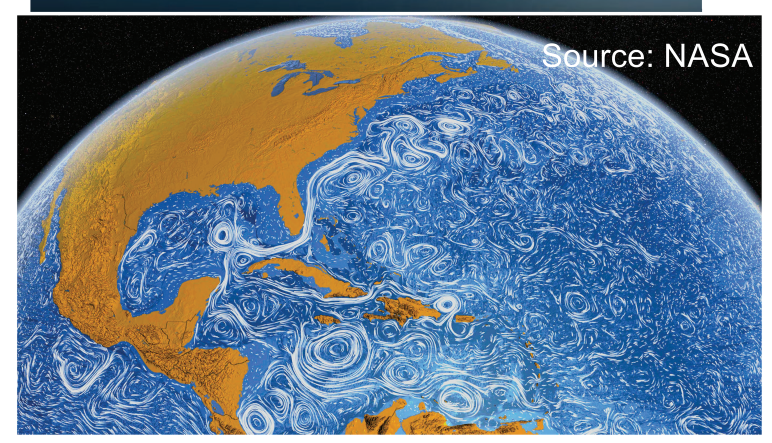


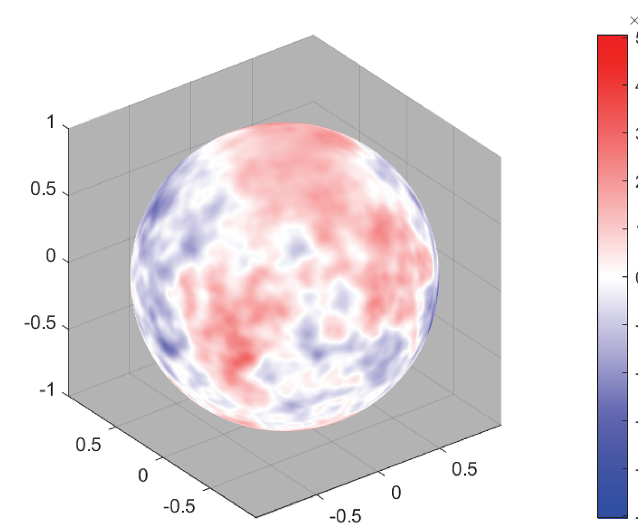
Record-size (at the time) 1024^3 simulation of MHD turbulence



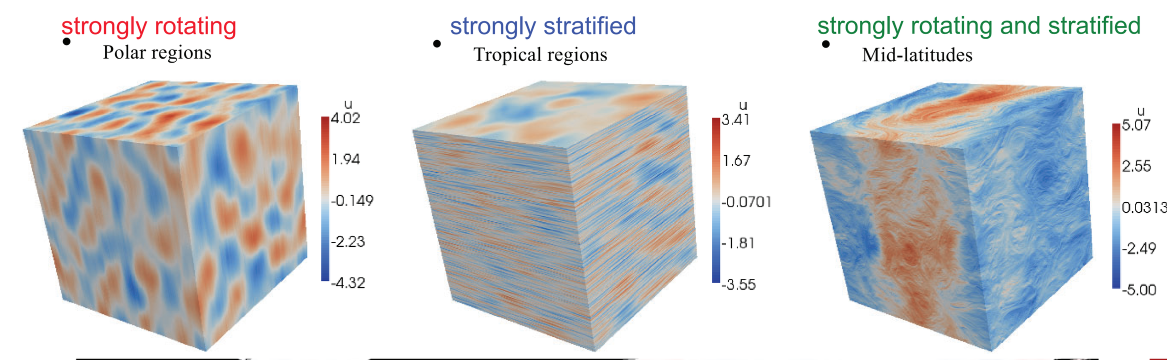
Geophysical Flows

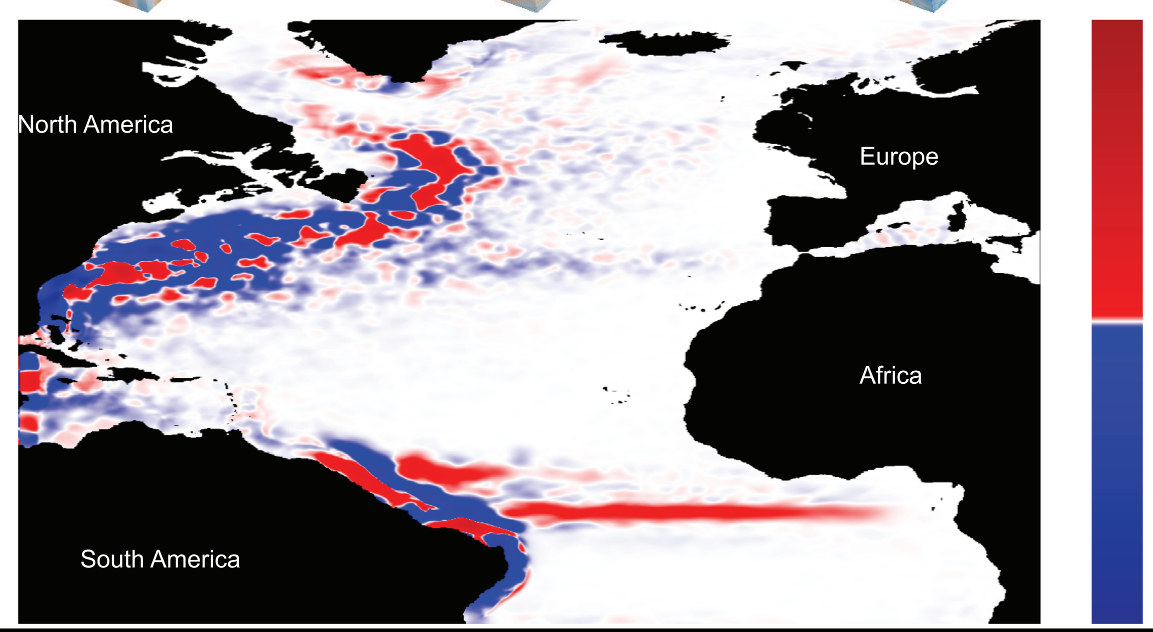






We analyze geophysical flows, using data from simulation and satellites. We quantify energy pathways across scales due to various physical processes using .





Our research falls under the broad umbrellas of fluid dynamics, nonlinear multiscale science, and scientific computing with a focus on the simulation and analysis of turbulence and complex fluid flows. Our general aim is to derive precise testable predictions about the nature of such flows, which are of interest to engineers, plasma physicists, astrophysicists, and climate scientists. The techniques we use and develop range from careful high-performance computations and semi-empirical physical reasoning, to abstract mathematical analysis and proving rigorous theorems. Moreover, the mathematical and numerical methodologies we have been developing provide novel computation-intensive ways for scientists and engineers to probe huge data sets from simulations, satellite observations, and experimental measurements. Our group relies on strong ongiong collaborations with the Laboratory for Laser Energetics (LLE) and Los Alamos National Laboratory (LANL).