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# Alfven Wave Collisions, the Fundamental Building Block of Plasma Turbulence: Theoretical, Numerical, And Experimental Verification

Gregory G. Howes (1), Kevin D. Nielson (1), Dereth J. Drake (2), James W. R. Schroeder (1), Frederick Skiff (1), Craig A. Kletzing (1), and Troy A. Carter (3)

(1) University of Iowa, Physics and Astronomy, Iowa City, United States (gregory-howes@uiowa.edu), (2) Valdosta State University, Physics, Astronomy, and Geosciences, Valdosta, Georgia, United States, (3) UCLA, Physics and Astronomy, Los Angeles, California, United States

Turbulence plays a key role in the evolution of space and astrophysical plasmas, mediating the transfer of energy from large-scale turbulent motions to small scales where the turbulent energy is ultimately converted to plasma heat. The cascade of energy from large to small scales is mediated by the nonlinear interaction between counter-propagating Alfven waves, or Alfven wave "collisions," the fundamental building block of astrophysical plasma turbulence. First, I present an analytical solution for the nonlinear evolution of Alfven wave collisions that elucidates the physical mechanism by which energy is transferred from large to small scales. Next, I show that the analytical solution is validated using nonlinear gyrokinetic simulations of weakly collisional plasma turbulence. Finally, I present the experimental verification of the physics of Alfven wave collisions in the laboratory using the Large Plasma Device (LAPD) at UCLA.