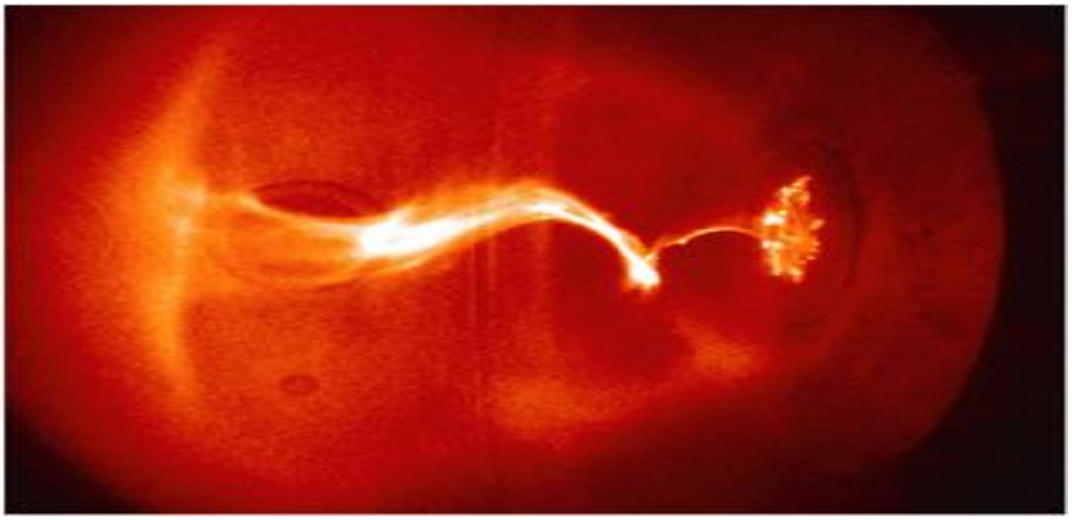
PHYSICS COLLOQUIUM



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From Sandpiles to Burning Plasmas: How Turbulent Self-organization Facilitates Fusion Energy

Abstract

Reaching the conditions necessary for the production of fusion energy requires a minimum combination of pressure and heat confinement in the hot fusion fuel. Because of the density and temperature gradients that consequently exist, the fuel is in a turbulent state in which small seemingly random mixing events occur which tend to relax and eliminate the gradients. When it has a high enough intensity, this turbulence makes it harder to reach the conditions for fusion energy production. However, under the right conditions, these turbulent fluctuations can spontaneously organize into well-ordered states that, in turn, can regulate and reduce the rate at which particles and heat escape the plasma. This then makes it easier to reach the conditions necessary for fusion energy production. This talk describes how a combination of serendipitous findings in large fusion experiments, more controlled smaller scaled experimental studies, theory, and large-scale computational modeling have helped fusion scientists piece this puzzle together and reach a reasonable understanding of the processes of turbulent transport and self-organization in magnetically confined fusion plasmas. We use the results see why producing energy from fusion reactions is challenging, what next steps must be taken to produce net energy gain in the world's first burning plasma, and finally sketch out possible pathways to fusion energy reactors.

3:00-4:30 p.m., Friday, October 6th in McLane 162