Gradient Dynamics for Turbulent Space Plasmas

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The local topology of the streamlines and magnetic lines of the plasma often determines important phenomena occurring in space physics. Since field line local topology may be transparently described through field gradients (Vieillefosse, Physica 125 A, 150, 1984), it is appealing to reformulate plasma dynamics using the gradients of the velocity and magnetic field as dynamical variables.

In this work we present an attempt in this direction: the velocity gradient dynamics, well explored in Hydrodynamics, is here extended to the magnetic variables of MHD. Furthermore, the Probability Distribution Functions of the defined quantities are investigated for a real turbulent space plasma: statistical aspects of topological variables are indeed expected to be extremely relevant in the turbulent regime, where a stochastic field scenario is, in practice, taking place.