1st Asia-Pacific Conference on Plasma Physics, 18-23, 09.2017, Chengdu, China

Global and local (Lie-carried) helicities of two-vortex single-fluid and two-fluid plasmas and the chirality of solar wind turbulence

Zhu, Jian-Zhou

Su-Cheng Centre of Fundamental and Interdisciplinary Sciences @ Gaochun, Nanjing, China

The global magnetic helicity and cross helicity of single-fluid magnetohydrodynamics (MHD) measure the linkage of magnetic lines and that of magnetic and vortex lines. These ideal invariants also characterize the chirality of topological MHD. Extended MHD (XMHD), as a two-vortex single-fluid model, and two-fluid model of plasma dynamics have corresponding quanties which may play important roles in solar wind turbulence [1,2,3]. However, the important concept of topological fluid mechanics is local or Lie-carried invariant. Corresponding the global helicities, people indeed have found local helicities. The local ones are not simply the local densities of the global ones, but require appropriate gauges for re-definition. We present the local helicites of XMHD and two-fluid model of plasmas and discuss essence of the special gauges and local helicities for understanding the fine structures of solar wind turbulence, and, study the temporal non-local or memory effects in nonbarotropic plasma fluids.

References

[1] Abdelhamid H. M., Lingam M., Mahajan S. M., 2016, ApJ, 829, 87.
[2] Sahraoui F., Goldstein M. L., Belmont G., Canu P., Rezeau L., 2010, Phys. Rev. Lett., 105, 131101.
[3] Zhu J.-Z.，2017, MNRAS, in print (DOI: 10.1093/mnrasl/slx075; see also : arXiv:1703.01705)