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Turbulent cascades in MHD

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Ever since the phenomenological description of Hydrodynamic turbulence by Kolmogorov in 1941 there have been many attempts to derive a similar description for turbulence in conducting fluids (i.e Magneto-Hydrodynamic turbulence). However such a description is going to be based inevitably on strong assumptions that do not necessarily carry over from the Hydrodynamic case. In this talk I will discuss some of the properties of the energy and helicity cascade in turbulent MHD [5, 6, 4, 2] flows and focus on the differences with the hydrodynamic case [3, 1]. The investigation is going to be based on the analysis of transfer functions obtained from high resolution direct numerical simulations. Our results show that the transfer of kinetic energy from the large scales to kinetic energy at smaller scales, and the transfer of magnetic energy from the large scales to magnetic energy at smaller scales, are local, as is also found in the case of neutral fluids, and in a way that is compatible with Kolmogorov (1941) theory of turbulence. However, the transfer of energy from the velocity field to the magnetic field is a highly nonlocal process in Fourier space. Energy from the velocity field at large scales can be transfered directly into small scale magnetic fields without the participation of intermediate scales. The cascade of magnetic Helicity in MHD appear to be even more non-local processes. Some implications of these results to turbulent cascade models will be discussed.

References

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