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Magnetic Reconnection in plasma turbulence

Magnetic reconnection is a fundamental process that play a key role in collisionless magnetized plasma turbulence. Energy injected at large fluid scales is injected non linearly toward the smaller and smaller scales down to ion and electron kinetic scales where the cascade is modified as it crosses different physical regimes and finally dissipation is thought to occur. However, differently from the hydrodynamic case, coherent structures known as current sheets are spontaneously generated during the cascade. As soon as the ion scale is reached, in most case the current sheets disrupt due to the onset of reconnection becoming a direct energy source at sub-ion scales competitive with the standard wave-wave cascade. The current sheet structures are typically characterized by a multi-scale structure with an ion-scale layer embedding a thinner electron layer where eventually dissipation occurs. What dissipation is in a collisionless plasma is a matter of strong debate. On the top of that, recently electron-only reconnecting structures have been observed by MMS satellites and subsequently reproduced numerically. Here the ions seem not to participate to the reconnection process. A comparative analysis of the structure functions of standard and electron-only reconnection structures allows one to distinguish the role of the ions and electrons in the dissipative-like process at very small scales.