3D turbulent reconnection and particle acceleration

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Turbulence is a natural state of fluids with a high Reynolds number. It is also known that turbulence dramatically changes the transport properties of fluids, including mass and heat transfer. The problem of reconnection of magnetic fields arises as the Ohmic diffusion of magnetic field lines is negligibly small in highly conducting fluids, while astrophysical observations demonstrate that magnetic reconnection can proceed at a high rate. A realistic case of 3D reconnection in the turbulent medium was considered in Lazarian & Vishniac's (1999) study and since then the proposed model has been supported by observations and numerical simulations. The latter showed that turbulence can be generated in the reconnection layer by the outflow of the matter that accompanies the process of reconnection. In the talk, I will discuss the new developments in the field, including the PIC simulations of the turbulent reconnection as well as the processes of the acceleration of energetic particles that accompany turbulent reconnection. In particular, I will discuss the signatures of the First Order Fermi acceleration demonstrated by numerical simulations and the relation of the process to observed astrophysical phenomena at different scales. I shall also compare the turbulent reconnection to the alternative ideas of fast magnetic reconnection, e.g. by the tearing instability. In particular, I will show that turbulent reconnection induces flux freezing violation in the entire turbulent volume over all the scales of strong MHD turbulence. In this context, I present arguments against treating some scales of the turbulent cascade as experiencing tearing reconnection.