Observations and MHD simulations of fine structure in magnetic reconnection in the solar corona

Hiroaki Isobe

Department of Applied Mathematics and Theoretical Physics, University of Cambridge

and

Department of Earth and Planetary Science, University of Tokyo

One of the fundamental issues to be solved in the physics of magnetic reconnection is the large gap between microscopic scale, where resistivity originates, and global scale of magnetic field. For example, the ion inertia length and ion Larmour radius in the solar corona are 10^{7-8} times smaller than the typical size of solar flares. Presumably there are some meso-scale structures that connect the different scales, but the nature of such fine structures and their consequences to global dynamics are poorly understood. In this paper we will review recent observations of fine structure in solar flares that indicate turbulent nature of reconnecting current sheets and important role of plasmoid ejection. In the other half of the paper we present the result of MHD simulations of solar emerging flux regions. It is found that interchanging filamentary structure arises in the emerging flux due to the magnetic Rayleigh-Taylor instability. As a result, current sheet between the emerging flux and the pre-existing coronal field is deformed, and leading to the localization of tearing instability and the formation of many small plasmoids (magnetic islands). When these small plasmoids are ejected from the current sheet, fast reconnection occurs in a spatially intermittent way. Thus the simulation demonstrates the excitement of turbulence in the current sheet and its consequences to the global dynamics of magnetic reconnection. Based of these observations and simulations we will discuss the possible scenario that links the micro and global scales in astrophysical reconnection.