[SO-13] Thinning of Line-tied Current Sheets in the Solar Atmosphere and in the Earth's Magnetosphere

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In solar magnetic arcades and in the earth's magnetotail, there exists a magnetic field component crossing the current layer. Possibility of magnetic reconnection in such a field geometry has been taken for granted without any skeptical contemplation. Theoretically, however, the presence of the magnetic field component crossing the current layer makes tearing instability difficult to occur. Although a few theoretical studies provided support for possibility of tearing instability in an arch-shaped field, those studies did not consider the line-tying condition. Many numerical studies have been able to produce magnetic reconnection in solar magnetic arcades and in the geomagnetotail. However, few studies have made a scrutiny into the evolution of the current layer leading to trigger of magnetic reconnection. In this paper, we investigate the evolution of a current layer in an arch-shaped line-tied field by artificially suppressing magnetic reconnection. Below a certain threshold of magnetic shear (in a magnetic arcade) or entropy gradient (in the geomagnetotail), diffusive transport of plasma across field lines diminishes the current density of the current layer. Thus, the system evolves away from possibility of magnetic reconnection. On the contrary, above a certain threshold, diffusive transport of plasma further increases the current density. Since this is a runaway process (i.e., an instability), the current sheet can be so highly thinned to enter the scale of the microphysics governing the trigger of magnetic reconnection. Relevant applications to solar eruptions and geomagnetic substorms will be discussed.

[SO-14] Relationship between CME Initial Speed and Magnetic Helicity of Magnetic Clouds

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In order to understand the relationship between solar and interplanetary phenomena, we have examined the initial properties of coronal mass ejections (CMEs) and magnetic helicity of magnetic clouds (MCs) for 24 CME-MC pairs. MCs are fitted with the linear force-free cylindrical model to obtain MC parameters (orientation, size, magnetic field magnitude, impact parameter, chirality, etc). The relative helicity per unit length of MC is calculated by $\frac{H_{MC}}{L} = 4\pi\frac{B_0^2}{\alpha}\int_0^R J_1^2(\alpha r) r\,dr$. Comparing the square of CME initial speeds (V_{CME}^2) with the magnetic helicities (H_{MC}), we find that there is a positive correlation between V_{CME}^2 and H_{MC}, and the linear correlation coefficient (CC) between the two parameters is 0.52. We obtain a better correlation (CC=0.61) for 17 events whose impact parameter (ρ, the shortest distance of the satellite to the MC axis normalized by MC radius) is less than 0.5. Considering that the magnetic force in a flux rope is intimately related to magnetic helicity, our result supports that the magnetic force is responsible for the CME eruption. From this result we suggest that the high speed CME is associated with large magnetic helicity.