

Magnetic Helicity Injection and the Trigger of Solar Flares

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The storage of magnetic free energy and the evolution of magnetic topology in the solar corona must be critical processes for the trigger process of solar flares. Magnetic helicity that is the measure of magnetic linkage is closely related to both the processes, and is widely believed to be a crucial quantity for the trigger of solar flares. Recently, new techniques have been developed to measure the injection rate of magnetic helicity into the solar corona through the solar surface, using vector magnetic field measurements. The results of the magnetic helicity measurement indicated that the X-ray activity increases with the injected magnetic helicity as well as the complexity in the distribution of magnetic shear sign on the solar surface. It suggests that the sign reversal of magnetic shear plays some role for the trigger of flares. Motivated by this, we proposed the new model that magnetic reconnection to annihilate the both signs of magnetic helicity may cause the onset of solar flares. The numerical simulation demonstrates that magnetic reconnection between oppositely sheared fields not only generates the sigmoidal structure of magnetic field, but also indeed drive large scale eruption above the sigmoid through the feedback interaction of double reconnection, which proceeds on the T-shape current sheet. It is quite consistent with the observations of flaring active regions. In this talk, we review the recent results of magnetic helicity measurement, and report about the indication of large scale simulation, which is driven by the vector magnetograph observations.