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Study on the Solar Flare Trigger Mechanism by using 3D Data Driven Magnetohydrodynamic Simulations

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Solar Flare can unleash large amount of energy from the Sun into the solar system and may affect global space based technologies on Earth. However, the detail process of the solar flare mechanism, especially in the early phase of the flare, is still not completely understood. It is believed that initially flare takes place from the highly sheared magnetic field in the active region of the Sun which contains very large non-potential energy. This strong sheared field is then destabilized by some trigger processes which responsible in releasing the free energy through some eruptions.

Several results from the previous numerical simulation study (Kusano et al., 2012) suggested that small magnetic flux which is imposed to the various simple magnetic structures can trigger the eruptions. Two different types of small magnetic structures near the polarity inversion line (PIL) are suggested as the possible configurations for the trigger of flares. They are the small bi-pole fields of opposite polarity or reversed shear compared to the highly sheared magnetic field in the scale of active region. Started from this result, we extend this work by using more realistic configuration of magnetic fields which mimic the solar coronal magnetic structure.

In this presentation, we will present some results of our simulations to elucidate the trigger process of solar eruption based on the 3D magnetohydrodynamic (MHD) model. In order to do this, we perform Nonlinear Force Free Field (NLFFF) extrapolation (Inoue et al., 2014) using the vector magnetogram data of the active region NOAA 10930 from the Hinode satellite. The NLFFF of the active region before the eruption showed that strong sheared magnetic field appeared near the PIL. We systematically carried out the numerical simulations, in which several emerging fluxes are injected onto different points in the NLFFF. As a result, we confirmed that some types of small emerging flux can trigger the eruption. It verifies that the previous work mechanism (Kusano et al. 2012) can be applied to more realistic magnetic structure. Our result suggests that the position and intensity of the emerging flux with respect to the initial NLFFF condition is very crucial for triggering the solar eruption.

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