Simulation Study of Solar Eruptions Associated with Interaction between Newly Emerging Flux and Coronal Arcade Field

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Many kinds of eruptive phenomena, such as flares, filament eruptions and coronal mass ejections (CMEs) are seen in the solar atmosphere. Though various triggering mechanisms for these eruptive phenomena have been proposed both observationally and theoretically, the detailed mechanisms are under debate. One candidate is an interaction between the newly emerging flux and the coronal arcade field [1]. It has been revealed statistically that the reconnection between the emerging flux and the coronal arcade field plays an important role. However, its physical role for eruptions is still unclear. In order to investigate the triggering mechanism associated with newly emerging flux and which conditions are required to trigger the eruptions, we performed 2.5-dimensional magnetohydrodynamic simulations (in 2-dimensional space with three magnetic and velocity components) and carried out parameter survey about the magnetic field strength, the location of the emerging flux and the shear angle of the arcade field. As a result, two distinct mechanisms are seen and occurrence of these two depends on the location of the emerging flux. One is dominant in the region where the location of the emerging flux is far from the PIL (polarity inversion line) of the arcade field, and the other is dominant in the region where the location of the emerging flux is around the PIL. Eruptions by former mechanism are due to the compression of the arcade field by the emerging flux and likely to occur when the magnetic field strength of the emerging flux is larger or the location of the emerging flux is closer to the PIL. Eruptions by latter mechanism are due to the coupling of several reconnections and likely to occur when the magnetic field strength of the emerging flux is smaller and the direction of the magnetic field is reconnection-favorable. For both mechanisms, the strongly sheared arcade field is preferable for eruptions. We conclude from the dependence to the shear angle of the arcade field that the latter mechanism is similar to the reversed shear model [2] while the torus instability [3],[4] does not work well in our mechanisms.