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Simulation Study of Solar Plasma Eruption by Interaction between Emerging Flux and Coronal Arcade Field

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Many kinds of eruptive phenomena, such as eruptive flares, solar filament eruptions and coronal mass ejections (CMEs) are seen in the solar atmosphere and sometimes have an crucial influence on the earth's magnetosphere.It is widely believed that these eruptive phenomena are caused by the same MHD mechanism by which magnetic energy stored in the corona is released. On the other hand, the detailed mechanism has not been clarified. Many observational studies reported the events which are triggered by the interaction between the newly emerging flux and the coronal arcade field. It is also suggested in these studies that reconnection has an important role in the triggering mechanism. In order to clarify the triggering mechanism by interaction between the emerging flux and the coronal arcade field and its parameter dependence, we perform 2.5-dimensional MHD simulation. The controlled parameters are the magnetic field strength, the location of the emerging flux relative to the arcade field, and the shear angle of the arcade field. As a result, two types of mechanisms are found and these are separated in a parameter space of the location of the emerging flux. One of them appears when the location of the emerging flux is around the polarity inversion line (PIL) of the arcade field and this mechanism depends on reconnection between the emerging flux and the arcade field, as pointed out by the observations. Another appears when the location of the emerging flux is far from the PIL and depends on reconnection in the arcade field above the PIL. We discuss how the interaction between the emerging flux and the arcade field causes eruptions and which kinds of conditions are required. Our results show the possibility to predict whether an eruption occurs or not by investigating the amount of flux of the emerging flux and the distribution of the ambient magnetic field.

Keywords: solar flare, solar filament eruption, coronal mass ejection