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Simulation Study on the Trigger Process of Solar Flares

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Solar flare is one of the most catastrophic phenomena in our solar system, and it is widely believe that magnetic reconnection plays a main role for the liberation of magnetic energy driving solar flare. However, what triggers magnetic reconnection in solar flares is still an open question to be solved. It is important to reveal the trigger mechanism of solar flares not only for the understanding of solar coronal activity but also for the advancing predictability of space weather. In this study, first, we analyze the initiation process of the X3.4 class solar flare on December 13, 2006, based on the observation by the Hinode satellite, and propose a new scenario that the feedback of two different reconnections, which can be initiated by the emerging of magnetic flux sheared oppositely to the preexisting magnetic arcade, should trigger solar flare. Second, we carry out the numerical experiments to verify this hypothesis in terms of the two different types of three-dimensional magnetohydrodynamic simulations, in which the linear force-free model field and the realistic nonlinear force-free field are used for the preexisting magnetic arcade, respectively. Both the simulations clearly demonstrate the proposed scenario can work to abruptly commence magnetic reconnection in the realistic geometry of solar active regions. Finally, we like to discuss about the possibility to predict the onset of solar flares in terms of the combination of high resolution observation of solar magnetic field and the data-driven numerical simulation.

Keywords: solar flares, trigger, simulation, reconnection, MHD, Hinode