Simulation Study on the Three-Dimensional Dynamics of Flux Tube in the Solar Corona

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The eruption of magnetic flux tube in the solar corona is important to understand the formation mechanism of Coronal Mass Ejections(CMEs). The trigger mechanism, however, is not clear and different models based on the loss-of-stability theory and the loss-of-equilibrium theory have been proposed. For instance, Priest & Forbes (1990) developed the flux tube eruption model based on the loss-of-equilibrium. They explained that the flux tube equilibrium embedded in magnetic arcade may erupt as a result of breaking an equilibrium condition due to change the boundary condition. Furthermore, they pointed out the magnetic reconnection occurs in the lower part of flux tube, while it ascends. This model, however, is limitted to the two-dimensional space and not considered the three-dimensional instability. Therefore, it is possible for the flux tube to be unstable before arriving the loss-of-equilibrium point. So, we carried out the linear stability analysis for the flux tube equilibrium proposed by Priest & Forbes, and performed the three-dimensional nonlinear simulation.

As a result, we found that the flux tube is unstable to the kink mode instability, as the system approaches to the loss-of-equilibrium state. The three-dimensional simulation shows that when the flux tube is long enough, it ascends continuously, whereas the short flux tube stops at certain height. We will report the detailed results.