The Onset Mechanism of Solar Eruption

K. Kusano [1)]

[1)] Institute for Space-Earth Environmental Research, Nagoya University,
Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan
kusano@nagoya-u.jp

Abstract

Solar eruptions, such as solar flares and coronal mass ejections, are the most catastrophic eruptions in our solar system, and have been known to affect terrestrial environments and infrastructure. Because their onset mechanism is still not sufficiently understood, our capacity to predict the occurrence of solar eruptions is substantially hindered. Recently, however, the systematic simulation of solar eruptions for a wide variety of magnetic structures and the comparative study between the high resolution satellite observations and the realistic numerical simulations of three-dimensional magnetic field improve our understanding of solar eruptions. In this paper, we show the most widely acceptable picture of solar eruptions, in which the nonlinear interaction between an ideal magnetohydrodynamics (MHD) instability and magnetic reconnection play a crucial role. Magnetic reconnection works for transporting magnetic helicity from sheared magnetic loops into a flux rope, and a flux rope becomes more unstable. The growth of instability of flux rope further drives magnetic reconnection. We also propose that a small scale magnetic field of specific structures is capable of triggering this nonlinear feedback process, and discuss about the predictability of flares based on the high-resolution magnetic field observation.