MHD simulation of magnetic reconnection associated with emerging magnetic flux in the solar atmosphere

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Many kinds of solar activities are caused by release of magnetic energy, which is supplied from the solar interior as magnetic flux injection which is observed as 'emerging flux'. On the other hand, observations show that various kinds of solar activities such as jets, flares and filament eruptions often occur in emerging flux regions. This suggests that emerging flux is not only significant for magnetic energy injection, but also significant for triggering other solar activities by the interaction with the ambient coronal magnetic field.

In this study, we perform MHD simulations of solar emerging magnetic flux. CIP-MOCCT (Kudoh, 1997) method is used for our simulations. By using this method we can perform MHD simulation at higher resolution than previous simulation methods; this method has big advantage to save machine power. The porpose of using CIP-MOCCT method is to simulate whole active reigion and interaction between ambient magnetic field and emerging magnetic flux.

Though we are still in an experimental stage, we report our current results. For example we reproduce results of Yokoyama and Shibata (Nature, 1995). Though we simulate their model with smaller number of grid points, our results are even better than theirs, showing sharper dicontinuities. When magnetic reconnection occurs between emerging flux and coronal field, some plasmoids are created by tearing instability and ejected from the reconection region. Then the plasma confined in the plasmoids is released and multi filamentary surge structures are created as many as the plasmoids.

Futhermore, we report our result of three-dimensional MHD simulation of magnetic reconnection between emerging flux and coronal bipolar magnetic field. Arch-shaped current sheet is formed at the interface between the emerging flux and coronal magnetic field. Magnetic reconnection takes place along the current sheet and high speed (300 km/s) and high temperature (10ˆ7 k) jet ejects from the reconnection site. On the othe hand, an arcade structure (reconnected loop) with cuap-shaped is created along the magnetic neutral line between one polarity of the emerging flux and the other polarity of the coronal field.