

## Dynamic magnetic reconnection in the magnetosphere as evidenced by plasmoids

磁気圏における動的リコネクションの証拠としてのプラズモイド

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Magnetic reconnection is one of the most important processes in space plasma physics. In the earth's magnetotail, which is situated in the night-side of the space around the planet and that possesses an elongated current sheet formed as a result of interaction with the solar wind, explosive magnetic reconnection takes place and spacecraft in-situ observations of the process have been made extensively. Recent observations show that the process involves formation of magnetic islands at various scales and ejection of plasmoids, urging us to abandon the quasi-steady X-line picture. Recent studies also indicate that more energetic particles are produced when magnetic islands participate in the acceleration process. In this talk, observational studies indicating the dynamic behavior of magnetic islands as well as simulation works indicating how the involvement of magnetic islands changes the characteristics of magnetic reconnection will be reviewed.

### 1. The emerging picture

The standard picture that one tends to draw when one discusses the process of magnetic reconnection is a two-dimensional quasi-steady X-line picture. Magnetic reconnection is triggered in an elongated thin current sheet and the maturing process that leads eventually to the single X-line state would involve interaction of multiple X-lines that formed in the initial elongated current sheet. That is, the triggering phase would involve formation of magnetic islands. Even after the single X-line state has matured, long simulation runs show that non-steady behavior of an X-line leads to ejection of magnetic islands of various scales. These provide good enough reason to survey the signatures of magnetic islands in the in-situ data obtained by spacecraft in the magnetosphere. In addition, recent simulation studies show that particle acceleration efficiency varies depending on the presence of magnetic islands. The emerging picture is that an X-line in reality is non-stationary to involve magnetic islands and the presence of magnetic islands matters to some of the features of magnetic reconnection that attract our attention.

### 2. Related observations in the magnetosphere

The magnetosphere is the space around Earth and filled by a collisionless plasma. Magnetic reconnection is one of the major drivers of the dynamics processes in the region. By flying a

spacecraft through the region, in-situ observations of processes can be obtained. The data consists of field data (magnetic and electric fields at various frequency ranges) and particle data (velocity space distribution function of ions and electrons) sampled at the position of the spacecraft.

In this talk, three recent observational papers will be reviewed. (1) Observation at the magnetopause current layer of an magnetic island flanked by two active X-lines [1]. (2) Observation in the magnetotail of the center of a magnetic island showing features that the island seems to have formed via coalescence of smaller islands [2]. (3) The same event as in (2) but observation of a solitron wave train that is likely to be of Buneman instability origin [3].

### 3. Related simulation studies

Recent simulation studies have shown that magnetic islands enhance the particle acceleration efficiency drastically. Four recent papers indicating the importance of island coalescence and island contraction will be reviewed [4~7].

## References

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