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## 磁場揺動によるリコネクションの高速化機構の実験的検証
## Magnetic fluctuations during fast reconnection in plasma merging experiment

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Magnetic reconnection drives explosive release of magnetic energy in magnetized plasmas, such as solar flares in solar corona, magnetic substorms in the earth's magnetosphere, and anomalous plasma heating and acceleration in laboratory plasmas. Particularly interested questions are "How does fast magnetic reconnection happen?" and "How is magnetic energy converted to plasma kinetic/thermal energy?". We have been experimentally investigated these issues in terms of MHD waves, current sheet instabilities, and plasmoid ejection in plasma merging device.

Magnetic fluctuations were observed during reconnection inside the current sheet in TS-3 plasma merging experiment with a guide field (Fig.1 (a)): the guide field at the X-point $B_x$ of 60mT is comparable to the reconnecting field $B_{//}$. The frequency spectrum of fluctuations has clear peak at 1.5-2MHz, which is twice as high as local ion gyro frequency. Fluctuations propagate to toroidal direction with about 100 km/s, which is close to the local Alfvén velocity [*Kuwahata et al., 2011*]. The current sheet width decreased when magnetic fluctuations appeared. Its width was finally compressed shorter than the ion skin depth and normalized reconnection rate increased as the sheet width decreased (Fig.1 (b)-(d)). Furthermore, the fluctuation had large amplitude, which is larger than 10% of reconnecting magnetic field, and propagated to the downstream region and toroidal direction with 50% of Alfvén velocity.

Numerical simulation studies report that whistler dynamics suppresses and Kinetic Alfvén Wave (KAW) dynamics becomes dominant [*Kleva et al., 1995; Biskamp, 1997; Rogers et al., 2001*] in the presence of a guide field. Our numerical calculation of dispersion relation yields that Kinetic Alfvén Wave (left-handed polarization) can propagate in the vicinity of the X-point. Fluctuation measurement of 3-magnetic components suggests that the observed magnetic fluctuations are left hand polarized wave. As a consequence, the observed magnetic fluctuations with characteristic of KAW have good correlation with the enhancement of reconnection rate in the presence of a guide field.

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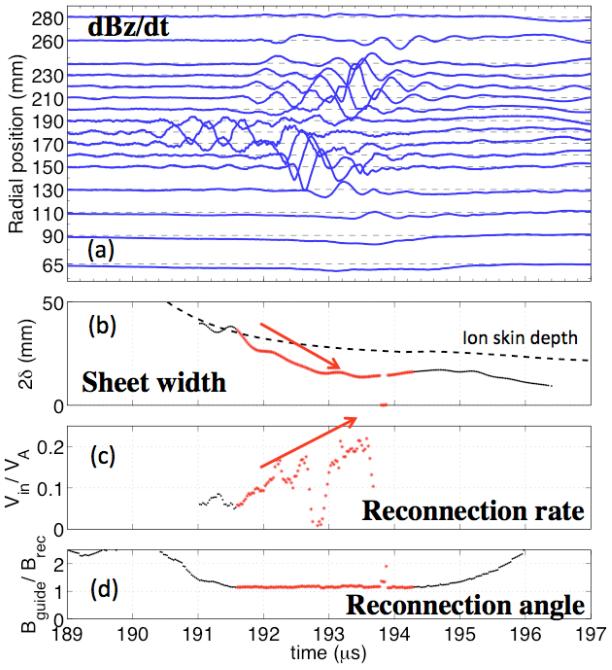


Fig. 1 Typical magnetic fluctuations and various plasma parameter: (a) Reconnected magnetic fluctuations, (b) solid and dashed line indicate current sheet width and ion skin depth $c/\omega_{pi}$, respectively, (c) normalized reconnection rate $E_{rec}/(B_r V_A)$, and (d) the ratio of guide field to reconnecting magnetic field.