**29D20P**

# UTST球状トカマク実験における磁気リコネクションに関するドップラー分光計測

# Doppler Spectroscopy Measurement of Magnetic Reconnection in the UTST Spherical Tokamak Experiment

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Electron acceleration in magnetic reconnection event has been experimentally investigated using the plasma merging technique in the University of Tokyo Spherical Tokamak (UTST) device. In the presence of a strong guide field parallel to the reconnection electric field, electron acceleration by the reconnection electric field might become significant[1]. When the strong guide field exists, the electron current in the diffusion region is less likely to be scattered by the reconnected poloidal magnetic field and can be accelerated effectively by the reconnection electric field[2].

Typical reconnecting magnetic field (poloidal field in the upstream region) is 15 mT, while the guide field (toroidal field) at the X-point is 150 mT, which is much larger than the reconnecting field. Hence, in the UTST device, magnetic reconnection with significant guide field takes place during the ST merging period.

Intense emission of He II line (468.58 nm) was observed only in the vicinity of the X-point by using a multi-channel spectroscopic measurement system[3]. This localized emission indicates the generation of energetic electrons inside the current sheet region, possibly due to the electron acceleration by the strong toroidal electric field induced by magnetic reconnection in the presence of a guide field.

The dependences of the emission intensity and the delay time on the reconnection electric field indicate that the electron acceleration possibly takes place in the vicinity of the magnetic reconnection X-point with a strong guide field. The value of the $T_e$ shown in Fig. 1(c) is significantly lower than the necessary energy for the He II emission, 51 eV. These results are the first evidence of the particle acceleration in magnetic reconnection observed in the laboratory plasma merging experiment.

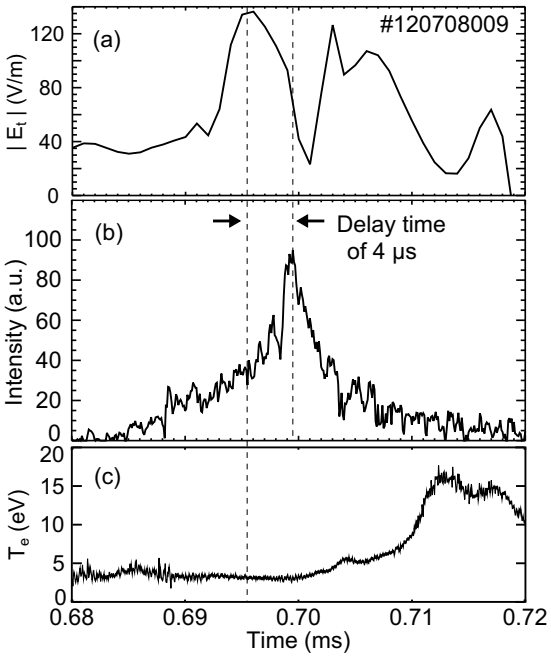


Fig 1: Time evolution of (a) the electric field $E_t$, (b) the He II emission inside the current sheet and (c) the electron temperature $T_e$ at the X-point.

[1] Paolo Ricci *et al.*, Phys. Plasmas, **11**, 4102 (2004).
[2] P. L. Pritchett and F. V. Coroniti, J. Geophys. Res., **109**, A01220 (2004).
[3] S. Kamio *et al.*, Rev. Sci. Instrum., **83**, 083103 (2012).