# 19PA-019

## Study of the Particle Behavior Using Local Ion Emission in Magnetic Reconnection
磁気リコネクションにおける局所発光を用いた粒子の振る舞いの研究

Shuji Kamio, Takenori G Watanabe[1)], Hiroki Nakamata[1)], Hiroki Ishikawa[1)], Naoto Kawakami[1)], Kotaro Yamasaki[1)], Takuma Yamada[2)], Michiaki Inomoto[1)], and Yasushi Ono[1)]
神尾修治, 渡辺岳典[1)]、中俣浩樹[1)]、石川裕貴[1)]、川上直人[1)]、山崎広太郎[1)]、山田琢磨[2)]、井通暁[1)]、小野靖[1)]

*National Institute for Fusion Science, 322-6, Oroshicho, Toki, Gifu 509-5292, Japan*
*[1)]The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8561, Japan*
*[2)]Kyushu University, 774 Motooka, Nishi-ku, Fukuoka 819-0395, Japan*
核融合科学研究所　〒509-5292　岐阜県土岐市下石町322-6
[1)]東京大学　〒277-8561　千葉県柏市柏の葉5-1-5
[2)]九州大学　〒819-0395　福岡県西区元岡774

In order to investigate the particle behavior in the magnetic reconnection, a Doppler spectroscopic system was developed in the ST merging experimental device UTST. In the measurement using the emission excited by the accelerated electrons at the X-point, local outflow and temperature were observed. Describing the radial ion outflow velocity profile at the magnetic reconnection was obtained using the moving X-point and move of the current sheet.

### 1. Introduction
Magnetic reconnection is an essential phenomenon in magnetized plasmas in the fields of solar physics and earth's magnetospheric research. As well as the pileup and ejection phenomena, the guide field reconnection is expected to have some unique features, the guide field pressure would sustain inflow pressure to keep wide current sheet, resulting in MHD scale slow reconnection it would also provide strong electron acceleration near X-point region. In the presence of a strong guide field parallel to the reconnection electric field, electron acceleration by the reconnection electric field might become dominant [1]. When the strong guide field exist, 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]. In this study, we discuss about the experimental results of the ion outflow using the ion Doppler spectroscopy diagnostic with the local emission by the electron acceleration.

### 2. Experimental Setup
In the UTST was constructed to investigate the feasibility of merging startup of high-beta STs under a more reactor relevant condition with no internal poloidal field coils [3]. When the magnetic field lines reconnect, the magnetic energy in the upstream region is mainly converted to plasma kinetic energy in the downstream region.

For measure the ion temperature and velocity, a Doppler spectroscopic system was developed using a PMT array [4]. This system shown in Fig. 2 provide multi point (eight spatial channels) polychromatic measurement with temporal response faster than a typical MHD time scale.

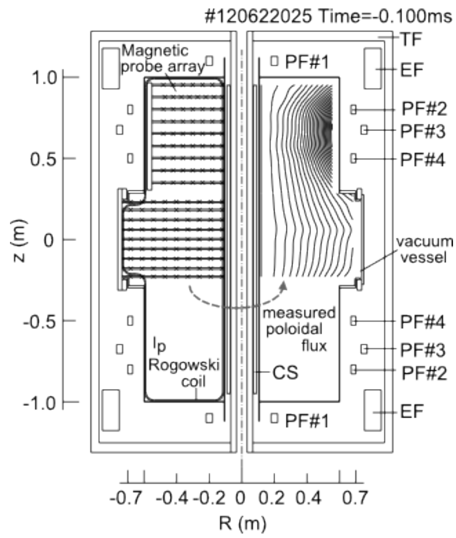


Fig. 1. Cross-section view of the UTST device shown together with the internal diagnostics.

### 3. Experimental Results
Figure 3 shows poloidal flux surface and toroidal current density during the plasma merging measured by the magnetic probe array. Two different results were observed that X-point was moved to inside and outside by changing the current of the

equilibrium coils. This different results were observed also in the spectroscopic measurement shown in Fig. 4. In the UTST reconnection experiments, intense emission of He II line was observed only in the vicinity of the X-point [5]. 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. Using this emission, the local ion velocity was observed. However, the reason of the notably observed the reversed outflow direction in two cases was not revealed.

In order to investigate these differences, an additional magnetic probe was developed for measuring detail magnetic structure near the X-point.

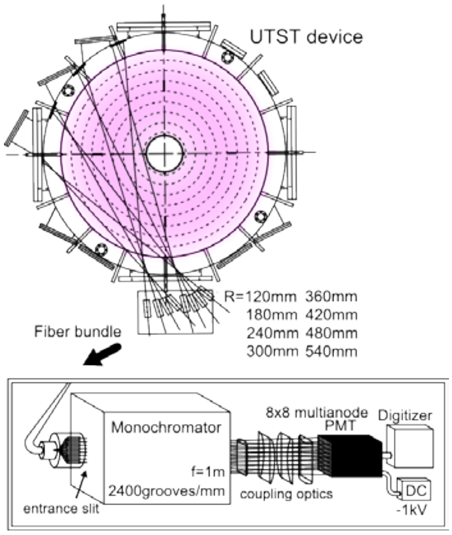


Fig. 2. Cross-section view of the UTST device and schematic view of the spectroscopic system.

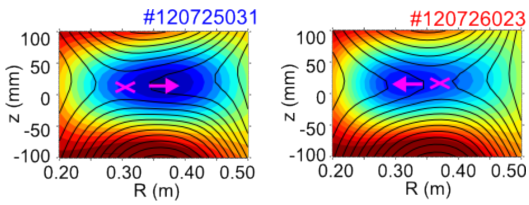


Fig. 3. Poloidal flux surface (contour lines) and toroidal current density (color coded) during the plasma merging.

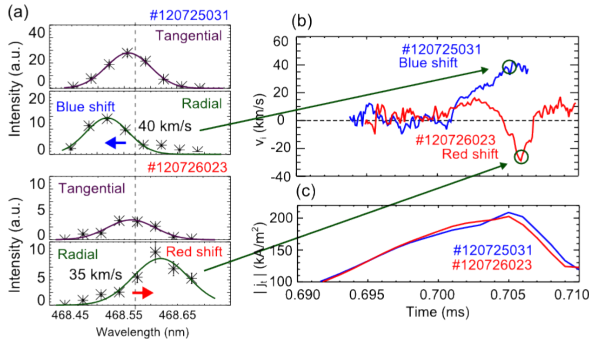


Fig. 4. (a) He II line spectra in radial and tangential views and time evolutions of (b) the ion outflow velocities and (c) the maximal value of the sheet current.

## 4. Summary

In the measurement using the emission excited by the accelerated electrons at the X-point, local outflow and temperature were observed. Describing the radial ion outflow velocity profile at the magnetic reconnection was obtained using the moving X-point and move of the current sheet.

## References


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