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Investigation of Electron Acceleration of Magnetic Reconnection by SXR Tomographic Diagnostic on TS-6 Merging Experiment

Junguang Xiang[1], Shinjiro Takeda[1], Yunhan Cai[1], Hiroshi Tanabe[2], Haruaki Tanaka[1], Yasushi Ono[1,2]
[1]Graduate School of Engineering, The University of Tokyo
[2]Graduate School of Frontier Sciences, The University of Tokyo
e-mail (speaker): jgxiang@ts.t.u-tokyo.ac.jp

As the upgrade of TS-3, TS-6/TS-3U[1] not only provides wider filed of viewing (FOV) for optical diagnostics, such as ion Doppler spectroscopy[2], Thomson scattering, and soft X-ray (SXR) tomography, but also is able to perform high-magnetic-field and high-power plasma merging experiments. Double-filter high-resolution SXR tomographic imaging system had been developed on TS-6, as a key diagnostic to investigate electron acceleration mechanism by revealing the distribution of high-energy electrons. This diagnostic mainly consists of two micro-channel plates (MCPs) equipped with two different filters (2.5 μm Al filter and 1 μm Mylar filter) respectively, optical fiber bundles, and a high-speed imaging system, as shown in Fig.1. Two images appearing on phosphor plates of MCPs can be simultaneously measured by just one high-speed imaging system, owing to reasonably arranged optical system. The temporal and spatial resolution of this diagnostic can be up to 5 μs and 4 mm respectively at present.

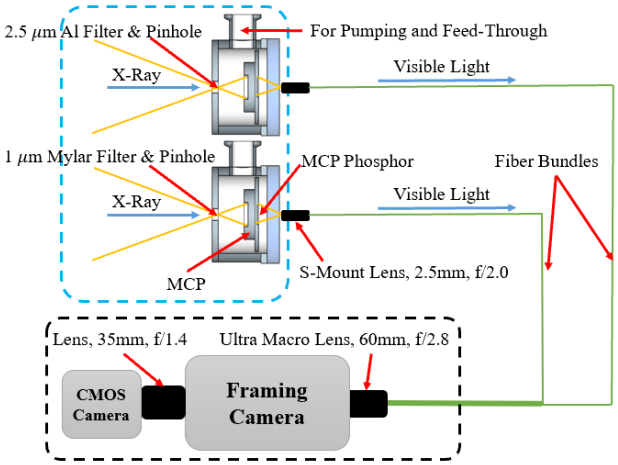

Fig. 1: The schematic diagram of SXR pinhole camera and imaging system.

We had successfully observed SXR in 2021 for the first time, and determined that the energy range of SXR emitted during magnetic reconnection on present merging experiments is more than 100 eV but less than 400 eV by the use of double filters. We also obtained the distribution of high-energy electrons by tomographic reconstruction, and found that electrons can be accelerated both in the inboard-side and outboard-side downstream regions, as shown in the Fig. 2, which is consistent with the experimental results on UTST[3]. The SXR emissivity is much stronger in the inboard-side, which means that electrons are more likely to be accelerated to higher energy in this side where the toroidal magnetic field is much higher.

More precise measurements of SXR under higher magnetic field and higher power are being performed, and related results are to be shown.

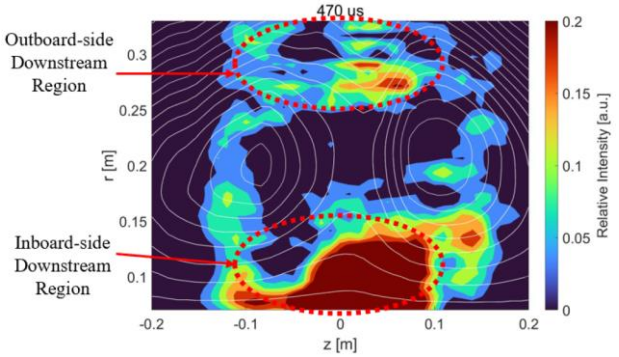

Fig. 2: Reconstructed results of SXR images. The white curved lines represent magnetic field lines of two merging ST plasmas.

References

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