博士論文公聴会の公示（物理学専攻）

学位申請者： King Fai Farley Law

論文題目：Laboratory study on outflow jet formation via semi-relativistic reconnection with high-intensity laser

（高強度レーザーを用いた準相対論的磁気リコネクションによるアウトフロージェット形成に関する実験的研究）

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場所：理学研究科 H 棟 7 階セミナー室（H701 号室）

主査：藤岡　慎介

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論文要旨：

Magnetic reconnection is a rearrangement of magnetic field topology in plasmas, also known as an energy conversion process from magnetic field energy to the kinetic energy of charged particles in the plasma. This phenomenon is accounted for a wide range of energetic astronomical phenomena, for example, solar coronal mass ejection, high energy photon emission from black hole systems and formation of stars.

The main scope of this study is on magnetic reconnection outflow from plasma in a semirelativistic magnetization regime, where the magnetic field energy density exceeds the electron rest mass density but below that of the ion. The accretion disk corona of black hole systems lies in this regime, while the mechanism behind its high energy photon emission is still unsure. One of the proposed emission mechanism is magnetic reconnection, which provides energetic particles as a power source through the outflow jet. In this study, the magnetic reconnection of a magnetic field in kilotesla order is produced by using an intense laser with pulse duration in picosecond (10-12 s) order to study outflow jet in semi-relativistic reconnection.

In the first part of this study, proton deflectometry is developed to directly probe the intense magnetic field generated in a laser platform. By injecting a proton beam with a wide energy spectrum, time-resolved magnetic field probing was also achieved. The second part of this study is about a magnetic reconnection experiment performed by the LFEX laser facility. The reconnection magnetic field of 2.1 kT is generated by the micro-coil scheme and measured by time-resolved proton deflectometry. Electron magnetization comparable to accretion disk corona of Cygnus X-1, a typical black hole binary system, was obtained. The particle energy spectrum of the reconnection outflow jet was measured, which possesses significant power-law component. This result supports magnetic reconnection models for powering hard-state X-ray emission from accreting black hole systems.