3Ca05

マルチピコ秒ペタワットLFEXレーザーを用いた
湾曲ターゲット中の磁気リコネクション現象の研究
Study of magnetic reconnection in PW laser irradiated curved targets

Law King Fai Farley[1], 安部勇輝[1], Korneev Phillip[2], Morace Alessio[1], Joao Jorge Santos[3], Ehret Michael[3], 有川安信[1], 坂田匠平[1], 李昇浩[1], 松尾一輝[1], Liu Chang[1], 森田大樹[1], 落合悠悟[1], 余語覚文[1], 古賀啓資[1], 岡本和輝[1], Golovin Daniil[1], 上司尚善[1], 千徳靖彦[1], 尾崎哲[4], 坂上仁志[4], 藤岡慎介[1]

King Fai Farley Law[1], Yuki Abe[1], Phillip Korneev[2], Alessio Morace[1], *et. al.*
（著者が多い場合，英文著者名の記載を5名程度とし後はetal.にしてもかまいません）

[1]阪大レーザー研, [2]NRNU MEPhI, [3]ボルドー大, [4]核融合研
[1]ILE, [2]NRNU MEPhI, [3]Univ. of Bordeaux, [4]NIFS

Magnetic reconnection is an important process especially in astrophysics, which is a process of evolution of magnetic field topology, represented by the picture of recombination between anti-parallel configured magnetic field lines. An important feature of this process is that it dissipates magnetic field energy in the form of kinetic energy in energetic charged particles, widely known as reconnection outflow jet.

In this study, we performed magnetic reconnection experiment by irradiation of high intensity laser LFEX on the inner surface of a curved metal targets (Fig. 1), which spontaneously produce (1) Two-directional current flow by laser induced electron vacancy and (2) radially expanding plasma flow by laser heating.

In this experiment, the magnetic field geometry was characterized by deflection of probing proton beam, and the outflow jet in experiment is detected by radiochromic film, recognized as a pair of proton beam with a small divergence. Both energy spectrum measurements of proton and electron in outflow jets showed power-law distribution in non-thermal component. Also, properties of such reconnection outflow showed dependency on the spatial length of the target along the outflow direction.

Physical process behind such experiment results is studied by 3-D collisionless particle-in-cell simulation by simulation code EPOCH. Simulation results showed qualitatively similar trend when compared with experiment, while the absolute magnitude is affected by the down-scale of the simulation because of the limitation of computation power. The essence of the difference would be that shown in Fig. 2, which visualized the magnetic field lines in two different spatial scales which are in scale of experimental targets. This showed the potential of this scheme of laser-driven magnetic reconnection as a platform of studying magnetic reconnection in controllable means.

In this presentation, the laser-driven magnetic reconnection scheme mentioned above and the details of simulation studies would be presented.

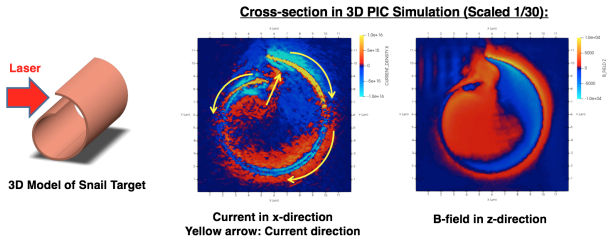

Figure 1: Scheme of irradiation of curved metal target (Left), Current direction(Center) and magnetic field distribution(Right) in the target.

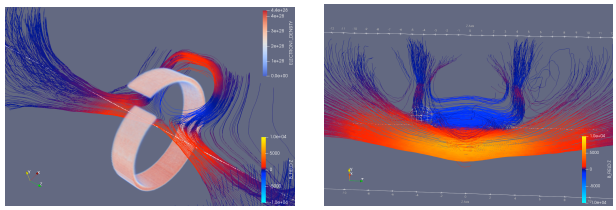

Figure 2: Magnetic field lines in two different spatial scale L of reconnection geometry, along the outflow connection: (Left) “Short” while L~d_{laser}, (Right) “Long” such that L~5d_{laser}.