講演番号
7P91

レーザーによるキロテスラ強磁場発生のマニピュレーション

Manipulation of laser-driven kilotesla magnetic field generation

Law King Fai Farley、安部勇輝、村上匡且、藤岡慎介
LAW King Fai Farley, ABE Yuki, MURAKAMI Masakatsu and FUJIOKA Shinsuke

阪大
Osaka Univ.

In recent inertial confinement fusion research, kilotesla order intense magnetic field is suggested as one way to control the flow of energetic charged particles for energy deposition, mainly electrons, to improve the energy coupling efficiency during heating. A magnetic field generation scheme with laser-driven micro-coils, inducing a large current in a single-loop by electron acceleration away from the laser-plasma interaction site for kilotesla magnetic generation, is being developed and demonstrated.

Here we report the manipulation of kilotesla magnetic field generation by a pair of micro-coils with a modified shape, for robust application by a simpler laser-irradiation scheme. As shown in Figure 1, two micro-coils are placed with their coil axis being aligned on the same straight line. Both of them are irradiated by one of the four beam of LFEX laser, which interacts with and accelerate electrons from the coil material, inducing a large current and produce magnetic field between the two micro-coils.

In order to characterize the magnetic field, a proton beam (Blue arrow) is used to probe the magnetic field generated by the two micro-coils. The proton beam is generated by another beam of LFEX laser, via TNSA (Target Normal Sheath Acceleration) by laser irradiation on thin metal foils. The magnetic field strength estimated by the deflected pattern showed reproducible time evolution, as shown in Figure 2, in the magnetic field generated by this scheme. One of the laser shot (indicated as 20210917T2) was performed in doubled energy when compared to the another laser shot (indicated as 20210916T1), where this difference is well reflected on the induced micro-coil current strength. Maximum magnetic field generated was about 1.8 kT, generated by an intense current of 900 kA in the current loop.

Our result showed the potential and capability of the laser-driven magnetic field in future inertial confinement fusion studies.

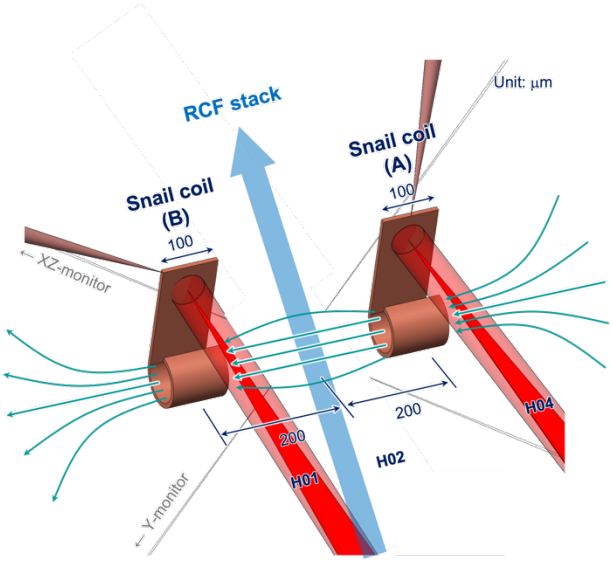

Figure 1. Schematic of the magnetic field generation and characterization

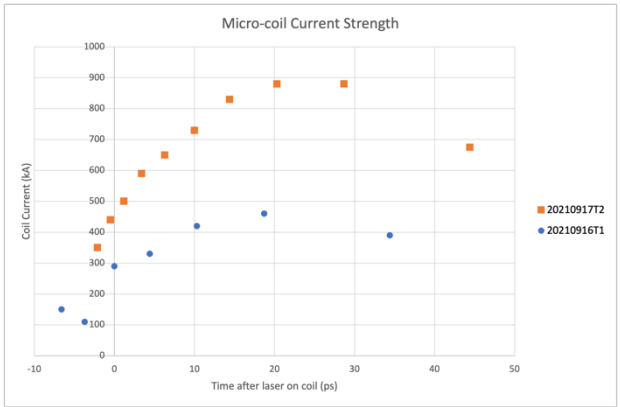

Figure 2. Time evolution of current in micro-coil under different input laser energy