Ion current density profile of laser ablation plasma transported in multicusp magnetic field

Kazumasa Takahashi*[1], Takumi Uchino[1], Keisuke Ikegami[1], Toru Sasaki[1], Takashi Kikuchi[1], and Nob. Harada[1]

[1] Nagaoka University of Technology, Nagaoka, 940-2188, Japan
*Corresponding author: kazumasa@vos.nagaokaut.ac.jp

Laser ion sources are capable of supplying ion beams with high current because a laser produced plasma has initially high number density same as that of solid. [1]. By transporting ablation plasmas for several 10 cm ~ 1 m, the beam pulse width of 20 us which is required for heavy ion inertial fusion (HIF) at the ion source can be obtained [2]. Therefore, the laser ion source is considered to be one of the candidate for the ion source for the HIF.

Because a pulsed laser is used for generation of plasmas, the laser ion sources supply pulsed ion beams, which have the ion current waveform of the shifted-Maxwellian distribution. To obtain current waveform with less variation in the pulse, modulations or extending the transport distance of the plasma is required. In addition, uniform plasma profile with large area is also required to realize multi-beamlet extraction [3].

We have been proposed that applying multicusp magnetic field to ablation plasmas to get high current with long pulse beams by confining the plasma in the lateral direction [4]. In this study, to obtain uniform plasmas in the lateral direction, we investigated the relation between plasma density distribution and magnetic structure by measuring ion currents in the lateral direction during transport through the multicusp magnetic field.

The second harmonic wavelength 532 nm of a Nd:YAG laser with 16-18 ns pulse width and 0.4 J pulse energy was used to generate ablation plasmas. The incident angle of the laser was 60 deg from the line perpendicular to the target surface. The laser was focused with a lens and the estimated intensity is order of 10^8 W/cm^2 on the target.

To generate the magnetic field, neodymium magnets whose magnetic flux density on the surface is about 0.2 T were located around a drift tube. Plasma ion currents were measured with biased Faraday cups.

We evaluated the ion current of the plasma as a function of the distance between the target surface and the Faraday cups with different configurations of the multicusp magnetic field. The relation between plasma density distribution and magnetic structure will be discussed.

References

[1] J. W. Kwan 2005 *IEEE Trans. Plasma Sci.* **33,** 1901
[2] M. Okamura *et al* 2014 *Nucl. Instrum. Meth. Phys. Res A,* **733,** 97–102
[3] J. W. Kwan *et al*. 2001 *Nucl. Instrum. Meth. Phys. Res. A* **464,** 379
[4] K. Takahashi *et al*. 2016 *J. Phys. Conf. Series* **717,** 012113