Contribution ID: **2766** Contribution code: **SUPM051** Type: **Poster Presentation**

Control of Electron Injection in LWFA with a Laser-ablated Aluminum Plasma by inserting a thin-layer of different metal.

Sunday, 7 May 2023 16:00 (2 hours)

Laser wakefield acceleration (LWFA) using metal targets has been developed for high-vacuum and high-repetition rate operations compare to the gas targets[1-2]. However, the ionization effect due to high intensity fs laser should be considered as propagating through the plasma and the difference of LWFA mechanisms between aluminum plasma and helium plasma has been investigated with the simulation. The partially ionized aluminum ions are ionized to higher charge state up to Al11+ as the main laser is propagating through the metallic plasma. As comparing to helium plasma case, a lot of electrons are injected into the wake cavity even at lower laser power and the energy of accelerated electrons are decreased. By increasing the plasma density, the charge and the oscillating amplitude of injected electrons can be optimized for betatron radiation.
We proposed a structured metal target using a thin Ti or Cu wire in aluminum to improve the beam quality. The aluminum plasma with a thin Ti or Cu plasma zone can be produced by laser ablation. When changing the focal position of fs laser pulse with respect to the position of the thin-layered zone, the injection timing of electrons depleted from Ti or Cu ions can be adjusted. We present and discuss the simulation results depending on the thickness and the position of the thin layer.

Funding Agency

This work was supported by the National Research Foundation of Korea(NRF) grant founded by the Korea government(MSIT).
(NRF Grant No. : NRF-2021R1A2C2094300, and RS-2022-00143178)

Footnotes

[1] J. Kim, Y. Hwangbo, W.-J. Ryu, K.N. Kim, S.H. Park, JINST. 11, C03012 (2016)
[2] Shin, Sang Yun, and Seong Hee Park, SPIE Relativistic Plasma Waves and Particle Beams as Coherent and Incoherent Radiation Sources IV. Vol. 11778. (2021)

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Session Classification: Student Poster Session