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Recent Progress in SPring-8 Laser-wakefield Acceleration Platform

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Laser-wakefield acceleration (LWFA), providing potentially jitter-free sources of radiation and electrons, is one of the rapidly developed scientific fields [1]. Staging LWFA is considered to be a necessary technique for developing full-optical high energy electron accelerators. Splitting of the acceleration length into several technical parts and with independent laser drivers allows not only the generation of stable, reproducible acceleration fields but also overcoming the dephasing length while maintaining an overall high acceleration gradient and a compact footprint [2, 3].

The Laser Acceleration Platform is a unique experimental platform specially designed for laser wake-field acceleration researches, which is located in the RIKEN SPring-8 center, Harima, Hyogo Prefecture, next to the 8 GeV storage ring and SACLA linear accelerator and XFEL. In this presentation, we will introduce our recent progress in this platform, mainly on the staging LWFA and undulator radiation.

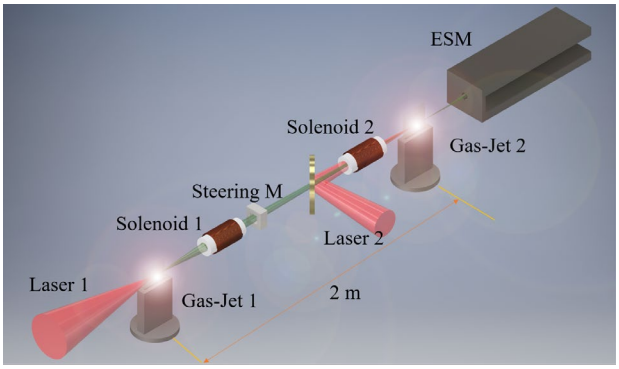

Figure 1 Experimental setup of staging acceleration.

The experimental setup of staging LWFA is schematically shown in Fig.1. The first laser was focused by an f/10 OAP on the front edge of a 4-mm step nozzle of a He gas-jet to generate an electron beam as an injector. Double solenoids were used as energy selection and focus the injector beam to a second gas-jet located at 2 meters away [4]. A pulse driven steering magnet was also installed for fine tuning of the injector pointing. The second (booster) laser was focused by an f/20 OAP on a 4-mm He gas-jet with flat density distribution.

Figure 2 gives the measured results of ESM. Without injector, the booster stage only generated low energy electrons, because the plasma density was carefully tuned that no significant self-injection could happen. The second figure shows the electron energy with injector only. The voltage of the double-solenoid was selected to collect and focus injector beam with central energy of 75 MeV and energy spread ~3%. With both injector and booster on, we could observe the modulated spectra. Clear deceleration and/or acceleration of the beam electrons were observed. The maximum energy gain observed was ~75 MeV, corresponding to ~150 MeV/cm, which was consistent with our PIC simulation results.

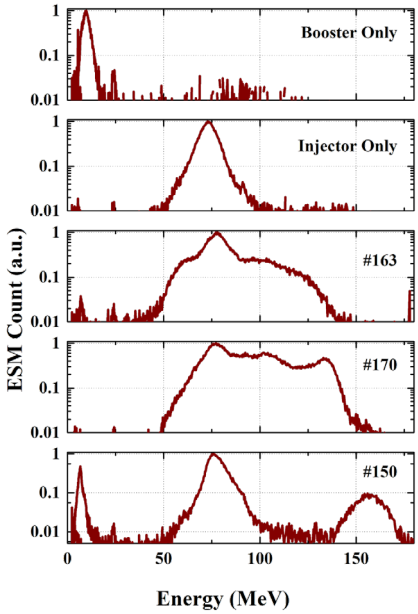

Figure 2 Output spectrum.

We have also experimental demonstrated the undulator radiation generated by LWFA electron beam passing through a micro-undulator. Details can be found in the presentation.

References

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