

Status of Laser wakefield Acceleration Research under ImPACT-UPL Program in Japan

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A staging laser wakefield acceleration (LWFA) research that aims for laser-driven free-electron X-ray laser (XFEL) under the ImPACT (Impulsing Paradigm Change through Disruptive Technologies Program promoted by the Cabinet office, Government of Japan) will be reviewed at the conference. LWFA is expected to be a novel scheme for accelerating electron beams beyond GeV-class energy with compact devices. In recent studies, the pointing stability of the electron beams from LWFA has been dramatically improved by plasma-micro-optics (PMO) that is a plasma device functioning as a focusing and/or optical-guiding tool for intense laser pulses [1].

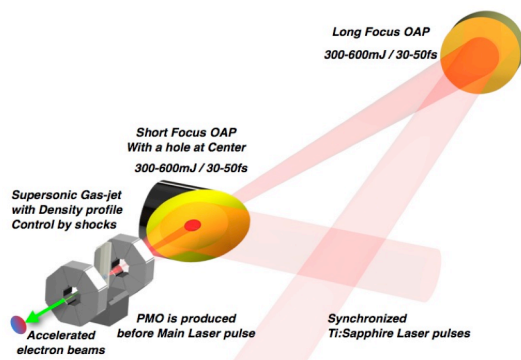


Figure 1 Typical setup for 2-staged LWFA with a single gas-jet at PPC Osaka University.

The PMO enables electron beams to be precisely controlled and transported by the beam-optics of conventional accelerators. With these techniques a staging LWFA driven by independent two laser pulses in a gas-jet (See Fig. 1) has been demonstrated successfully. Well-collimated quasi-mono-energetic electron beams below 100 MeV range are produced with good repeatability as an injector. Furthermore, Sub-GeV

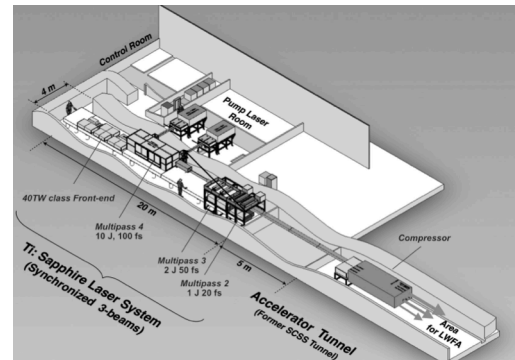


Figure 2 A bird's-eye view of LWFA platform in an accelerator tunnel at Spring-8/RIKEN Harima site.

electron beams are also produced with a 4 mm-booster laser wakefield. These results will be presented and discussed.

A future experimental site at Spring-8/RIKEN shown in Figure 2 is being prepared for the exclusive use of the laser-driven XFEL studies. The status of the test area on the laser-driven XFEL at Spring-8 /RIKEN will be presented.

Acknowledgements

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References

- [1] T. Hosokai, et.al., Phys. Rev. Lett. **97**, 075004 (2006)
- [2] N. Nakanii, et.al., Phys. Rev. ST Accel. Beams. **18**, 021303 (2015)
- [3] T. Hosokai, et.al., Appl. Phys. Lett. **96**, 121501 (2010); Y. Mizuta, et.al., Phys. Rev. ST Accel. Beams. **15**, 121301 (2012); N. Nakanii, et.al., Phys. Rev. ST Accel. Beams. **18**, 021303 (2015)