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Investigation of Superintense Laser-Matter Interactions with a 4 PW Laser

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Strong field physics is an emerging physics area prompted by the development of ultrahigh power lasers. Lasers with peak power exceeding 1 PW have been developed in a number of institutes for exploring laser-matter interactions at extreme conditions. As the focused laser intensity with such lasers can easily exceed 10^{18} W/cm^2, relativistic plasmas with the electron motion in the relativistic regime can be produced, which have been utilized for laser-driven electron/ion acceleration [1-3]. A multi-GeV electron beam can be produced from a He gas target driven by a PW laser, and the GeV electron source can be used for Compton backscattering to produce MeV gamma rays. The development of ultrahigh power lasers, thus, offers new generation of particle and radiation sources, which can initiate another new challenging research in laboratory astrophysics and nuclear physics as well as in plasma physics. At the Center for Relativistic Laser Science of Institute for Basic Science, two PW laser beamlines with outputs of 1.0 PW and 1.5 PW at 30 fs were utilized for research on laser-driven particle acceleration since 2012 [4,5]. One of the PW beamlines was upgraded to a 4 PW beamline with an output energy of 83 J and pulse duration of 19.4 fs [6]. Here we present the development of the 4 PW laser and applications to high field physics.

References

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