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## 夜話（レーザープラズマ加速入門 [A Brief Introduction to Laser-driven Plasma Based Particle Acceleration]

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Laser-plasma acceleration has been attractive since the idea of laser wakefield accelerator (LWFA) was proposed in 1979 by Tajima and Dawson. One of the advanced features of plasma acceleration is that it supports large electric field reaching 100GV/m, which makes the potential compact accelerator to be possible. Various mechanisms for electron injection control, laser pulse guiding and beam quality improving have been proposed and demonstrated in the past decades. Electron beams up to 8 GeV with the charge quantity of tens picocoulombs have been addressed in experiments. With the development of laser technology, multi-PW laser is available nowadays and the corresponding intensity exceeds 1021 W/cm<sup>2</sup>. It results in the generation of high energy ion beams when such an intense laser pulse irradiates on a dense target. The tens-MeV proton beams accelerated by laser-plasma interactions have the unique features of short duration, high brilliance, and low emittance. This work introduces the basic physics of laser-plasma interactions and the corresponding charged particle acceleration mechanisms. Comprehensive theoretical models for both electron and ion acceleration are presented. Practical formulas of the limited acceleration length and the energy scaling laws based on the laser-plasma parameters are given. The typical numerical method, Particle-in-cell simulation, is also briefly mentioned.

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