Enhanced Target Normal Sheath Acceleration Based On Laser Relativistic Self-Focusing

Fuqiu Shao, Debin Zou, Tongpu Yu, Yan Yin, Jianming Ouyang and Hongbin Zhuo
College of Science, National University of Defense Technology, Changsha, China

The enhance target normal sheath acceleration based on the laser relativistic self-focusing is investigated by theoretical analysis and particle-in-cell simulations. The underdense plasma acting as a nonlinear optical lens can nonlinearly focus the relativistic laser pulse, leading to a higher intensity laser with a smaller spot and steeper pulse front. In the underdense plasma, the temperature of the hot electrons will be greatly enhanced due to the occurrence of resonant absorption when the electron-betatron-oscillation frequency is close to its witnessed laser frequency [Pukhov et al., Phys. Plasma 6, 2847 (1999)]. Then these hot electrons penetrate through the backside solid target, inducing a stronger sheath electric field at the rear surface of the target, which can accelerate the protons to a higher energy. It is also shown that that the optimum length of the underdense plasma is approximately equal to the self-focusing distance.

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[3] F. L. Zheng, et. al., *Phys. Plasmas* **20**, 123105 (2013)