Collisionless shock acceleration of high-flux quasimonoenergetic proton beams driven by circularly polarized laser pulses

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Laser-driven ion accelerators have the prospects of realizing compact and affordable ion sources for many exciting applications, many of which require ion beams with narrow energy spread as well as high flux. Here, using an 800-nm circularly polarized laser pulse interacting with an overdense plasma that is produced by a laser prepulse ionizing an initially ultrathin plastic foil, we experimentally demonstrate collisionless shock acceleration of quasimonoenergetic proton beams with peak energies up to 9 MeV and extremely high fluxes of 3×10^{12} protons/MeV/sr [1]. Two-dimensional particle-in-cell simulations reveal that collisionless shocks are efficiently launched by circularly polarized lasers in exploded plasmas, resulting in a narrow energy spectrum. Furthermore, this novel scheme predicts the generation of quasimonoenergetic proton beams with peak energies of approximately 150 MeV using current laser technology. These results represent a major step for developing high-flux, high-energy and monoenergetic ion sources for applications such as cancer therapy.

Reference

[1] H. Zhang, B. F. Shen,[a)] W. P. Wang, S. H. Zhai, S. S. Li, X. M. Lu, J. F. Li, R. J. Xu, X. L. Wang, X. Y. Liang, Y. X. Leng, R. X. Li,[b)] and Z. Z. Xu， Phys. Rev. Lett. **119**, 164801 (2017).