Laser-plasma acceleration of quasi-monoenergetic protons from microstructured targets

Particle acceleration based on high intensity laser systems (a process known as laser–plasma acceleration) has achieved high quality particle beams that compare favourably with conventional acceleration techniques in terms of emittance, brightness and pulse duration. A long-term difficulty associated with laser–plasma acceleration—the very broad, exponential energy spectrum of the emitted particles—has been overcome recently for electron beams. Here we report analogous results for ions, specifically the production of quasi-monoenergetic proton beams using laser–plasma accelerators. Reliable and reproducible laser-accelerated ion beams were achieved by intense laser irradiation of solid microstructured targets. This proof-of-principle experiment serves to illuminate the role of laser-generated plasmas as feasible particle sources. Scalability studies show that, owing to their compact size and reasonable cost, such table-top laser systems with high repetition
rates could contribute to the development of new generations of particle injectors that may be suitable for medical proton therapy.

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