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Electron rephasing in a laser-plasma accelerator

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Energy gain in laser wakefield accelerators is generally limited by dephasing between highly relativistic electrons and the driving laser pulse. But as the relative phase depends on both the driver and the cavity length, the effects of dephasing can be mitigated with appropriate tailoring of the plasma density along propagation. The ideal case would provide constant phase adaption, but such a target is difficult to design.

Here we present a simplified approach, which uses a sharp upward plasma density transition, generated by introducing a knife edge into the gas jet. Depending on the position of the shock, we observe that this onetime boost can augment the cutoff energy of electrons by almost 50 percent.

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