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Direct Observation of electron shedding from a laser driven wakefield accelerator

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Electron beams from a wakefield accelerator are usually assumed to be short, comparable to the plasma wavelength. Under certain conditions, as the electrons start to exit the accelerator, the plasma wavelength increases and the electrons are moved into the decelerating phase of the wakefield. At this point, the electrons start to lose energy, and a fraction of them are separated and lost from the beam, a process we call as "electron shedding."
Using femtosecond relativistic electron microscopy, we imaged the evolution in the longitudinal current density of the beam as it exits the accelerator. It is seen that an initially short electron beam lengthens to > 40 times the plasma period in the accelerating stage before losing electrons on the way. The process results from a modification of the energy distribution of the beam resulting in a lower useful charge and contributes to the formation of dark current, reducing its efficiency.

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