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Experimental scaling of fast electron beams generated by high-intensity laser-solid matter interactions

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High intensity ultra-short laser pulses interacting with thin solid targets are able to produce energetic proton and ion beams by means of extremely large accelerating fields. The process starts with the emission of fast electrons that, escaping the target, set an electrostatic potential, responsible for the subsequent acceleration of heavier particles. The characterization of such electrons is thus important in view of a complete understanding of the acceleration process. Here, we present temporally-resolved measurements of the fastest escaping electron component. Charge, electric field and temporal duration of the emitted fast electron beams are determined using a temporal diagnostics based on Electro-Optical Sampling with 100 fs temporal resolution. Experimental evidences of scaling laws for fast electron beam parameters respect to the impinging laser energy (0.25 −2.5 J range) are retrieved and compared with theoretical models, showing an excellent agreement. It allowed for the first time experimental evaluation of the cooling time of the fast electron electron component.

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