

# Measuring lifespan of hot, relativistic electrons produced in ultra-intense laser-solid interactions

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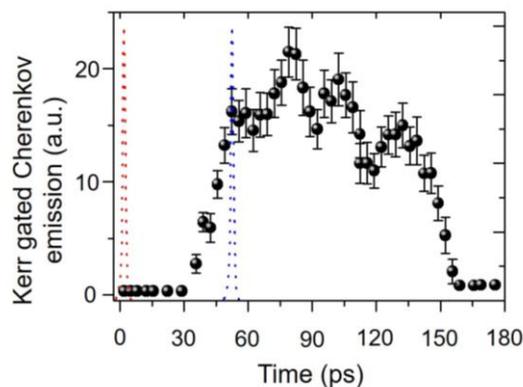
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During the interaction of ultra-intense laser (UIL) ( $> 10^{18}$  W/cm<sup>2</sup>) with a solid, relativistic electrons with currents as large as mega-amperes are generated. The transport of these hot electrons is crucial for a number of potential applications including the fast ignition and inertial confinement fusion [1-2]. Hot electron transport inside the solids is an inherently transient problem and a full understanding requires a diagnostic capable of *in-situ* mapping the transport inside solid. These relativistic electrons, travelling at near light speed inside solids, emits Cherenkov emission. Hence, the measurement of Cherenkov radiation lifetime can provide unique signature of lifespan these electrons inside the transparent solid target. By temporally resolving the Cherenkov emission, we are now able to track the lifetime of relativistic electrons inside the solid.

A *p*-polarized high contrast (of  $10^9$ ) UIL of 25 fs pulse duration at central wavelength 800 nm with 1.0 J energy is focused with an *f*/3 off axis parabolic mirror to a 10  $\mu$ m spot at near normal angle of incidence ( $\leq 2^\circ$ ) resulting an intensity  $2 \times 10^{19}$  W/cm<sup>2</sup> on 10 mm thick Al-coated BK7. The Cherenkov radiation is measured at the rear side of the target using ICCD. The interaction laser pulse is temporally gated using a nonlinear-medium activated by another synchronised laser pulse. By varying the temporal delay between the gating pulse and the interaction pulse, we are able to temporally resolve the Cherenkov emission. Combining this with spectrally resolved measurements, we are able to track the lifetime of different electron energy populations inside the solid target, for the first time.



Gated lifetime of Cherenkov emission in thick Al-coated BK7 glass.

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