# Electron trapping by strong Coulomb coupling in a relativistic laser plasma

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When an ultra-intense laser pulse (I > $10^{19}$ W/cm2) impinges onto a solid, a hot plasma is formed within the relativistic skin depth of a few tens of nanometers. From here, electrons are accelerated by the laser field to relativistic energies and propagate through the target. These electrons partly reflux, or recirculate, on complex trajectories, while strong electromagnetic fields and return currents build up. A proper understanding of this electron transport in solid-density plasmas is crucial for progress in key applications including laser-driven x-ray sources, which can be used in backlighting, for x-ray Thomson scattering experiments, or can provide alternative radiation sources for both scientific and medical applications. The spatio-temporal electron energy deposition is essential for the quest of laser-accelerated protons and the Fast Ignitor concept in inertial confinement fusion.

We measure the three-dimensional distribution of K$\alpha$ emitting ions inside a 25 µm Ti foil irradiated by sub-picosecond laser pulses at a relativistic intensity of several $10^{19}$ W/cm². X-ray spectra with high spectral (E/ΔE~ 15,000) and spatial (Δx ~ 11 µm) resolution are measured at four observation angles. After applying Abel- and Laplace inversion, we derive the time-integrated radial and axial (depth-dependent) K$\alpha$ yield. Axially, the emissivity decays exponentially towards the target rear side. This axial gradient transitions into a homogeneous emissivity for radii > 45 µm. Our results are in qualitative agreement with particle-in-cell simulations.

## References

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