The photo electron cutoff for for ionization with intense few cycle pulses: From atoms over clusters and nanoplasmas to liquids

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High order above threshold ionization leads in atoms to a well known cutoff for the photo electron energy of 10.007 Up, where Up is the ponderomotive energy. Does a similar cutoff exist in extended targets and if so, how does it evolve from the atomic limit ?

We will show that this is indeed the case where for finite systems the cutoff is larger than the atomic one for two reasons (i) photo electrons can re-scatter from a different atom since (in contrast to high harmonic generation) the process is incoherent, (ii) they impact the at recollision with a higher momentum since they are accelerated by a positive background potential (of the cluster or nanoplasma).

A very simple description gives a universal maximal cutoff energy as a function of the radius of the extended target R scaled to the quiver amplitude and the depth V of the background potential.

Comparison with new experimental data on clusters and results from molecular dynamics simulations for different parameters of cluster size (a few 10 to a few 10000 atoms) pulse intensity, pulse length (in the 10 fs range) and photon wavelength (from 2 microns to 400 nm) show good agreement with the simple prediction and underscore its universal character.