Double Ionization in Shaped Laser Fields


*Institut für Kernphysik, Goethe-Universität Frankfurt, 60438 Frankfurt am Main, Germany

Synopsis We present selective tunnel-ionization of an electron with defined sense of rotation inside a single atom and analysis of the energy spectra of such electrons.

In semi-classical pictures electrons with non-vanishing magnetic quantum number m rotate around their ionic cores. Rotating charges are termed ring currents. Is the sign of m related to the sign of the ring current in a single atom? Is it possible to switch ring currents on and off with attosecond precision? Our experiment shows that elliptically polarized laser pulses selectively tunnel-ionize electrons with defined sign of m leaving behind an ion with defined ring current confirming theoretic predictions [1,2]. Further we find that the initial momentum distributions upon tunnel-ionization depends on m as well. This leads to a shifted energy dependent yield for ionization from m-prepared states. Finally we show how to demerge angular offsets for different m-states allowing for the preparation and detection of ring currents with sub-cycle temporal precision [3]. The three-dimensional electron momenta have been measured in coincidence with their ionic cores using cold-target recoil-ion momentum spectroscopy (COLTRIMS) [4].

References

1 E-mail: eckart@atom.uni-frankfurt.de