Double Ionization in Shaped Laser Fields

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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].

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References

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