

# ATTOSECOND STEERING OF ELECTRONIC MOTION

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Using a reaction-microscope, three-dimensional electron and ion momentum ( $\vec{P}$ ) spectra have been recorded for carrier-envelope-phase (CEP) stabilized few-cycle ( $\sim 5$ -6 fs), intense ( $4 \cdot 10^{14}$  W/cm<sup>2</sup>) laser pulses (740 nm) interacting with atoms and molecules. In a collaborative effort experiments on He atoms have been performed at the MPQ whereas the fragmentation of H<sub>2</sub> molecules was investigated at the new CEP stabilized pump-probe facility at the MPIK. For He atoms preferential emission of low-energy electrons ( $E_e < 15$  eV) to either hemisphere is observed as a function of the CEP<sup>1</sup>. Clear interference patterns emerge in  $\vec{P}$ -space at CEPs with maximum asymmetry, interpreted as attosecond holographic “self”-images of re-scattered electron wave-packets by means of a simple model and in line with previous theoretical predictions<sup>2</sup>. For H<sub>2</sub><sup>+</sup> molecules we do observe, for the first time and different from earlier measurements<sup>3</sup>, electron localisation in the  $1\omega$  and effective  $2\omega$  fragmentation channels depending on the kinetic energy release (KER)<sup>4</sup> in general agreement with but at better significantly better contrast than predicted by theory<sup>5</sup>. Moreover, we find the asymmetry varying as a function of the orientation of the molecules and inspect CEP dependent coincident electron emission from the first step, i.e. ionizing the H<sub>2</sub> molecule and starting the bound-state dynamics in H<sub>2</sub><sup>+</sup>. Finally, we present results of wave-packet dynamic calculations, show data for more complicated molecules and envision future directions.

<sup>1</sup> R. Gopal et al., Phys. Rev. Lett. (accepted)

<sup>2</sup> D.G. Arbó et al. Phys. Rev. A **74**, 063407 (2006).

<sup>3</sup> M.F. Kling et al., *Science* **312** (2006) 246

<sup>4</sup> M. Kremer et al., Phys. Rev. Lett. (submitted)

<sup>5</sup> V. Roudnev and B. D. Esry, PRA **76**, 023403 (2007)