Mapping attosecond electron wave packet motion

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Measuring electron wave packet motion in an atom or molecule is one of the next aims for attosecond science. There will be two approaches. One is to measure photoelectron spectrum from a bound state ionized by a single attosecond X-ray pulse [1]. The other is to map electron motion onto the spectrum of a single attosecond X-ray pulse emitted from atoms or molecules that contain electron motion to be observed [2]. We discuss the second approach.

An intense laser pulse splits the bound state electron to the continuum electron wave packet and the remaining electron. When the continuum electron wave packet re-combines with the bound state electron, and then the attosecond optical burst is produced due to the dipole interaction. From the spectrum we can obtain information on the molecular orbital [3], vibrational motion [4] and bound state wave packet motion [2].

We theoretically show that single electron motion in a two-center potential can be observed using carrier-envelope stabilized, few-cycle laser pulses.

[1] G. L. Yudin, A. D. Bandrauk, and P. B. Corkum, **Phys. Rev. Lett. 96**, 063002 (2006).
[2] H. Niikura, D. M. Villeneuve and P. B. Corkum, **Phys. Rev. Lett. 94**, 083003 (2005).
[3] J. Itatani *et al.*, **Nature 432**, 867 (2004).
[4] S. Baker, J. S. Robinson, C. A. Haworth, H. Teng, R. A. Smith, C. C. Chirila, M. Lein, J. W. G. Tisch, J. P. Marangos, **Science 312**, 424 (2006).