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Generation and manipulation of attosecond light pulses

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Attosecond pulses of light can be generated in the extremely non-linear interactions between an ultrashort, intense laser pulse and a gas of atoms, via the process of high harmonic generation [1,2]. In one approach, a number of odd harmonics of rougly equal strength are combined to form a train of sub-femtosecond pulses. If the harmonics are locked in phase to each other, the train will consist of the emission of one attosecond pulse every half cycle of the driving laser field [1,3]. It is in general not trivial to ensure that the harmonics are phase-locked as they are generated with intrinsically different phases. These phases originate in the strong field dynamics of the light-matter interaction [4].

We will discuss different ways of generating and manipulating attosecond pulses via high harmonic generation. We will show how the harmonics can be phase-locked and better synchronized so as to form optimal pulse trains [3]. We will also show that it is possible to generate trains of pulses separated by a full laser cycle, by combining the driving laser field with its second harmonic [5]. The strong field continuum dynamics driven by the two-color field is very different from that of the one-color field and varies strongly with the delay between the two laser fields [6].

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(2) M. Hentschel *et al*, Nature **414**, 509 (2001).
(3) R. Lopez-Martens *et al*, PRL **94**, 033001 (2005).
(4) P. Antoine, A. L'Huillier, and M. Lewenstein, PRL **77**, 1234 (1996).
(5) J. Mauritsson *et al*, in preparation (2006).
(6) M. B. Gaarde *et al*, in preparation (2006).