高次谐波和阿秒脉冲产生中的相位匹配和优化
HHG and phase-matching in generation of isolated attosecond pulses

为了探测和控制原子内部飞秒尺度的电子动力学过程，单个阿秒脉冲激光将成为有力的工具。至今为止，气体中的高次谐波过程是产生单个阿秒脉冲和阿秒脉冲序列的有效过程。相比于阿秒脉冲序列，单个阿秒脉冲的产生因其对激光器的苛刻要求更难以实现，仅在极少的实验室中能够生成。这里，我们提供一个新的利用30飞秒商业激光器生成短于100阿秒单脉冲的方案。

For the purpose of detecting and controlling the electronic dynamics at the sub- femtosecond time scale inside atoms, single isolated attosecond pulses are desirable tools. Up to now, HHG in gas has been proved to be an effective process for generating both isolated as pulses and a train of as pulses. Compared to as pulses trains, generation of isolated attosecond pulses is technically difficult because of the stringent requirements on the driving laser, and so far all experiments using such pulses have been performed in only a few laboratories. Here, we propose a new scheme to generate isolated sub-100 attosecond pulses with 30 femtosecond lasers.

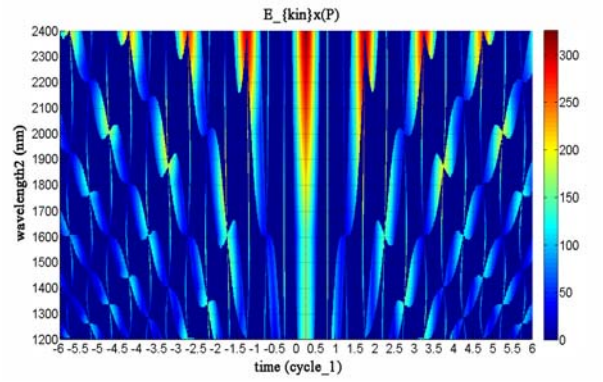

Figure 1 | The dependence of E_{kin}x(P) on time and the wavelength
图1 | 电子动能与时间及波长关系

The most important parameter that determines the bandwidth of the supercontinuum and the duration of the ultrashort HHG emission is the difference between the highest and the second highest kinetic energy.

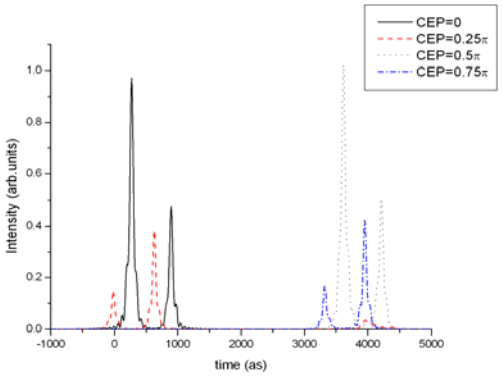

Figure 2 | The temporal profiles of the XUV pulses
图2 | 极紫外脉冲的时间包络

We optimize the time delay and the wavelength of the control field to produce isolated ultrashort attosecond pulses. The optimizing range of the wavelength of the control field can be generated by optical parametric processes from the driving field.

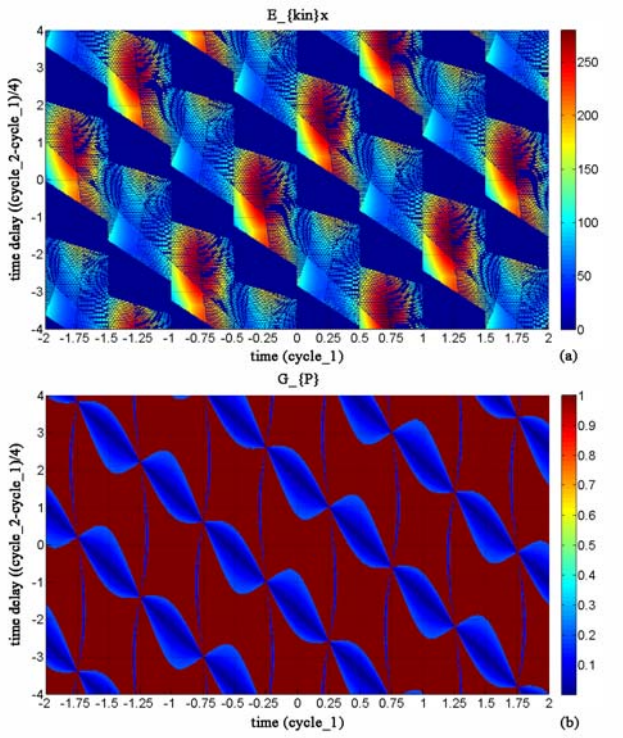

Figure 3 | (a) The dependence of E_{kin}x on time and time delay
(b) The dependence of E_{kin}x on time and time delay
图3 | 电子动能和偏振门与时间及延时关系

Up to now, it is a challenge to generate isolated sub-100 attosecond pulses with driving field longer than 25 femtosecond. We try to combine the polarization gating technique and optimization of two-color lasers: modulating the driving field from two directions by one control field which has an angle of 45 degrees from the driving field. With proper parameters, with a 30 femtosecond driving field, one HHG emission and its short electron trajectory is chosen corresponding to a clean 60-attosecond pulse.

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