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LECTURE

**“Transitions in the continuous spectrum of atoms
induced by two ultrashort pulses with time delay”**

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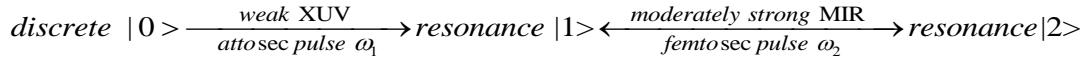
Seminar room, ground floor, NHRF

Transitions in the continuous spectrum of atoms induced by two ultrashort pulses with time delay

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There is a growing interest, both theoretically [1] and experimentally [2], in recent years for ultrafast processes in atoms induced by one or more coherent pulses. Motivated by this we have examined the scheme



where $|0\rangle$ is a discrete state, and $|1\rangle$ and $|2\rangle$ are resonance states.

The attosecond and femtosecond pulses with central frequencies ω_1 and ω_2 ($\omega_1 \gg \omega_2$) act with an ultrashort time delay, t_D between them. In addition to the t_D , the external control parameters are the intensity and the full-width at half maximum (FWHM) of the femtosecond pulse.

As a specific application we examine the time-resolved dynamics associated with the processes $He\ 1s^2\ ^1S \rightarrow (2s2p)\ ^1P^o \leftrightarrow (2p^2)\ ^1D$. For the transition $1s^2\ ^1S \rightarrow (2s2p)\ ^1P^o$, the FWHM of the XUV pulse is 160 attoseconds and its peak intensity at $10^{11}\ \text{W}/\text{cm}^2$ as it was used recently in the experiment of Kaldun et al [2]. The few-cycle mid-infrared (MIR) pulse couples the resonance states and its duration is varied in the range of a few decades of femtoseconds. Its intensity is in the range $5 \times 10^{10} - 5 \times 10^{11}\ \text{W}/\text{cm}^2$.

The results include the time-resolved formation of either the $(2s2p)\ ^1P^o$ or the $(2p^2)\ ^1D$ resonance, while they are coupled with each other. For the $(2s2p)\ ^1P^o$ state, comparison is made with the case where the time-dependent buildup of its asymmetric profile, excited from $1s^2\ ^1S$ by the same attosecond pulse, is calculated in the absence of coupling to another resonance.

References

- [1] Th. Mercouris, Y. Komninos and C. A. Nicolaides, *Time-dependent formation of the profile of the $He\ 2s2p\ ^1P^o$ state excited by a short laser pulse*, Phys. Rev. A **75**, 013407 (2007). Erratum, Phys. Rev. A **87**, 069905(E) (2013).
- [2] A. Kaldun, A. Blättermann, V. Stooß, S. Donsa, H. Wei, R. Pazourek, S. Nagele, C. Ott, C. D. Lin, J. Burgdörfer, T. Pfeifer, *Observing the ultrafast buildup of a Fano resonance in the time domain*, Science **354**, 738 (2016).