DIPARTIMENTO DI MATEMATICA E FISICA
"NICCOLO' TARTAGLIA"

Attosecond Pulses for the Investigation of Electron Dynamics in Biologically Relevant Molecules

Interviene

Prof. Mauro Nisoli

Dipartimento di Fisica, Politecnico di Milano

Abstract

Attosecond science represents one of the frontiers in Ultrafast Optics, since it offers the possibility to influence, control and monitor the motion of electronic wave packets inside atoms and molecules. Attosecond science is now a well-established research field, which offers formidable tools for the investigation and control of fundamental atomic and sub-atomic electronic processes. In the last years, attosecond pulses have been used to measure ultrafast electron dynamics in molecules. Sub-femtosecond electron localization after attosecond excitation has been observed in H2 and D2 molecules; control of photo-ionization of D2 and O2 molecules has been achieved by using attosecond pulse trains. I will present an application of attosecond pulses to the investigation of ultrafast electron dynamics in a biomolecular building block, the amino acid phenylalanine.

The process of electron transfer in molecular complexes is of crucial importance in biochemistry since it triggers the first steps in a number of biochemical processes such as photosynthesis, cellular respiration and electron transport along DNA. Theoretical studies have pointed out that very efficient charge dynamics can be driven by purely electronic effects, which precede any rearrangement of the nuclear skeleton and which can evolve on a temporal scale ranging from few femtoseconds down to tens of attoseconds. This ultrafast charge dynamics, essentially driven by electron correlations, has been referred to as charge migration.

Here we report on a clear experimental measurement of charge migration in the amino acid phenylalanine, after attosecond excitation. Charge migration was evidenced in phenylalanine as an oscillatory evolution in the yield of a doubly-charged molecular fragment. We have also performed theoretical calculations to describe the hole dynamics induced by an attosecond pulse similar to that used in the experiment. The results of the numerical simulations clearly show the production of an ultrafast electron dynamics, characterized by oscillation frequencies in good agreement with the experimental result.

Seminario

Venerdì 30 gennaio 2015

Sala Riunioni, ore 12.00

Via Musei, 41 - Brescia

UNIVERSITÀ CATTOLICA del Sacro Cuore