Attosecond Optical Electronics

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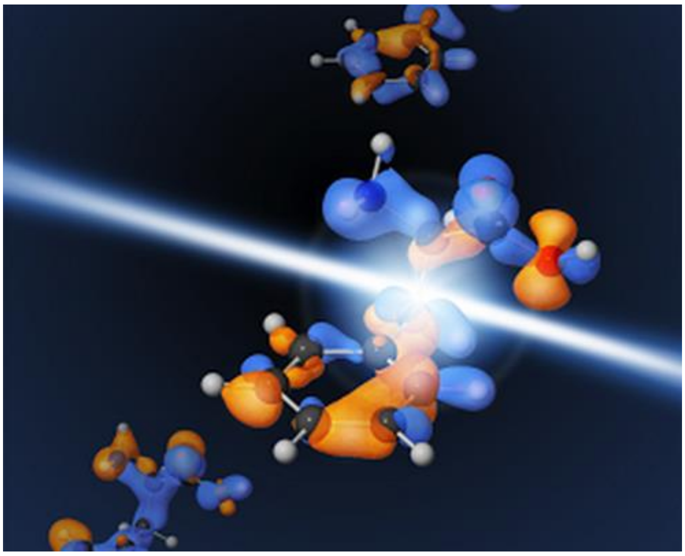

Since the invention of the laser more than 50 years ago, researchers have been consistently shortening the length of laser pulses. Using these pulses as strobe lighting has enabled observation of faster and faster phenomena. For instance the development of table-top femtosecond (10^{-15} s) in the 1980s and 90s enabled Zewail to follow the transfer of atoms in chemical reactions in real time (for which he was awarded the Nobel prize in 1999). Using one of these ultrashort pulses to initiate the process (pump), a second pulse probes the subsequent dynamics at a later time.   By repeating the measurement for different delays between the pulses "molecular-scale movies" can be generated. However, to "see" movement of much lighter electrons even shorter pulses attoseconds (10^{-18} s) are required.

In this talk I will describe the development of attosecond lasers in the last 10-15 years, the methods used to measure the duration of these fantastically short bursts of light, and show how they can be used to observe (and potentially control) the fleeting electronic processes in atoms, molecules and nanostructures. In particular I will describe a recent experiment in which ultrafast coherent electron transfer within an amino acid was observed. Such behaviour could be critical to a number of biological processes such as photosynthesis, charge conduction in molecular wires and damage to DNA by ionising radiation.