

In 1999 Ahmed Zewail won the Nobel Prize in Chemistry for his work on femtochemistry, that is on developing techniques to use laser pulses to “photograph” chemical reactions on the scale of femtoseconds, i.e. one thousand of one million of one millions of a second. The dream of the XXI century is the observation of complex quantum dynamics on sub-femtosecond and sub-nanometer scales in physical, chemical and biological systems. Atto-science is a key technology to realize this with table top/low cost physics. In atto-science ultrashort laser pulses are impinged on matted to produce yet shorter atto-second (thousand times shorter than femto) pulses of ultraviolet (UV) or even X-ray radiation, and electrons of surprisingly high kinetic energy. The attosecond XUV pulses can be used to test dynamics of atoms, molecules, solids, 2D solids like graphene, biomolecules, bio-complexes etc. The present proposal focuses on developing theory and experiments to understand the essence of the relevant physics, especially in the contexts of many body effects, neglected so far in standard descriptions. Our main and in fact THE goal is the realization of the dream: observation of complex quantum dynamics on sub-femtosecond and sub-nanometer scales. This will allow to understand numerous processes of primary importance for chemistry, bio-photonics and biology.