Department of Physics and Astronomy presents:

Taming and Imaging Electron Motion in Action

PRESENTED BY

MOHAMMED HASSAN,

Physics Department, The University of Arizona

THURSDAY

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IN JH 136

Refreshments will be served in the JH 1st Floor Vending Area at 3:30

ABSTRACT

In recent decades, developments in attosecond (attosecond $=10^{-18}$second) physics have enabled real-time studies of electron dynamics in matter. Tracing electron motion on its native time scale becomes crucial for accurate clocking of microscopic phenomena. Attosecond physics has been based on the generation and exploitation of extreme-ultraviolet (XUV) attosecond pulses for probing electron dynamics in atoms, molecules, and nanostructures [1]. Attosecond spectroscopy provides insights into atomic and electronic motion in real time. However, the trajectory of this motion in the spatial domain, as time evolves, remains beyond reach. Therefore, ultrafast physics calls for a new technique to map atomic and electron motion in both the temporal and spatial domains. Recently, Ultrafast Electron Microscopy (UEM) and Diffraction (UED) have permitted the imaging of atomic motion in real time and space. The temporal resolution in ultrafast electron imaging measurements, typically on the order of a few hundred femtoseconds, is limited by the electron pulse duration and by its synchronization with an optical trigger pulse. Ultrafast electron imaging has found a vast range of applications that spans chemistry, physics, material science, and biology [2].

In this talk, I will discuss the synthesis of the world's first optical attosecond pulses in the visible and nearby ranges and the use of this tool to control bound electron motion in atoms [3]. In addition, I will introduce ultrafast imaging techniques and how one can break the temporal resolution limits in UEM by generating a 30-fs electron pulse exploiting the optical gating approach [4]. Obtaining this few tens of femtosecond temporal resolution in UEM opens the door - for the first time - to image electron dynamics in real time. Finally, I will explain the generation of single-isolated attosecond electron pulses by optical gating to establish the attosecond electron imaging tool that we call "Attomicroscopy." Attomicroscopy will enable the imaging of electron motion, from a few hundreds of attoseconds to a few femtoseconds [5].

References

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