UNL Department of Physics and Astronomy presents:

Discovery of Archimedean Spiral Vortex Patterns from Electron Matter Waves

PRESENTED BY

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Refreshments will be served in the JH 1st Floor Vending Area at 4:15

ABSTRACT

Light-matter interaction is an overarching theme in physics and applications. Numerous studies have led to the discovery of a variety of intriguing coherent phenomena from strong-field and ultrafast processes, including high harmonic generation (HHG), above-threshold ionization, sequential and nonsequential multiple ionization, etc. The existing attopulses in the XUV and soft X-ray regimes from HHG or free-electron laser (FEL) are milestones in achieving the ultimate goal of attoscience, which is control of chemical reactions by making electron movies. Since atoms and molecules as the building blocks of matter are many-body quantum systems (given their quantum size) with large degrees of freedom, the grand challenge in fully understanding those processes in attoscience resides in the difficulty of describing accurately the interactions among electrons (known as electron correlation), between electrons with ions, and between electrons with the time-dependent laser field. My research aims to develop analytical and numerical tools to investigate the dynamics and effective couplings among these quantum degrees of freedom, with a focus on correlated processes and arbitrarily-polarized light.

In this talk, after presenting an overview on attosecond physics, I will briefly describe our quantum methods used to investigate these strong-field and ultrafast processes from two-electron atoms and molecules by elliptically-polarized light. Later, I will focus on one of attopulse applications: our discovery of Archimedean spiral vortex-like patterns from single-electron ionization of He atom by a pair of circularly polarized attopulses (a temporal two slits), which has already opened a new interdisciplinary area in physics. Different aspects I shall discuss include effects of attochirp, effects of electron correlation, and possibly interaction of multiple temporal pairs of slits.

Possible applications of this novel electron phenomenon include diagnostic tools for laser pulses with an emphasis on polarimetry and attochirpmetry, attosecond quantum beats and optical switches, a reference pattern for chronoscopy of photoemission, and electron grating spectrometers.