Announcing the Final Examination of Thi Tran Chau Truong for the degree of Doctor of Philosophy in Physics

Date: November 8, 2023
Time: 9:00 a.m.
Room: PSB 445
Dissertation title: Progress towards Attosecond Science with a Turn-key Industrial-grade Ytterbium Laser

Abstract:

Advancements in laser technology over the last decades have allowed compression of laser light pulses to few-femtosecond durations. To obtain even shorter pulses, a new mechanism was required. The discovery of high-order harmonic generation, a non-perturbative nonlinear optical process, allowed the conversion of ultrafast laser pulses into a coherent extreme ultraviolet light (XUV) source of attosecond pulses. The attosecond XUV light source, which corresponds to the natural time and energy scales of electron motion in matter, has provided a tool to capture the fastest dynamics in atoms, molecules, and solids and opened the field of attosecond science. However, the generation of isolated attosecond pulses has traditionally required state-of-the-art, few-cycle Ti:Sapphire laser systems and advanced facilities, which limit its applications in other science fields. Recently, ytterbium-doped solid state and fiber lasers have become attractive tools for ultrafast science and industrial applications, due largely to their prospects for scaling to high peak- and average power and their turn-key operation. However, applying these sources as driving lasers for attosecond pulse generation is challenging due to their long pulse durations.

In this dissertation, I discuss progress towards attosecond time-resolved experiments using a turn-key Yb:KGW laser amplifier. First, we overcome the unfavorable long laser pulse duration by generating broadband, coherent supercontinuum spectra via nonlinear propagation in a molecular gas-filled hollow-core fiber. The pulses are compressed to sub-two-cycle durations using a two-channel field synthesizer, and methods to mitigate thermal effects at high average powers are explored. The laser pulses are characterized using a new single-shot waveform measurement technique based on multiphoton excitation in a solid medium, and we demonstrate its applicability to studies of attosecond field reshaping during nonlinear propagation. Finally, a source of isolated attosecond pulses based on a two-stage hollow-core fiber compressor with carrier-envelope phase stabilization and temporal gating is proposed.

Outline of Studies:
Major: Physics

Educational Career:
M. Sc. University of Central Florida, USA, 2023
M. Sc. HCMC University of Education, Vietnam, 2013
B. S. HCMC University of Education, Vietnam, 2011

Committee in Charge:
Dr. Michael Chini (Chair)
Dr. Zenghu Chang
Dr. Luca Argenti
Dr. Peter Delfyett (External Committee Member)

Approved for distribution by Dr. Michael Chini, Committee Chair, on October 16, 2023.

The public is welcome to attend.