Master thesis project at the Relativistic Attosecond Physics Laboratory

Title: Temporal characterization of sub-two-optical-cycle laser pulses

Introduction:
Nowadays the duration of the shortest laser pulses reaches the theoretical limit of about a single optical cycle. This corresponds to a few femtoseconds at typical laser wavelengths (750 nm). The temporal characterization of these pulses is still a challenging measurement due to their shortness (few-fs ~1 µm) and broad spectra that approaches an octave. Various techniques have been developed to realize temporal measurements, among others FROG, SPIDER, and d-scan. Many of these techniques require a sophisticated evaluation algorithm to determine the temporal/spectral intensity and phase due to the complex relationship between these properties and the measured quantities.

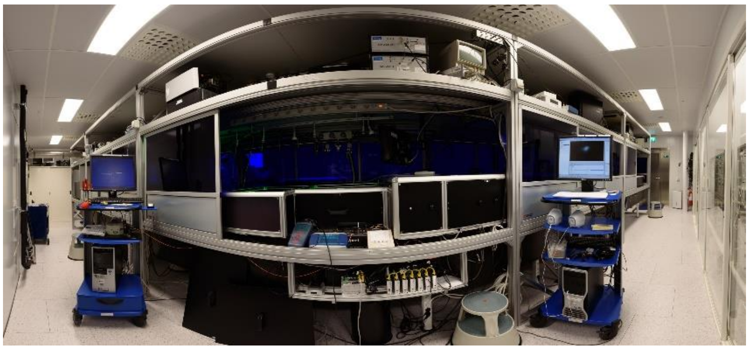

Fig. 1. *Light Wave Synthesizer 20 (LWS-20), a worldwide unique homemade laser system providing few-cycle long laser pulses focusable to highly relativistic intensities.*

Aim:
The goal of the project is to implement and utilize a complete temporal characterization technique in our sub-two-cycle (<5-fs) laser system called Light Wave Synthesizer 20 (LWS-20). The technique is called chirp-scan and is based on the measurement of the second harmonic spectrum for different spectral phases.
As a first step, the evaluation algorithm, which is used to retrieve the temporal structure of the laser pulses, will be optimized to achieve a quick and user-friendly evaluation process. Utilizing this program, the technique will be characterized in different parts of the spectral range of the laser to accelerate the temporal compression process of the laser. Furthermore, a simple program will be written to calculate the expected experimental trace for arbitrary pulse shapes. Finally, a feedback loop will be realized (to the shaper in the laser) to automatically compress the pulses.

Requirements:
The most important is that you have interests in and some basic experience with experimental research. You must be highly motivated and have the ability to work independently as well as a part of the research group. It is required that you are fluent in both oral and written English. During the work, you will deal with optics, laser-plasma physics, LabVIEW, and MATLAB.

Contact:
Send your questions and application to Prof. Laszlo Veisz (laszlo.veisz@umu.se) or Dr. Alexander Muschet (alexander.muschet@umu.se).