Master thesis project at the Relativistic Attosecond Physics Laboratory

Title: Water nanodroplet target for relativistic nanophotonics experiments

Introduction:

This project about relativistic nanophotonics is based on the unique combination of two state-of-the-art research fields. The first is ultra-high intensity laser physics providing lasers pulses with intensities generating extreme states of matter, i.e., ionizing them and generating electron-ion plasma. The second field is nanotechnology contributing to this project by nanometric targets that are irradiated by a laser pulse. The interaction of these ultra-intense laser pulses with nanomaterials (Fig. 1) results in relativistic electron pulses with a temporal duration in the attosecond regime, i.e., the shortest ever created. These short electron pulses can serve to film in 3D electron dynamics in solids via electron diffraction/microscopy.

Aim:

The goal of the project is to characterize, optimize and modify a new target system made of water droplets of a few-100 nm. A basic setup, including a pulsed valve to provide a small amount of water, a heater to evaporate it and a supersonic nozzle that allows the droplet formation from vapor, is working in the lab. As a first step, the droplet size will be characterized from this setup under various conditions. The nozzle will be modified to reduce the size of the generated water droplets down to the 100-200 nm range. Then the spatial distribution of these droplets will be determined and reduced in one dimension by a heated slit to generate a thin volume filled with them. When the target is suitable for experiments, the droplets will be irradiated by the Light Wave Synthesizer 100 (LWS-100) laser to accelerate electrons and measure their main parameters in cooperation with a PhD student. These electron bunches have potentially 100 attosecond (10^-16 s) temporal duration, which is the shortest ever created with interesting potential applications.

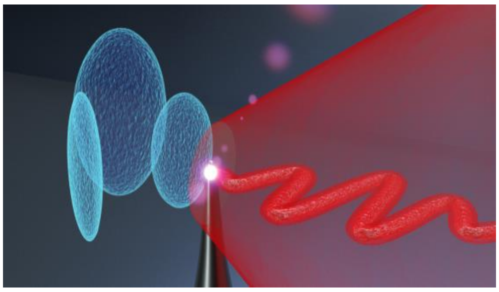

Fig. 1. *Illustration of relativistic nano-photonics. An ultra-intense and short laser pulse (red) irradiates a nanomaterial (bright white spot) and generates electron bunches (blue) with attosecond duration.*

Requirements:

The most important is that you have interests in and some basic experience with experimental research. During the work, you will deal with optics, laser-plasma physics, LabVIEW, and MATLAB. 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.

Contact:

Send your questions as well as application to Prof. Laszlo Veisz (laszlo.veisz@umu.se) or Aitor De Andres (aitor.de.andres@umu.se).