Master thesis project at the Relativistic Attosecond Physics Laboratory

Title: Relativistic nanophotonics driven by few-cycle laser pulses

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 solid 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 utilize such nanometric tips and spheres with intense laser pulses having sub-two optical-cycle duration to generate relativistic electrons. As a first step, nanotips with a diameter of about 100 nm will be produced for the experiments from different materials. Then they will be irradiated by the Light Wave Synthesizer 20 (LWS-20) laser to accelerate electrons and measure their main parameters in cooperation with a PhD student. Among others, charge, electron spectrum, angular distribution of the electrons will be measured and correlated with the laser and experimental parameters. The electron spectrum will be determined in different directions and optimized with the experimental geometry such as the focusing of the laser pulse. Eventually an electric field enhancement of the laser will be also investigated and optimized by controlling experimental details. On a longer term, the attosecond temporal extension of the electron bunches will be measured.

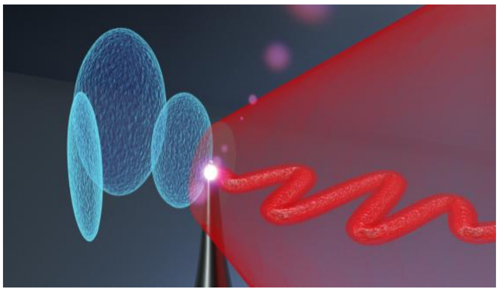

Fig. 1. *Illustration of relativistic nano-photonics. An ultra-intense and short laser pulse (red) irradiates a nanomaterial (bright white spot) and generates electron bunches (blue) with attosecond duration.*

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).