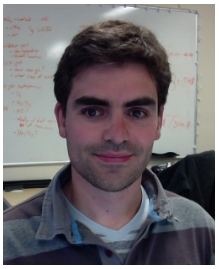

The 23 KPSI Seminar
ITBL G201 room (KPSI) , QST
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# High-intensity short-pulse laser proton acceleration from condensed hydrogen jet


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Ultrahigh intensity lasers have become a key new technology over the last two decades. Growing from Terawatt to Petawatt peak powers and further, they are potential drivers for fundamental physics research as well as applied science and technology. For instance, ultra-intense lasers can be currently used to reach into the regime of relativistic plasmas and emulate astrophysical situations in the laboratory. Applications being investigated range from compact accelerators and light sources to material science, energy science and medical imaging and diagnostics. Specifically, relativistic plasmas created by ultrahigh intensity lasers have been shown to be a very efficient source of high energy electrons and ions, accelerating protons to 10 - 100 MeV energies.

A recent breakthrough in cryogenic jet target development at SLAC has delivered a continuous target of liquid hydrogen with variable thickness down to 1 μm. Multi-dimensional Particle-In-Cell (PIC) simulations for PW laser parameters predict that this target is near optimum for producing high-energy laser-produced protons with energies of more than 100 MeV. These energies can be achieved due to relativistic transparency where the laser effectively heats the micron-scale target and goes through the thin sheet of hydrogen and continues to accelerate protons which were initially accelerated by Target Normal Sheath Acceleration (TNSA) through an Enhanced Sheath Field (ESF). In addition, this debris-free target can be operated at high-repetition rates.

In this talk, I will present the results of recent experiments performed at two high-power laser facilities: Draco at HZDR (30fs, 3J), and TPW at Austin (150J, 137fs), on laser-proton acceleration using a cryogenic hydrogen target. The spectral and spatial characteristics of the proton beams produced will be described in detail with respect to future potential applications. Finally, I will discuss some of the exciting opportunities offered by future facilities integrating bright coherent X-ray sources with high-power optical lasers to bring a new insight into relativistic laser-solid interaction dynamics.

Maxence Gauthier, PhD

Maxence completed his Ph.D. at the Laboratoire pour L'utilisation des Laser Intenses (LULI), Palaiseau, France (Ecole Polytechnique thesis prize 2013) and undergraduate studies at the Ecole Supérieur d'électricité. His research interest lies in the field of relativistic laser-plasma interaction. His work is focused on the production of energetic ions using high-intensity short pulse laser and their potential application to generate and diagnose high energy density plasmas. More specifically, he has been involved in experiments aiming at measuring ion stopping power in isochorically-heated warm dense matter, studying processes relevant to astrophysics such as magnetic field self-generation and collision-less shock acceleration.


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