The TMO Instrument: Opportunities and Plans for Time-resolved Atomic, Molecular and Optical Science at LCLS-II

Abstract

The unique capabilities of LCLS, the world's first hard X-ray FEL, have had significant impact on advancing our understanding across a broad range of science, from fundamental atomic and molecular physics, to condensed matter, to catalysis and to structural biology.

A major upgrade of the LCLS facility, the LCLS-II project, is now underway. LCLS-II is being developed as a high-repetition rate X-ray laser with two simultaneously operating, independently tunable FELs. It features a 4 GeV continuous wave superconducting linac that is capable of producing uniformly spaced (or programmable) ultrafast X-ray laser pulses at a repetition rate up to 1 MHz spanning the energy range from 0.25 to 5 keV.

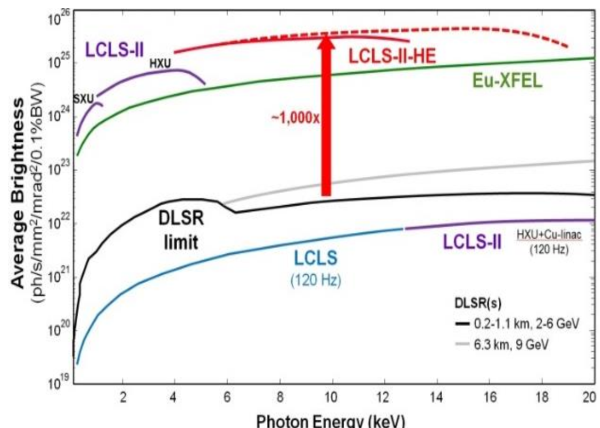

Figure 1. Calculated average brightness for LCLS-II and proposed LCLS-II-HE, including future X-ray facilities: the European XFEL and Diffraction-Limited Storage Rings (DLSRs).

The Time resolved AMO (TMO) instrument, one of the four new LCLS-II instruments, will support AMO science, strong-field and nonlinear science, and a new dynamic reaction microscope. TMO will support many experimental techniques not currently available at LCLS and will locate two experimental endstations. A new reaction microscope endstation will house a COLTRIMS type spectrometer to accommodate extreme vacuum, sub-micron focus spot size, and target purity requirements as dictated by coincidence experiments. The accumulation of data will be performed on an event-by-event basis using the the 1MHz full repetition rate of LCLS-II. A second TMO endstation will be optimized for performing high energy, high resolution, time- but also angular-resolved photoelectron spectroscopic measurements. By leveraging its existing suite of spectrometers (i.e. high resolution iTOF, eTOF, LAMP double-sided VMIs, Kaesdorf spectrometers) a high resolution, high throughput, hemispherical electron analyzer will also be available. The photon fluence at TMO should reach up to 10^{22}photons/cm2, thus allowing to be tailored to specific experimental needs.

This talk will present some of the important science opportunities, new capabilities and instrumentation being planned for NEH 1.1 (TMO) at LCSL-II.

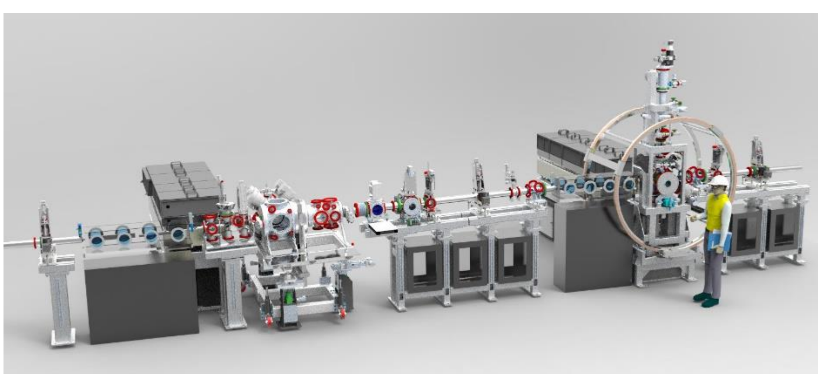

Figure 1. Experimental setup of the NEH 1.1. Showing both endstations which are capable to take full advantage of both the high per pulse energy from the copper accelerator (120 Hz) as well as high average intensity and high repetition rate from the superconducting accelerator (1MHz).

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