TMO capabilities for Run 18

The new Time-resolved Atomic, Molecular and Optical Science instrument (TMO) will provide access to the first Interaction Point (IP1) in Run 18. TMO is optimized to support AMO science, strong-field, and nonlinear science areas. A new variable gap undulator system will be used, providing horizontal polarization for photon energies from 270 eV to 2000 eV, with pulse energies expected to be in the 0.5 to 5 mJ range. In Run 18, TMO will operate with the 120 Hz copper accelerator and an "early science" period will bridge the gap between TMO commissioning and general user access. Ultra short pulses (XLEAP) should be available for user proposals. Proposals should target experiments using up to 120 Hz beam delivery.

Key Performance Parameters for Run 18

Commissioning of TMO is planned to begin in April 2020, to be followed by an “Early Science” phase. It will then be available to users during Run 18 with the following performance parameters.

Parameter	**Value**
Repetition Rate (Hz)	Up to 120, (1, 10, 20, 30, 60, 120)
Energy Range (eV)	270 - 2000
Pulse Duration (fs)	≤ 40; plus XLEAP capability (see below)
Spot size range (um)	1.5 - 10
Polarization	Linear, horizontal
Single Pulse Energy (mJ)	Up to 5
Two Bunch, Two Color Mode	available

XLEAP Parameter	**Value**
XLEAP Pulse Duration (fs)	≤ 0.6
Pulse Energy, single shot (µJ)	25 - 75
Bandwidth FWHM (eV)	4 - 8

Run 18 proposals using XLEAP should be consistent with using single X-ray pulse delivery. LCLS intends to commission dual sub-femtosecond pulses with tunable energy and delay, but this is not guaranteed for Run 18. Users should submit proposals which employ more traditional few-femtosecond (5-10 fs) pulse pairs for pump/probe studies. If the two pulse attosecond operation is successfully developed, the option to use attosecond pulse pairs may be presented during the run. Users should assume added risk and prepare for extended tune up periods. Note, that on soft X-ray two-pulse operation for Run 18, two pulse modes will be limited in delay range. Accessible delays will be between +5 fs and +1000 fs. For more information, please contact James Cryan (jcryan@slac.stanford.edu) or Peter Walter (pwalter@slac.stanford.edu).

Optical Laser Parameter	**Value**
Wavelength (nm)	266, 400, 800, 1300 - 2500
Pulse Duration at 800 nm (fs) FWHM	50
Repetition rate (Hz)	120
Peak intensity on target for 800 nm (W/cm^2)	10^{14}
Focus spot for 800 (um)	50

TMO experimental endstations for Run 18

TMO will initially provide two standardized modular endstations which will be operated at the first TMO focus spot. One endstation at a time will be installed. For more information, please contact Peter Walter pwalter@slac.stanford.edu

LAMP

A high-resolution double-sided electron-ion coincidence velocity map imaging (VMI) spectrometer specifically designed for use in the LAMP endstation will be deployed. This detects ions and/or electrons, allowing for simultaneous and, under certain conditions, coincident measurements of all charged particles. Important Note: There will be **no** imaging option available in TMO, only charged particle spectroscopy.

[1] Osipov, et. al., (2018). The LAMP instrument at the Linac Coherent Light Source free-electron laser. Review of Scientific Instruments, 89(3), 035112. https://doi.org/10.1063/1.5017727

Coaxial VMI

The second experiment setup provides an electron velocity map imaging (VMI) spectrometer where the ionizing laser source propagates along the symmetry axis of the spectrometer. Ths coaxial VMI provides a unique 2-dimensional projection of the 3-dimensional electron momentum distribution.

[2] Cryan, J., et. al., (2018). A co-axial velocity map imaging spectrometer for electrons. AIP Advances, 8(11), 115308.https://doi.org/10.1063/1.5046192