SLAC MeV-UED
Laser Capabilities, Run 3

Matthias C. Hoffmann
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UED Laser System Schematic

800 nm, ~65 fs FWHM, 360 Hz

Ti:Sapphire Based Laser System

- Multipass Amplifier (custom)
- Legend
- Vitara
- Electronic Synchronization*

- Injector Compressor
- Collinear Tripling Generation
- Gun
- Pump Compressor
- SHG/THG/FHG
- OPA
- OPA Extensions (Vis, UV, MIR)
- Optical Delay Line
- THz
- Chamber
- * Recently upgraded (13 fs integrated jitter RMS between LLRF and laser)
Detailed Optical Layout in Bunker

**Attenuation:** ND Wheel, 0-4.0 ND; Waveplate + polarizer for 800+ harmonics

**Spatial Steering:** motorized lens

**Vacuum In-Coupling:** 25.4 mm diameter, 2 mm thick CaF2 window (typical; AR-coated option)

**Focusing Optic:** CaF2 lens, f = 500 mm (typical; AR-coated option); work after focus to pass through capillary

**Time Delay:** 150 mm stage with retroreflector (maximum delay ~ 800 ps)
## Core Capabilities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetition rate</td>
<td>Single shot → 360 Hz (options for 40, 60, 90, 120, 180 Hz)</td>
</tr>
<tr>
<td>Typical optical pulse energy</td>
<td>&gt; 10* mJ @ 800 nm, &gt; 1 mJ @ 400 nm, &gt; 0.30 mJ @ 266 nm, &gt; 0.05 mJ @ 200 nm</td>
</tr>
<tr>
<td>Nominal pulse duration</td>
<td>~75 fs (FWHM)**</td>
</tr>
<tr>
<td>Optical delay</td>
<td>Up to 3 ns (physical delay stage)</td>
</tr>
<tr>
<td>Optical spot size</td>
<td>~300 um (FWHM)</td>
</tr>
<tr>
<td>Polarization</td>
<td>Linear (options for adjustable linear, circular by request)</td>
</tr>
</tbody>
</table>

* Pulse energies above 1 mJ may have spectral / temporal distortions from the vacuum incoupling window  
** Expect <150 fs for 200 nm
 Expanded Wavelength Suite

Optical Parametric Amplifier
HE Topas (Light Conversion),
UV-Vis extension module

- NIR (1100-2400 nm)
- Visible (400-1100 nm)
- UV (240-400 nm)
- Mid-IR (3-15 um)

Typical Energy:
- ~1 mJ 1100-2400 nm
- ~300 uJ 500-800 nm
- ~25 uJ 240-500 nm
## Extended Capabilities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-IR</td>
<td>~1 mJ at 1100-2500 nm</td>
</tr>
<tr>
<td>Tunable VIS/UV</td>
<td>~ 10 - 100 uJ, depending on wavelength</td>
</tr>
<tr>
<td>Mid-IR</td>
<td>~ 100-5 uJ for 3 um to 15 um MIR</td>
</tr>
<tr>
<td>THz LN</td>
<td>~ 5 uJ single cycle THz, 0.2-3 THz</td>
</tr>
<tr>
<td>THz Organic crystals</td>
<td>2 uJ single cycle THz, 1-6 THz bandwidth</td>
</tr>
</tbody>
</table>

*Significant set-up time required for these options*
THz/MIR experimental layout

- THz/MIR generated outside chamber
- Requires motorized parabolic mirror inside chamber
- THz pulse diagnostics with extra EO sampling path
- Significant amount of time required to set up
Limitations of single-cycle THz pump experiments

- **Severe** streaking effects of electrons at sample is challenge
- **Blind spot** at time zero
- Requires samples with that provide signal well after time zero
- Streaking effect less severe at shorter wavelengths
Thanks!

https://lcls.slac.stanford.edu/instruments/mev-ued/specifications

Contact: hoffmann@slac.stanford.edu