



Titan Laser Status

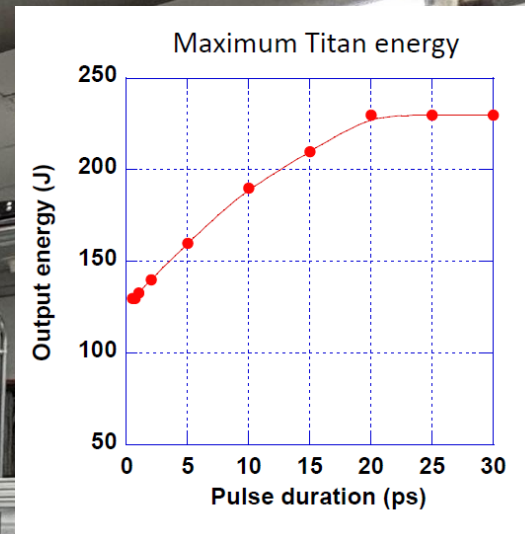
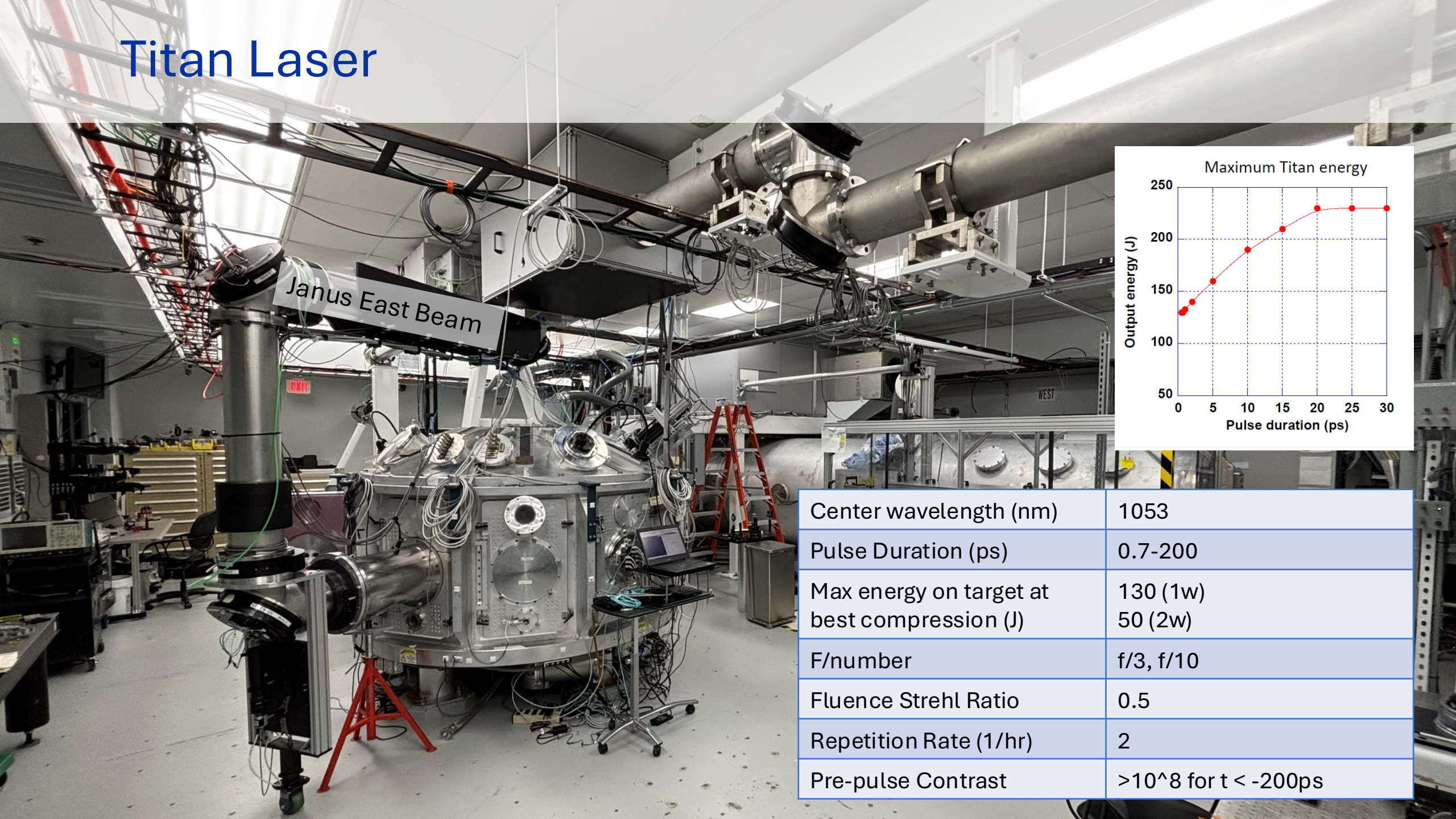
2026 NIF/JLF User Group Meeting

February 11, 2026

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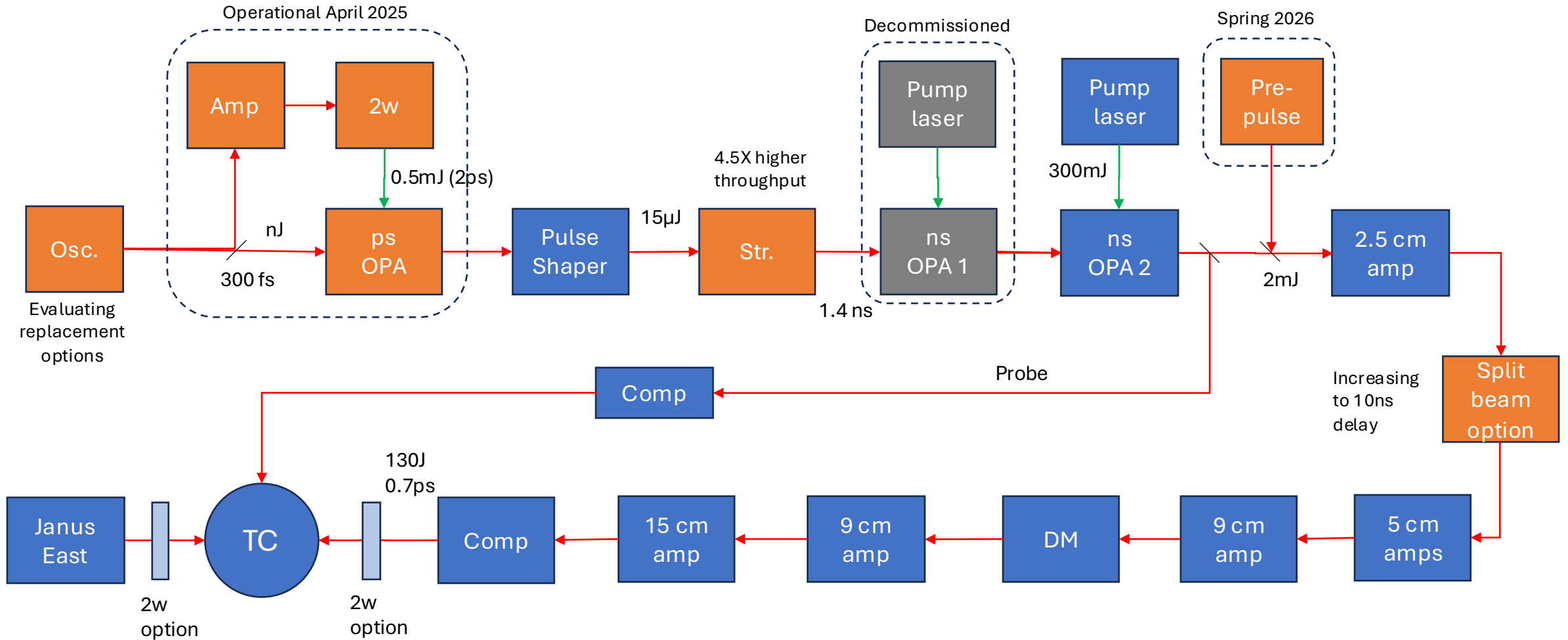
Prepared by LLNL under Contract DE-AC52-07NA27344.

Titan Laser

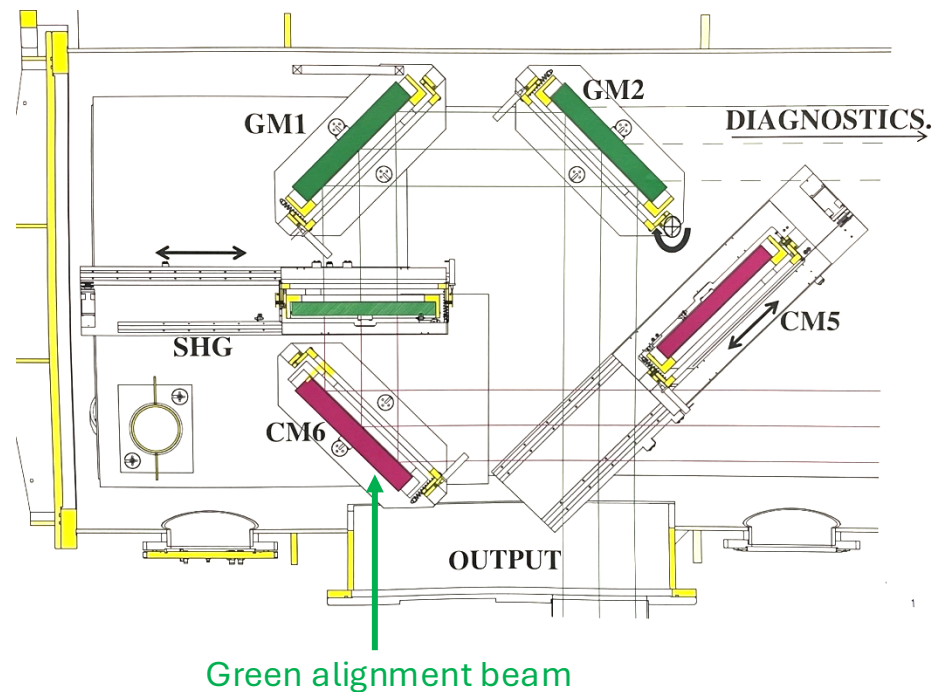
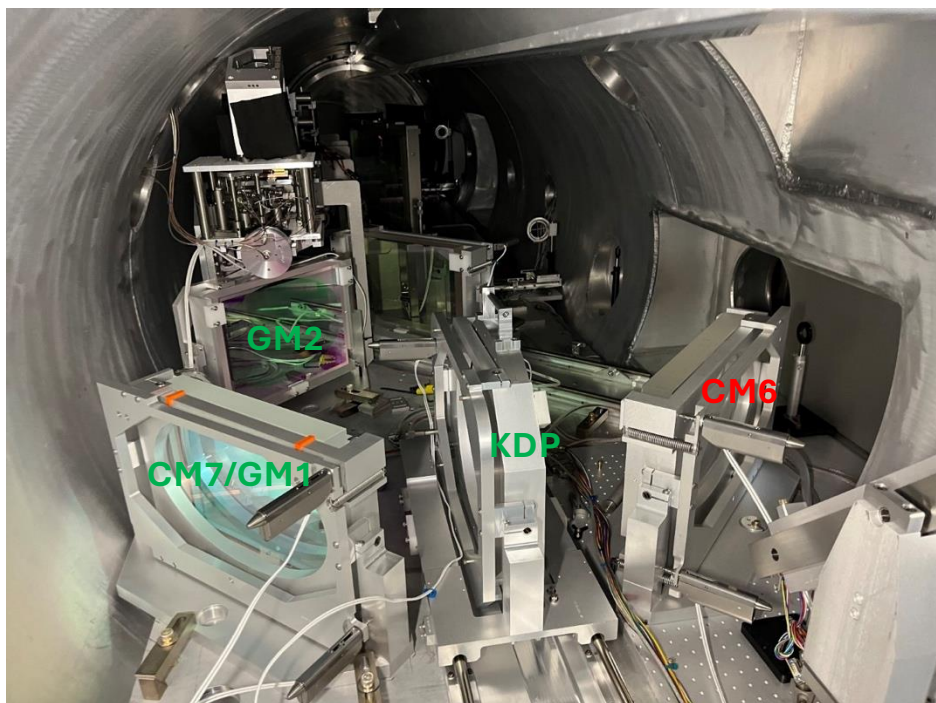


Center wavelength (nm)	1053
Pulse Duration (ps)	0.7-200
Max energy on target at best compression (J)	130 (1w) 50 (2w)
F/number	f/3, f/10
Fluence Strehl Ratio	0.5
Repetition Rate (1/hr)	2
Pre-pulse Contrast	$>10^8$ for $t < -200$ ps

Titan laser components with updates

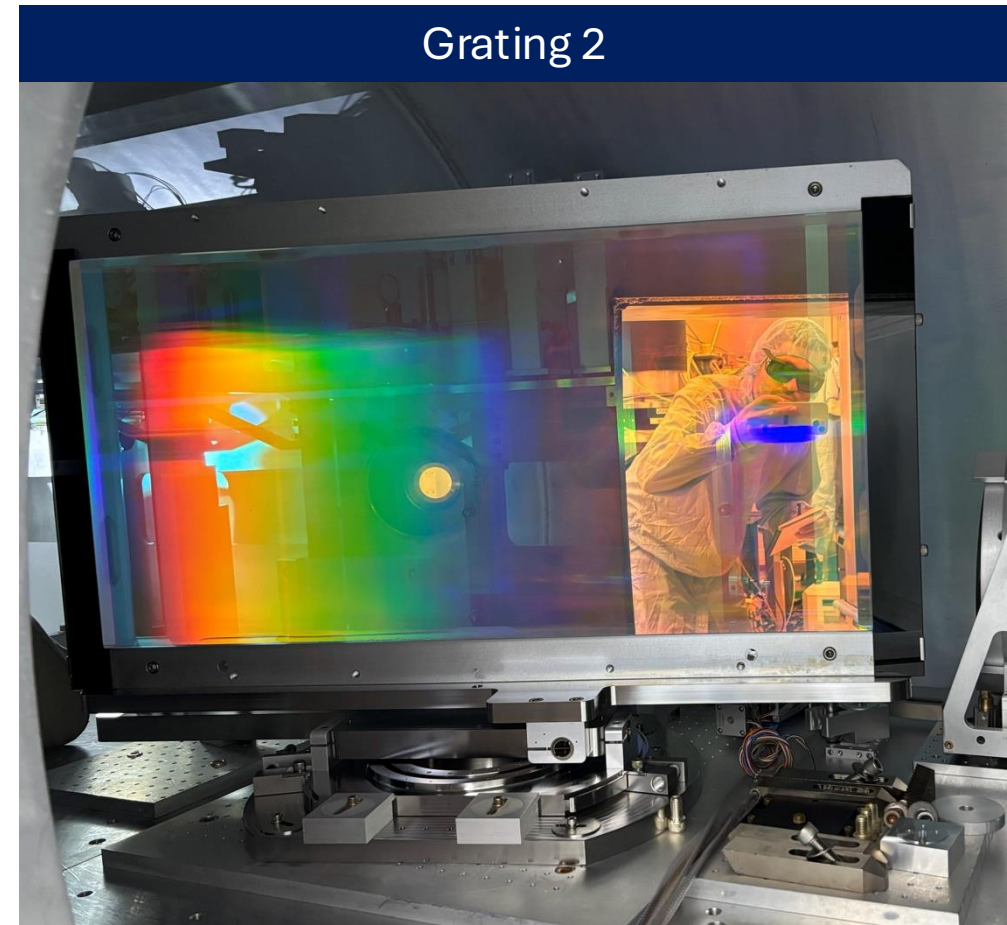
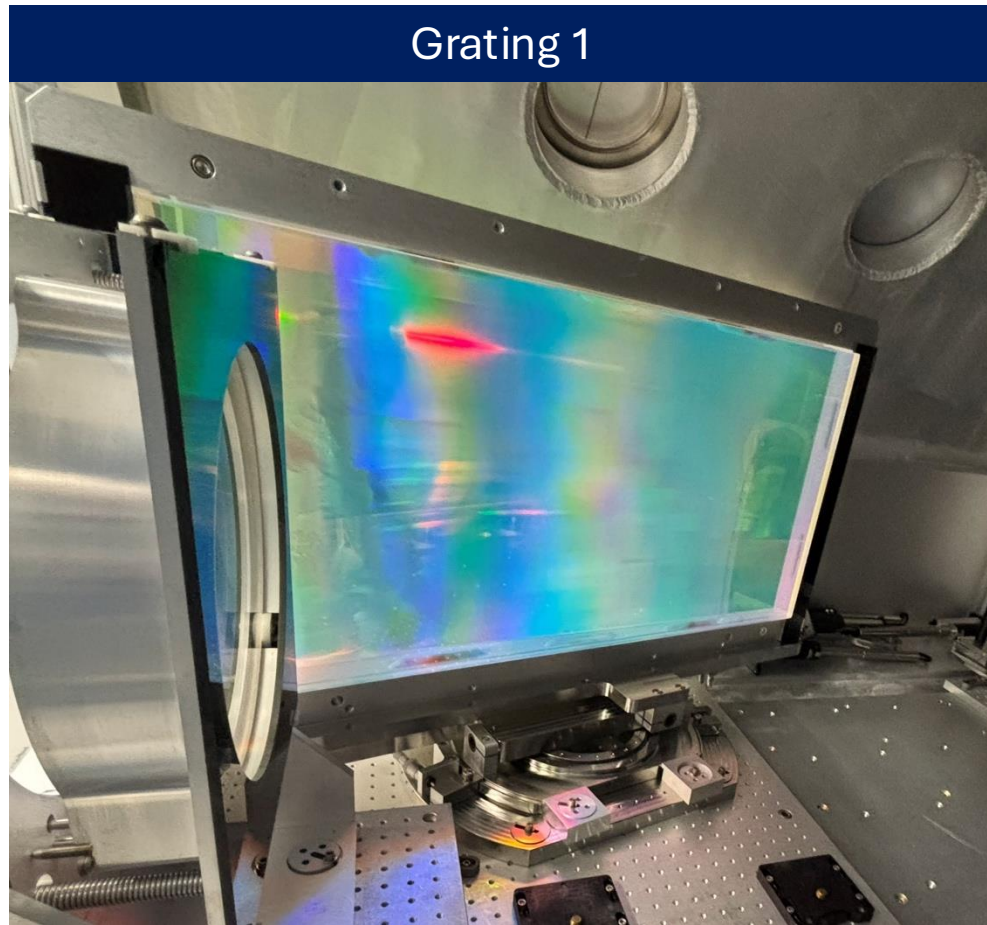


Titan full-aperture 2ω was activated in May 2024



- 30cm dia. x 2mm thick KDP crystal installed in compressor chamber
- 2ω optics are manually added/changed
- Minimal diagnostics are currently available for 2ω

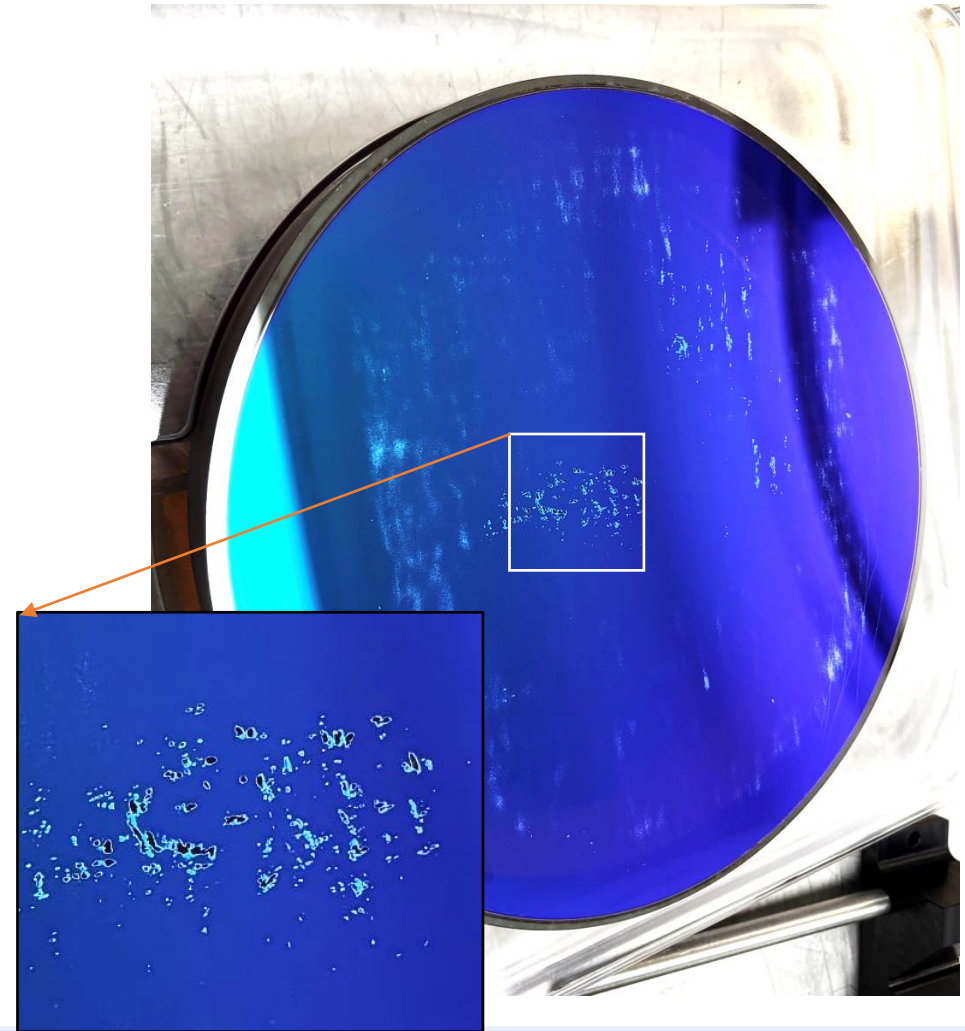
New Titan compressor gratings have been in-operation for 1 year without issues



- Gratings were manufactured by the LLNL diffractive optics group

The maximum energy of Titan is currently limited by the off-axis parabola mirror

- One of the parabolas was damaged during a campaign last year.
- Damage will be investigated with support from Laser Material Interactions group.
- Energy limits will stay at their current values for now.



New pre-pulse diagnostics have been installed and commissioned



- Ultrafast Innovations (UFI) Tundra 3rd order autocorrelator (scanning)
- Fermionics InGaAs photodiode modified to increase survivability¹ (on-shot) providing an effective dynamic range of 10^{10} .

¹R. Acree et al., Proc. SPIE 10084 (2017)

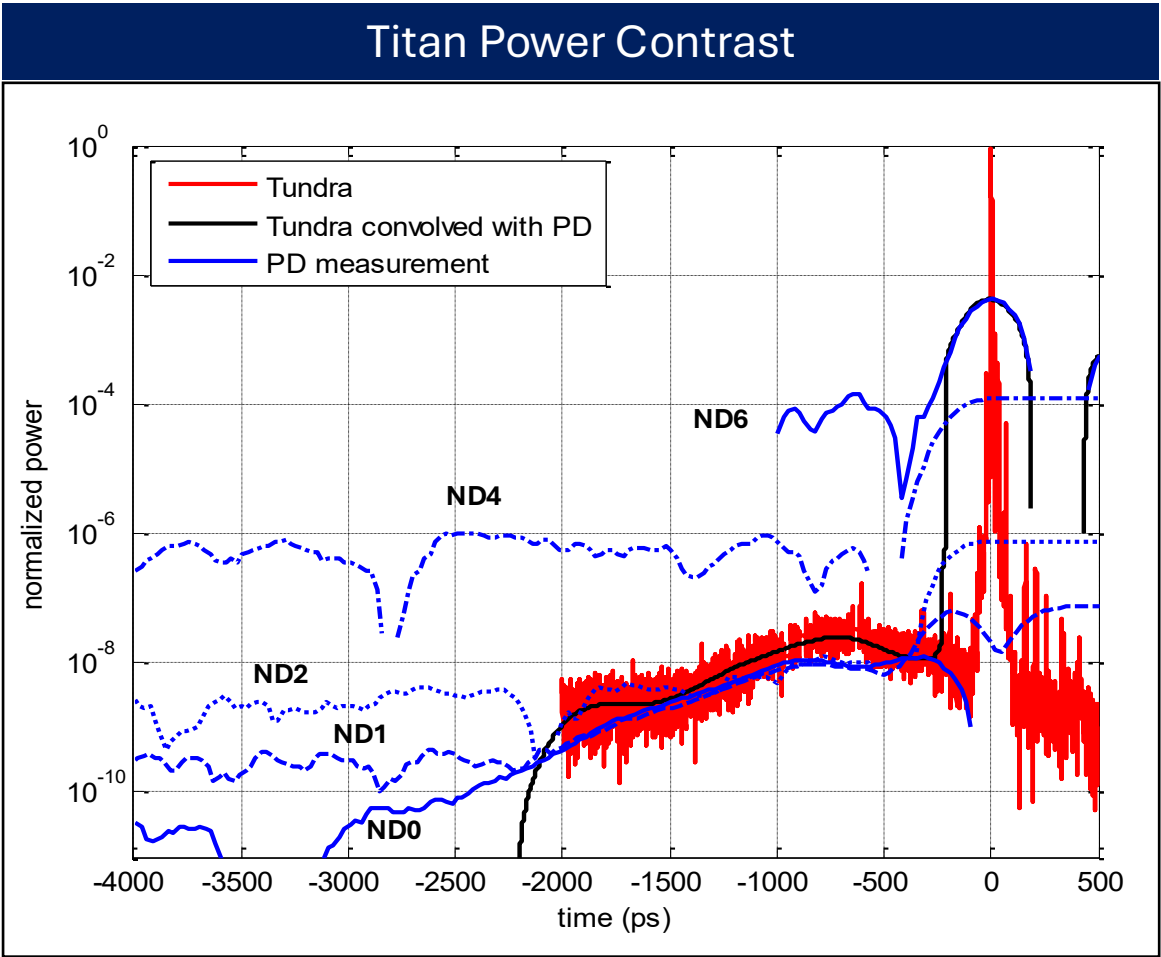
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Tundra



Modified Diode

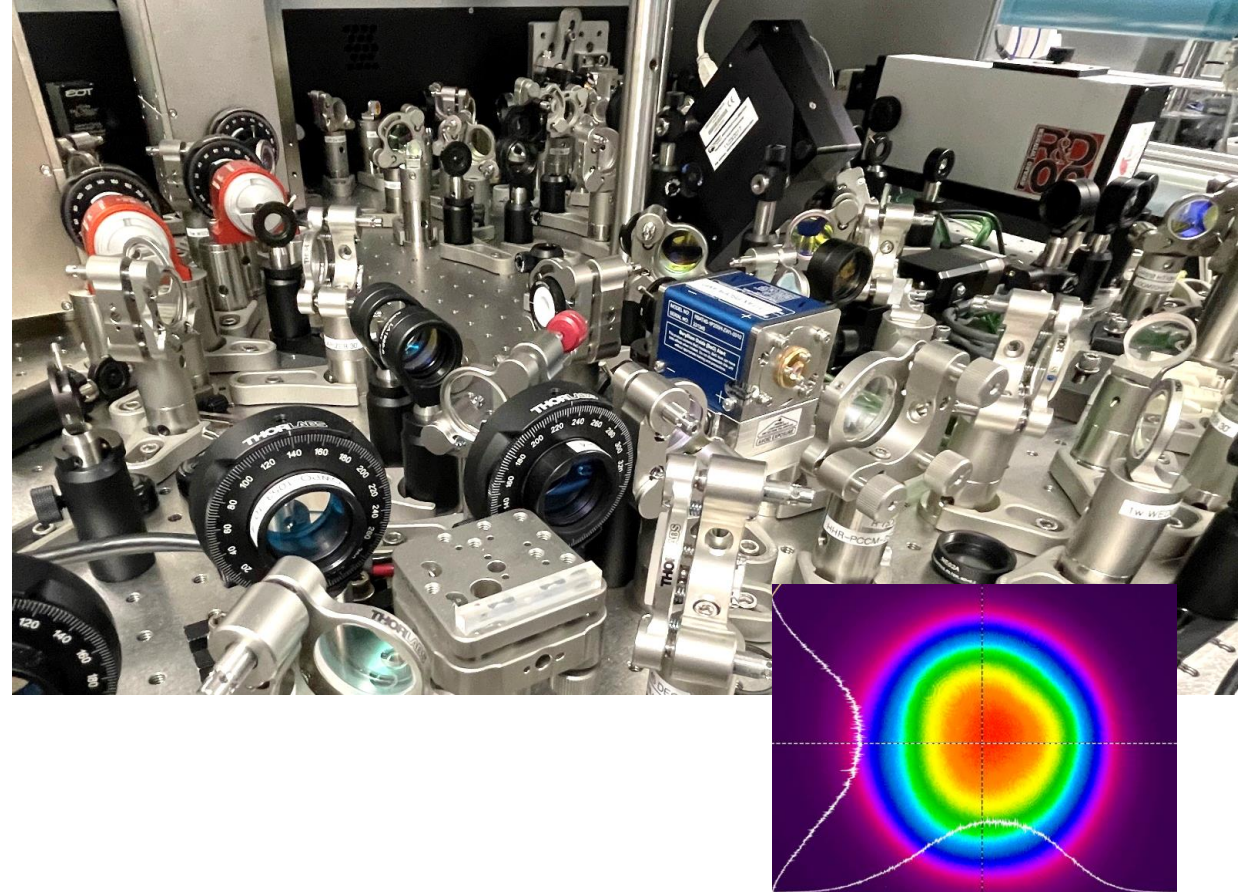


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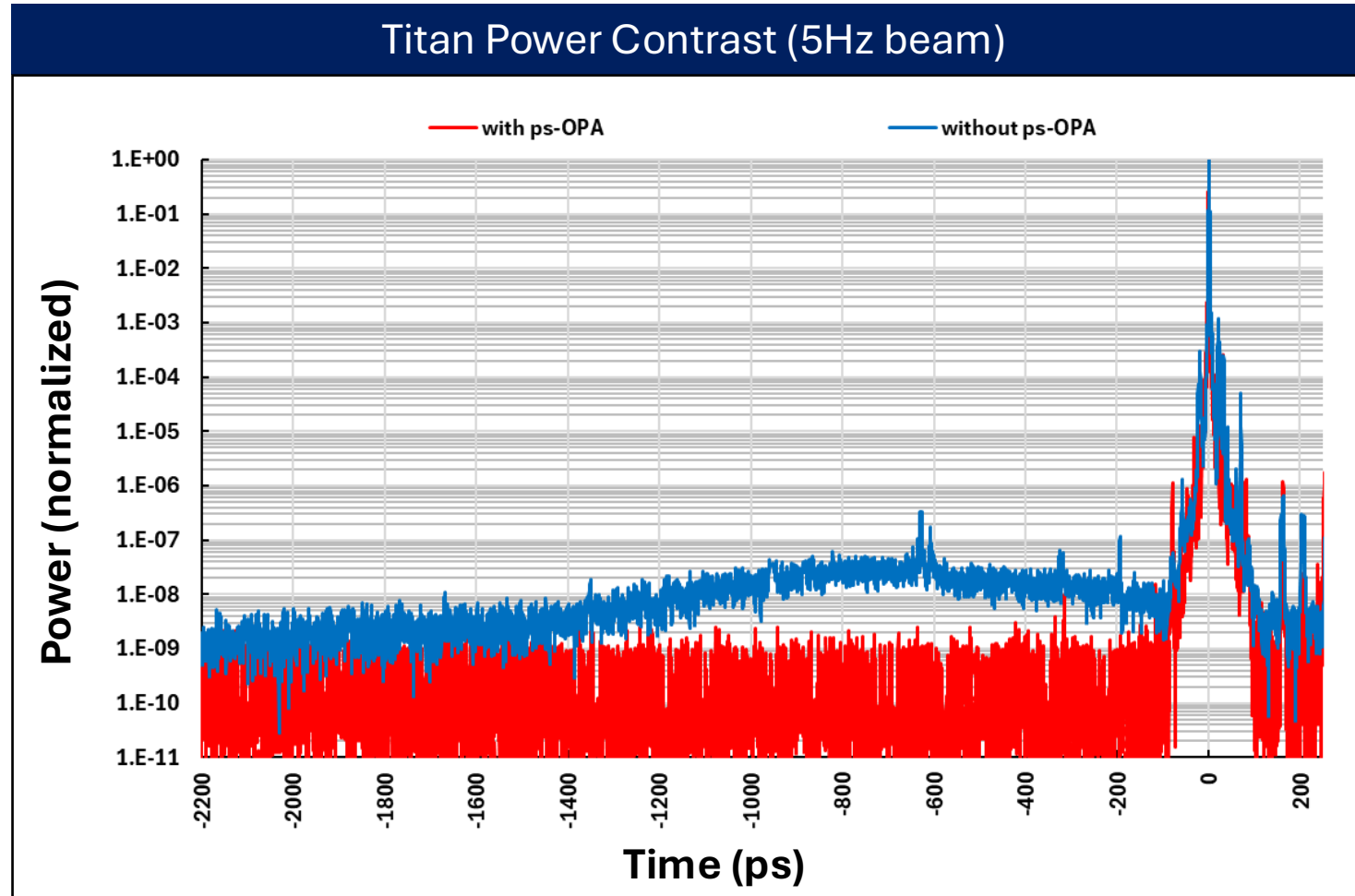
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The ps-OPA was integrated into Titan in April 2025

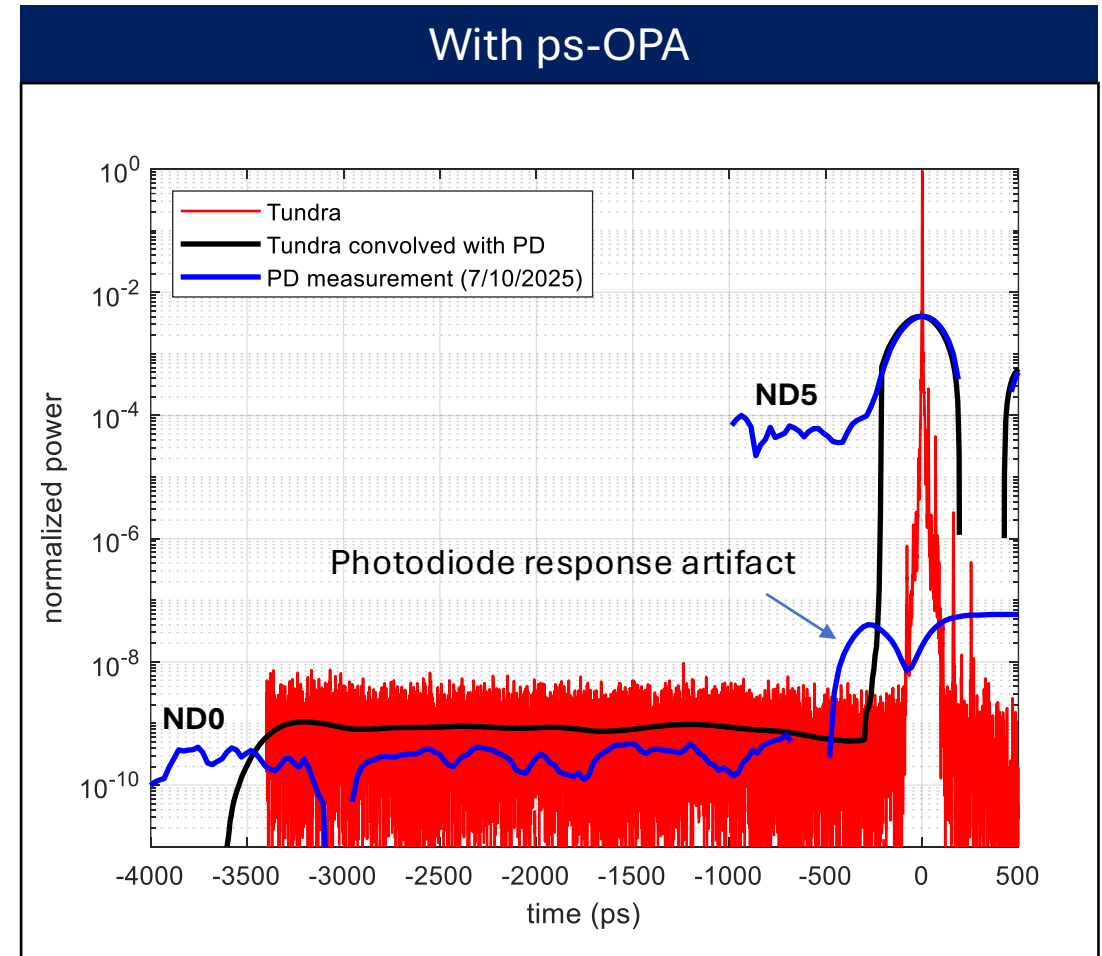
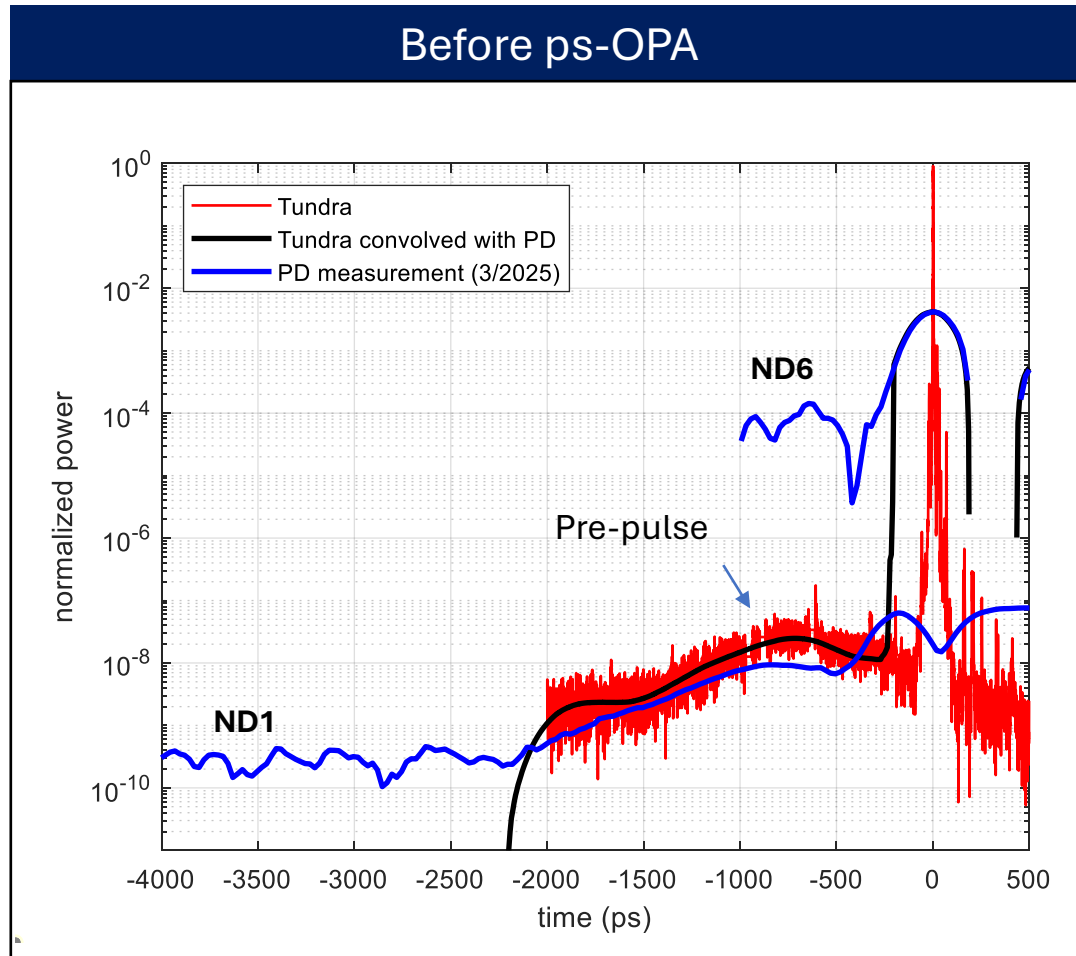
- Amplification of ps pulses improves temporal contrast.
- This is done with two OPA stages in BBO with 300fs, 1053nm seed and 2ps, 527nm pump.
- Active pump timing synchronization compensates for temporal drift to maintain stable performance.



Implementing the ps-OPA in the Titan front end significantly reduced the ns scale pre-pulse

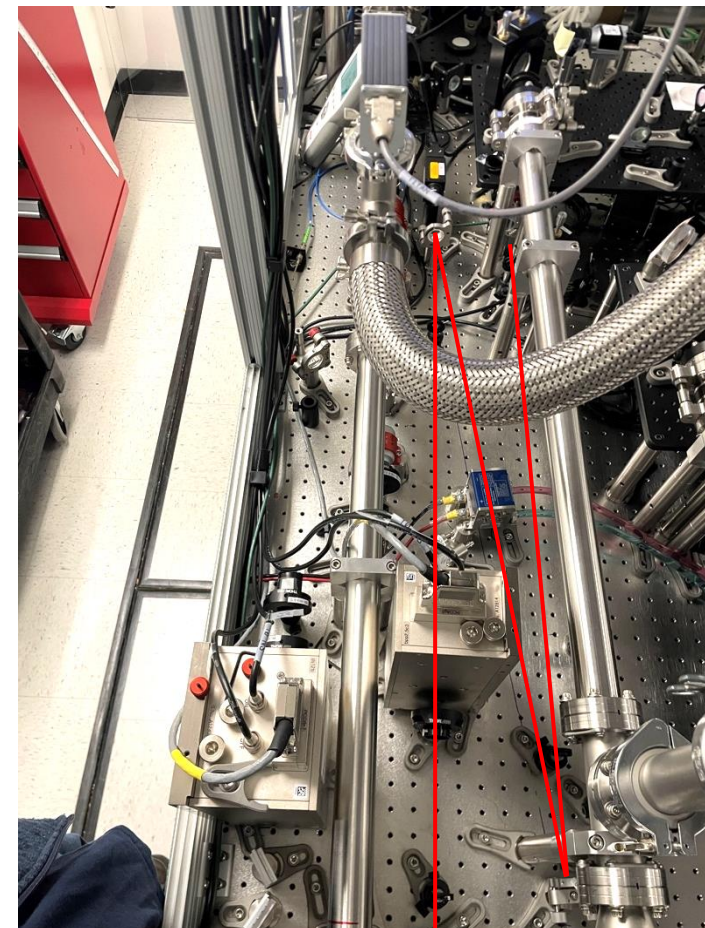


On-shot measurements also do not show the ns timescale prepulse



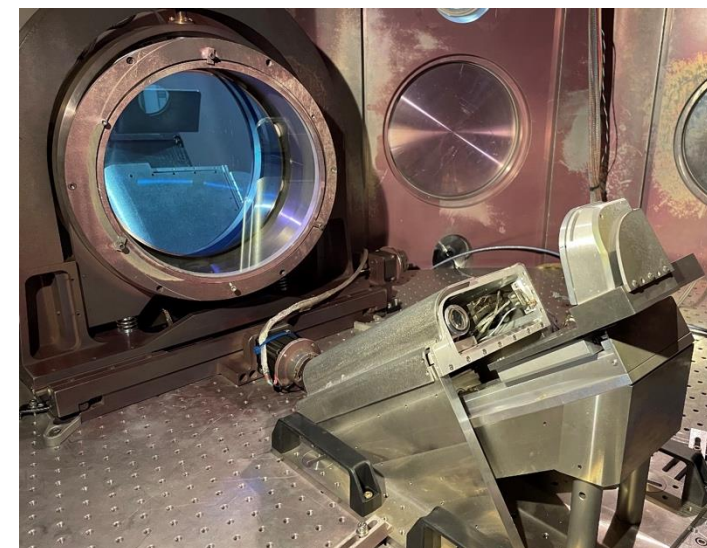
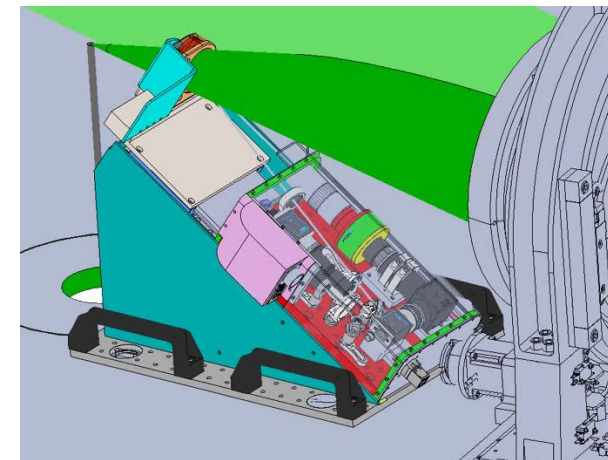
A controllable pre-pulse capability for Titan is currently being commissioned

- We have built a regen amplifier which will be injected into the Titan beampath.
- The regen is seeded by an independent front end consisting of a ModBox pulse shaper and fiber source.
- Specifications
 - Wavelength: 1053 nm
 - Max energy on target: 100 mJ (upgradable if needed)
 - Timing: adjustable
 - Pulse duration: up to 5ns
 - Pulse shaping: 125ps resolution, 60dB extinction
- This capability is expected to be available Spring 2026

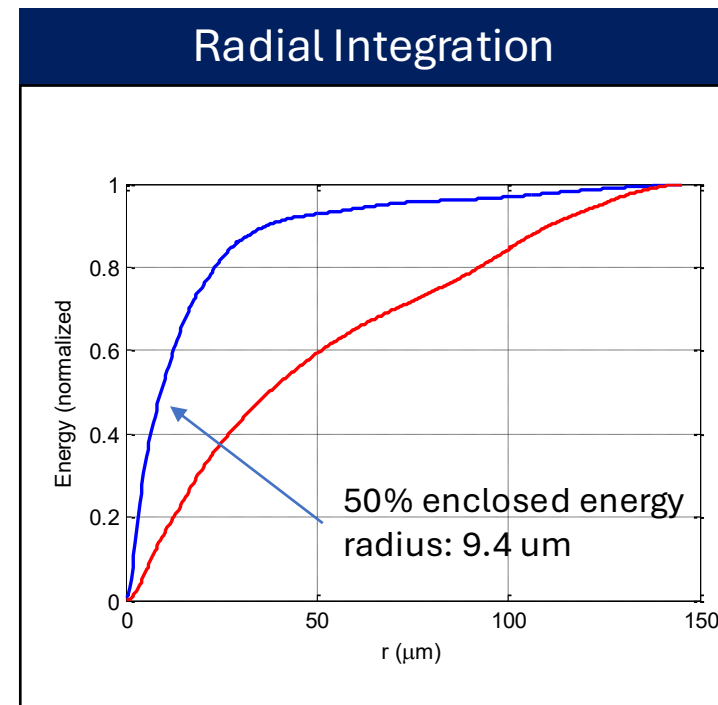
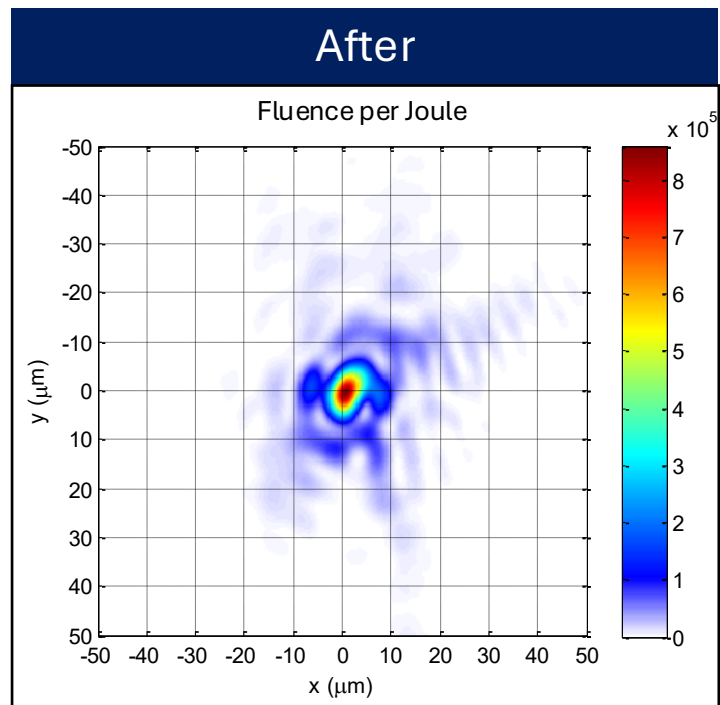
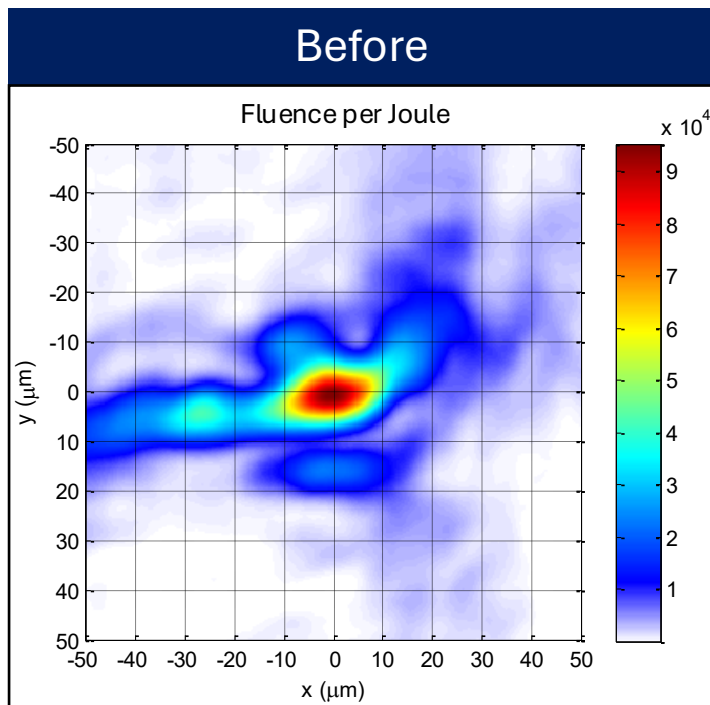


Titan TCC laser diagnostic allows measurement and optimization between shots

- Cameras are vacuum-compatible
- Far-field measurement is linked to adaptive optics system for focal spot optimization
- Near-field camera images parabola to evaluate beam quality and parabola condition, and aid in alignment
- MIIPS diagnostic (2ω spectrum) coupled to SLM-based pulse shaper for temporal optimization and pulse shape control (future upgrade)



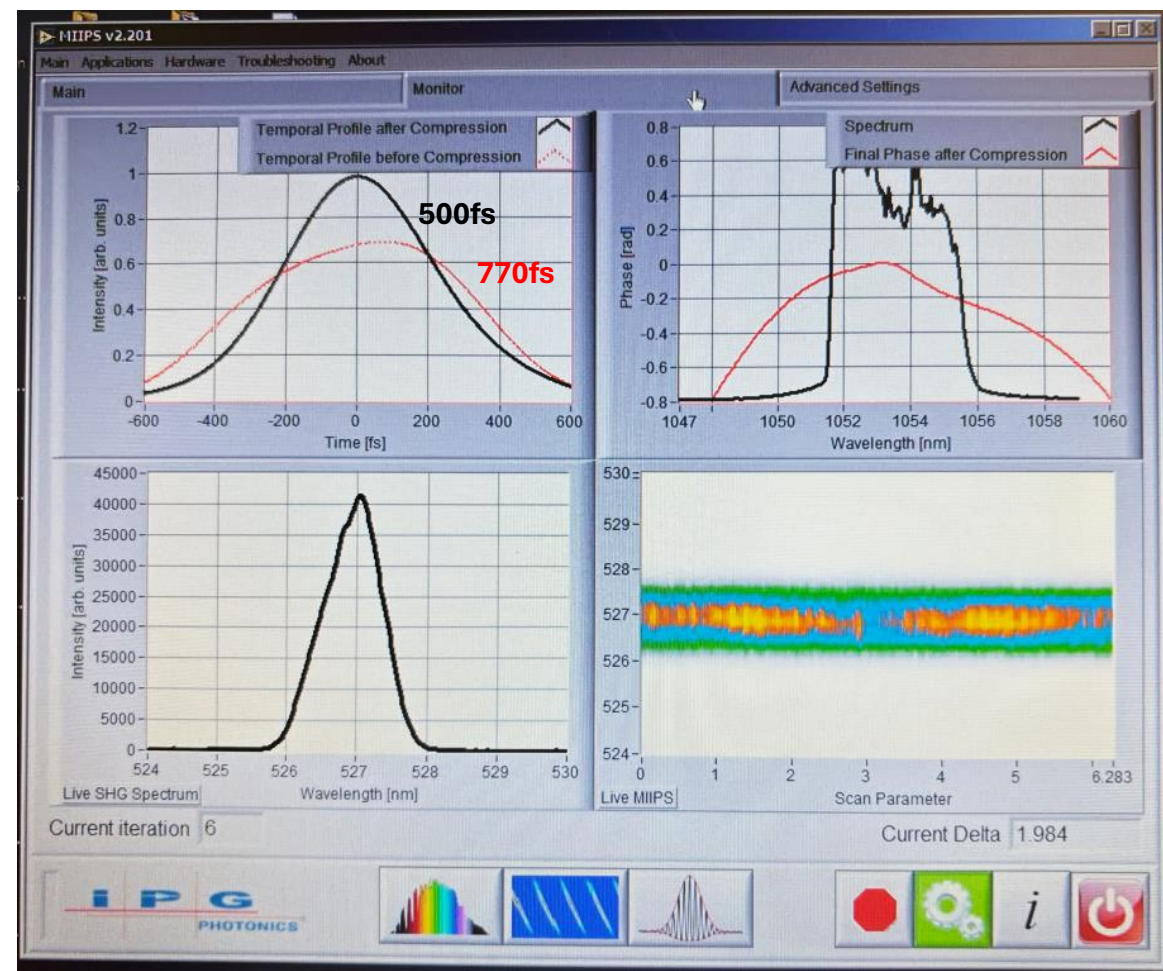
TCC focal spot optimization with DM in the laser bay



- Focal spot optimization is done with DM in the laser chain using a wavefront sensor at the amplifier output and the TCC focal spot diagnostic
- The optimization shown here resulted in a 10X increase in peak fluence which would exceed 10^{20} W/cm² for a 130J, 0.7ps pulse.

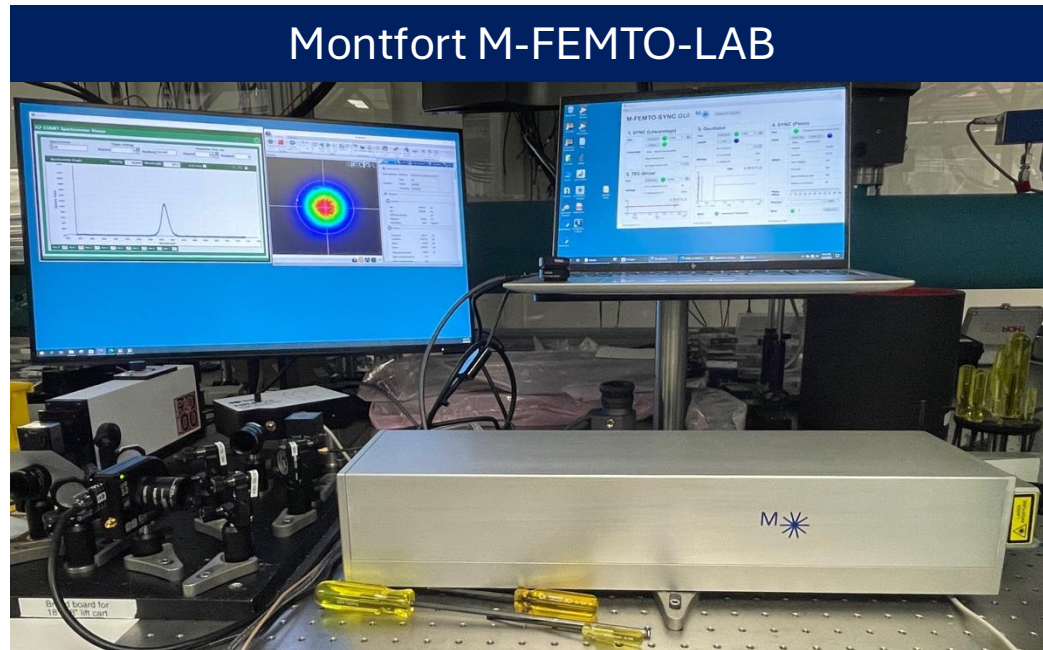
Pulse shape optimization

- The Titan pulse shape is optimized for shortest duration using the Biophotonic solutions MIIPS Box pulse shaping and measurement device.
- This is currently done at the diagnostic table using the low energy 5Hz beam and we are planning to integrate this into the TCC diagnostic.
- Recent measurements of the low energy beam shows 35% reduction in pulse duration
- We are developing a single-shot FROG on the diagnostic table for on-shot pulse shape measurements like the ARC laser.



MIIPS: Multiphoton Intrapulse Interference Phase Scan
 FROG: Frequency Resolved Optical Gating

We will evaluate two new fs oscillators as candidates for replacing the discontinued Titan and Comet oscillators



- Testing in laser bay is in-progress
- Soliton mode locking (with SESAM)
- User serviceable



- Arrives Spring 2026
- Kerr-lens mode locking
- Not user serviceable
- Vendor claims robust long-term operation

We continue to improve JLF capabilities

- Vacuum upgrades to Laser Bay, COMET, Titan
- New off-axis parabolas – COMET (1w, 2w), Titan (5) f/3 and (5) f/10
- New doubling crystals – COMET, East&West 20-mm KD*P
- New 1053-nm oscillators – Montfort, Light Conversion FLINT (arriving soon)
- Titan ps-OPA to reduce prepulse
- Titan prepulse regen to add prepulse in controlled manner
- Titan prepulse diagnostics – Tundra and Modified Photodiode
- Titan split-beam delay – adding capability for 10-ns separation (planned)
- STILETTO activation and commissioning experiment
- Long-pulse temporal shaping – ModBox
- SSD on East and West
- TA1 diagnostics upgrade

<https://jlf.llnl.gov>

