FACET·II
Facility for Advanced Accelerator Experimental Tests

Status of the FACET Experimental Laser

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Office of Science

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Laser Performance

Function	Present	Optimal Present	How do we do better?
Power-amp Pump [J]	2.2	2.6	Can turn up lamps, but not tested
Power-amp Output [J]	0.7	0.8	
Beam Transport Input [J]	0.7	0.7	
Compressor Input [J](beam transport output)	0.6	0.6	
Minimum Beam Size @ Compressor [radius, cm]	2.0	1.7	
Pulse Length Before Compression [ps] [FWHM]	150.0	150.0	
Compressor Output [J]	0.36	0.44	Replace lenses in transport (ordered, should be here any day)
Pulse Duration after compression (fwhm) [fs]	55.0	40.0	Spectrum says we should be good. Need to build compressor in laser room
Peak Power [TW]	6.6	11.1	
Intensity* [10^{18} W/cm^2]	44.1	73.5	3 um focus (my notes aren't clear on fwhm or rms)
a0*	4.5	5.8	

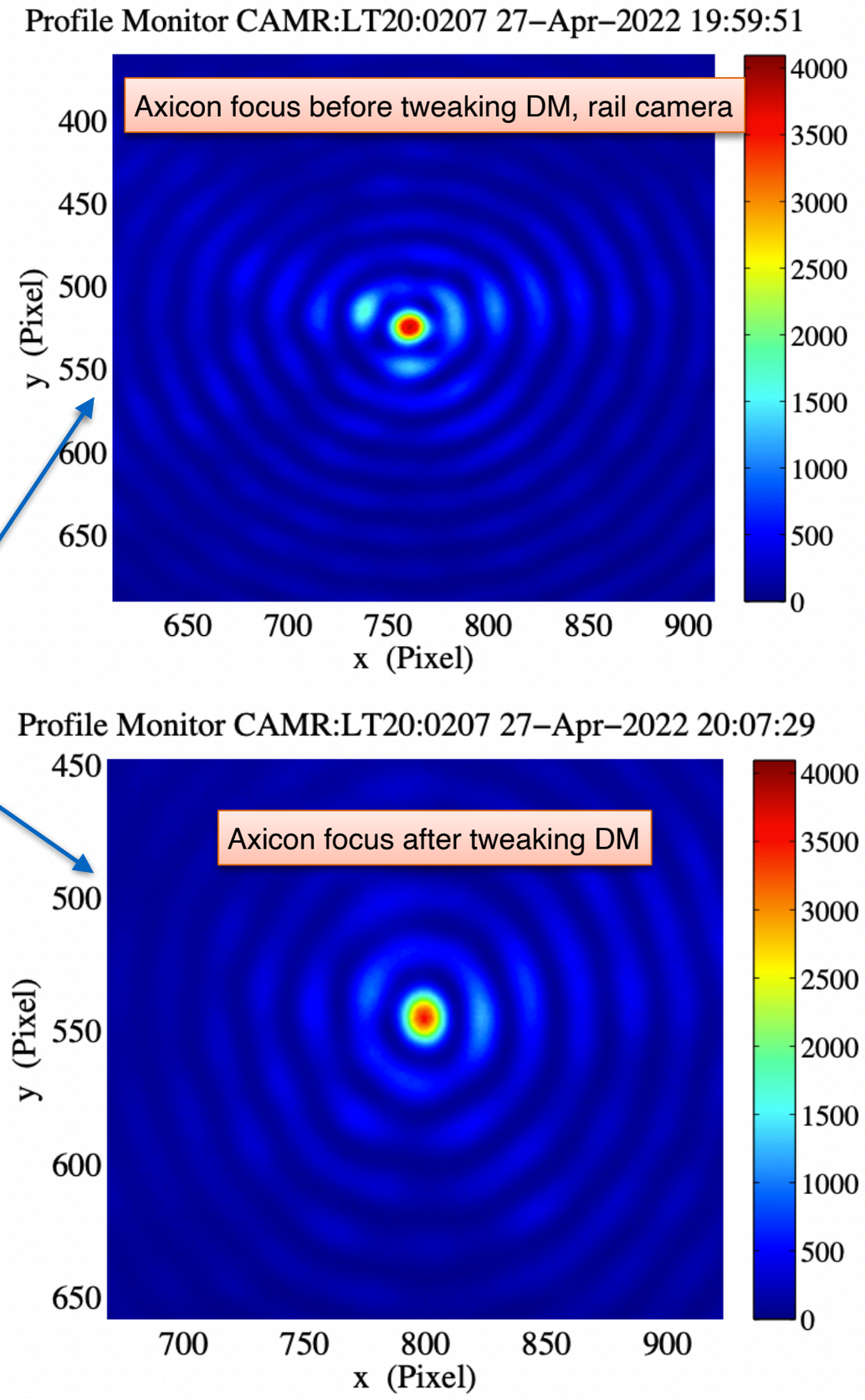
Past and Future Upgrades

What we've done:

- Removed all but two windows
  - Previous source of astigmatism
- Active transport pointing management
  - Less variable astigmatism from gallery temperature changes
- Active laser room pointing management
  - Less sensitive to laser room temperature/ humidity
- Improved SAGA water handling
- Installed deformable mirror
  - Can actively, remotely adjust beam wavefront
- Removed every unnecessary waveplate
- Upgraded RP Attenuator to be 100% reflective

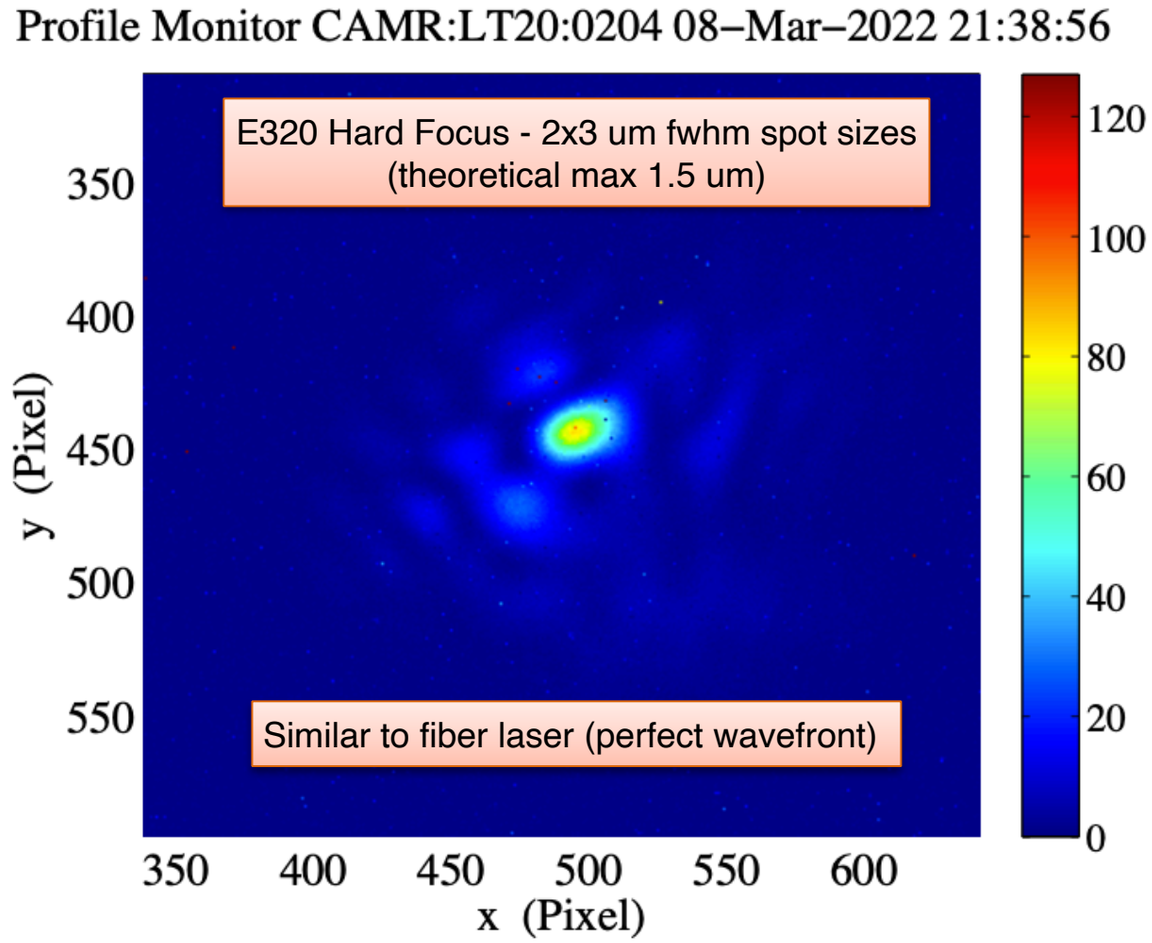
What we still have to do:

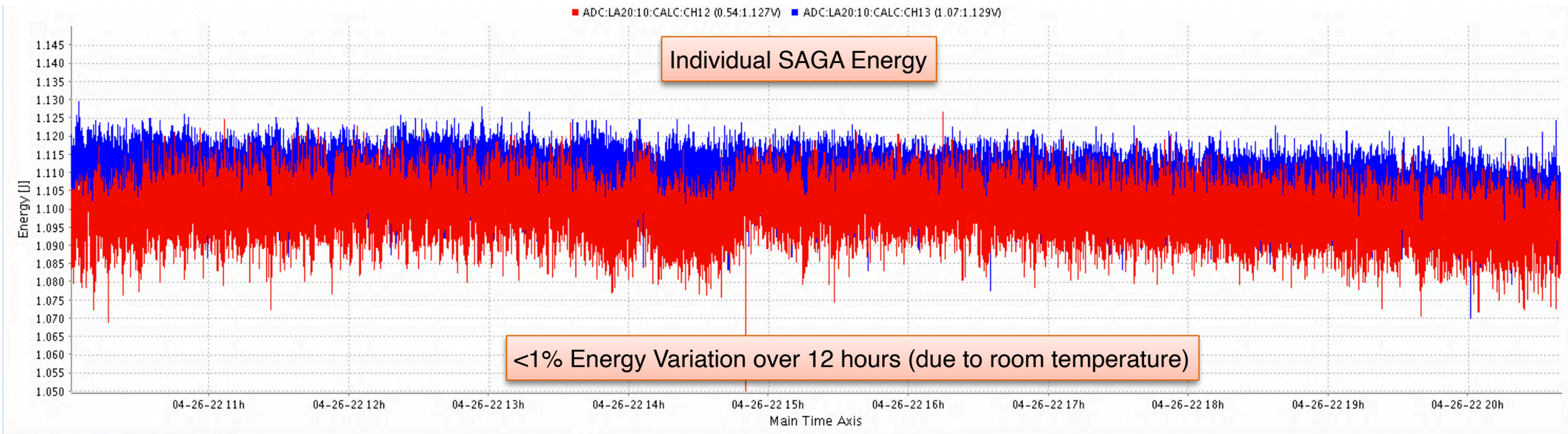
- Replace lenses in transport (+14% energy)
- Get the pulse length down to ~40 fs fwhm
  - Already measured with regen in laser room, recheck with main amp in laser room



Laser performance

- SAGA performance is much improved over FACET
  - Currently at >30 million shots on lamps (30 days of running)
  - 2% rms energy variation
- Focusing hard (f#/2)
  - 2 x 3 um fwhm measured
  - 1.6 um fwhm theoretical best

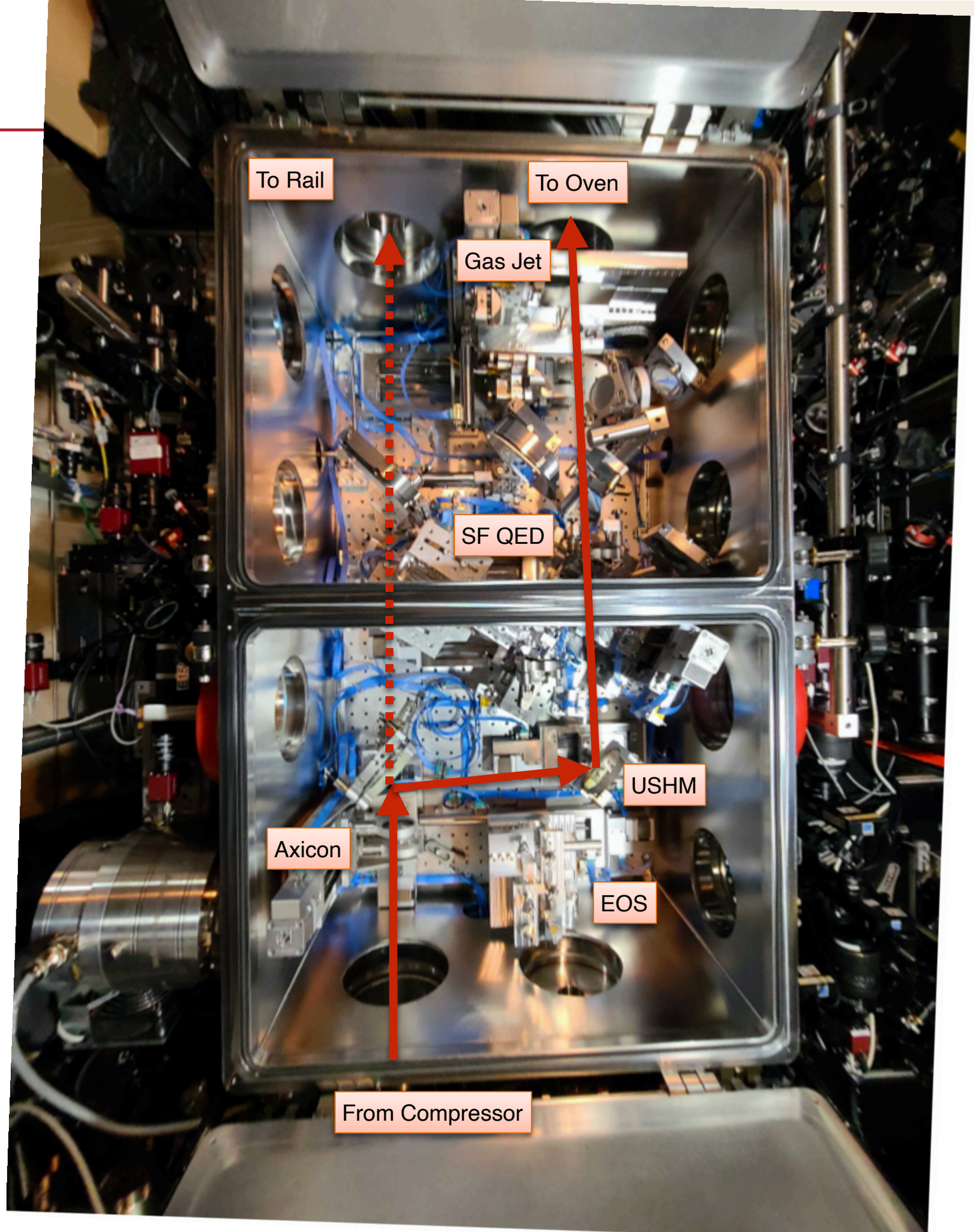




Current and Future Work - Overall laser in good shape

- Pulse length
  - Currently at 55 fs fwhm, targeting 40 fs fwhm
  - LCLS experts are “90% sure” the issue is grating angle tuning
  - Similar experience at MEC
  - Build compressor upstairs - get there first
  - Current timeline has shortest pulse length by end of September 2022 (“Summer down”)
- Energy
  - Replace transport lenses as time allows, probably September 2022
  - What
- Examine stability of laser on long time scale
  - Park the laser downstairs, in run condition and see what happens
- Exercise remote alignment procedure, examine repeatability

Questions?


To Rail
To Oven
Gas Jet
SF QED
USHM
Axicon
EOS
From Compressor