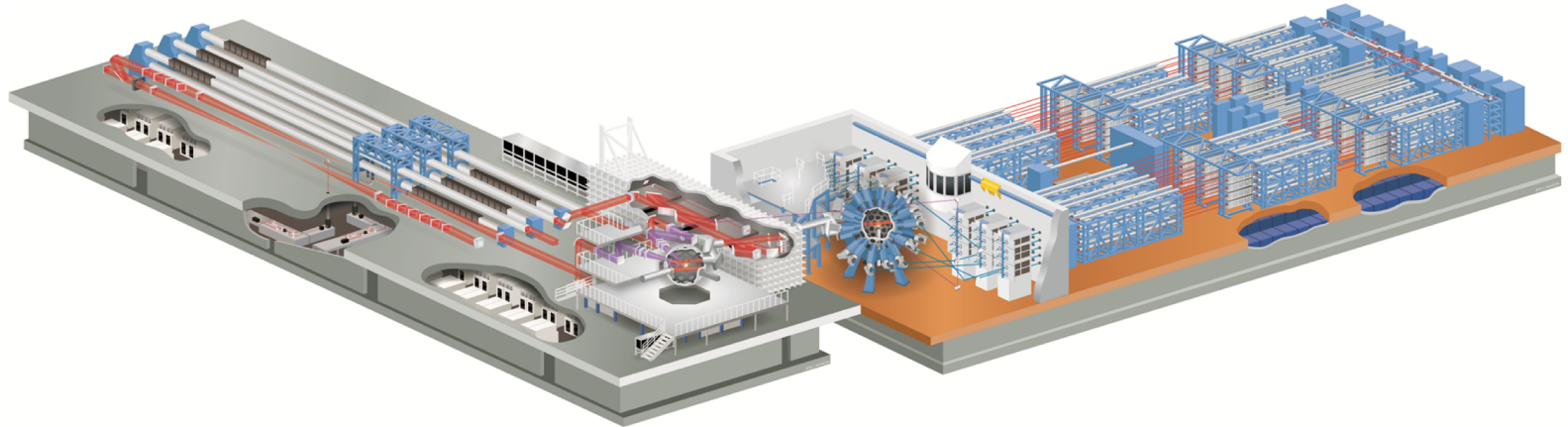


# Status of the FY19 OLUG Findings and Recommendations



**Mingsheng Wei**  
**University of Rochester**  
**Laboratory for Laser Energetics**

**APS DPP OLUG Update**  
**Fort Lauderdale FL**  
**22 October 2019**

## LLE is committed to addressing the needs and concerns of the Users

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- **Progress continues on prior year OLUG Findings and Recommendations (F&Rs)**
- **Plans are in place to address many of the 2019 F&Rs**
- **The call for FY20-21 Omega facility time for “Academic and Industrial Basic Science Experiments” was closed on 4 Oct. and awards will be announced in November**
- **The LaserNetUS Initiative funded by DOE Office of Fusion Energy Sciences (FES) provides 8 OMEGA EP shot days for open-access user experiments in 2019/2020**

# LLE is making progress on a number of the prior year OLUG F&Rs



## ❑ Increase MIFEDS magnetic fields

- MIFEDS Gen 2.x (upgrades) has been successfully implemented in Q4FY19
  - Single unit can generate up to 80 T in mm<sup>3</sup> with Helmholtz configuration
  - Additional coil assembly modifications for further qualification and planned use in three OMEGA experiments in Q1FY20
- MIFEDS Gen 3 is under development – qualification in Q4FY20

## ❑ Make gas-jet targets available on OMEGA and OMEGA EP

- Mach 2 to Mach 8 standard nozzles are available for use
- Qualified gases: Hydrogen, Inert gases (He, N<sub>2</sub>, Ar, Ne, Kr, Xe, CO<sub>2</sub>)
- Demonstrated densities up to  $4 \times 10^{20}$  electrons/cm<sup>3</sup>
- Operation with short-pulse beams was successfully on OMEGA EP in Oct. 2018 (to maximum pressure of 800 psia)
- Use with MIFEDS 2.x was demonstrated recently
- Development of a 1500 psia device is in process
  - Qualification is anticipated Jan. 2020.

## ❑ Upgrades and improvements of the ASBO and SOP diagnostics

- 2X Up magnification (implemented at the back end) for VISAR was completed and is operational
- 2X Down magnification telescope is designed and in procurement
- Other improvements (see slide 9)

Green = complete

Orange = in process

Red = deferred lack of funding

Black = no update or little progress

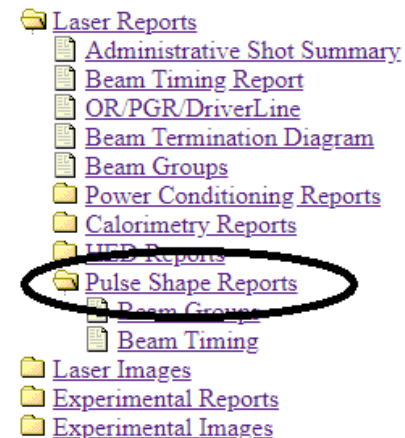
# Plans are in place to address most of the 2019 OLUG F&Rs

## 1. Have the Shot Request Forms “auto-save” the entered text

- Requirements are clear
- LLE owns this item
- Status and path forward:
  - *LLE IT was recently tasked to assess options for implementation*

## 2. Add diagnostic and beams info documentation to PI Portal

- Requirements could use some elaborations
- LLE owns this item
- Status and path forward:
  - *Documentation links are operational*
  - *LLE X-Ops and ESG (Chuck’s group) are specifying redesign of diagnostics page consistent with OLUG request*
  - *Beam groups and beam timing are available (post-shot) in the Pulse Shapes Report*
  - *Accurate beam timing data are in the database and could be extracted with inquires.*



# On-target pulse shapes and timing are available post-shot in Shot Images and Report

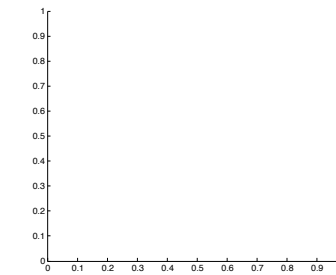
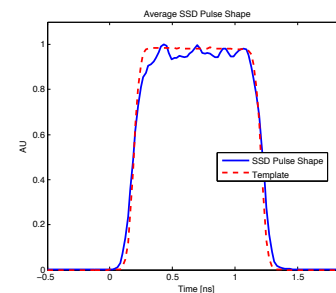
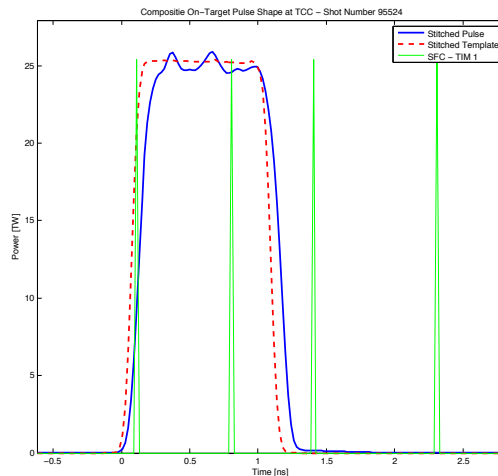
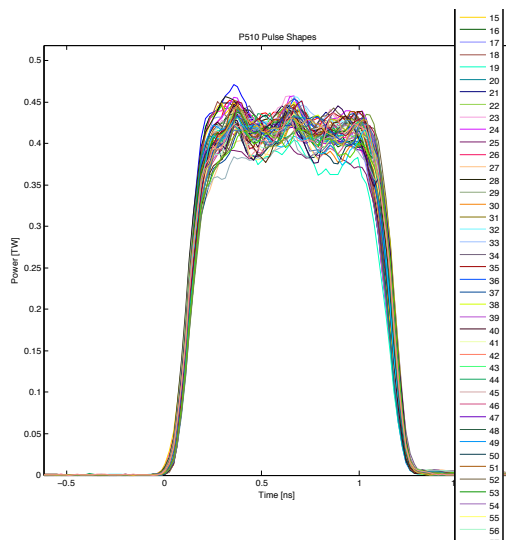


OMEGA Beam Timing Report  
 Shot Number: 95524  
 RID: 75349  
 Shot Date: 2019-10-10 14:32:56  
 Shot Type: Target High Yield  
 SSD Pulse Shape: 5G10v001

BEAM TIMING SUMMARY			
Group	Driver	Req. TO	Meas TO
1	SSD	0.00	0.03

BEAM TIMING DETAIL			
Beam	Driver	Req. TO	Meas TO
10	SSD	0.00	0.02
11	SSD	0.00	0.02
12	SSD	0.00	0.00
13	SSD	0.00	0.01
14	SSD	0.00	-0.00
15	SSD	0.00	-0.00
16	SSD	0.00	0.00
17	SSD	0.00	0.01
18	SSD	0.00	0.01
19	SSD	0.00	0.02
20	SSD	0.00	0.02
21	SSD	0.00	0.02
22	SSD	0.00	0.02
23	SSD	0.00	0.02
24	SSD	0.00	0.02
25	SSD	0.00	0.02
26	SSD	0.00	0.02
27	SSD	0.00	0.02
28	SSD	0.00	0.01
29	SSD	0.00	0.01
30	SSD	0.00	0.04
31	SSD	0.00	0.04
32	SSD	0.00	0.04
33	SSD	0.00	0.04
34	SSD	0.00	0.02
35	SSD	0.00	0.04
36	SSD	0.00	0.04
37	SSD	0.00	0.03
38	SSD	0.00	0.04
39	SSD	0.00	0.04
40	SSD	0.00	0.04
41	SSD	0.00	0.04
42	SSD	0.00	0.04
43	SSD	0.00	0.02
44	SSD	0.00	0.02
45	SSD	0.00	0.03
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47	SSD	0.00	0.02
48	SSD	0.00	0.02
49	SSD	0.00	0.02
50	SSD	0.00	0.04
51	SSD	0.00	0.04
52	SSD	0.00	0.04
53	SSD	0.00	0.04
54	SSD	0.00	0.04
55	SSD	0.00	0.04
56	SSD	0.00	0.03
57	SSD	0.00	0.04
58	SSD	0.00	0.04
59	SSD	0.00	0.04
60	SSD	0.00	0.03
61	SSD	0.00	0.03
62	SSD	0.00	0.03
63	SSD	0.00	0.03

OMEGA On-Target Pulse Shape Summary



# Plans are in place to address most of the 2019 OLUG F&Rs



## 3. Tools for estimating diagnostic signal levels

- Requirements are clear
- PIs own much of this; Instrument PI's and Experiment PI's primarily
- Status and path forward:
  - *This is a big ask, but starting point data requested is doable*
  - *Instrument PI's for "most frequently used" and starting point data (camera threshold, sensitivity)*
  - *PI's sharing back of the envelope calculations at two week/one week briefs would be helpful*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 4. Extended image plate (IP) calibrations at <10 keV and 200 keV - 1 MeV

- Requirements could use collaboration with LLNL and users
- LLE and PIs own
- Status and path forward:
  - < 10 keV possible, need specific requests - priority diagnostics and use cases
    - ongoing IP calibration work led by LLNL team
  - 100 keV – 1 MeV presently not available at LLE; some information published before by others

## 5. Calibrations for spectrometer crystals

- Requirements could use elaboration/priorities (XRS = P1, SXS = P2 ?)
- LLE owns
- Status and path forward:
  - LLE has some data, will make available as diagnostics web page is updated
  - Tritium and Be handling make calibration challenging; MSTs, ARTEP, NIST, and LLE x-ray lab have capability, will work to bring characterization data online in 2020

# Plans are in place to address most of the 2019 OLUG F&Rs

## 6. Increase Dante filter and part availability

- Requirements are clear
- This item may require community/LLNL support
- Status and path forward:
  - *Originally, LLNL would review configurations for survivability and limit the number of shots with debris concerns.*
  - *~1/2 year replacement cycle is likely to remain*
  - *Catalog filters and including in as-shot data file for open source analysis is supportable*

## 7. $\gamma$ -ray spectroscopy for nuclear science at OMEGA, prompt and delayed emission

- Requirements are clear
- PIs own - LLE will partner with spectrometer developers
- Status and path forward:
  - *$\gamma$ -ray spectrometers with sub-MeV resolution from 1-20 MeV desired*
  - *Energies up to 200 MeV is a challenging problem*
  - *Gas debris collection (like RAGS on NIF) would need PI's to lead*



# Plans are in place to address most of the 2019 OLUG F&Rs



## 8. Allow VISAR/SOP capability on TIM14 (opposite to the EP Sidelighter beam)

- Requirements are clear
- LLE owns this item
- Status and path forward:
  - Feasible; LLE designing optical relay system, straightforward, will take time
  - Limitation will be as described in request - no concurrent capability with TIM12

## 9. VISAR/SOP Upgrades/Improvements

- Requirements are mostly clear; SOP calibration could use more specificity (to R. Rygg); Long term improvements need to be aligned with LLNL and NIF plans (NDWG)
- LLE owns this item
- Status and path forward:
  - **Possible source of wiggle being tested this week - see the back-up slides**
  - *Slit view/alignment snapshot into data flow is IT request*
  - *PI portal with space-time distortion calibration info and data - will address with webpage update*
  - *SOP sensitivity calibration - need more definition*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 10. Implement hardware mitigation for early-time radiation artifact on XRFC's

- Requirements are clear
- LLE owns, could use help
- Status and path forward:
  - *There is no room in a TIM to add LLNL "ERASER" capability*
  - *LLE studying R. Benedetti work - could use some help*

## 11. Add CR-39 processing capability at OMEGA

- Requirements clear
- LLE and MIT owns
- Status and path forward:
  - *Capacity has been increased at LLE and maxed out, dedicated staff to support pRad*
  - *A paradigm shift may increase scanning capacity with current workshop - will be partnership with MIT*
    - *LLE to form a working group on how to proceed*

# Plans are in place to address most of the 2019 OLOG F&Rs



## 12. Ensure selectable pieces for SXR match inventory

- Requirements clear
- LLE and LLNL own
- Status and path forward:
  - *Plan is to change from a text box to drop down list*
  - *Is SXR ripe for re-engineering? (LLNL?)*

## 13. Add charged-particle signal mitigation to multiple diagnostics

- Requirements clear – list of diagnostics would be helpful
- LLE and LLNL owns (HERIE diagnostic frequently employed)
- Status and path forward:
  - *Would likely be a new spectrometer (not modified XRS)*
  - *Specify other x-ray diagnostics for consideration*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 14. Modify EPPS to measure higher energy electrons ( $E_{\max} \sim \text{GeV}$ )

- Requirements clear
- LLNL owns (LLE can't modify EPPS - LLNL would need to do this)
- Status and path forward:
  - *LLE will engage LLNL on this item (N. Lemos PI)*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 15. Add a SLOS for multi-frame single pinhole imaging

- Requirements clear
- LLE owns, *or user driven*, \$0.5 million per camera!
- Status and path forward:
  - *UXI sensors are not readily available*
  - *SNL/Z foundry Export Admin Regs. - not ITAR- but close*
  - *LLE willing to work with PI's that have access to the technology - NDWG?*

## 16. Improve framing-camera pointing procedures for x-ray imaging

- Requirements clear
- LLE owns
- Status and path forward:
  - *An internal FY20 project to improve initial pointing accuracy is under consideration*

# Plans are in place to address most of the 2019 OLUG F&Rs

## 17. Thomson scattering on DT shots for compatibility with DT3He backlighter

- Requirements clear
- LLE owns
- Status and path forward:

➤ *Done!*

## 18. Second and/or third Thomson Parabola Ion Energy analyzer (TPIE)

- Requirements- identical TPIE or expanded capability?
- LLE, LANL, LLNL, and MIT own
- Status and path forward:
  - *Possibly build a second TPIE (?)*
  - *Can LLNL provide resources? LLE can support operation of more TPIE's*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 19. Request to implement a more sensitive nTOF detector for secondary DT-n measurements

- Requirements clear
- LLE owns
- Status and path forward:
  - *LLE has a preliminary analysis of the requirements for the detector*
  - *An internal FY20 project is under consideration, relatively small engineering effort*

## 20. Investigate upgrades to fixed x-ray pinhole cameras (XRPHCs)

- Requirements clear
- LLE owns
- Status and path forward:
  - *Can use IP instead of CID (at reduced resolution)*
  - *Cannot change filtration or reduce Be - the blast shield is 5/6 of attenuation - can't go thinner for fixed XRPHCs (there may be some options for modifying TIM-based XRPHCs)*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 21a. Thomson Scattering capability on OMEGA EP (feasibility study)

- Requirements clear
- LLE owns
- Status and path forward:
  - *Recommend the PI's talk with D. Froula about specific requirements*
  - *Likely multi-year project, but can take advantage of generations of instruments developed on OMEGA*

## 21b. Stray light mitigation for Thomson EPW spectrometer

- Requirements clear
- LLE owns
- Status and path forward:
  - *Narrower notch filter for EPW (1nm) under consideration (LLE ESG)*



# Plans are in place to address several of the 2019 OLUG F&Rs



## 22. Tritium gas fill capability into a warm spherical capsule

- Requirements clear
- LLE owns
- Status and path forward:
  - *Routinely do T<sup>3</sup>He*
  - *Could eventually provide DT and HT fill from pre-mix bottles*
  - *LLE to consider options and report at 2020 OLUG*

## 23. Special gas fills using variable fuel mixture, with or without tritium

- Requirements clear
- LLE and LLNL owns
- Status and path forward:
  - *LLE limited in capacity and DT inventory is constrained by NY-DOH regulations, and ratio of D:T is what is required for the OMEGA cryo program*
  - *LLNL may add a second tritium facility outside the superblock*

# Plans are in place to address several of the 2019 OLUG F&Rs



## 24. Planar Cryo system for EP

- Requirements clear
- LLE owns
- Status and path forward:
  - *An FY19 engineering effort was conducted, CDR completed*
  - *An internal FY20 project has been prepared and partially funded - will update status at 2020 OLUG*

# Plans are in place to address several of the 2019 OLUG F&Rs



## 25. Extend individual beam delay capabilities by a fixed amount

- Requirements clear
- LLE owns (with LANL support!)
- Status and path forward:
  - *LLE Opto-Mechanical group is assessing the request and will communicate with LANL PI's*

## 26. OMEGA: Any beam, any delay (or at least a 3<sup>rd</sup> leg)

- Requirements clear
- LLE owns
- Status and path forward:
  - *Any beam – any delay is not possible on OMEGA*
  - *Long delays between Drive and BL are possible - how much delay do users want?*
  - *LLE continues to evaluate options for three legs, will report on this at 2020 OLUG*
  - *OMEGA EP TOP9 beam path is now another UV source in OMEGA(one beam) at up to 500J, and could be up to 10ns in pulse length*

# Plans are in place to address most of the 2019 OLUG F&Rs

## 27. Longer duration OMEGA EP UV (and IR?) beams

- Requirements need a little more definition
- LLE owns
- Status and path forward:
  - *LLE is working on Extra-long pulse regen oscillators - will update at 2020 OLUG*

## 28. Opposing OMEGA EP UV beams

- Requirements clear
- LLE owns
- Status and path forward:
  - *Funding required vs capability, will continue to look for economical ways to do this project and will maintain ports and beam path areas clear, needs ~\$2 million*

# Plans are in place to address most of the 2019 OLUG F&Rs



## 29. A UV probe, ~ 50-150 nm, using high harmonic generation (feasibility study)

- Requirements clear
- U. Michigan owns
- Status and path forward:
  - *Might be a good fit for development with OPAL*
  - *More requirements and ideas to develop the capability are welcome*

## 30. Calibrate and cross calibrate charged-particle diagnostics routinely used on OMEGA

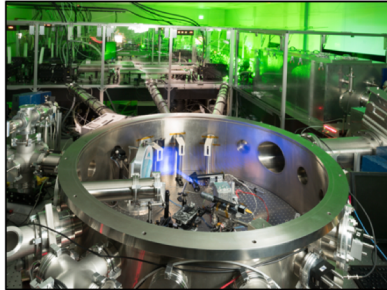
- Requirements need definition and procedures
- LLE and MIT own
- Status and path forward:
  - *LLE willing to work with OLUG on this item - need more definition of exact requirements*

# LLE issued a special call for Academic and Industrial Basic Science (AIBS) experiments at the Omega Laser Facility in FY20-21

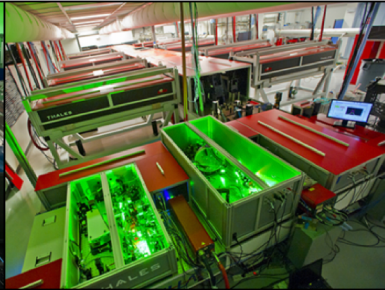


- **NNSA made 11 grant awards from the last NLUF call with Omega shots in FY20-21**
  - Used ~2/3 of the notional NLUF facility time allocation
- **The AIBS call is intended to continue to support basic science experiments led by academic and industrial users and facilitate graduate students education and training**
  - About 10 shot days each year in FY20 and FY21 are available for the AIBS program
- **11 proposals submitted to this program are currently under merit review**
- **Beam time awards will be made in November with experiments starting in Feb 2020**

# The LaserNetUS Initiative brings together the high-intensity laser science community in the U.S. and enables a broad range of frontier scientific research



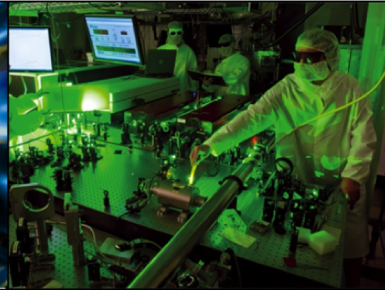
Colorado State University  
Advanced Beam Laboratory: Petawatt Laser



Lawrence Berkeley National Laboratory  
Berkeley Lab Laser Accelerator (BELLA) Center



Lawrence Livermore National Laboratory  
Jupiter Laser Facility



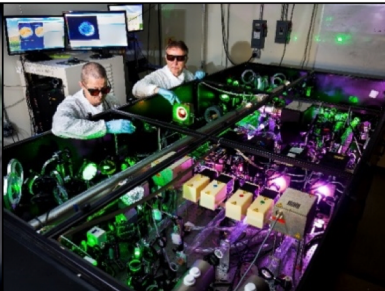
Ohio State University  
Scarlet Laser Facility

ALLS (Canada)  
joining now

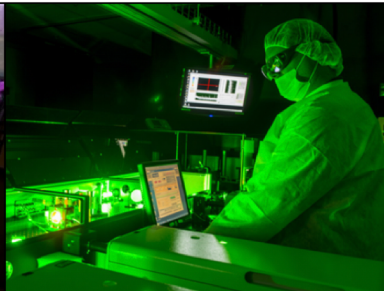
European discussion  
in progress



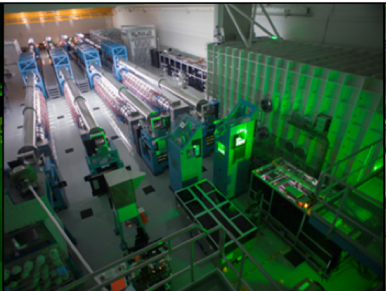
SLAC National Accelerator Laboratory  
Matter in Extreme Conditions (MEC) Laser Facility



University of Michigan  
Center for Ultrafast Optical Science: HERCULES



University of Nebraska - Lincoln  
Extreme Light Laboratory



University of Rochester  
Laboratory for Laser Energetics: OMEGA EP



University of Texas - Austin  
Center for High Energy Density Science:  
Texas Petawatt Laser

- US Department of Energy research network funded by the Office of Fusion Energy Sciences (FES) to give US scientists access to intense laser sources
  - Currently funds operations and/or upgrades of 9 facilities – 6 Universities and 3 National Laboratories

<https://www.lasernetus.org>



**LaserNetUS**

Facilities - Facilities Access Proposal Submissions Events - Annual Meetings Contact

# LLE is committed to addressing the needs and concerns of the Users and providing continued support of basic science and user community growth



- **Progress continues on prior year OLUG Findings and Recommendations (F&Rs)**
- **Plans are in place to address many of the 2019 F&Rs**
- **The call for FY20-21 Omega facility time was closed on 4 Oct. and awards will be announced in November for “Academic and Industrial Basic Science Experiments”**
- **The LaserNetUS Initiative funded by DOE Office of Fusion Energy Sciences(FES) provides 8 OMEGA EP shot days for open-access user experiments in 2019/2020**

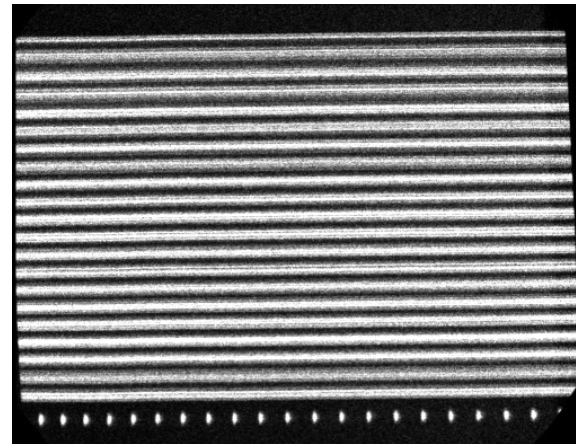
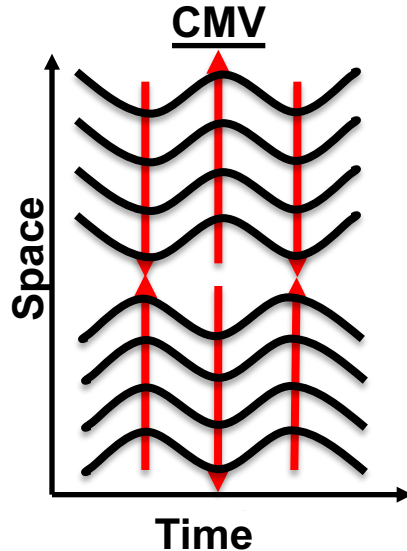


## Extra slides

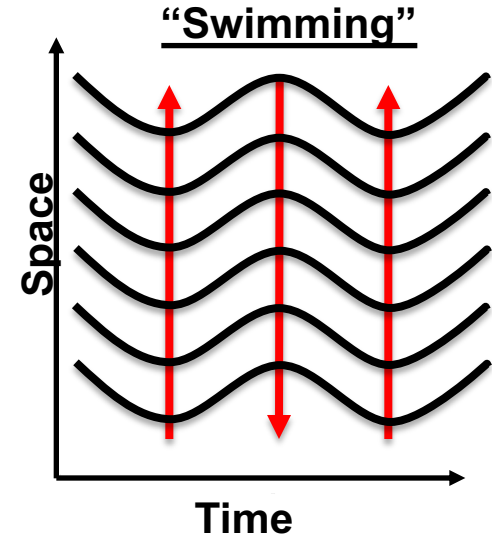
# Unusual Spatial Oscillations have been observed on ROSS based diagnostics on the EP laser system

Oscillations are different from normal common mode voltage (CMV) oscillations.

- Common Mode Voltage (CMV) is a magnification change that causes the image to either expand or contract from a centrally located position on the detector. This distortion is a well understood issue related to ramp drivers.
- EP Spatial Oscillations appear to “swim” up and down consistently across the entire image.

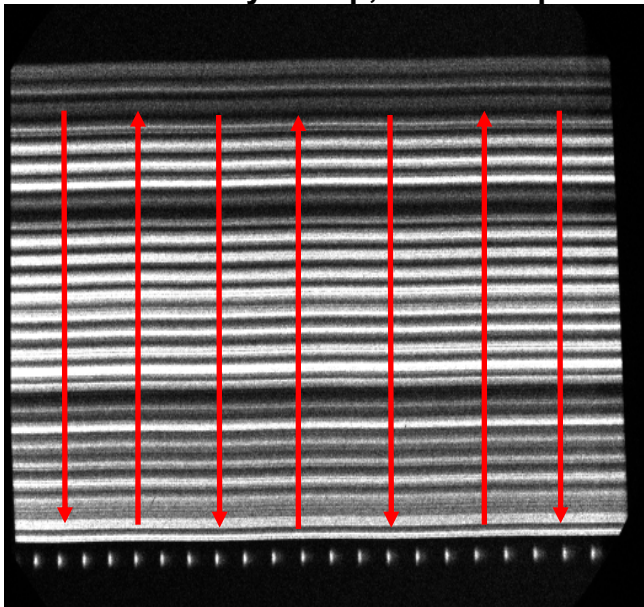


Normal VISAR streak

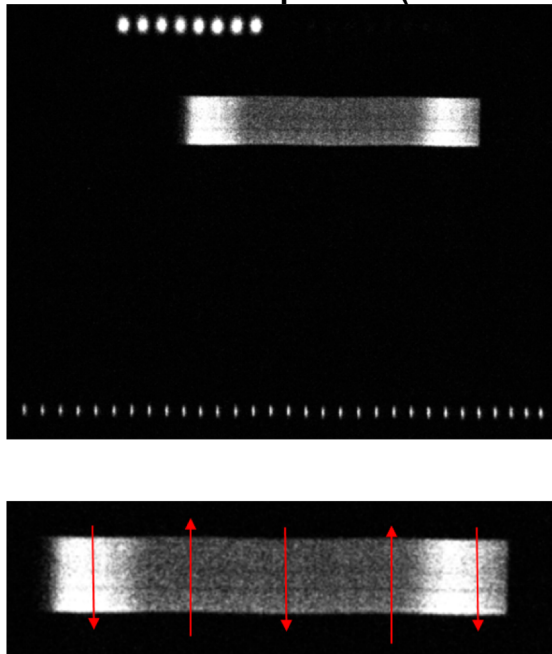


## EP VISAR ROSS cameras commonly display a swimming motion on the fringes during shot day set-up, as do UV ROSS cameras

VISAR 1 Shot day set-up, 9 ns sweep



UV ROSS on 10 Sept 2019 (with zoom in region)



The "swimming" motion extends across the entire image and can be seen in both the signal and fiducial comb

## Spatial oscillations, tolerable on certain diagnostics, are particularly problematic on VISAR where spatial changes are critical to the primary measurement.



- **Observations:**
  - - The UV ROSS and VISAR cameras are both near the North side of the EP Bay (UV ROSS is in the 5000 bay and the VISAR cameras are along the North wall of the Target Bay)
  - - The spatial swimming oscillation appears to have a frequency of ~2GHz
  - - Certain sweep speeds make the oscillations more apparent while other speeds tend to mask the oscillations.
  - - The ROSS cameras contain a 2GHz comb generator but we have tested with this comb powered on and off and they do not appear to be correlated to the oscillations
  - - Different ramp drivers were tested and both yielded the same results with oscillations
  - - The oscillations sometimes seem to be less noticeable or even non-existent on maintenance days, however this has not been rigorously tested yet.