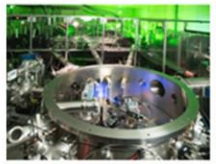
LaserNetUS: North America's First High Intensity Laser Research Network

Kramer U. Akli
HEDLP & QIS Program Manager
Fusion Energy Sciences,
DOE Office of Science

U.S. DEPARTMENT OF ENERGY
Office of Science

Fusion Power Associates Annual Meeting
December 15-16, 2021

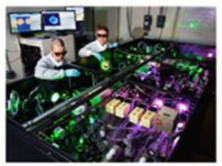

Advanced Beam Laboratory


Berkeley Lab Laser Accelerator (BELLA) Center


Jupiter Laser Facility


Scarlet Laser Facility


Matter in Extreme Conditions


Center for Ultrafast Optical Science: HERCULES


Extreme Light Laboratory


Laboratory for Laser Energetics: OMEGA EP


Center for High Energy Density Science: Texas Petawatt Laser


Advanced Laser Light Source (ALLS

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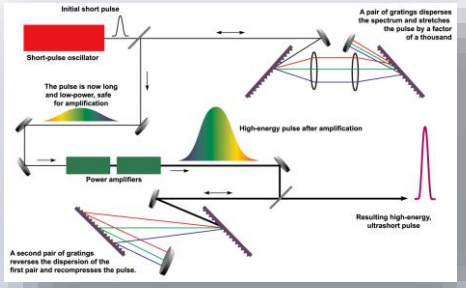
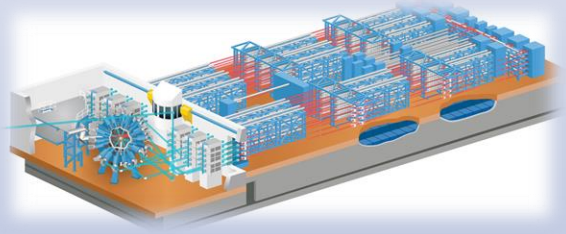
High Power and High Intensity Lasers are used to create and study HED Plasmas

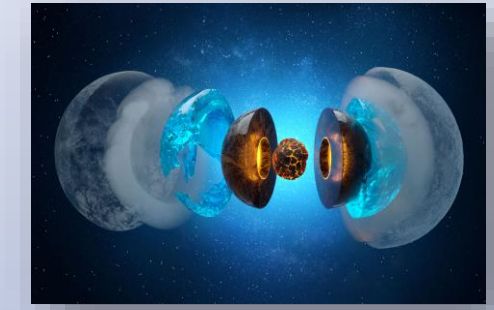
Three types of lasers

1. **Short Pulse High Intensity**

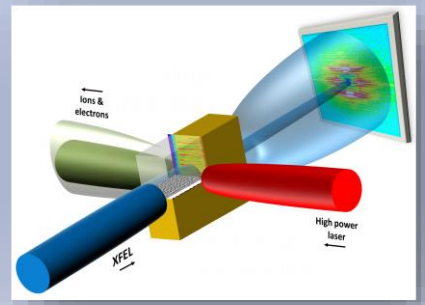


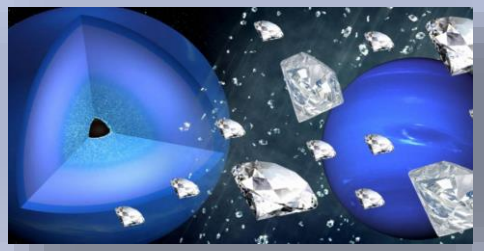


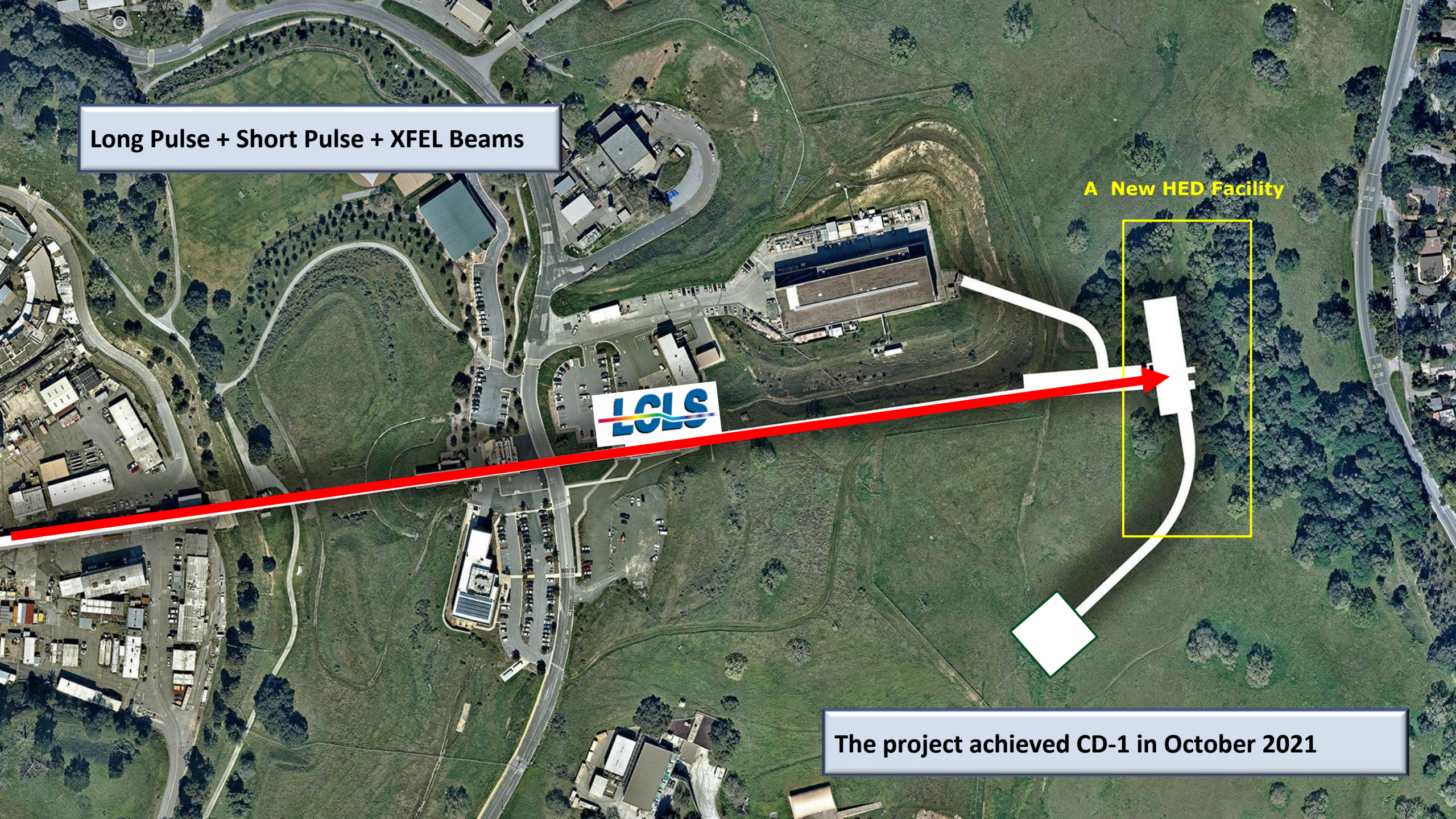
2. **Long Pulse High Energy**

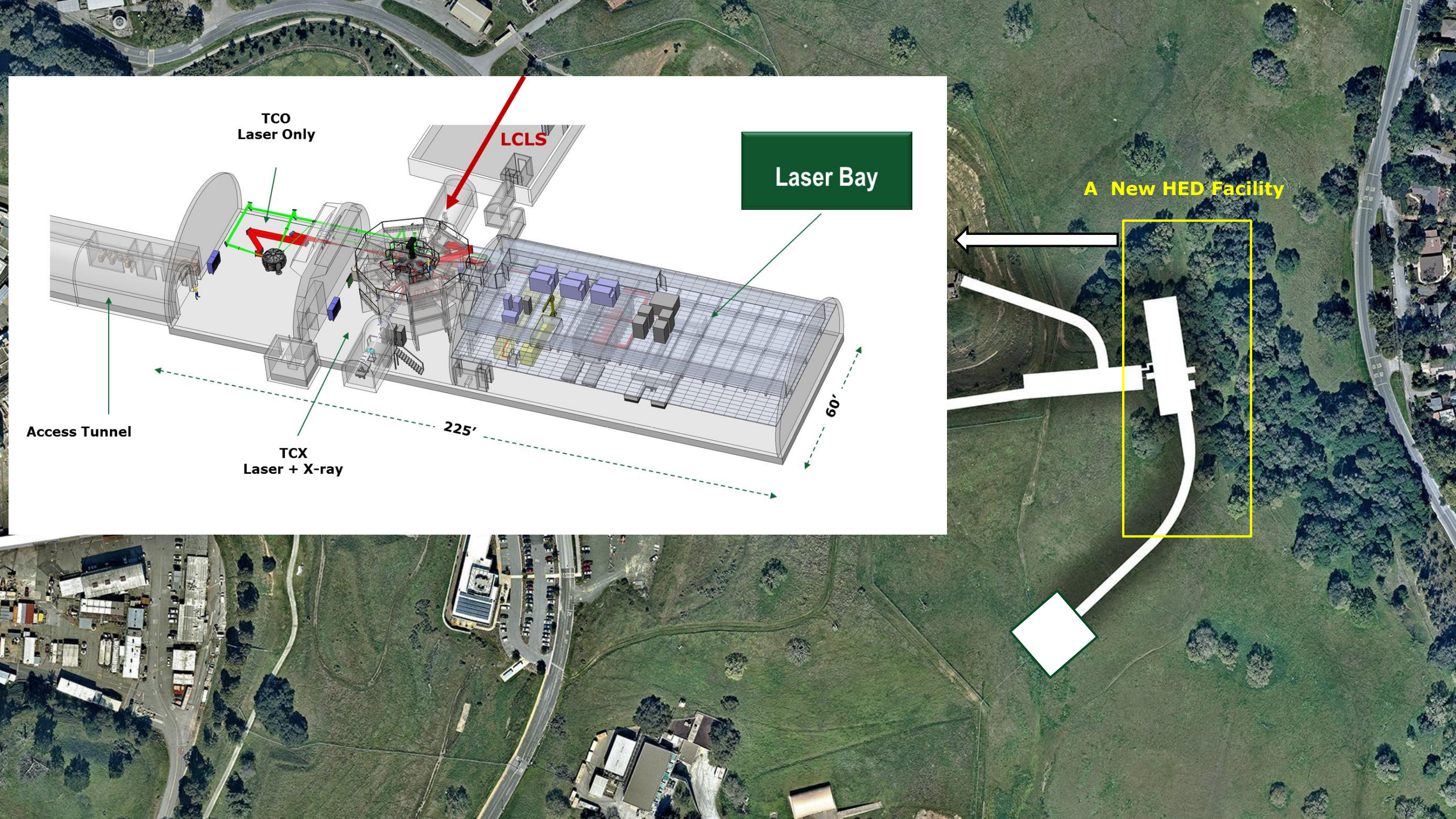


3. **X-Ray Free-Electron Laser**






Long Pulse + Short Pulse + XFEL Beams
A New HED Facility
LCLS
The project achieved CD-1 in October 2021


TCO
Laser Only
LCLS
Laser Bay
A New HED Facility
Access Tunnel
TCX
Laser + X-ray
225′
60′

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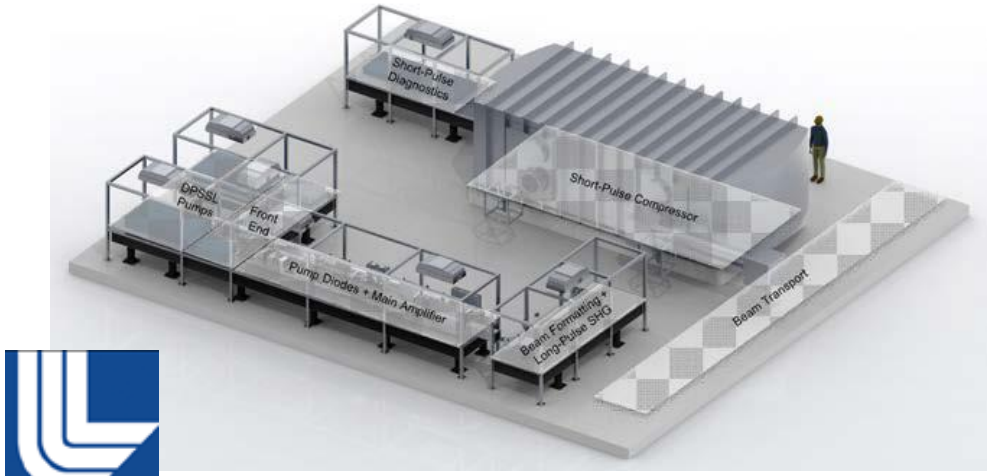
SLAC, LLNL and LLE are partnering to build the laser systems

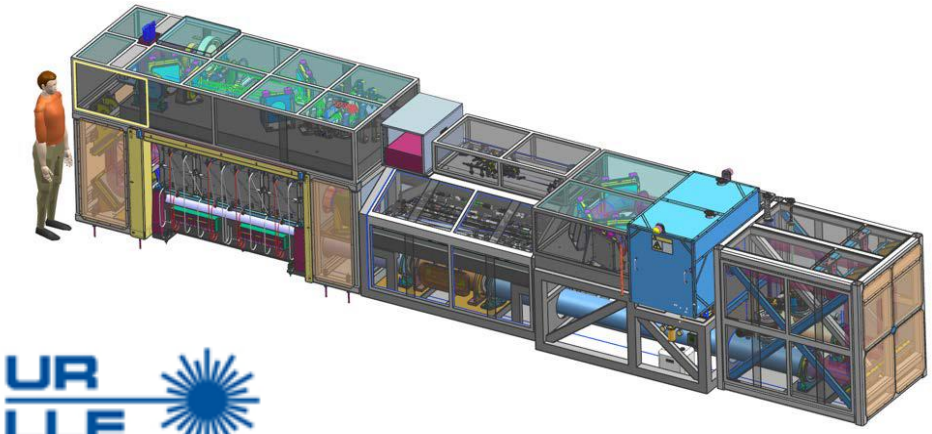
High Repetition rate (HRR) Laser

- **HRR petawatt laser: 1 PW, 10 Hz, 150J, 150 fs**
  - Upgradable to up to 2 PW.
- HRR long pulse laser: 200J, 20 ns, 10 Hz, 0.527 µm



High Energy Laser

- **High energy long-pulse laser: 1 kJ, 20 ns pulse-shaped, 0.527 µm**
- Upgradable to up to 5 kJ



UR LLE

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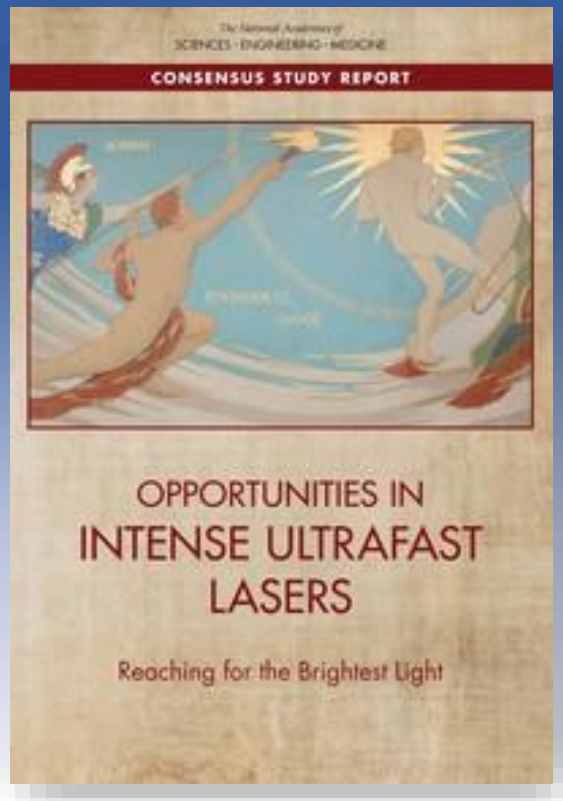
Opportunities in Intense Ultrafast Lasers "Reaching for the Brightest Light"



Sponsored by :
DOE-SC, DOE-NNSA, AFOSR, and ONR

Recommendations

1. **DOE should** create a broad **national network (universities, industry, government labs)** in coordination with OSTP, DOD, NSF, and others.
2. US research agencies should engage stakeholders to **define facilities and laser parameters** that will best serve research needs.
3. **DOE should** lead development of **an interagency national strategy** for developing and operating large- and mid-scale projects and developing technology.
4. **DOE should** plan **for at least one large-scale open-access, high-intensity laser facility** that leverages other major science infrastructure in the DOE complex.
5. Agencies should create U.S. programs that **include mid-scale infrastructure, project operations, development of technologies; and engagement in research at international facilities such as ELI.**

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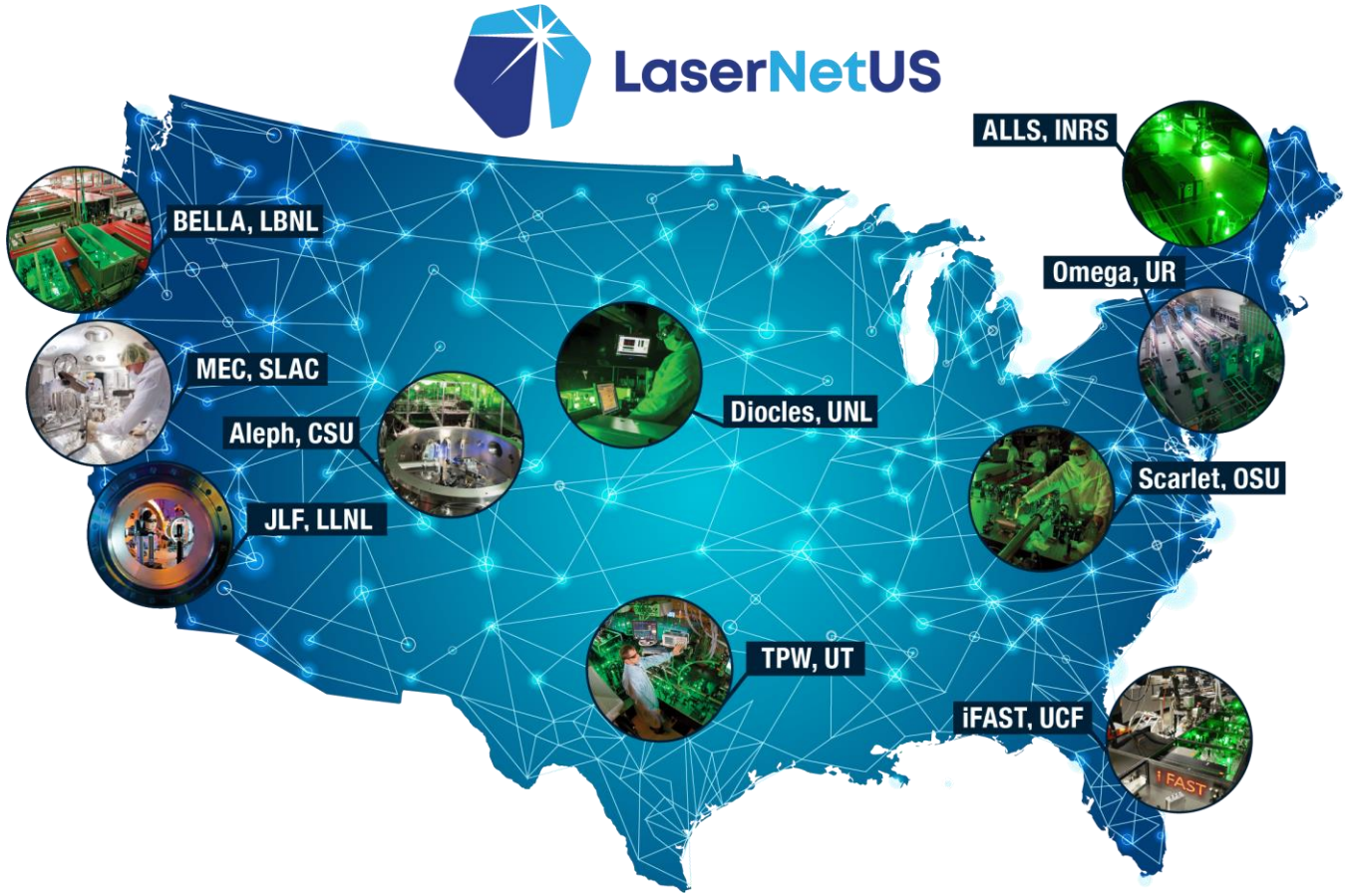
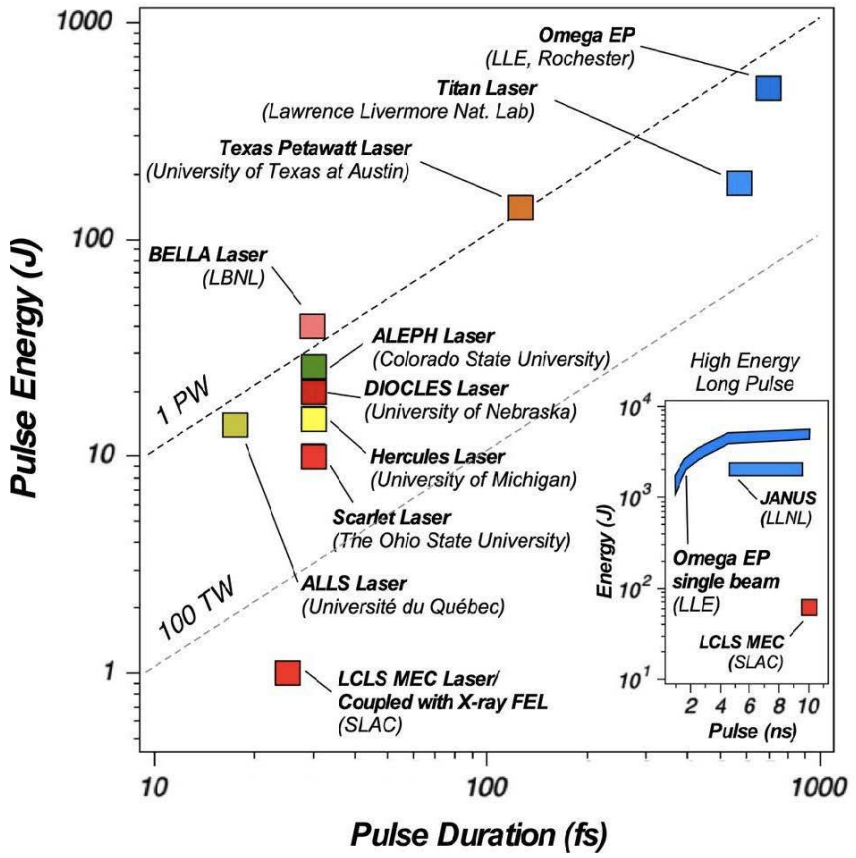
LaserNetUS was established August 20th, 2018



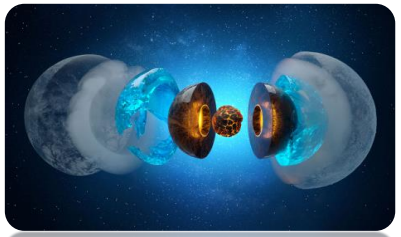
BERKELEY LAB
UR LLE
SLAC NATIONAL ACCELERATOR LABORATORY
UCF UNIVERSITY OF CENTRAL FLORIDA
Lawrence Livermore National Laboratory
TEXAS The University of Texas at Austin
COLORADO STATE UNIVERSITY
University of Nebraska Lincoln
INRS Institut national de la recherche scientifique
The Ohio State University

Dedicated to the proposition that ALL research groups should have access to the brightest light

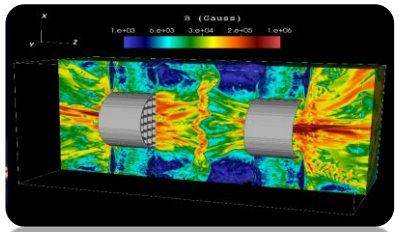
Network creates capabilities for science & applications



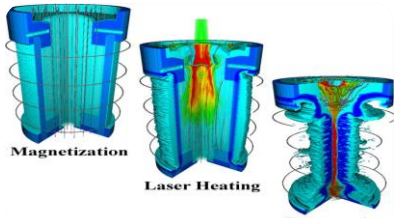
Astrophysics & Planetary Science



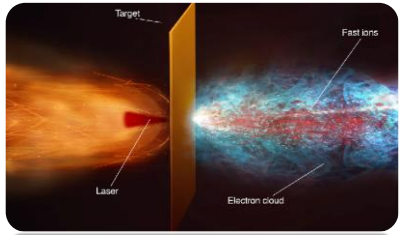
Hydrodynamics



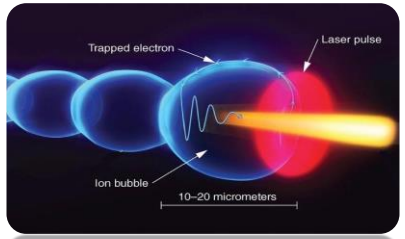
Magnetized Plasmas



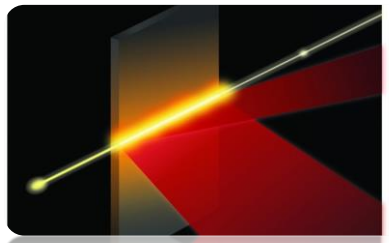
Ion acceleration and Neutron sources



Electron acceleration and Photon sources



Plasma Photonics



The physics enabled by high power lasers is central to FES and HEDS, but also to a broad range of disciplines and to societally relevant applications

USERS

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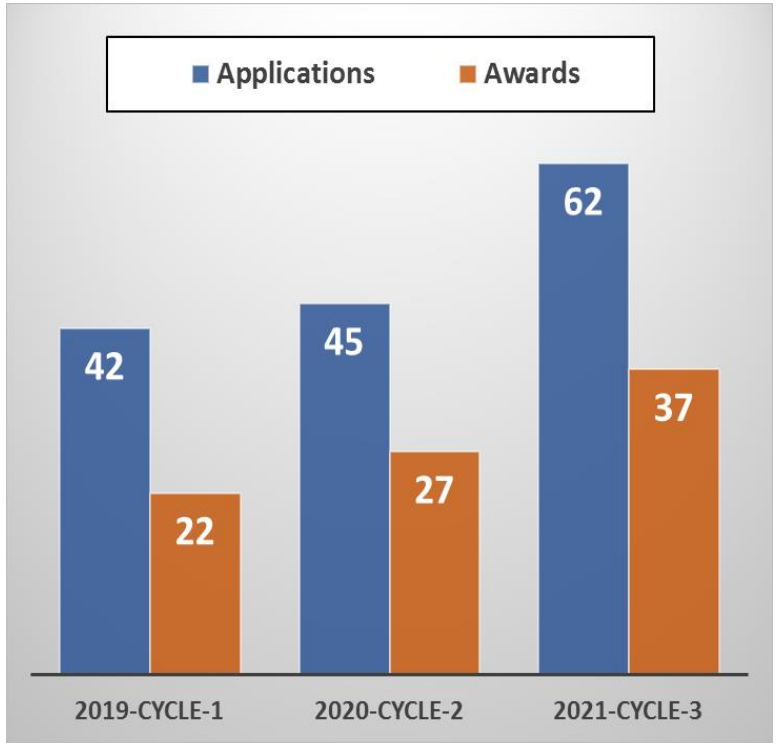
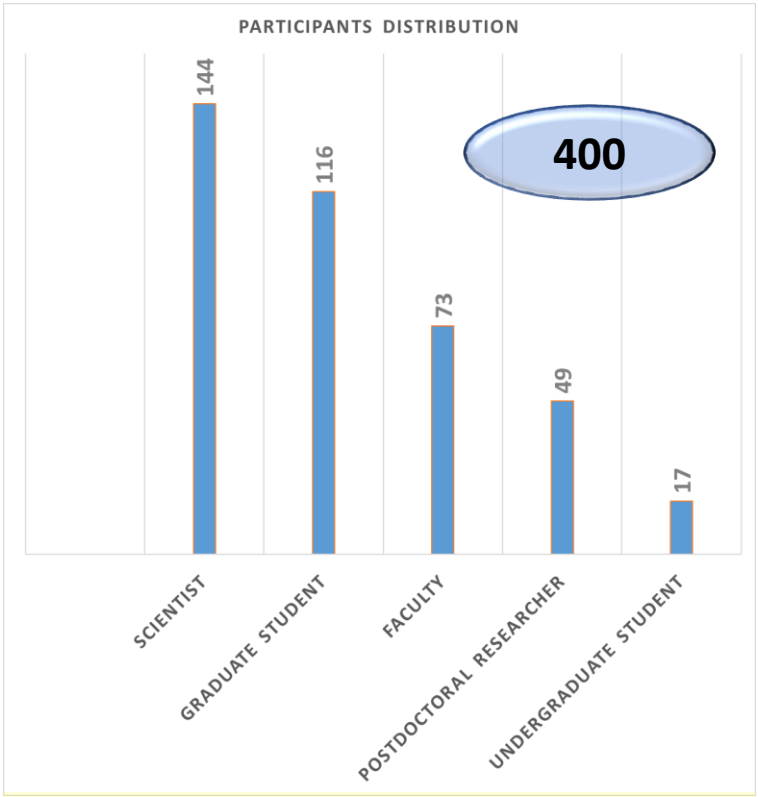
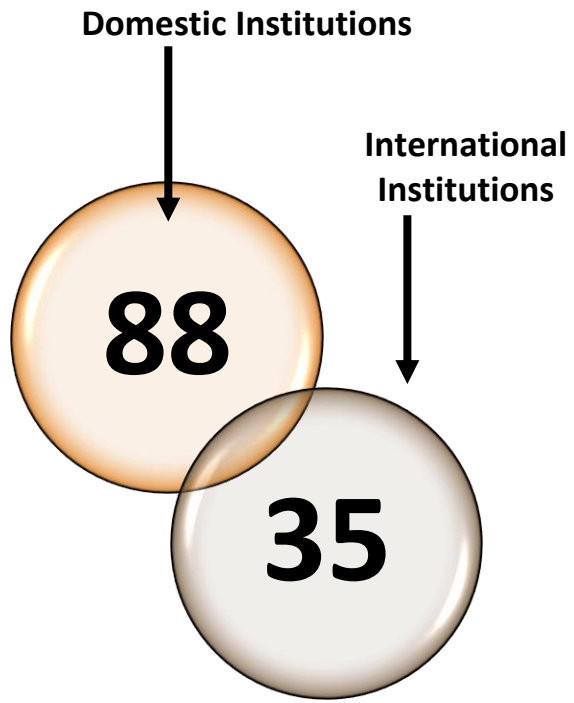
LaserNetUS by the numbers





90 graduate students from U.S. and Canada



Total # of institutions: 123

10 facilities

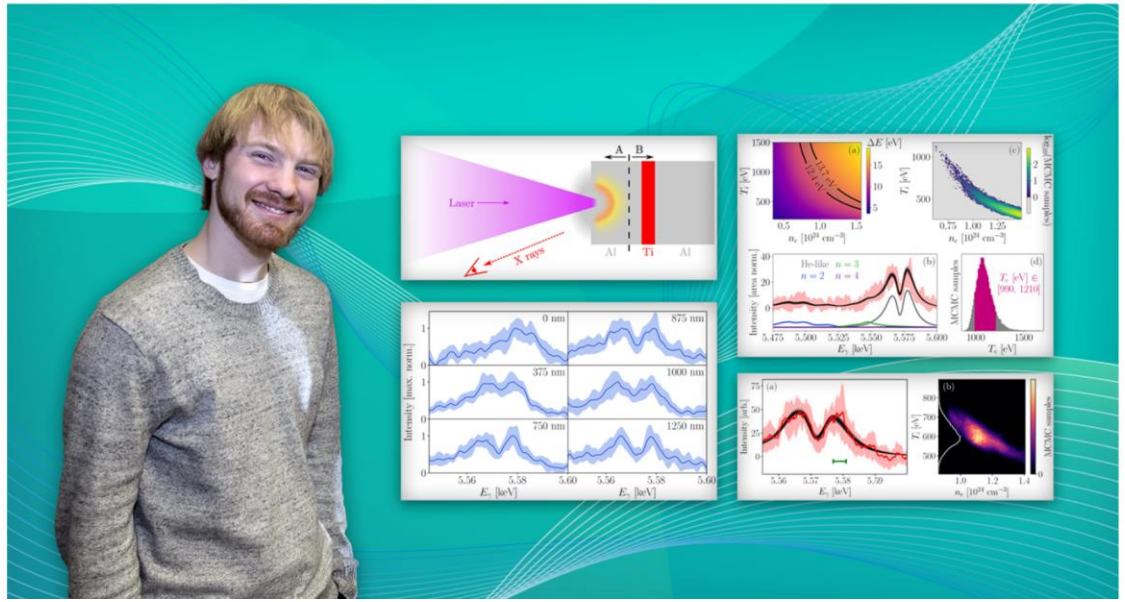
50 experiments performed

912 members

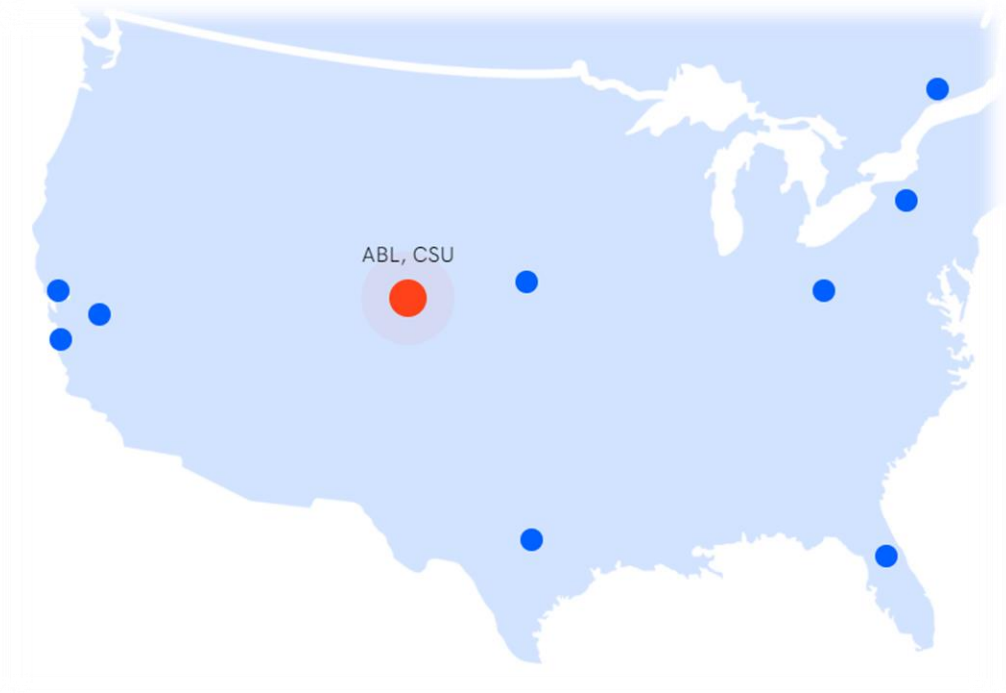
LaserNetUS encourages students to submit proposals

PPPL scientists create insight into perhaps the most extreme state of matter produced on Earth

Nov 23, 2021. News

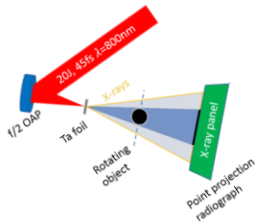


Experiments were conducted at CSU



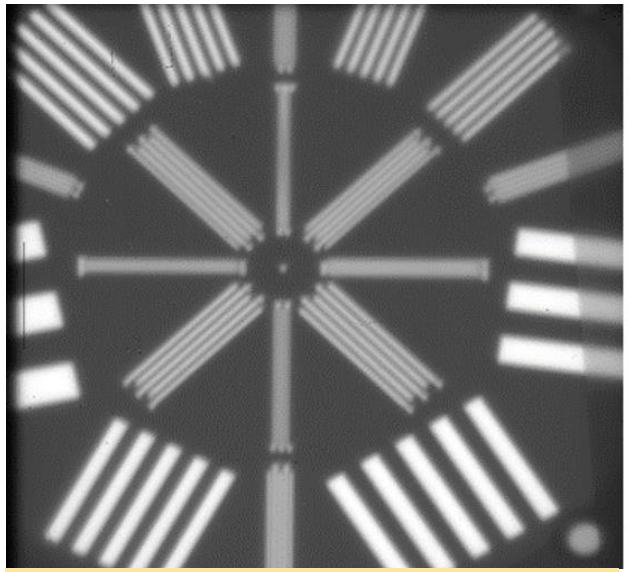
Solid-Density Ion Temperature from Redshifted and Double-Peaked Stark Line Shapes
B. F. Kraus et al., Phys. Rev. Lett. 127, 205001 (2021).

Tomographic imaging with an intense laser-driven gamma-ray source

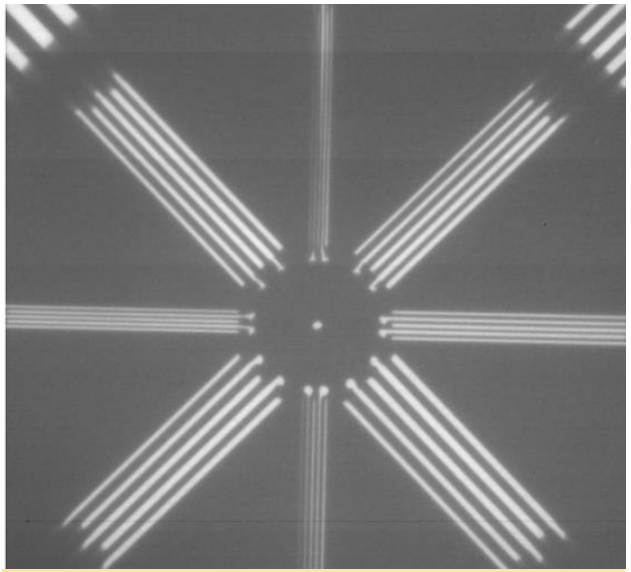


- Higher resolution, directional source improves imaging
- High-value industrial applications, e.g. aerospace
- Global security: detect hidden nuclear material

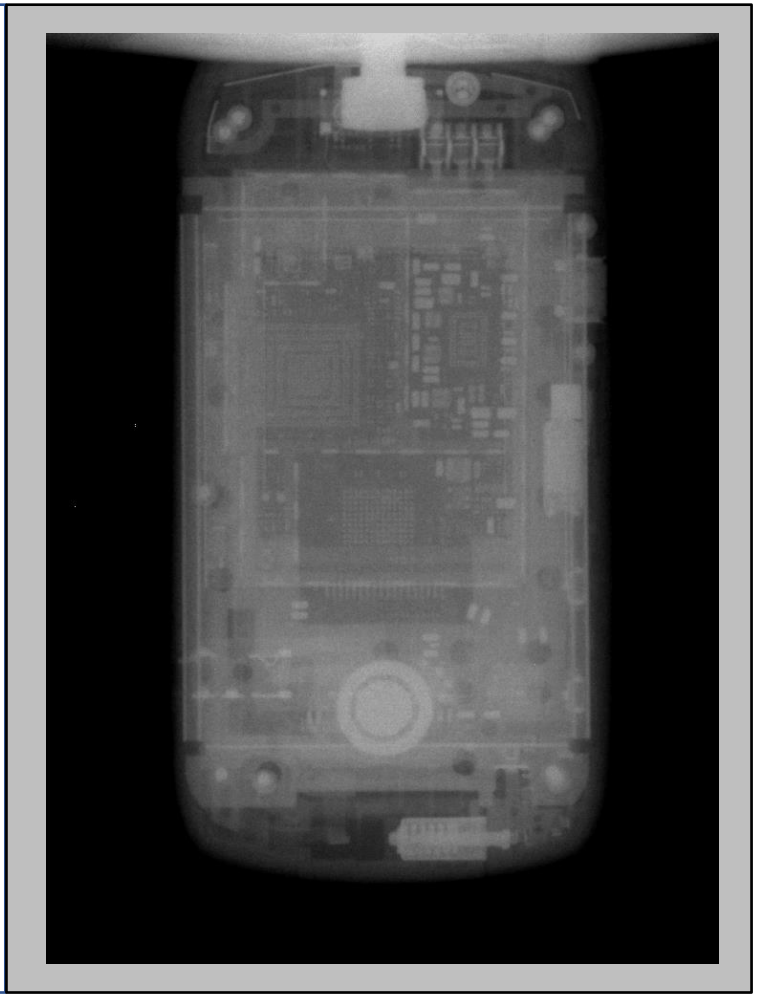
Los Alamos NATIONAL LABORATORY EST. 1943



Microtron 4x mag 15 MeV



CSU Laser 10 J, 50 fs, 5x mag



ABL Facility

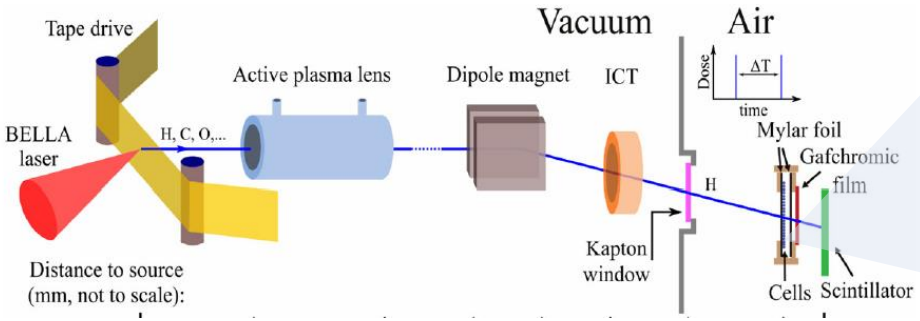
Evaluating the radiobiological effects of laser-accelerated protons

Evaluating the radiobiological effects of laser-accelerated protons

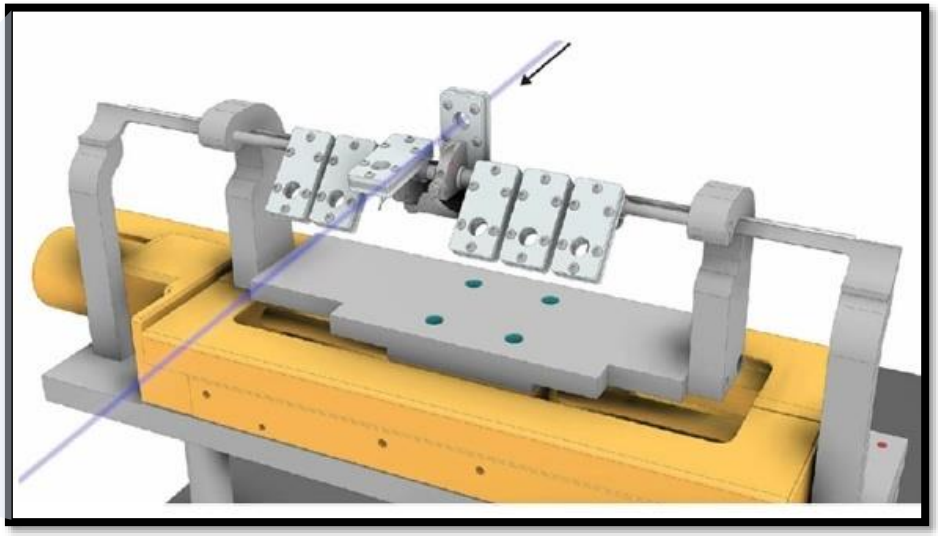
UCSF University of California San Francisco

BERKELEY LAB BioSciences

BELLA Laser



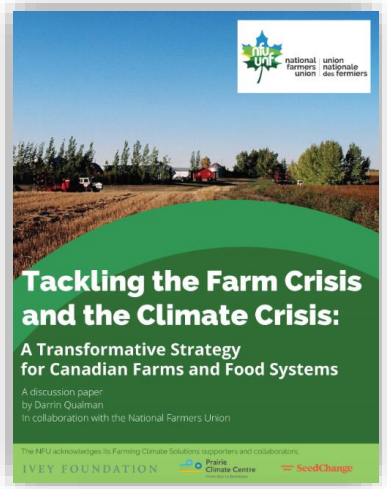
Cell culture assembly

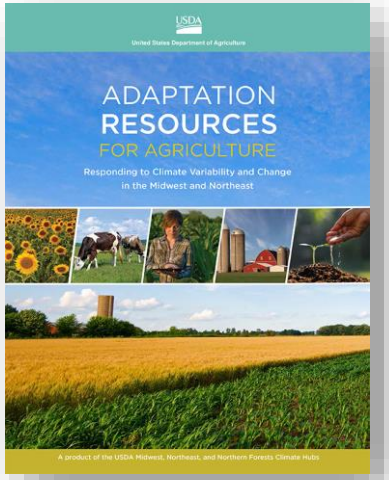


- **Investigate the FLASH effect for improved radiotherapy using laser accelerated protons.**
- **Ultra-high dose rates in in vitro cultures of normal human prostate cells and tumor derived cells studies.**

Dynamics of mineral nutrient distribution at the cellular to whole-plant levels

Dynamics of mineral nutrient distribution and homeostasis, at the cellular to whole-plant levels

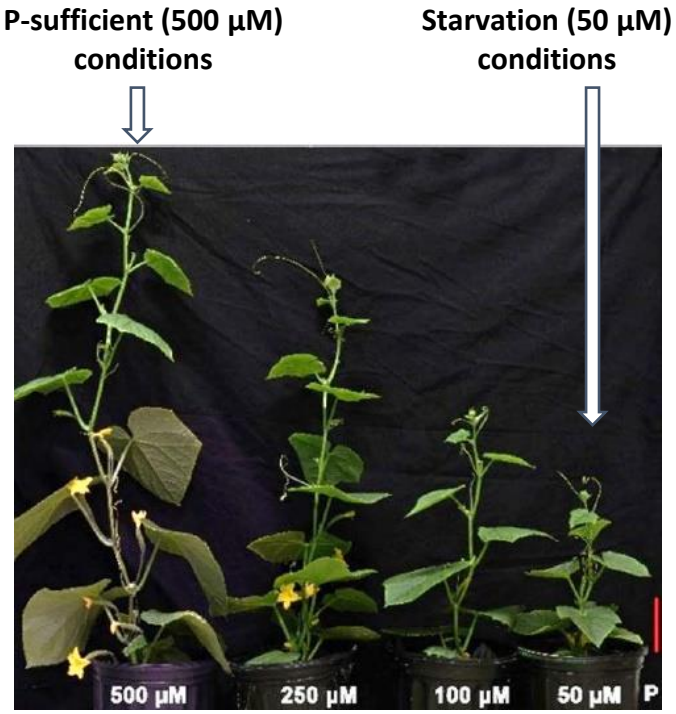




GIFS | GLOBAL INSTITUTE FOR FOOD SECURITY
Growing science for life
Nutrien - a Founding Partner

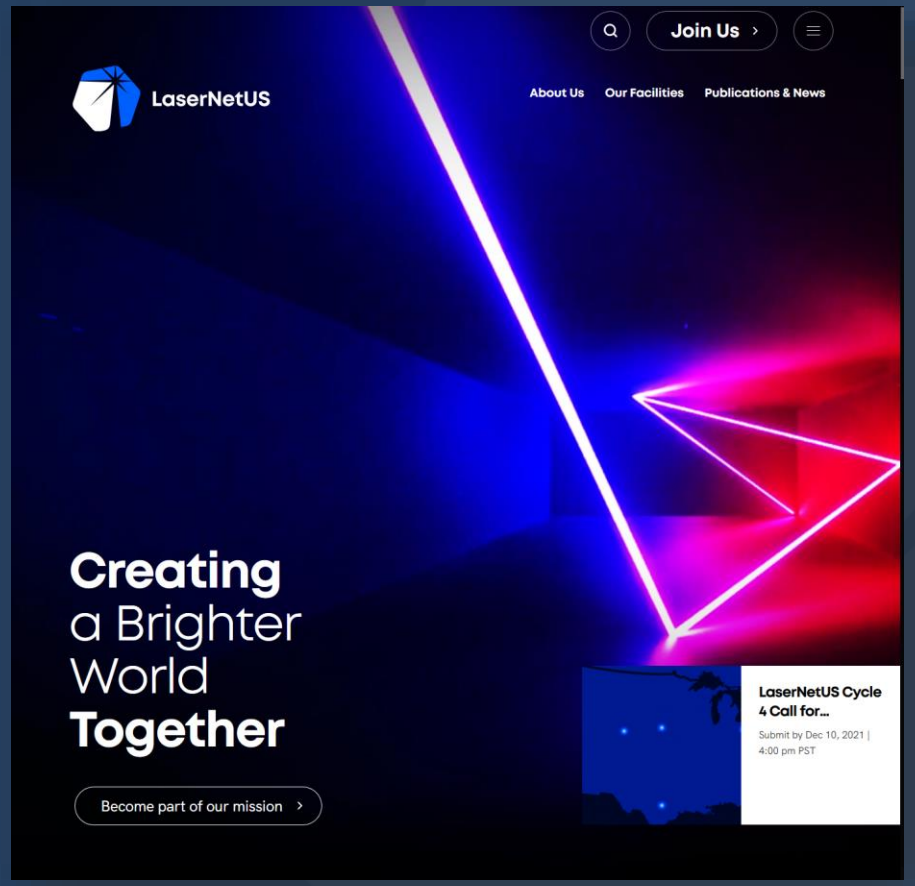
- Crop productivity and resiliency rely on the acquisition and distribution of mineral nutrients to both plant vegetative and reproductive organs
- The overall goal of this research is to establish the real-time changes in the translocation and distribution of mineral nutrient elements, at the cellular to whole-plant levels, under nutrient-limited conditions.
- X-ray absorption (XRA) platform based on laser Wakefield acceleration.

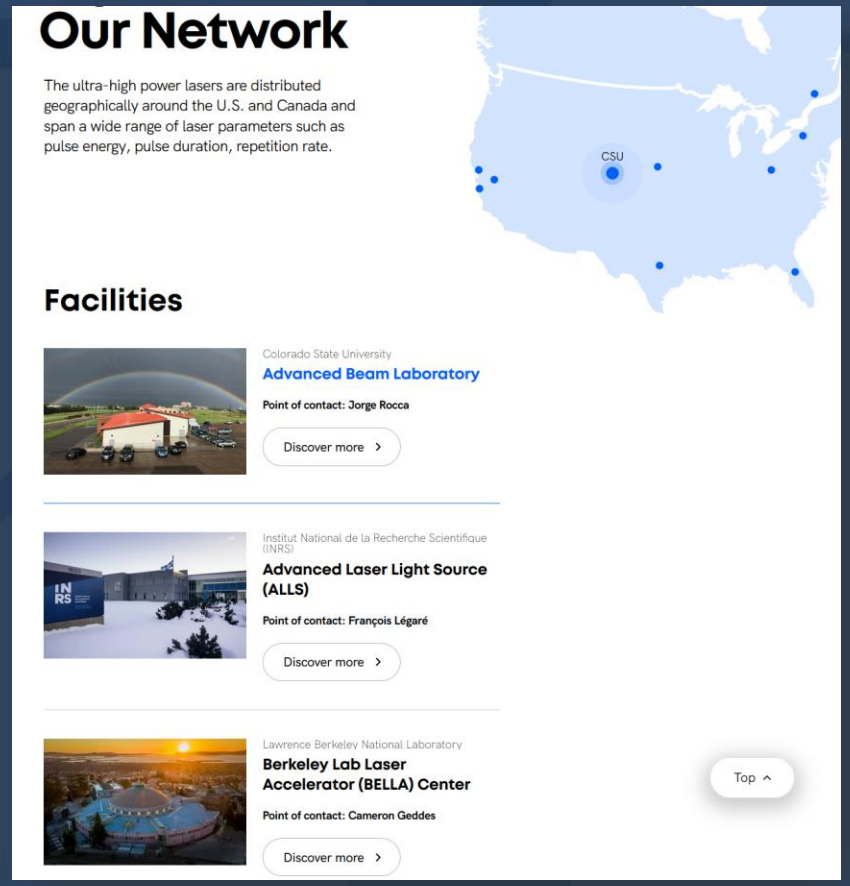
ALLS Facility

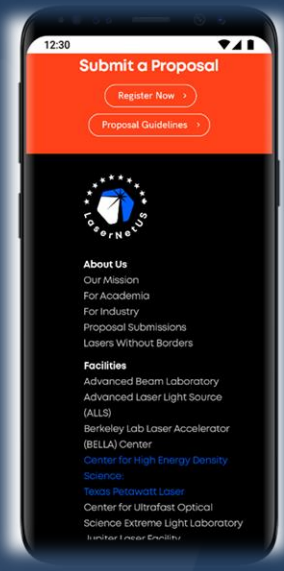


Effect of P levels in the nutrient solution on shoot growth in 4-week-old cucumber plants.

https://lasernetus.org/



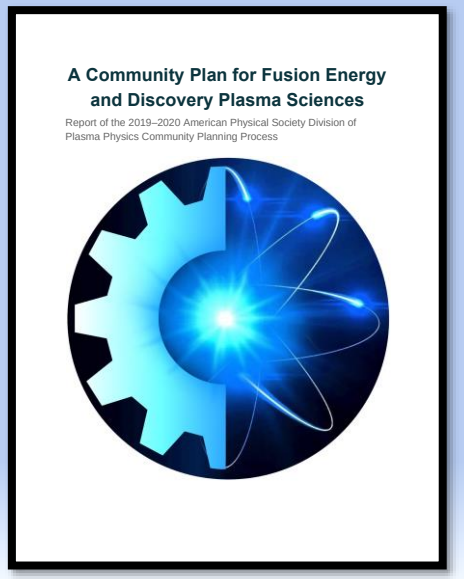




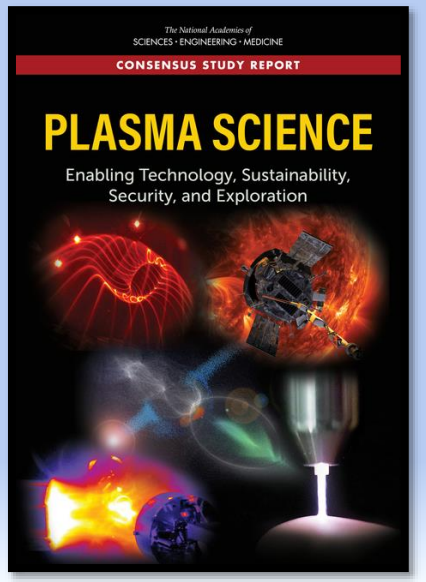
- **LaserNetUS new website and branding**
- **Complete rebuild to address SAB recommendation**
- **Focuses on helping users find the correct node for their research on all platforms.**

Recent reports support LaserNetUS growth

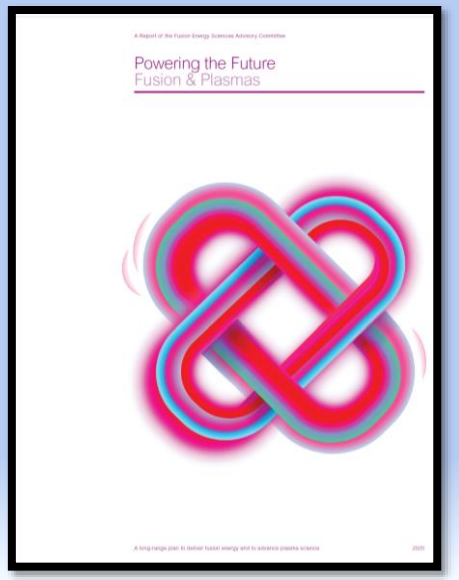
"Expand the scope and capabilities of LaserNetUS"



"Improve and upgrade existing LaserNetUS facilities…."



"This is an opportune time to address […] challenges, with increased access through LaserNetUS "



"<u>Increase operations support and aggressive upgrades to the LaserNetUS</u> network to expand the base of users while allowing for a diverse set of capabilities that maintain US competitiveness."

U.S. DEPARTMENT OF ENERGY
Office of Science

LaserNetUS organization chart

U.S. DEPARTMENT OF ENERGY, OFFICE OF FUSION ENERGY SCIENCES

LASERNETUS MANAGEMENT


CHAIR


VICE CHAIR


COORDINATOR

For more details visit:
https://lasernetus.org/about

LASERNETUS COMMITTEES



CHAIR VICE CHAIR

NETWORK FACILITIES

Carry out experiments awarded by the PRP, implement SAB recommendations, strategic planning for the network



CHAIR CO-CHAIR

INTENSE-LIGHT USERS ENGAGEMENT (I-USE)

Represent user's interest within the network



CHAIR VICE CHAIR

DIAGNOSTICS

Prioritization of common diagnostics development by engaging both users and facilities



CHAIR VICE CHAIR

SIMULATIONS

Establish connections between investigators and the teams that build simulation codes



CHAIR PAST CHAIR

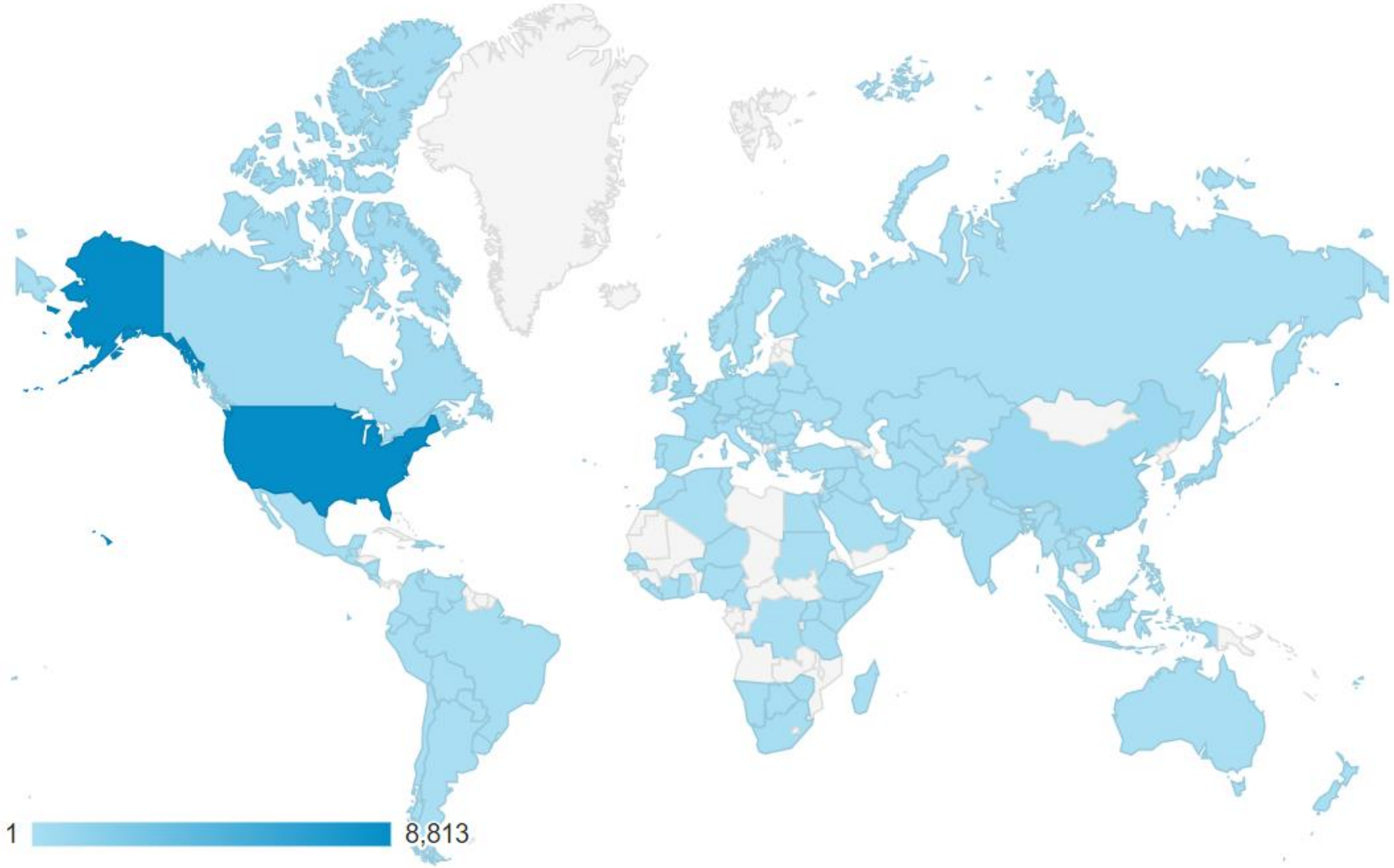
PROPOAL REVIEW PANEL

Conduct a fair and transparent review process for beamtime allocation.


CHAIR

SCIENTIFIC ADVISORY BOARD

LaserNetUS Website Google Analytics



Country	Users
	14,423 % of Total: 100.00% (14,423)
1. United States	8,813 (61.15%)
2. United Kingdom	843 (5.85%)
3. China	770 (5.34%)
4. Canada	437 (3.03%)
5. France	402 (2.79%)
6. Japan	331 (2.30%)
7. Germany	325 (2.26%)