



Facility for Advanced
Accelerator Experimental Tests

Welcome to SLAC

ALEGRO2025

Mark J. Hogan / Senior Staff Scientist / FACET and Test Facilities Division Director

March 4, 2025



Emergency Information



Fire

- Evacuate. Be aware of building exits.
- Follow building residents to the assembly area.
- Do not leave until you are accounted for, and have been instructed to.

Earthquake

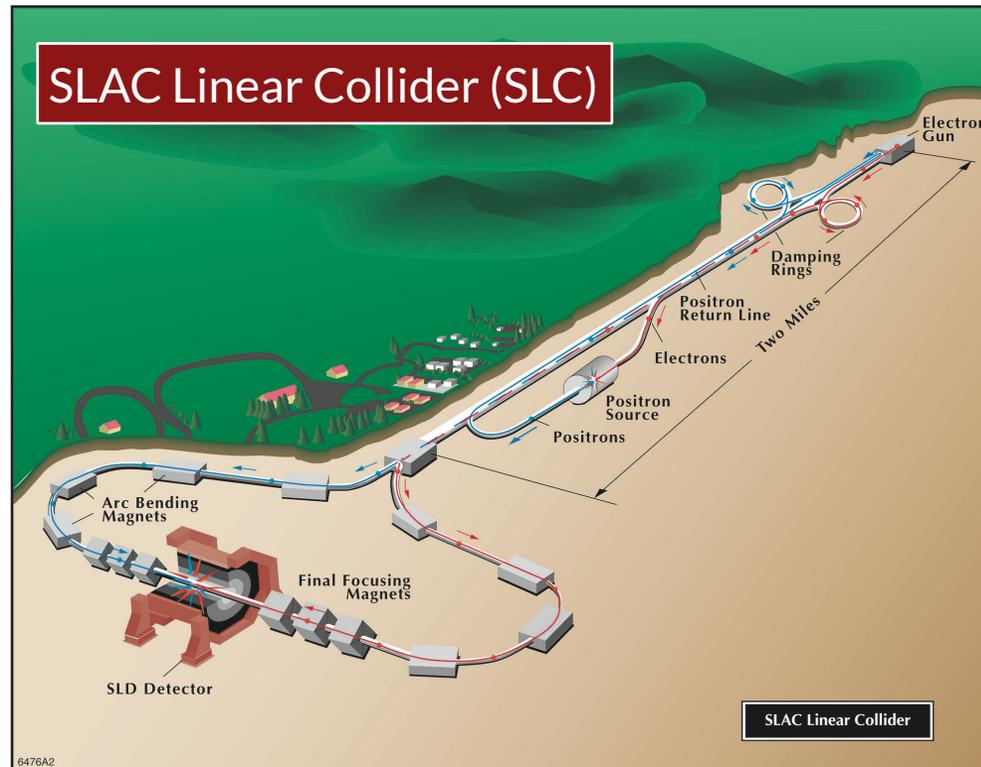
- Remain in building: duck, cover, and hold position.
- When shaking stops: evacuate building via a safe route to the assembly area.
- Do not leave until you are accounted for, and have been instructed to do so.

Evolution of the SLAC Campus from the '60's to the '90's

SLAC Linac circa 1960's

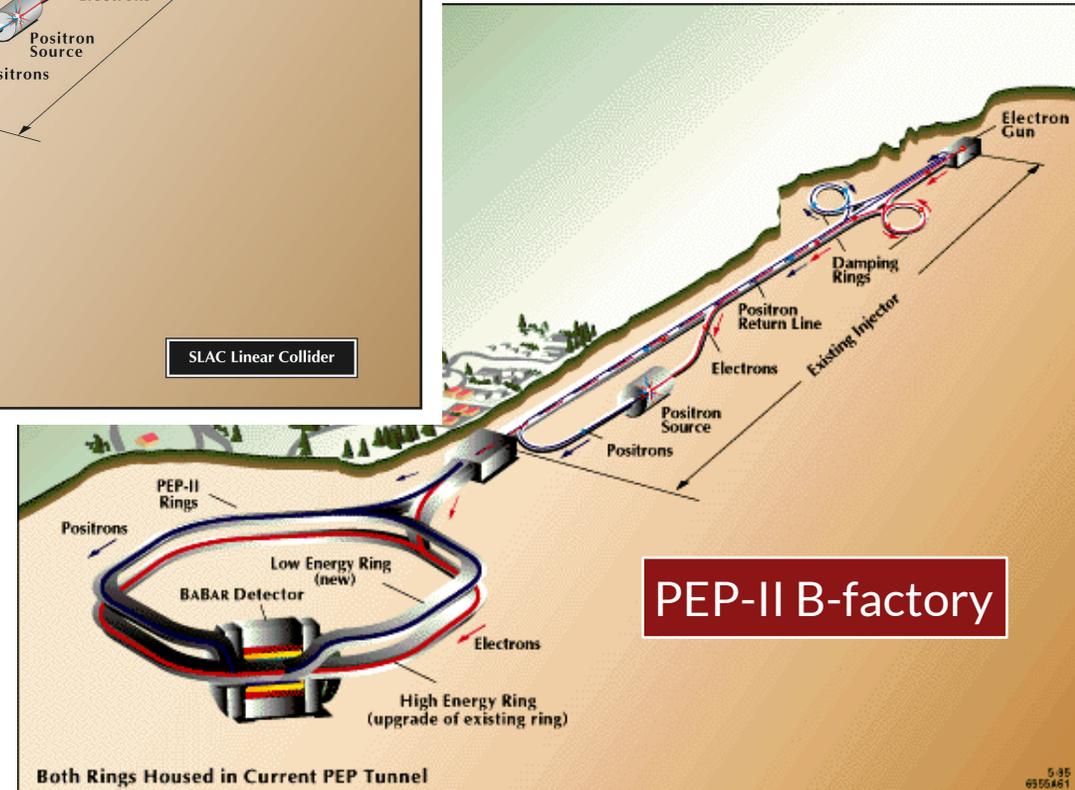


SLAC Linear Collider (SLC)



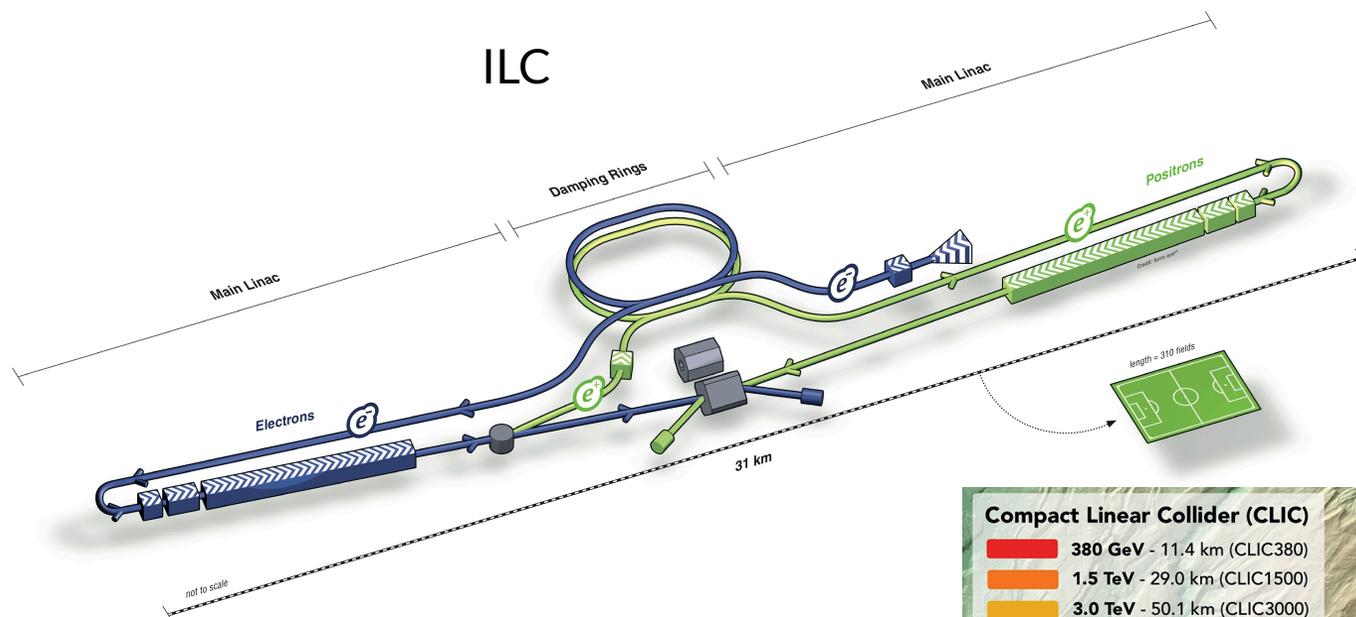
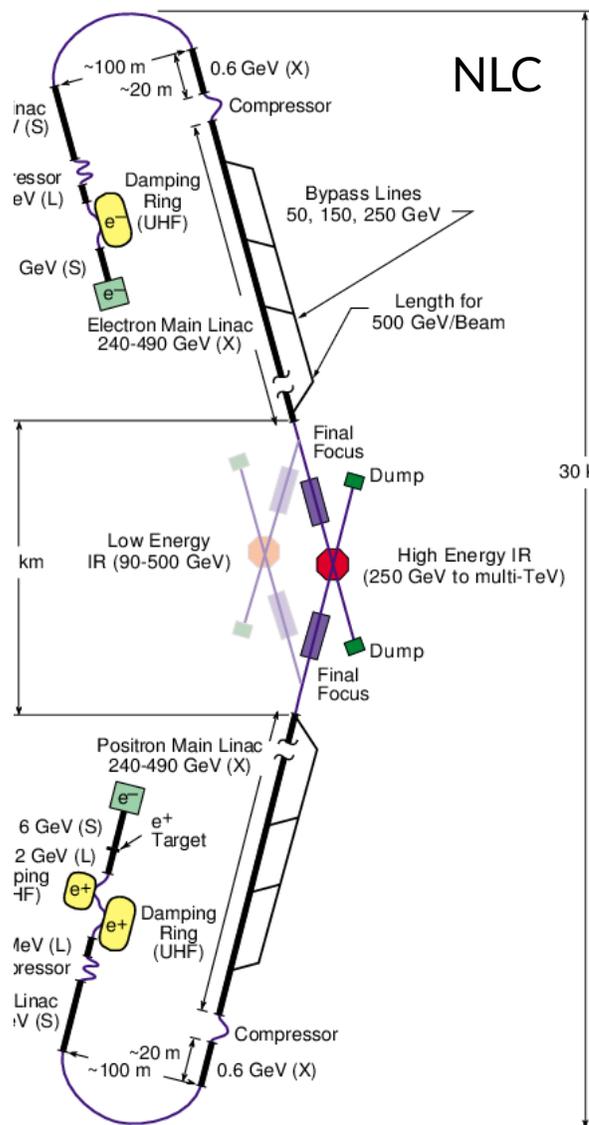
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PEP-II B-factory

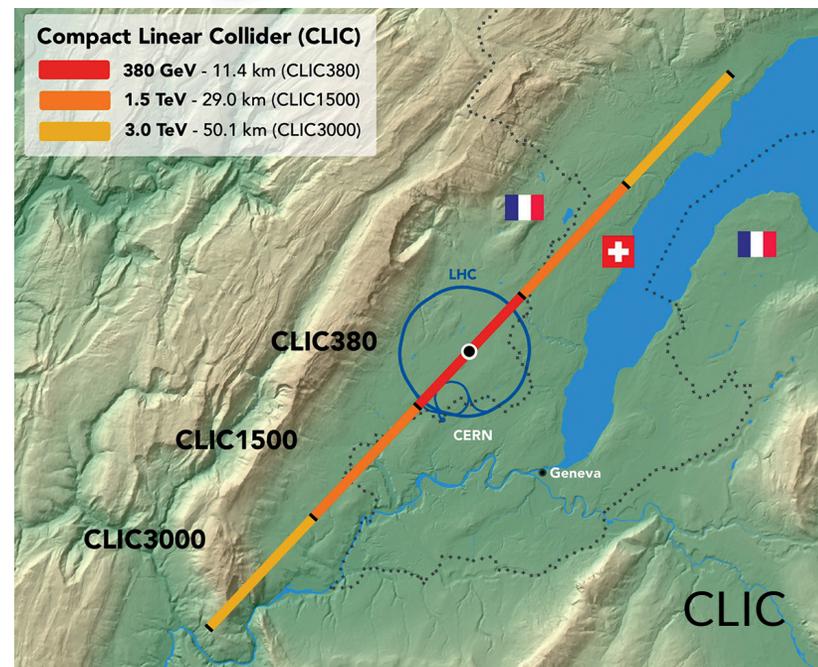


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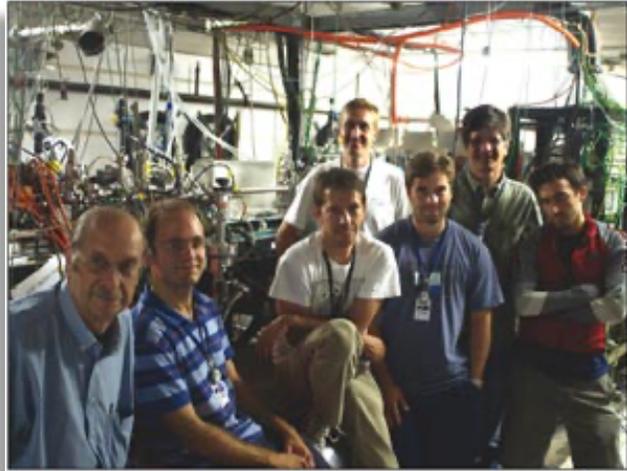
Many Ideas for Linear Colliders After SLC – None Yet Realized



New facilities were built at SLAC and elsewhere to test key technologies including the Next Linear Collider Test Accelerator (NLCTA) and the Final Focus Test Beam (FFTB)



FFTB Experiments Demonstrated the Capabilities of the Electron & Positron Beams from the SLAC Linac for PWFA Research



**ONE GeV BEAM ACCELERATION
IN A ONE METER LONG
PLASMA CELL**

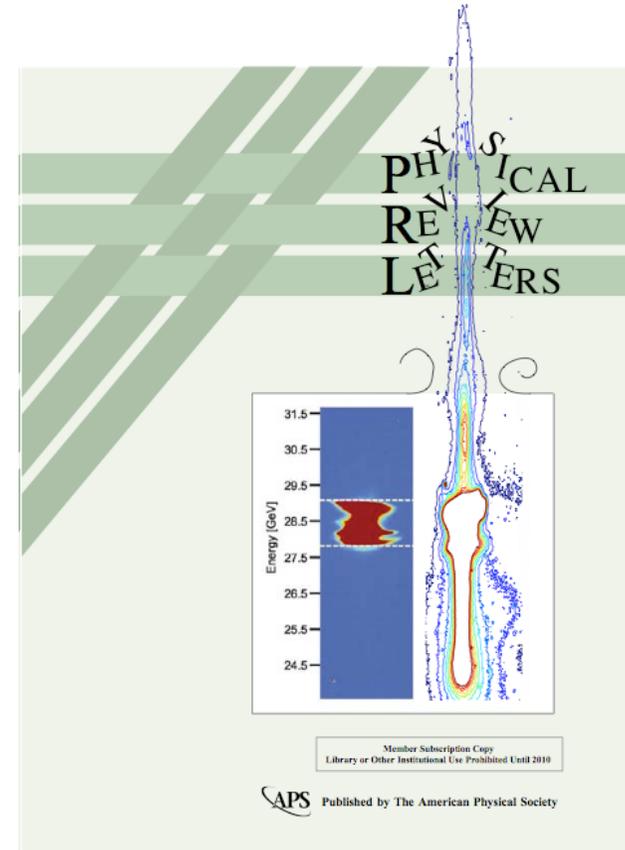
A Proposal to the
Stanford Linear Accelerator Center

Primary Investigators:
R. Assmann, C. Joshi, T. Katsouleas, W. Leemans, R. Siemann

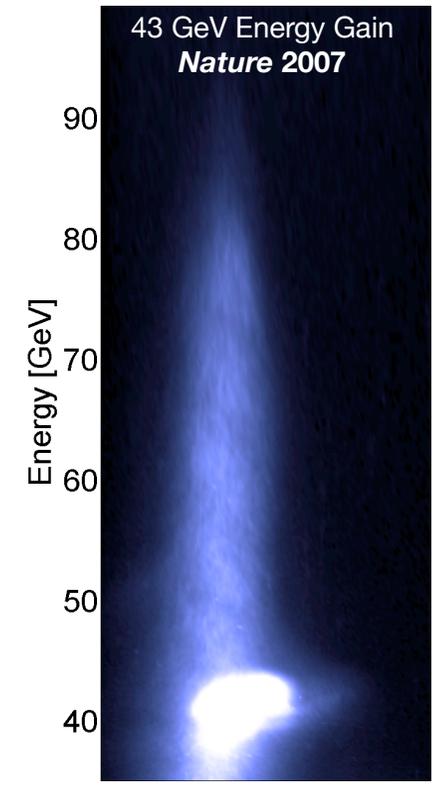
Collaboration:
S. Chattopadhyay, W. Leemans, LBNL
*R. Assmann, P. Chen, F.J. Decker, R. Iverson, P. Raimondi,
T. Raubenheimer, S. Rokni, R.H. Siemann, D. Walz, D. Whittum, SLAC*
C. Clayton, C. Joshi, K. Marsh, W. Mori, G. Wang UCLA
T. Katsouleas, S. Lee, USC

April 1997

1997:
First Proposal for PWFA @ SLAC



2005:
Breaking the GeV/m barrier
...and then some



2007:
Energy Doubling to 85 GeV

University-National Lab collaboration demonstrated that GeV/m gradients could be sustained over meter-scale distances in plasma

FACET National User Facility (2012-2016)



The FFTB was decommissioned in 2006 to make way for the LCLS and the era of hard X-ray lasers was born

FACET constructed using the first 2km of the SLAC linac to continue PWFA research in a new experimental area inside the linac tunnel

Primary Goal:

- Demonstrate a single-stage high-energy plasma accelerator for electrons

Timeline:

- Construction, Commissioning (2008-2011)
- Experimental program (2012-2016)

A National User Facility:

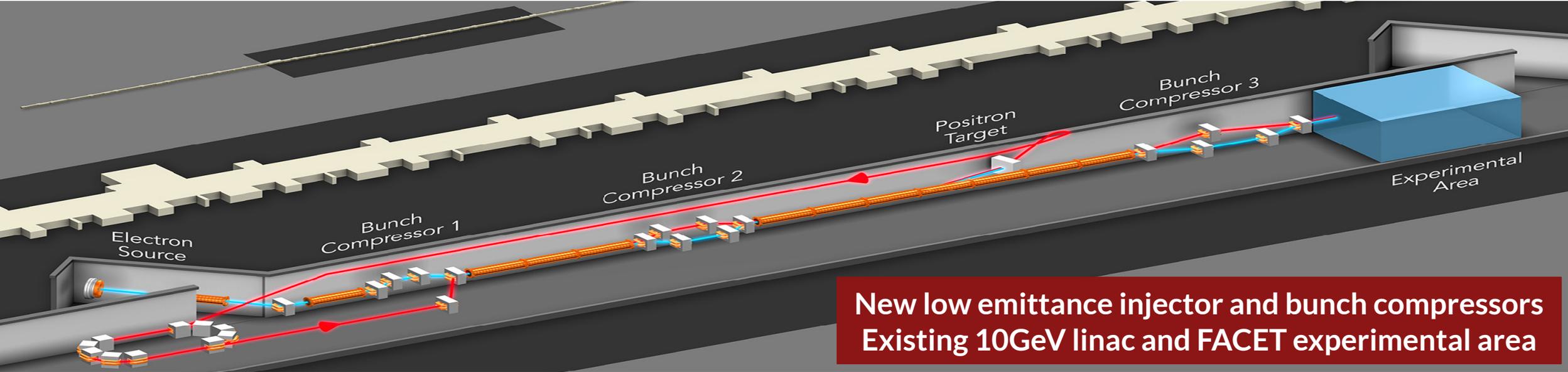
- Externally reviewed experimental program
- >200 Users, 25 experiments, 8 months/year operation

Key PWFA Milestones:

- ✓ Mono-energetic e⁻ acceleration
- ✓ High efficiency e⁻ acceleration (*Nature* 515, Nov. 2014)
- ✓ First high-gradient e⁺ PWFA (*Nature* 524, Aug. 2015)
- ✓ Demonstrate low emittance, energy spread (*Nature Physics*, Aug. 2019)

FACET-II: A National User Facility with a Broad User Program Based on 10GeV Beams and Their Interaction with Lasers, Materials and Plasma

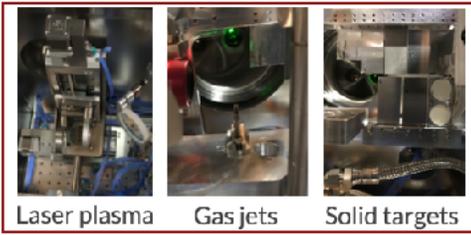
- FACET-II Technical Design Report SLAC-R-1072
- 10 GeV, 2nC, single/double bunch, 10 μ m, 30fs



**New low emittance injector and bunch compressors
Existing 10GeV linac and FACET experimental area**

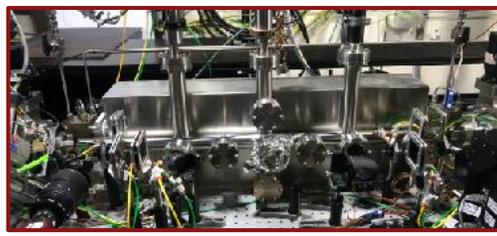
Experimental Area and Facility Are Coordinated and Planned Based on the Needs of the User Community

Have a look: [Video Tour](#) and [Street-view](#)

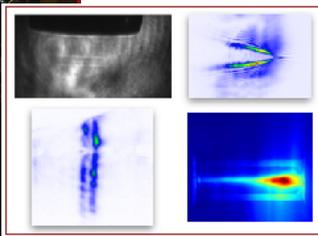
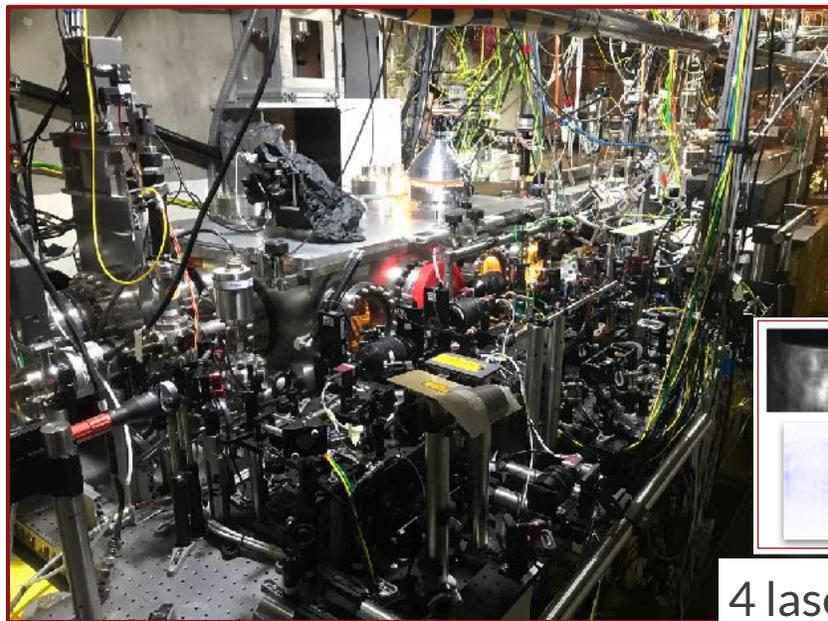


Laser plasma Gas jets Solid targets

Lithium oven

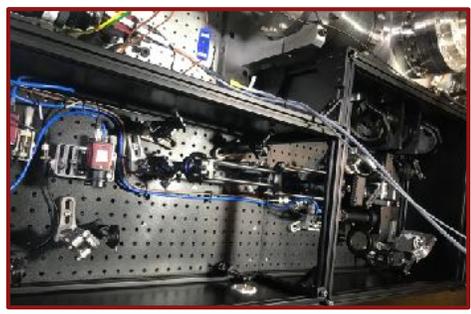


10 TW laser;
solid, gas and
plasma targets of
various density &
length;
specialized
electron, X-ray
and Gamma-ray
diagnostics



4 laser probe lines

The User Area is designed for ~17 experiments without major reconfigurations of the hardware



Laser diagnostics

If you have never seen the SLAC linac and the FACET-II experimental area, Spencer has organized lunchtime tours today and Wednesday

Outlook

- We are excited to welcome you and the ALEGRO series to SLAC and the U.S.
- It is an interesting time for high-energy physics and the path to the energy frontier at 10 TeV is not clear
 - This is a challenge and an opportunity for advanced accelerators!
- Concepts for colliders based on AAC technologies have emerged from time-to-time starting in the 1990's
 - There is an added level of detail and rigor going into the latest efforts as our field is maturing (e.g. HALHF)
- Conclusion from P5: HL-LHC, Higgs factory with FCC_{ee} or ILC, explore options for 10TeV (FCC_{hh}, muon colliders, wakefield colliders...)
 - HEP is global and alternatives are also being investigated: C³, HALHF, LC Vision
- Charge to the U.S. AAC community from P5 for a 10 TeV design study with self-consistent parameter sets is well aligned with the mission of ALEGRO

Brigitte, Patric and Spencer have put together an interesting program – let's enjoy it and get to work