Los Alamos NATIONAL LABORATORY

Research and Careers at LANL

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Research and Development at Los Alamos Supports Our Mission

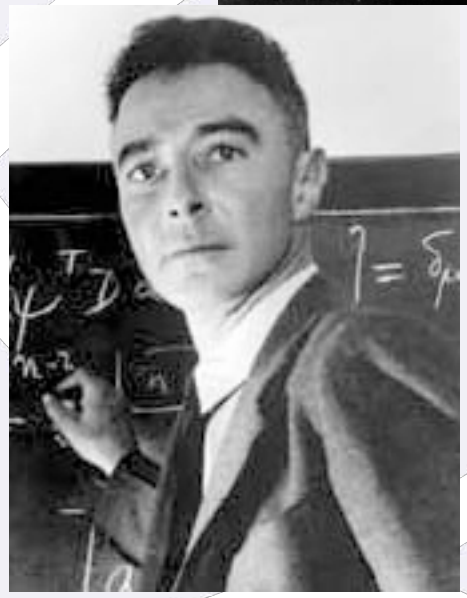
Nuclear Deterrence – develop highly reliable, predictive tools to answer questions about performance in a changing stockpile due to aging, manufacturing, and material replacement.

Energy Security – includes materials for nuclear reactors, waste treatment, energy production, conversion and storage, transportation fuels and energy efficiency.

Global Security – includes addressing threats from peer adversaries and emerging nuclear threats; from the earliest adversary planning through resilient event response; as well as providing technical capabilities and expertise in support of global efforts to understand and limit nuclear proliferation through strengthening international nuclear safeguards and security.

The Lab has a 70 Year History

- The Lab was established in 1943 as site Y of the Manhattan Project
  - Manhattan Engineer District, designed & built by the U.S. Army Corps of Engineers
  - P.O. Box 1663, Santa Fe, New Mexico
- Original mission: Design & build an atomic bomb
  - **July 16, 1945**: Detonation of 1st atomic bomb
  - **Aug. 6, 1945**: Little Boy dropped on Hiroshima
  - **Aug. 9, 1945**: Fat Man dropped on Nagasaki



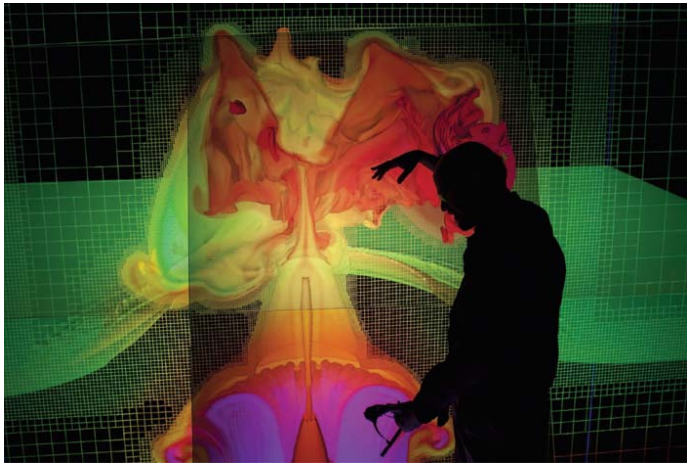
J. Robert Oppenheimer
1st director of LANL
1943-1945

Today our NNSA mission focuses on the Science, Engineering, and Associated Experiments required to Support a Modern Stockpile

- Hardware realization of physics concepts and designs
  - Concepts and stockpile studies
  - Systems Engineering and Requirements Management
  - Component Design and Development
- Maintenance
  - Surveillance and Issue Response
  - Weapons Safety Assessment and Response
  - Support Production Plants
- **Exploration/Validation Experiments**
  - **Large scale Hydro and Subcritical experiments**
  - **Smaller scale science- and issue-driven experiments**
  - **Model Development**

Exploration and Validation Experiments

- **Production Science and Manufacturing**
  - –Provides world-class, safe, secure, and reliable material research, development, technology demonstration, and manufacturing
- **Weapons Physics**
  - – Experiments to test and understand the physics associated with weapon design, materials, and performance
  - – Development of Advanced Models and Simulation Tools
- **Weapon Engineering & Experiments**
  - –Planning and execution of the stockpile stewardship program
  - –Development of associated tools: detectors, radiography, dynamic drive platforms, etc.



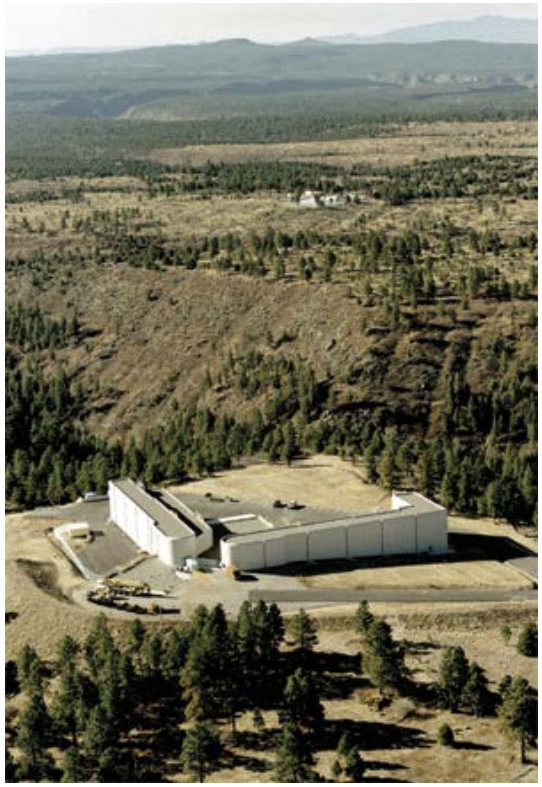
LANL Facility Investments Support Robust Predictive Capabilities and Production Agency (Manufacturing)Needs

Manufacturing Capability:

- LANL operates the nation's only full-capacity plutonium facility (PF-4)
- LANL is the Production Agency for Detonators
- Multiple facilities for small/pilot scale manufacturing capabilities including Sigma, TFF, etc.

Predictive and Validation Capabilities:

- Trinity: High Performance Computing (40PF)
- Dual-Axis Radiographic Hydrodynamic Test facility (DARHT)
- 8 active firing sites: up to 2000lbs of explosive
- Small scale, science laboratories



Researchers from Across the World come to LANL to Access a Broad Range of Signature Facilities

LANSCE: Los Alamos Neutron Science Center is an NNSA user facility with an 800 MeV proton linear accelerator

- Proton Radiography Facility (pRad)
- Isotope Production Facility (IPF)
- Ultracold Neutron (UCN) Research Facility
- Lujan Neutron Scattering Center
- Weapons Neutron Research Facility (WNR)

National High Magnetic Field Laboratory (NHMFL)

- NSF User facility with strongest long-pulse magnet in the world at 100 Tesla

Center of Integrated Nanotechnologies (CINT)

- co-lead by LANL and SNL, BES User facility for synthesis, characterization & integration lab tools for nanoscale research

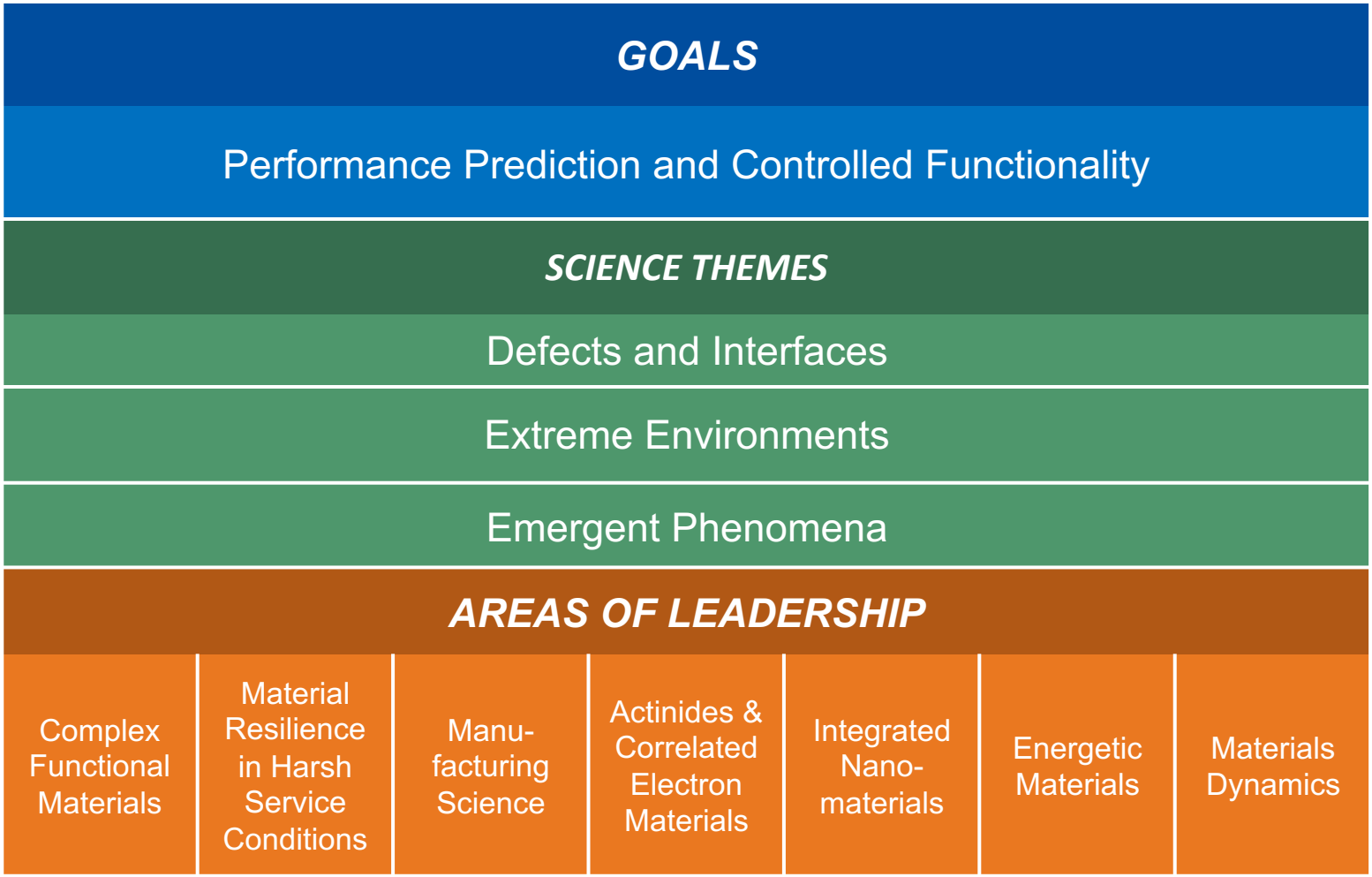
Dual Axis Radiographic Hydrotest (DARHT) Facility

- First U.S. radiographic, hydrodynamic test facility to produce 3D & time-resolved data

Trinity Supercomputer

- 40 Petaflops

Materials Research at the Laboratory Supports Our Mission

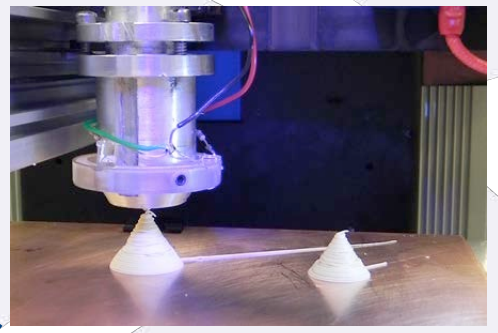


Leadership Area ‘Energetic Materials’
Additive Manufacturing Leads to Safer High Explosives

Structural defects at the mesoscale (porosity, grain boundaries, defects) **control shock initiation and reactive burn** in high explosives.

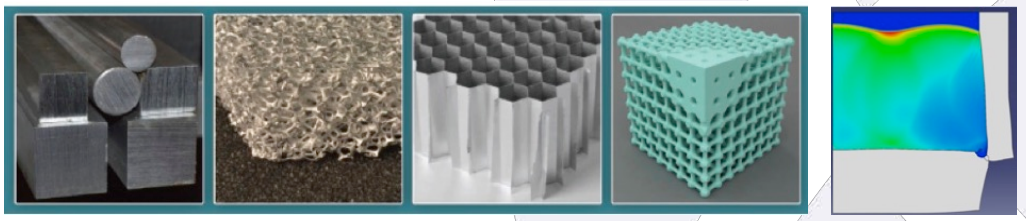
Challenge:

Current fabrication methods for HE do not allow for the systematic introduction of structure.



Gaining control of ignition and growth

None | Stochastic | Ordered | Ordered and graded | Designed breakout

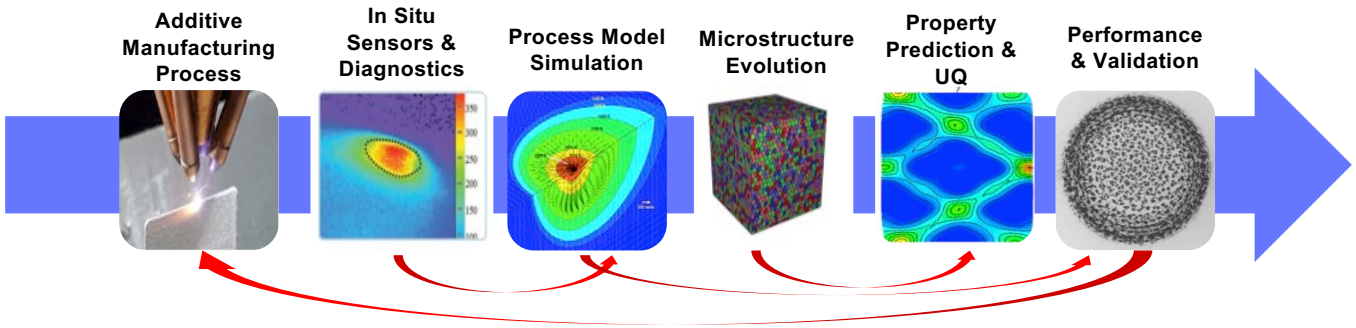


Additive fabrication techniques allow for structure to be hierarchically organized and tailored.

- Control direction of growth by designing anisotropic propagation speeds
- Engineer the size and location of sensitive regions (hotspots) within the bulk explosives
  - Control initiation regions for fully insensitive explosives (IHE)
  - Control of reactive flow

Manufacturing Science Area of Leadership requires integration and feedback between experiment and modeling across length and time scales.

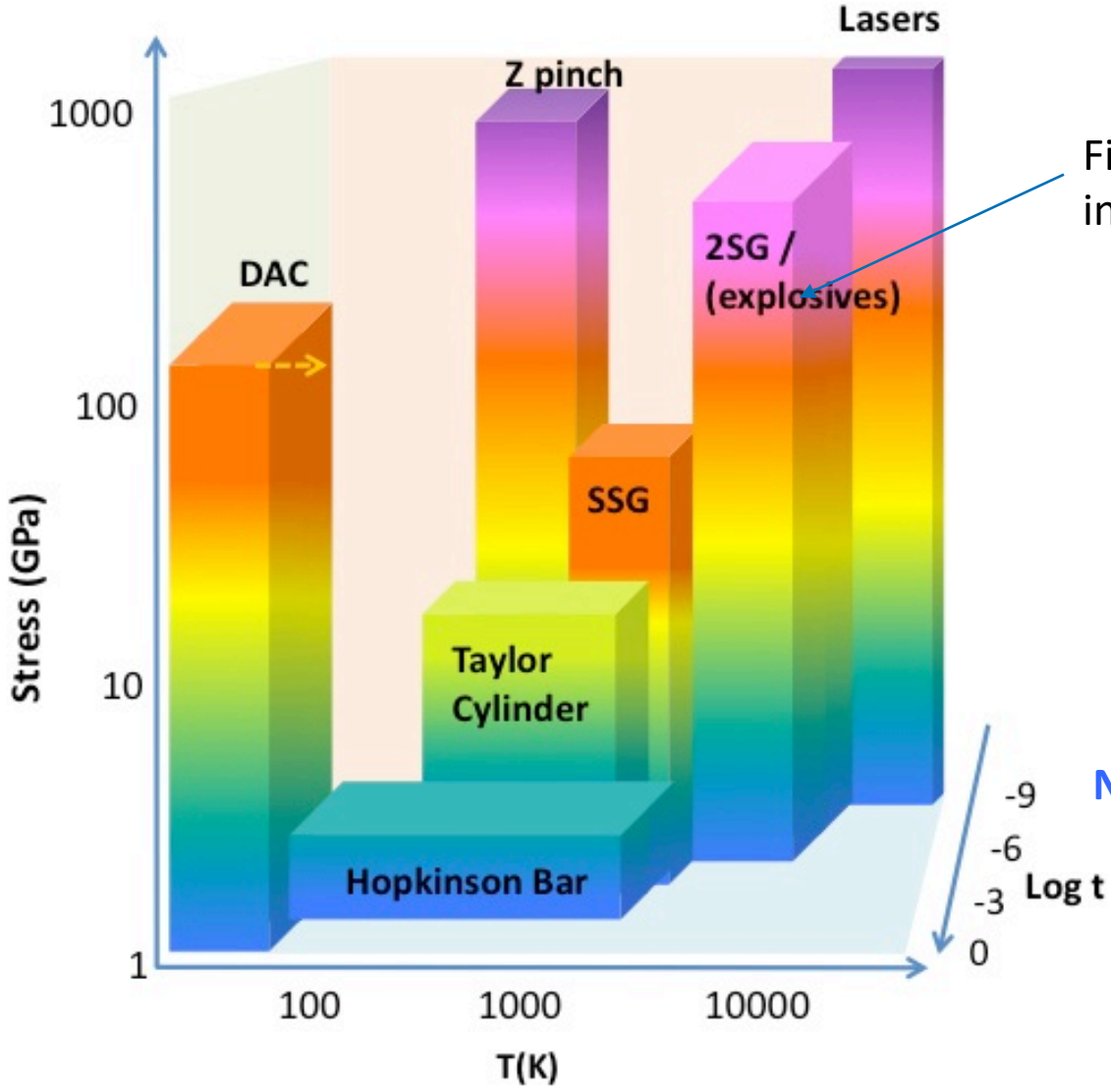
Manufacturing science can be defined as the application of fundamental science research and development activities in order to understand the critical steps in the manufacturing process for the purposes of control and optimization.



Some weapons production areas where manufacturing science can help:

- Reduce experiments and increase understanding
- Understand how changes in manufacturing may affect product performance
- Qualification of new manufacturing methods such as additive manufacturing
- Scale up (size, quantity, equipment)
- Process control and rapid feedback
- Solve manufacturing problems on the floor

Materials Dynamics Area of Leadership focuses on Structure-Property Performance Relationships in the Extremes of Mechanical Loading

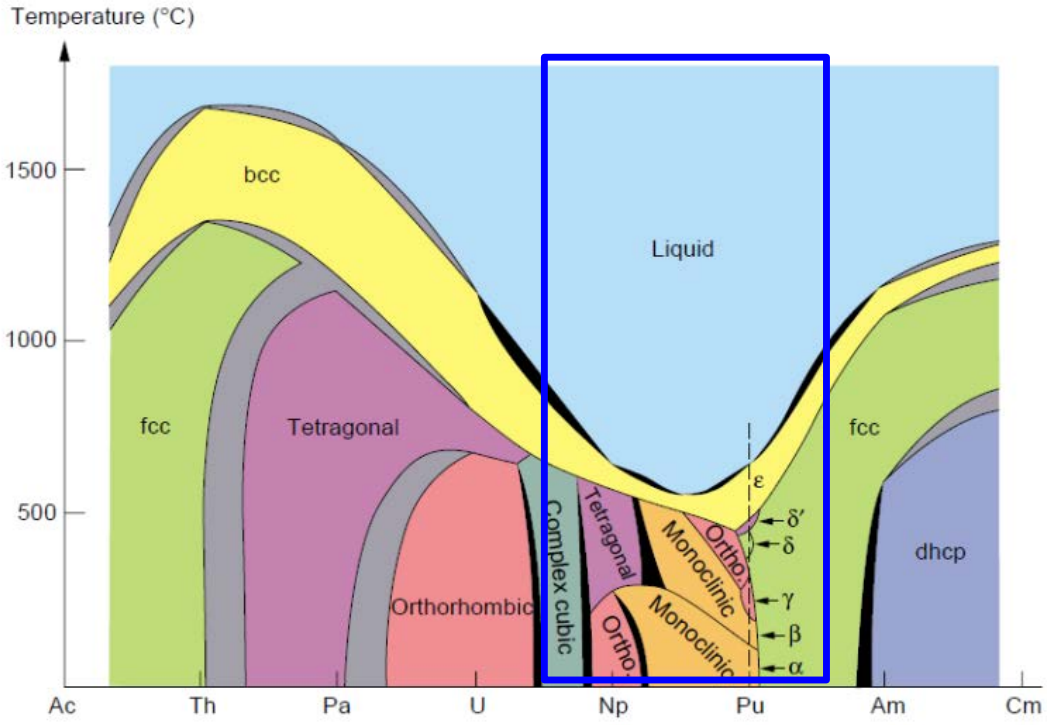


Firing site work is included here

N. Bourne, Materials in Mechanical Extremes, 2013

Actinides and Correlated Electron Materials Area of Leadership Focuses on Predictive Performance of Actinide materials

Pu Phase Diagram



Characteristically linked by the fact that the physical state of actinides—plutonium in particular—is governed by strong electronic correlations.

- **Dominates the elemental solid: six allotropes spanning 20% volume difference**
- **Shows systematically across 5*f* series**
- **Continues into the liquid: greatest viscosity of any element**

Smith, J.L., E.A. Kmetko, *Journal of the Less Common Metals* 90(1), 83 (1983)

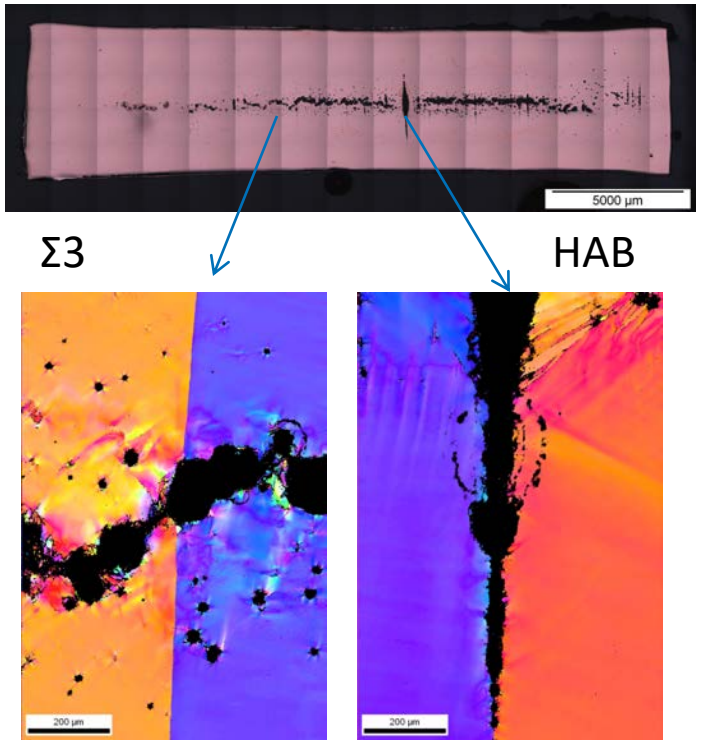
My Path Before and at LANL

- **University of Virginia**, BS in Aerospace Engineering (1992-1996)
- **Carnegie Mellon**, MS and PhD Materials Science (1996-2001)
  - **Arizona State University**, visiting scientist (1999-2001)
- **Los Alamos National Laboratory**
  - Post Doc: (2001-2003)
  - Technical Staff Member: (2003-2015)
  - Group Leader for MST-8 (LANL) (2015-2017)
  - Deputy Division Leader for Explosive Science and Shock Physics (2017 - 2019)
  - Division Leader for Materials Science and Technology (2019 – present)

Focus of My Own Research at LANL has been on High Strain Rate, High Stress Properties of Materials

- Establishing deterministic role of microstructure on damage – toward controlled performance
- Understanding the role of plasticity and phase transformation on material strength
- Extended past post mortem measurements to in-situ techniques at LANL & LCLS/APS to examine structure during dynamic loading

Funded through: NNSA Weapons program, DoD Programs, Office of Basic Energy Sciences and Laboratory Directed Research and Development (LDRD) Program



J.P Escobedo, E.K. Cerreta, and D. Dennis-Koller, *Journal of Metals*, 66 (2014) 113-12

Career Paths & Access Points at LANL:

R&D position:

- Post Doctoral, Post Masters, Post Baccalaureate
- R&D Scientist and R&D Engineer
- Research technologist and Technician

Management Roles:

- Program
- Line: Team, Group, Division level
- Technical Projects

Technical Support:

- Computer Science and Programming, Radiation Protection, Environmental Science, Industrial Hygiene, Nuclear Criticality, Power Systems, Cybersecurity, Industrial Engineering, Quality Assurance, Operations and Maintenance, etc.

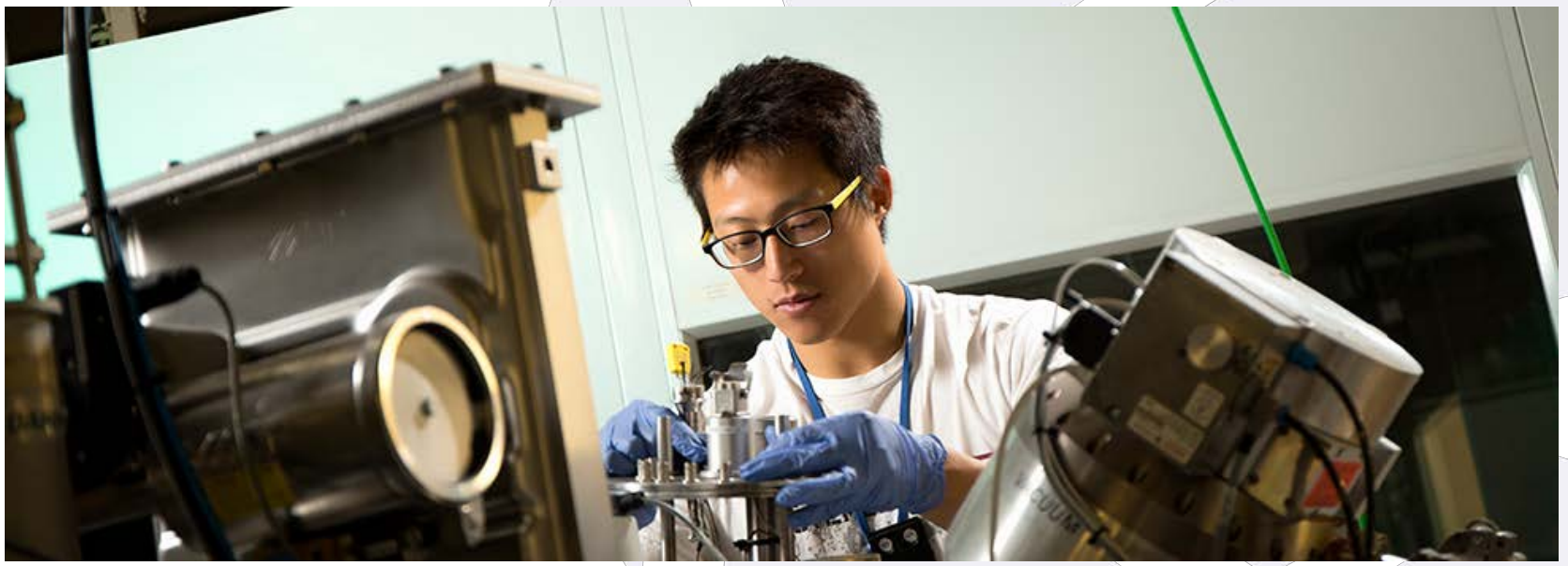
Access Points: Many ways to access opportunities to do research @ LANL

- Human Resources, User Facilities, Student Programs, the Institutes, and LANL Post-Doctoral Program

Jobs @ LANL

https://www.lanl.gov/careers/index.php

- Access to all Open Positions
- How to apply
- Recruiting events
- Explore Different Careers @ LANL
- Information regarding Diversity and Inclusion



Student Programs @ LANL

Positions:

- Undergraduate
- Graduate
- Post Baccalaureate
- Post Masters

Information About Program Resources:

- Salary Structure
- Student Symposia
- Students Association
- Career Resources
- Scholarships

Student Program Website

https://int.lanl.gov/employees/education/index.shtml

Program Coordinator

Emily Robinson
Student Programs Office
(505) 665-0964
errobinson@lanl.gov

LANL's National Science Education Center hosts 6 Institutes to Enable External Collaboration

Program Director: David L. Clark

MISSION: To provide creative mechanisms for education and training, research, and academic interactions with the Laboratory that promote mission-relevant multidisciplinary technology innovation.

Website:
Http://nsec.lanl.gov

- NSEC
  - NM Consortium
  - Center for Nonlinear Studies
  - Center for Space and Earth Sciences
  - Engineering Institute
  - Information Science and Technology Institute
  - Institute for Materials Science
  - Seaborg Institute

Post Doc Program

Information regarding the program:

- LANL Post Doc program
- Post Doc Research Symposium and Career Fair
- Post Doc Association
- Post Doc Housing
- Benefits
- Life @ LANL
- Career Development Events
- Post Doctoral Awards

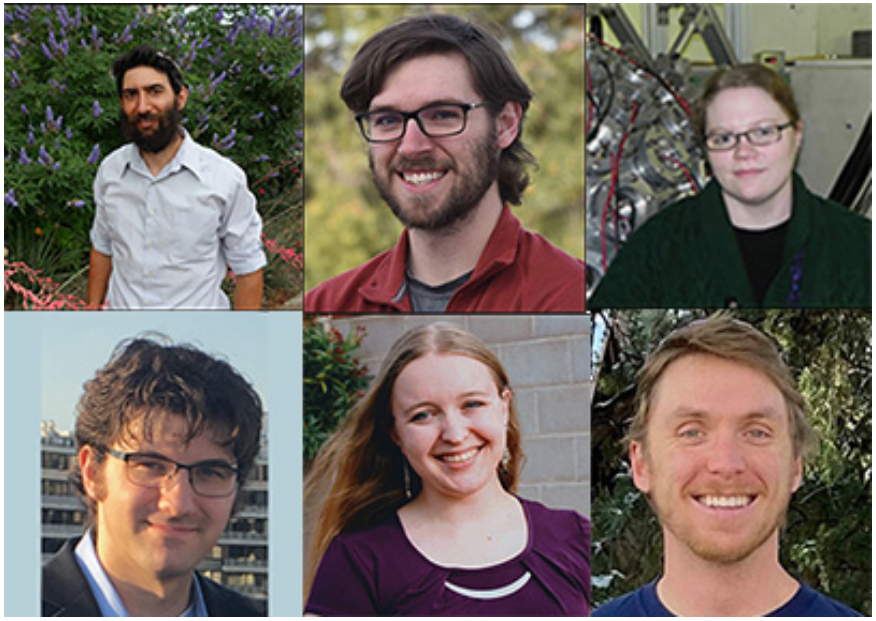
Contacts:

Postdocprogram@lanl.gov

Webpage:

https://www.lanl.gov/careers/career-options/postdoctoral-research/index.php

Current Agnew And Metropolis Fellows



Final Thoughts

- **Current NNSA mission has led to many R&D opportunities at Los Alamos**
  - Production Science
  - Weapons Physics
  - Weapons Engineering and Experiments

- **There are multiple access points for those looking to collaborate or for careers at LANL**
  - User Facilities
  - Student and Post Doctoral Programs
  - National Security Education Center (NSEC)
  - Human Resources

Contact Information:
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https://www.lanl.gov/org/ddste/aldps/materials-science-technology/index.php