LA-UR-17-30094
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Title:	LANSCE: Los Alamos Neutron Science Center
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Intended for:	Monitor display
Issued:	2017-11-02


LANSCE
Los Alamos Neutron Science Center

Expanding research opportunities toward a new and improved Lujan Center neutron-production target

Scientific achievement

- LANSCE researchers are studying enhancements in neutronic performance of the Mark-IV target design at the Lujan Center.
- Principal goals are to 1) increase flux and improve resolution for neutron energies above 1 keV for nuclear physics experiments and 2) preserve current strong performance at thermal energies for material science.

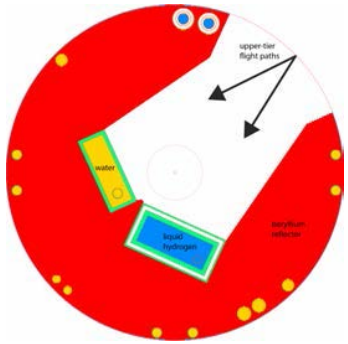
Significance and impact

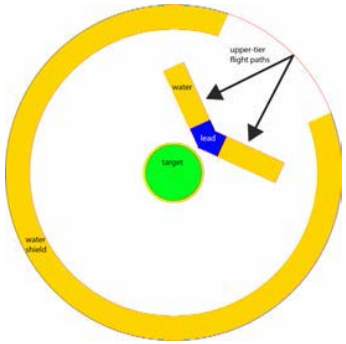
- Improvements will broaden reach of nuclear physics experiments at Lujan while simultaneously maintaining its world-class material research program.

Research details

- Work, which is funded by Weapons Infrastructure, supports Lab's Stockpile Stewardship and Basic Science missions and Nuclear and Particle Futures, Science of Signatures, and Materials for the Future science pillars by providing improved nuclear data and nuclear theory of importance to these areas.

Participants included P-27, ISR-1, MST-8, AOT-OPS, AOT-MDE, MPA-11. For details see *LANSCE Pulse,* Summer 2017.





From the LANSCE User Facility Director: A successful FY16 run cycle

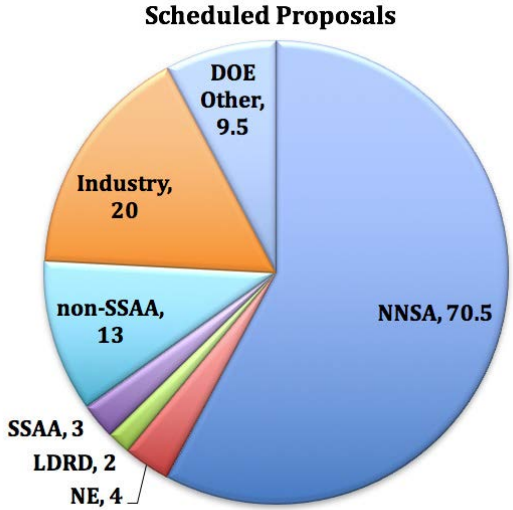
LANSCE User Facility Director Gus Sinnis
For details see *LANSCE Pulse,* Summer 2017.

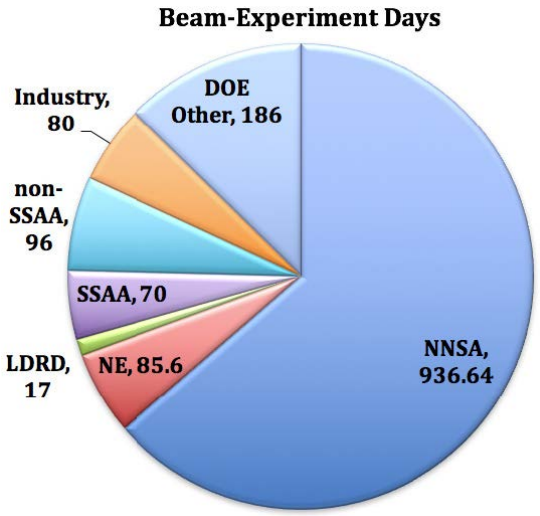
Scientific achievement

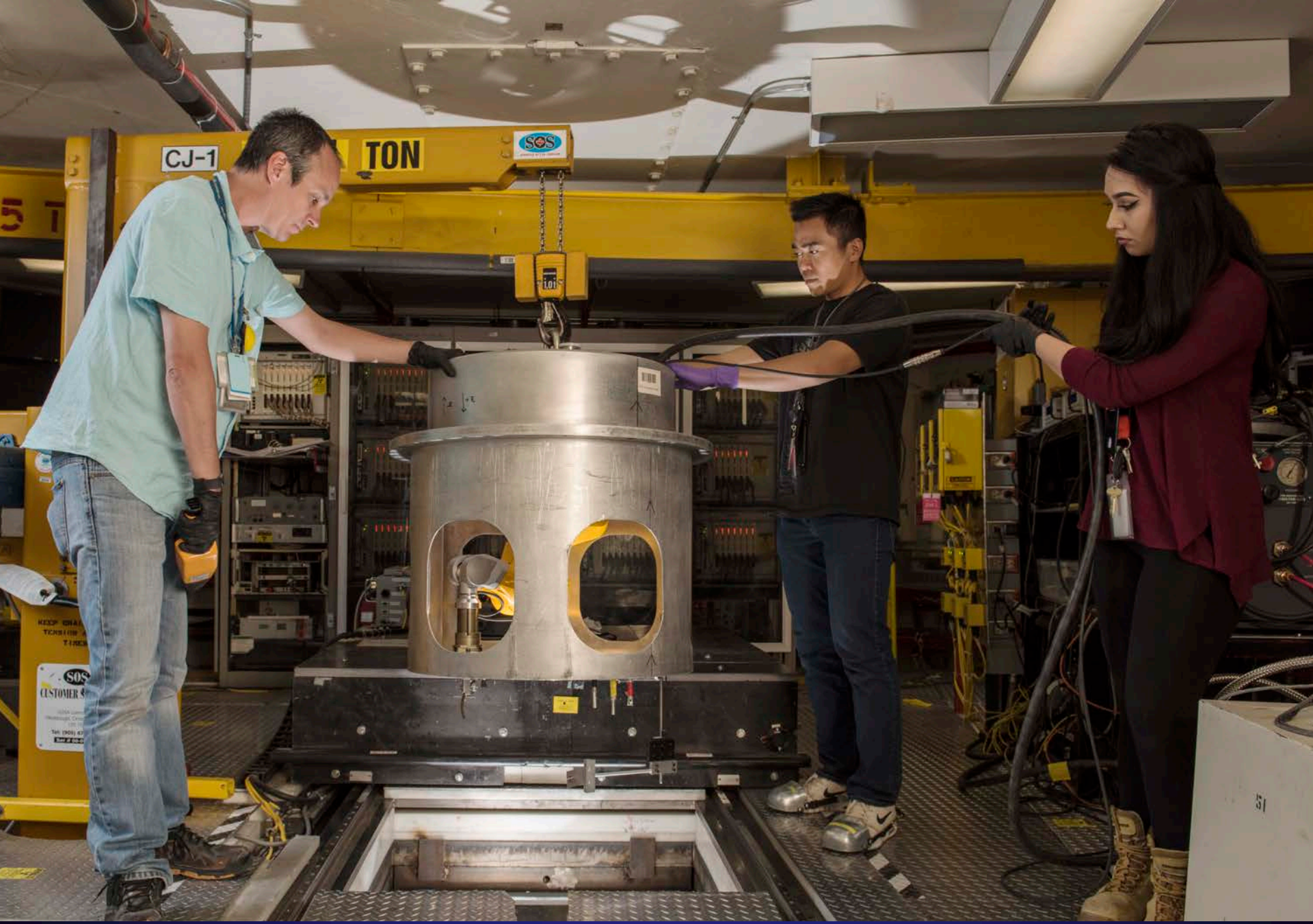
- LANSCE had another highly successful run cycle.

Significance and impact

- Accelerator operated at more than 85% availability, with exceptionally high availability in the last month of operations.
- At the three NNSA-designated national user facilities (pRad, WNR, and Lujan Center), LANSCE hosted 547 unique users, ran 122 proposals, and scheduled 1,471 beam-experiment days.
- NNSA continues to be the dominant sponsor of our programs, and we continue to deliver critical data for national security missions.





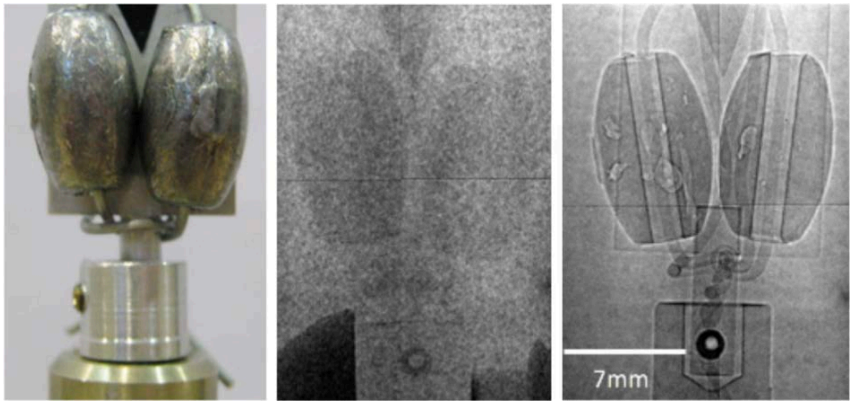


Manuel Lujan Jr. Neutron Scattering Center at LANSCE

First demonstration of neutron phase-contrast imaging using a cold neutron source at LANSCE

Scientific achievement

- Los Alamos researchers demonstrated that neutron phase-contrast conditions can be realized using the high flux and highly coherent cold neutron beams produced at LANSCE's 1L target.



Participants included MPA-CINT/National Science Foundation, MPA-11, MST-8, P-27, P-24, M-7, AET-6. For details see *LANSCE Pulse,* Summer 2017.

Significance and impact

- Similar to x-rays, neutrons can be used to nondestructively image a variety of samples, including nuclear and high explosive components.
- An advantage of neutrons over x-rays—especially at lower neutron energies—is the ability to image light elements or to penetrate many materials. Higher energy neutrons can penetrate dense, thick objects of materials such as steel, uranium, or plutonium and allow study of materials buried inside thick casings.
- Lujan Center's Asterix and SPEAR beam lines provide "cold neutrons" especially suitable for performing phase-contrast imaging.
- Ability to perform phase-contrast imaging, as well as cold neutron attenuation radiography at LANSCE, has important applications to issues that arise in explosives fabrication, as well as other programmatic and research areas.

Research details

- Work, which supports Lab's weapons and fundamental science missions and Materials for the Future, Science of Signatures, and Nuclear and Particle Futures science pillars, was funded by W76 Stockpile Stewardship, C1 and C2 programs, and benefited from use of equipment and expertise from Enhanced Surveillance.
- Work can benefit from Integrating Information, Science, and Technology for Prediction science pillar through improved computed tomography reconstruction and analysis algorithms for large and multi-probe data sets.

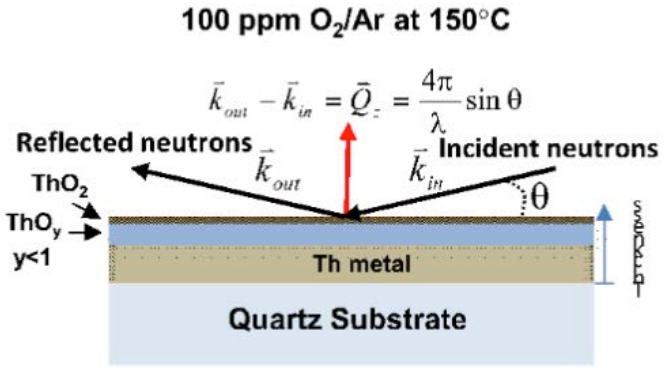
Neutron scattering investigations at LANSCE provide insight into properties of novel nuclear fuels

Scientific achievement

- Los Alamos researchers and colleagues used the neutron reflectometry capabilities of LANSCE to better evaluate thorium for use as an advanced nuclear fuel.

Significance and impact

- Thorium and uranium are the only two significantly radioactive elements that occur naturally in large quantities in Earth's crust. Weakly radioactive, thorium is three to four times more abundant than uranium and its chemical compounds have many applications independent of its radioactive nature.
- Neutron reflectometry capabilities at LANSCE were used to follow slow oxidation process in thorium samples.

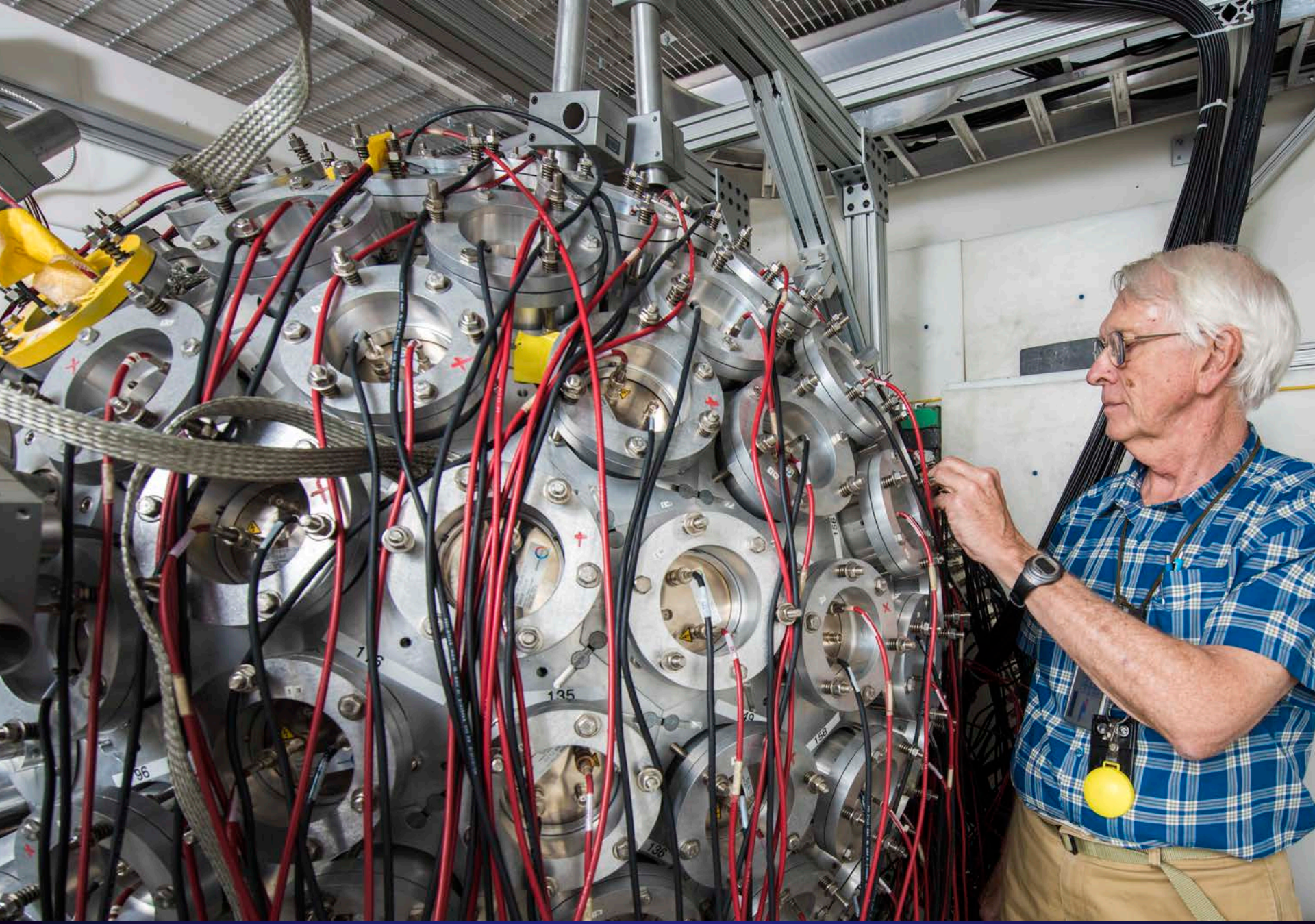


Participants included Chemistry Division, MPA-CINT/ University of California, Davis, Brigham Young University, Chinese Academy of Sciences, C-PCS. For details see *LANSCE Pulse,* Summer 2017.

- Neutron reflectometry is known as a non-contact, nondestructive, high-resolution analytical technique with superb ability to detect even minute amounts of elements like oxygen or hydrogen for precise characterization of chemical speciation.

Research details

- Financial support of this work, which supports Lab's Energy Security mission and Materials for the Future science pillar, was provided by the DOE through Los Alamos's LDRD program.
- Work benefited from use of the time-of-flight neutron reflectometer, SPEAR, at Lujan Center at LANSCE, which was funded by DOE Office of Basic Energy Sciences at the time the data was collected and Los Alamos National Laboratory.



Weapons Neutron Research Facility at LANSCE

High Performance Computing group tests Trinity computers at LANSCE/WNR Ice House

Scientific achievement

- An HPC team assembled a group to study the effects of neutrons on elements of the Trinity machine, using the capabilities at WNR's high-energy neutron source.

Significance and impact

- Ability of Los Alamos to perform its defense program mission depends on calculations that are performed on super computers.
- Super computers contain billions of bits and thousands of processors. One of the greatest threats to calculations performed on these machines comes from small subatomic particles called neutrons.
- These neutrons are produced when naturally occurring cosmic rays strike the atmosphere and cause nuclear reactions with the elements of air. When these neutrons hit semiconductors, they produce charged particles that deposit charge in sensitive volumes of the semiconductor and cause a wide range of failures.

Participants included HPC-DES, Universidade Federal do Rio Grande do Sul, Northeastern University, University of Waterloo. For details see *LANSCE Pulse,* Summer 2017.

- WNR high-energy neutron source produces a neutron spectrum very similar to the neutron spectrum produced by cosmic rays hitting the atmosphere.

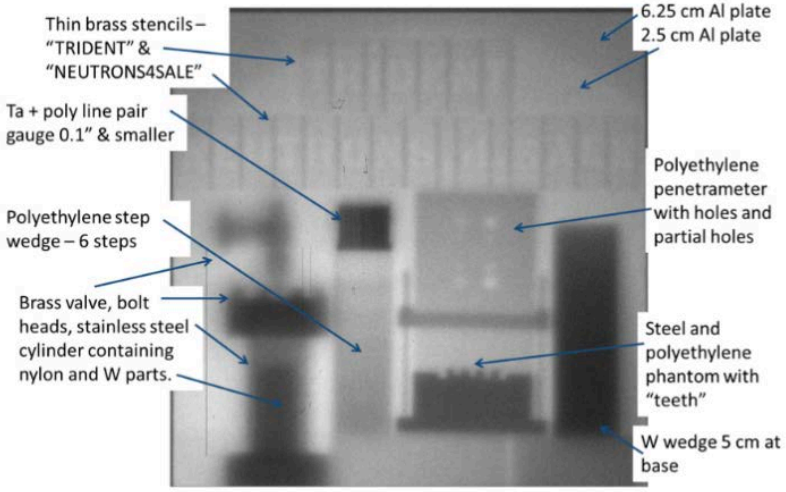
Research details

- Research, funded by the Advanced Simulation and Computing program, supports Lab's Stockpile Stewardship mission and Information, Science and Technology for Prediction science pillar by helping ensure that calculations performed in pursuit of the mission are reliably performed.

Characterization and application of a laser-driven intense pulsed neutron source using Trident

Scientific achievement

- A team of Los Alamos researchers supported a final campaign to use the Trident laser to produce neutrons, contributing their multidisciplinary expertise to assess experimentally if laser-driven neutron sources can be useful for MaRIE.
- Based on initial results, using intense short laser pulses to accelerate ions to energies sufficient for fast neutron production can provide focused, short pulse (<60 ns depending on time-of-flight) neutrons for applications.



Participants included LANSCE/Technical University – Darmstadt, P-24, NEN-1, MST-8, P-27, AET-6, University of California, Berkeley/MST-8, Tel Aviv University, Dresden HZDR. For details see *LANSCE Pulse,* Summer 2017.

Significance and impact

- MaRIE is the Lab's proposed experimental facility for the study of matter-radiation interactions in extremes.
- Neutrons provide a radiographic probe that is complementary to x-rays and protons and can address imaging challenges not amenable to those beams.

Research details

- Research funded as part of an initiative to assess if laser-driven neutron sources can be used for MaRIE. Development of neutron imaging detectors was funded by Enhanced Surveillance, Nuclear Energy, and a Laboratory capability development grant.

Proton Radiography Facility at LANSCE

Using LANSCE to gain insight into a dinosaur's skull

Scientific achievement

- Researchers used LANSCE's unique neutron imaging and high-energy x-ray capabilities to expose inner structures of the fossil skull of a 74-million-year-old tyrannosauroid dinosaur, nicknamed the Bisti Beast.
- Is the highest-resolution scan of a tyrannosaur skull ever done.

Significance and impact

- Bisti Beast skull is the largest object to date for which full high-resolution neutron and x-ray CT scans have been performed at LANL and required innovations to image entire skull and to handle image reconstruction from resulting large data sets.
- Advances state of the art in imaging capabilities at Los Alamos and is already proving useful in imaging larger programmatic items related to Lab's national security mission.

Participants included New Mexico Museum of Natural History and Science, University of New Mexico, University of Edinburgh, AET-6, P-27, MST-8. For details, see *LANSCE Pulse,* Summer 2017.

Research details

- Work funded by LANL capability development funds from AET and from NNSA Science Programs, and through a grant to UNM/NM Museum of Natural History staff through the New Mexico Consortium.

Nuclear reaction measurements at LANSCE: toward better calculations of nuclear criticality

Scientific achievement

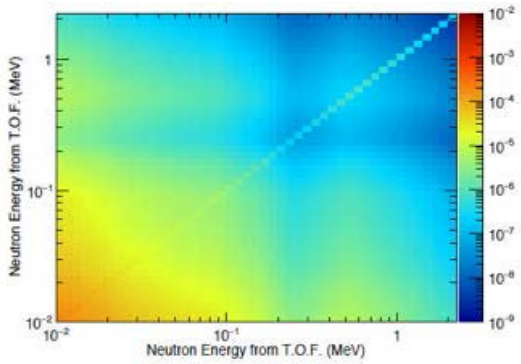
- Two experimental efforts at LANSCE made major advances in delivering precise nuclear data for plutonium in support of Science Campaign 1.

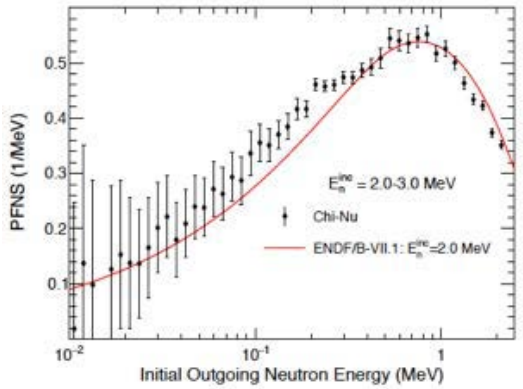
Significance and impact

- Criticality is an important concept in nuclear technologies. To accurately calculate criticality in a device, basic nuclear reaction data describing the chain reaction are needed.
- Chi-Nu collaboration measures prompt fission neutron spectrum; TPC collaboration addresses fission cross section.

Research details

- Research performed at WNR at LANSCE.
- Work on nuclear data for criticality scheduled to continue through next few years. TPC is switching towards a plutonium fission cross section relative to neutron scattering on hydrogen, which is the most accurate standard available for this type of measurement and which enables researchers to reach the target % uncertainty level. Chi-Nu will use high-energy array to improve understanding of the part of the PFNS that is above 2 MeV. A new instrument, LENZ (Low-energy n,z), has been developed and commissioned to measure another type of nuclear reaction, neutron-induced light charged-particle emission, some of which is also relevant for criticality.





For details, see *LANSCE Pulse,* Summer 2017.

Isotope Production Facility at LANSCE

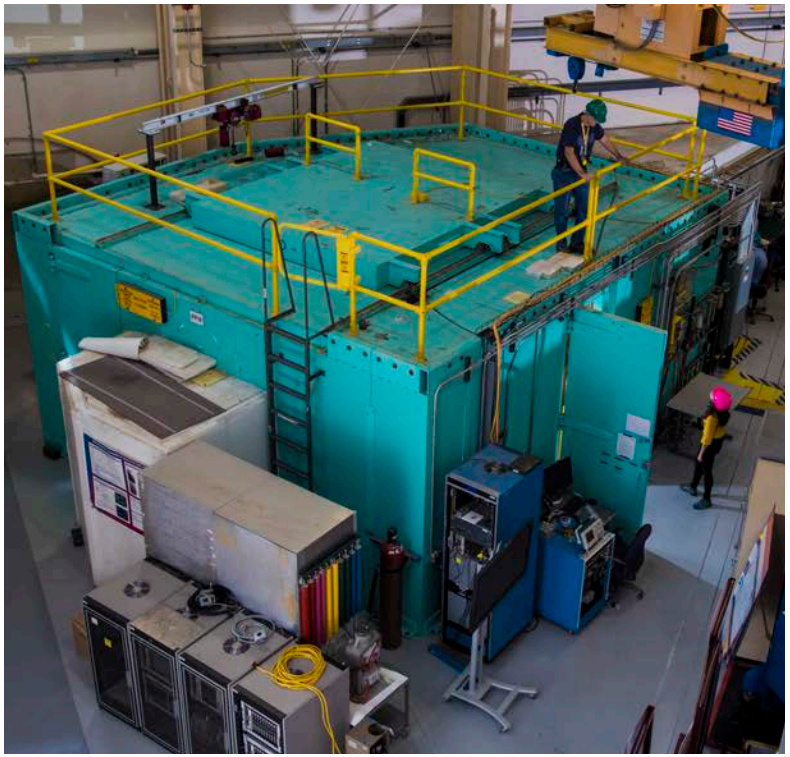
Isolating microstructural effects on the observed strength of additively manufactured stainless steel

Scientific achievement

- In situ heat treatment measurements completed on SMARTS at LANSCE provide a better understanding of how different additively manufactured (AM) microstructural features can be controlled to produce predictable properties.

Significance and impact

- Quasi-static mechanical strength of AM materials often exceeds that of traditionally wrought counterparts. AM process results in a distinct microstructure in 304L steel, including unique grain morphology, high dislocation density, and ferrite content—all of which affect strength.
- Precise measurements can provide a recipe to design microstructure-aware process models that enable science-based qualification of AM components.



Participants included MST-8; Sandia National Laboratories.
For details, see *LANSCE Pulse,* Summer 2017.

Research details

- Lujan Center provides unique hardware and software capabilities for rapid bulk microstructural characterization to accelerate qualification of AM materials. Results are an example of decades of experience with large datasets that provide foundation for data analysis of MaRIE experiments in material discovery.
- Research funded by Science Campaigns 1 and 2.

International Academy for Women of the Americas tours LANSCE

Scientific achievement

- Members of the Innovation Academy for Women of the Americas, a first-of-its-kind program bringing together undergraduate student women from New Mexico and Mexico majoring in the fields of science, technology, engineering, mathematics, or architecture (STEM+A), recently toured LANSCE.

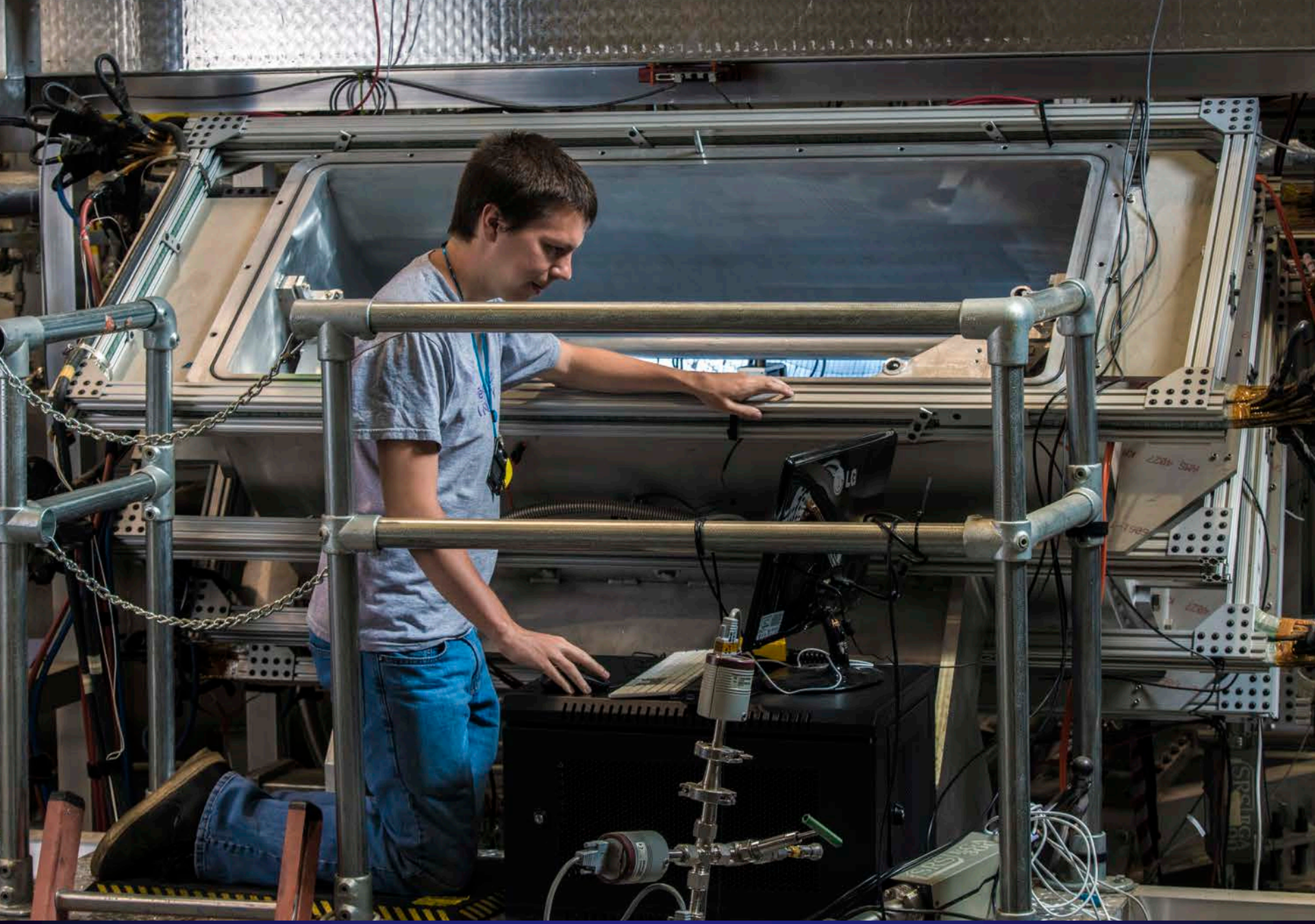
Participants included SPO-SC, P-23, ADEPS, MST-7, MST-8, Innovation Academy for Women of the Americas. For details, see *LANSCE Pulse,* Summer 2017.

Significance and impact

- Tour was part of their months-long course of intensive research, career mentoring, and leadership training at the academy, a partnership between the University of New Mexico, Universidad La Salle México, and Universidad Autónoma de Yucatán.

Research details

- Academy aims to increase bidirectional student mobility between United States, Mexico, and the Americas through an innovative academic and career development program for underrepresented, minority, and indigenous women in STEM+A fields.
- Group met with Los Alamos researchers as they toured LANSCE's Isotope Production and Proton Radiography facilities and learned about astrophysics and Los Alamos contributions to the High-Altitude Water Cherenkov Observatory (HAWC).



Ultracold Neutron Facility at LANSCE