PHYSICS FLASH

Fall 2023
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Transforming DUNE into a precision detector

LANL-led team installs first-ever calibration system in DUNE prototype

A Los Alamos-led team has reached a major milestone with the installation of the first full-scale prototype calibration systems for DUNE, the Deep Underground Neutrino Experiment. DUNE, DOE's Office of High Energy Physics highest priority project, will study neutrino oscillations in an effort to answer questions about the evolution of the universe and nature of matter. In particular, DUNE aims to understand if neutrinos violate certain fundamental symmetries that could help explain the observed matter-antimatter imbalance in the universe.

Led by Sowjanya Gollapinni (Applied and Fundamental Physics, P-2), Los Alamos researchers and external colleagues assembled and installed two full-scale prototypes of DUNE's ionization laser system in ProtoDUNE, a demonstration neutrino detector effort underway at CERN, the European Organization for Nuclear Physics lab, in Switzerland.

"This is a result three years in the making and represents a huge team effort," said Gollapinni, the technical leader for DUNE's Calibration and Cryogenic Instrumentation Consortium. "This is the first-time calibration instrumentation has been developed and is being tested for DUNE and marks an important milestone both for Los Alamos and DUNE."

Precise measurements require precise tools

DUNE consists of a near detector at Fermilab in Illinois and a far detector to be constructed 807 miles away, a mile underground, in Lead, South Dakota. Combined, the detectors will hold nearly 70,000 tons of ultrapure liquid argon. DUNE's unprecedented size and deep underground location makes calibration a challenge. To make the precise measurements required, Gollapinni developed a novel calibration system that uses high intensity class-IV laser beams to ionize liquid argon inside the detector and the resulting signals to gauge the spatial and energy response from the detector.

"The ionization laser system is the main calibration system of DUNE and is critical to making precise measurements of neutrinos and unlock some of the universe's most fundamental mysteries," said Mattia Fani, a P-2 postdoctoral researcher working on the project at CERN.

The calibration team on the roof of the ProtoDUNE detector during installation of the laser calibration system at CERN, Switzerland. From left: Jan Boissevain, Sowjanya Gollapinni, Mattia Fani, Eric Renner, David Rivera, Vladimir Solovov, Jose Maneira, and CERN crane operator Helder Fernandes.

The system will also help pinpoint issues during operation and aid the data acquisition effort. "For example, the laser calibration system will allow us to map the electric field and correct for field imperfections in our reconstructed data," said David Rivera, a P-2 Director's postdoctoral fellow.

The team plans to demonstrate the feasibility of the ionization laser calibration system in the 800 tons of liquid argon at ProtoDUNE as it gears up for phase-II operations later this year. Next, they plan to scale up the calibration systems to provide coverage for a fiducial mass of 10,000 tons in preparation for DUNE.

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> This success represents all the great work that is taking place within Physics Division and is a demonstration of the excellent science and engineering that is executed. I'm very proud of your accomplishments. You should also be proud. Well done!

From Frank's desk . . .

Recently, we have had many discussions regarding the safe introduction of new staff to Physics Division. These discussions underscore the need for each of us to provide the opportunity for open communication. Management, mentors, PICs (persons in charge), and experienced colleagues have a responsibility to encourage a questioning attitude. This is nicely described in the Laboratory's description of the Safe Conduct of Research (SCoR) principles (int.lanl.gov/org/ddops/aldeshq/integration-offices/scor-in-action/). I encourage you to explore this web page. It contains useful descriptions of the SCoR principles and provides links to many resources. New members of the division are expected to raise safety concerns prior to and while performing work. The division values an environment where such open conversations can take place, and it is up to each of us to foster and participate in these discussions. We will succeed by welcoming opinions that might be different from our own. Through this open communication we will improve our safety and our science.

I recently had opportunity to review all the awards received by Physics Division members in FY23. Each is recognition of a great accomplishment and testament to the great science performed by the award winner. I was thrilled to count 58 awards. This is truly remarkable. This success represents all the great work that is taking place within Physics Division and is a demonstration of the excellent science and engineering that is executed. I'm very proud of your accomplishments. You should also be proud. Well done!

In the past, the division office has met with each team in the division to learn about its science and research as well as hear concerns and comments from the team members. I am resuming this tradition and have scheduled meetings with each of your teams. I look forward to our discussions.

Frank Merrill, *Physics Division Leader* ■

As we look for more ways to recognize these small things, I invite you to join me in calling them out with a quick "thanks" or "nice job" to your colleagues when you see them happen—it goes a long way!

From Keith's desk . . .

Recognizing the small things that go right

Over the five years I've served as a group leader in Physics Division, I'm proud of the amazing work done by those in the division and groups I've led. Through close collaborations, hard work, technical skill, and extraordinary teamwork, the successes of the division continue to deliver science and engineering triumphs in support of our many missions.

I've also seen times when we've had problems and been impressed by how quickly we assess the issues, learn, and make improvements. What I see is that we are very good at recognizing and discussing both extremes: the great and the not so great.

Recently, P-1 held small group discussions to look at our work culture: what was good, what needs improvement, and what are the obstacles. Many common themes arose, but one that struck me was "How do we recognize the small things that go right?" These are things like the extra few minutes someone takes to walkdown the path between the elevator and the lab to look for new obstructions before moving the pallet jack with a load; the fast check for the ETL (Electrical Testing Laboratories) label on a piece of new electrical equipment that means it meets the National Recognized Testing Laboratory requirement; the quick review of a foreign national postdoc's authorized building list to make sure the training location he or she is headed to is on it; the reminder to check for watches and phones that catches that errant device as you enter a limited area.

These things happen every day and keep us all safe and secure and make us more efficient and productive. As we look for more ways to recognize these small things, I invite you to join me in calling them out with a quick "thanks" or "nice job" to your colleagues when you see them happen—it goes a long way! I will try to celebrate each of you and everything you do right every day. Let's be proud of our great work, even in the small things!

Keith Rielage, *Dynamic Imaging and Radiography Group Leader* ■

Durocher recognized for engaging presentation at Lab's 'Science in 3'

Postdoctoral researcher Mora Durocher (Dynamic Imaging and Radiography, P-1) received one of the three top prizes at this year's "Science in 3" event. The career development event, organized by the Postdoc Program Office, challenges participants to clearly and effectively present their research to a general audience in three minutes or less.

In her talk, Mora Durocher described the compression at work in a NIF implosion as similar to reducing a basketball to the size of a pea.

In "A glimpse at stellar cores the size of dust particles," Durocher described how a key diagnostic is used to analyze inertial confinement fusion (ICF) implosions at the National Ignition Facility (NIF). At NIF, a capsule the size of a flea is compressed until it reaches the size of speck of dust. As the capsule ignites under extreme temperature and pressure, a neutron imaging system captures neutrons, x-rays, and gamma-rays emitted from that process at a scale that would correspond to watching a 32-inch TV screen from 100 miles away. Durocher's work involves using raw image outputs to reconstruct the capsule at the time of its ignition to improve shots.

Durocher defended her PhD in astroparticle physics at Italy's Gran Sasso Science Institute in 2018. Upon joining Los Alamos as a postdoctoral researcher a year later, she worked on the High Altitude Water Cherenkov observatory as a member of P-1's gamma-ray astrophysics team before joining the Advance Imaging Team in 2022. Durocher is mentored by Verena Geppert-Kleinrath (P-1).

Mohamed presents on low-mode symmetries

Also representing Physics Division was Zaarah Mohamed (Thermonuclear Plasma Physics, P-4). In "Controlling low-mode asymmetries in double shell inertial confinement fusion experiments at the National Ignition Facility," she described recent experiments with different hohlraum and laser drive conditions that could potentially be varied to mitigate potential mechanisms that lead to failure of NIF implosions. Mohamed received her PhD in physics from the University of Rochester's Laboratory for Laser Energetics, where she focused on gamma- and neutron-based diagnostics applied to direct-drive ICF implosions performed at the OMEGA laser facility. She is mentored by Yongho Kim, Paul Keiter, and Eric Loomis (all P-4).

Zaarah Mohamed

Also receiving top "Science in 3" awards were Theresa Kucinski (Center for Integrated Technologies, MPA-CINT) and Daniel Trettel (Microbial and Biome Science, B-IOME). ■

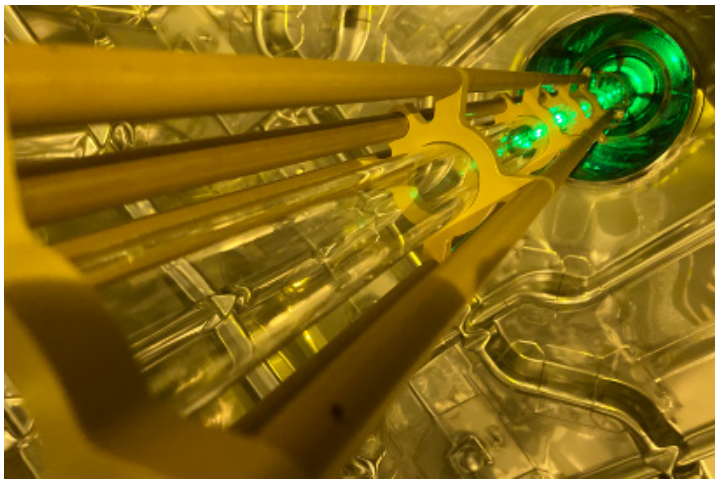
Transforming cont.

The work supports the Lab's fundamental science mission and Nuclear and Particle Futures capability pillar. The work was funded by Laboratory Directed Research and Development and DOE Office of Science High Energy Physics programs.

Researchers: Sowjanya Gollapinni, David Rivera, Mattia Fani, Jan Boissevain, Vern Sandberg, Adam Martinez, and Mark Ross-Lonergan (Applied and Fundamental Physics, P-2); Eric Renner and Walter Sondheim (Nuclear and Particle Physics and Applications, P-3); Jose Maneira, Nuno Barros, Rui Alves, and Vladimir Solovov (Laboratory of Instrumentation and Experimental Particle Physics, Portugal); Filippo Resnati (CERN, Switzerland); Glenn Horton-Smith and Lauren Carroll (Kansas State University); and Jelena Maricic and Ranjan Dharmapalan (University of Hawaii).

References: "Volume IV. The DUNE far detector single-phase technology," *JINST*, 15, (2020); "First results on ProtoDUNE-SP liquid argon time projection chamber performance from a beam test at the CERN Neutrino Platform," *JINST*, 15, (2020).

Technical contact: Sowjanya Gollapinni ■



Green light from a visible laser passes through the laser periscope inside the ProtoDUNE cryostat. The low power green laser is used to test the straightness of the nearly four-meter-long optical periscope and alignment between various sections of the periscope.

LANSCE project takes home gold pollution prevention award

Reusing radioactive shielding in the installation of new mercury shutters on two flight paths at the Los Alamos Neutron Science Center (LANSCE) has earned the "Shields Up!" team a gold 2023 Patricia E. Gallagher Environmental Award.

The annual awards, of which gold is the highest level, recognize individuals or teams whose efforts have minimized waste, conserved natural resources, or prevented pollution.

The project reused 95% of the shielding material, with the remaining disposed of as low-level waste. As a result, the team reduced the need to manage, dispose, and transport radioactive waste. The LANSCE flight paths are used for a variety of experiments supporting national security science.

The team included Kelly Knickerbocker, Michael Mocko, Mel Borrego, and Christopher Varela (Applied and Fundamental Physics, P-2); Beth Frye (Project Execution Office, PEO); Danny Velarde (Construction Managers Core, CM-CORE); Larry Leonhardt (Construction Superintendents Core, CM-CSCORE); Matthew Antezana (Waste Generator Service, WM-WGS); Anthony Gould, Emiliano Calabaza (Logistics Central Shops, LOG-CS); and Jack Smith, Marcos Romero, and Fermin Maes (Logistics Heavy Equipment Roads and Grounds, LOG-HERG). ■

Making the Lab a more inclusive place

You can help make LANL a more inclusive place for persons with disabilities by keeping the following tips in mind.

- Ensure accessibility: Accessibility is a common challenge for persons with disabilities. Ensure that workspaces and nearby services (e.g., restrooms, lactation pods, parking, etc.) are accessible, and when hosting in-person or virtual meetings, make sure to refer to accessibility checklists like those from Section 508 or Cornell. Creating a handout? Confirm that your PDF is accessible and complaint with Section 508 (it's the law!); refer to this helpful guide for more information.
- Be respectful: Some disabilities are invisible! Don't assume that your co-workers are able to hike, drink, take the stairs, focus while in noisy settings, etc. Also, be sure to use the correct language when referring to persons with disabilities, both verbal and written.
- Be considerate: Some of your colleagues may have care responsibilities or a flexible work schedule to accommodate their disabilities, so try to give as much notice as possible for work-related requests.

Learn more! The Lab's DiverseAbility ERG has a number of resources on and for persons with disabilities, including member interviews and what it means to have a disability. You can also learn more through the Americans with Disabilities Act (ADA). ■

Celebrating service

Congratulations to the following Physics Division employees who recently celebrated a service anniversary:

Adam Martinez, P-2	25 years
Jeremy Payton, P-1	25 years
Anemarie DeYoung, P-2	20 years
Yongho Kim, P-4	20 years
Jacqueline Mirabal, P-2	20 years
Jeremy Danielson, P-1	15 years
Paul Keiter, P-4	15 years
John Charonko, P-2	10 years
Ramon Leeper, P-2	10 years
James Harding, P-1	10 years
Theodore Perry, P-4	10 years
James Wernicke, P-1	10 years
Brian Cata, P-1	5 years
Christopher Fairbanks, P-2	5 years
Sean Kuvin, P-3	5 years
Elise Tang, P-1	5 years

PHYSICS FLASH
SINCE 1943

Published by the Physical Sciences Directorate.

To submit news items or for more information, contact Karen Kippen, ALDPS Communications, at 505-606-1822 or aldps-comm@lanl.gov.

For past issues, see www.lanl.gov/org/ddste/aldps/physics/physics-flash-archive.php.

Los Alamos NATIONAL LABORATORY

NNSA National Nuclear Security Administration

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Liu wins DOE Early Career Research Award

Multiyear funding supports research into understanding the origin of hadron mass

Nuclear physicist Kun Liu is the recipient of a DOE Early Career Research Award.

Researchers in universities and DOE national laboratories compete for awards under the DOE Office of Science Early Career Research Program. The funds support outstanding, early career scientists, stimulating their careers in the disciplines funded through Office of Science programs.

A member of the high energy nuclear physics team in Nuclear and Particle Physics and Applications (P-3), Liu aims to probe the emergent hadron mass through pion structure measurement at the AMBER experiment.

Understanding the origin of the hadron mass, which constitutes 99% of the visible universe, is one of the central goals of nuclear physics. The vast majority of the mass is believed to come from the strong force that tightly binds quarks and gluons together, so measuring the quark and gluon structure of the hadron will help explain how the hadron mass emerges through the strong interaction. In contrast to the abundant data on the proton structure, data on the pion structure are very scarce and outdated. This project will study the internal structure of the pion by colliding high-energy pions at the AMBER experiment at CERN by developing a detector to improve the existing AMBER spectrometer. That will enable the best-ever measurement of the pion structure, helping researchers understand and constrain the mechanisms leading to the emergence of the hadron mass.

"Receiving the DOE Early Career Award is an incredible honor, propelling our research on the internal structure of the pion and expanding our comprehension to shed light on the fundamental origins of our visible universe," Liu said.

Liu joined Los Alamos as a graduate research assistant, received his PhD from Peking University in China, became a Laboratory postdoc, and then converted to a staff scientist. His research interests center on understanding the inner structure of the nucleon. Since joining the Laboratory, he has primarily worked on the fixed target Drell-Yan experiments at Fermilab, probing the internal structure of the proton.

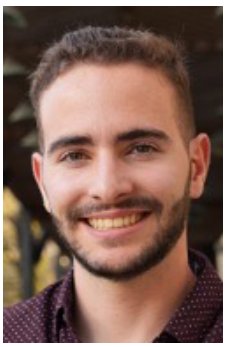
Other Los Alamos Early Career Research Award recipients include Rich Fiorella (Climate, Ecosystems, and Environmental Science, EES-14), for methods to improve modeling of coastal-urban environmental change using stable water isotope ratios and numerical tracers; Andrey Lokhov (Applied Mathematics and Plasma Physics, T-5) for improving the mathematics underpinning machine learning for many-body quantum physics, power grids, turbulence, and field theories; and Yu Zhang (Physics and Chemistry of Materials, T-1) for boosting multiscale modeling capabilities for molecular quantum electrodynamics on DOE exascale computers.

Technical contact: Kun Liu ■

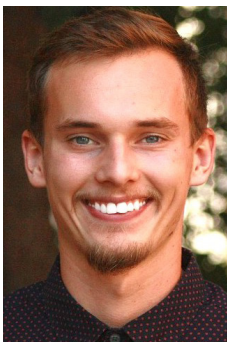
Bichon, Cuesta, Schmidt earn awards for Student Symposium presentations

Physics Division's Luis Bichon, Miguel Chacon Cuesta, and John Schmidt were recognized for their outstanding presentations at this year's Student Symposium. The annual program provides students the opportunity to gain professional presentation experience and network with other LANL personnel and students. The Lab's Partnerships and Pipeline Student Programs Office hosts the event.

Bichon



Cuesta



Schmidt

Bichon (Nuclear and Particle Physics and Applications, P-3) presented, in the physics category, "Elliptic flow measurement of J/ψ in PHENIX Run14 AU+AU at $\sqrt{s_{NN}}$ = 200 GeV." Bichon, a graduate student in the department of physics and astronomy at Vanderbilt University, is mentored by Cesar da Silva (P-3).

Cuesta (Thermonuclear Plasma Physics, P-4) presented, in the engineering category, "Finite element analysis of Phelix lower compression ring." Cuesta, an undergraduate student studying robotics engineering at Arizona State University, is mentored by Vincent Garcia (P-4).

Schmidt (Dynamic Imaging and Radiography, P-1) presented, in the physics category, "Unique magnet mapping systems for beam optics development." Schmidt, who earned his bachelor's degree in physics and applied mathematics from Iowa State University, is mentored by William Meijer (P-1).

Also presenting from the Physics Division were Eibhleann Hinrichs (P-1) and Jacob Petersen, Gabriel Serrano, Svetlana Backhaus, and Robert Dwyer, David Nystrom (all P-4). ■

Da Silva, Napora honored at student, mentor award ceremony

For their positive impact to the Laboratory, Cesar da Silva and Julie Napora (both Nuclear and Particle Physics and Applications, P-3) were recently recognized at the Lab's annual Student and Mentor award ceremony. Both are members of P-3's High Energy Nuclear Physics team.

Staff scientist Da Silva (right) received a distinguished mentor performance award. He was nominated by Julie Nelson, Arielle Platero, Jade Martinez, Gwendolyn Tsosie, Victoria Nofchissey, Elaina Saltclah, and Matthew Durham. Da Silva is co-investigator on a program to bring Indigenous women to nuclear physics, of which Napora was a member. According to his nominators, "[Cesar] has carved out a space for us to thrive in an environment we didn't think we had access to."

Recent Fort Lewis College graduate Napora (far right) received a distinguished student performance award. According to her nominator Krista Smith (P-3), Napora "has made exceptional contributions to our team's research in nuclear physics, represented the Lab extremely well in national and international meetings, and helped us attract new students and grow our mentoring program." Napora now heads to the University of Wisconsin to pursue her PhD in mechanical engineering.

The award ceremony is hosted by the Lab's Partnerships and Pipeline and Student Programs offices and the Student Programs Advisory Committee. ■

HeadsUP!

Coordinated effort retools machine shop

Remodel supports expanded mission-essential Physics Division operations

The machine shop's floors have a gloss to them. Overhead, bright lights reflect that gleam. Modern machining equipment is positioned throughout, giving workers ample space to maneuver. A fresh wood-topped work bench divides the room, providing a work surface and storage for hand tools. On the back wall is a smooth granite countertop for use when precisely measuring newly made parts.

The remodeled machine shop, on the Los Alamos Neutron Science Center (LANSCE) mesa, provides critical custom-fabricated parts for Physics Division experiments. The transformation is the result of a concerted effort by Physics staff, in coordination with members of LANSCE-Facility Operations (LANSCE-FO).

"I'm very excited with what we've done here," said Research Technologist Ruben Manzanares (Dynamic Imaging and Radiography, P-1), who led the effort. "The renovation reduces the need to outsource basic machining work, which improves efficiency and benefits our experiments. Instead of waiting a week for a new part, we can just go down to the shop and make it to exact specifications ourselves."

This upgrade is an example of the Laboratory's 5S + Safety initiative in action. To turn underutilized workspace into a safe, uncluttered workplace, the team planned the removal of old heating units and salvaged unusable equipment. They worked with LANSCE-FO and Building Management to repaint the walls and refinish the floors. They set in order new tools, cabinets, and machining equipment, and standardized practices to sustain the improvements.

The renovated 692 square-foot-space features the essentials of a machine shop.

Plans call for installing compressed air to ensure machines remain free of debris during use. The building's electrical system will be revamped to make use of space currently without electrical power. The increased capacity will eliminate hazards involved with moving machines and extending electrical cords across walkways.

The renovation team includes Manzanares, Louie Chacon, Brian Cata, Jason Medina, Steven Sandoval, Will Meijer, Larry Rodriguez, and Jeremy Payton (all P-1); Adam Martinez, Jackie Mirabal (Applied and Fundamental Physics, P-2); Mark Makela, Wade Uhrich, Walt Sondheim (Nuclear and Particle Physics and Applications, P-3); Justin Jorgenson, Ezra Hutterer, Tom Sedillo (Thermonuclear Plasma Physics, P-4); Christine War, Rayann Mora (Physics Division Office, P-DO); Ross Vargas (Property Management, LOG-PM); and Manny Archuleta, Jesse Sanchez (LANSCE-FO). NNSA's Office of Experimental Sciences and the Physical Sciences Directorate funded the renovation.

Technical contact: Ruben Manzanares ■