A Look into Our University Partnership Cohort

A Message to Our Universities

We hope this message finds you well and that you had a successful fall semester. As we transition into the new year, our team is excited to share our reflections on the continued progress, accomplishments, and momentum we have built together through the Securing Top Academic Research & Talent at Historically Black Colleges & Universities (START HBCU) program.

Each of our university partners - Alabama A&M, Florida A&M, Norfolk State University, North Carolina A&T, and Prairie View A&M - continue to strengthen their collaboration with Sandia, and we are grateful for the dedication and commitment demonstrated across our joint efforts. Moving forward, we will share a combined START HBCU newsletter to highlight achievements across all partner universities in one place. Our goal is to expand awareness of the incredible work happening at each university, foster greater visibility, and open the door to new opportunities for cross-university collaboration.

We look forward to building on this strong foundation for the long term. In this 2025 Volume 2 update, we are proud to highlight several achievements from the past summer and fall. The support from our Sandia team, including our Deputy Campus Partnership Managers - Patrice Gregory, Alex Belianinov, Monica Salter-Williams, and Dennisa Thomas - as well as our Deputy and Campus Executives and our esteemed faculty collaborators, plays an essential role in advancing our shared mission to expand the impact of the START HBCU program.

Thank you all for your continued partnership!

Celebrating our University Partner Achievements

Fall 2025-Spring 2026

Bonanza Capstone Project Support:

We are pleased to highlight the ongoing bonanza capstone Mechanical Engineering project for the fall 2025-spring 2026 academic year, with mentorship from Sandian Devin Dunaway in collaboration with Dr. Xiaobo Peng. This design challenge invites teams of students, including Zoe Hardeman, Tyrell Oliver, Christian Watts, Kamea Hill, Marquis Butler, and Remington Felder to design, build, and test a Nondestructive Mechanical Counterfeit Bolt Detection System, aimed at ensuring safety and quality in industrial applications. The project emphasizes the development of a system that is portable, efficient, nondestructive, cost-effective, and scalable, with the capability to accurately identify counterfeit bolts. This project provides students with both hands-on experience in mechanical engineering and addresses a critical need in the industry.

Fall 2025-Spring 2026

Mentorship for PVAMU Capstone Project:

Sandian Madison Helmstetter is providing mentorship for a capstone project in collaboration with Dr. Noushin Ghaffari. The students at Prairie View A&M are engaged in a joint effort between two teams to demonstrate both attacking and defending large language models (LLMs) and their surrounding systems. This project involves eight talented students: Xjiani Miller, Javion Looney, Daizhaun Jordan, Brittney Smith, Chandler Parks, Matthew Mosely, Mose Willis, and Royce Texada, who will be working on this effort through spring 2026.

November

Guest Lecture at Prairie View A&M:

Sandian Mo Payne delivered a guest lecture at Prairie View A&M for Dr. Osborne-Lee's Nuclear Forensic Analysis class. During his technical talk, Mo highlighted the goals of nonproliferation and discussed the current challenges facing nonproliferation regimes. The lecture provided an engaging platform for students to ask questions and explore the implications of nonproliferation efforts in today's world. Mo's unique perspective from his work at Sandia fostered a dynamic conversation with the students.

September

Panthers Invent 2025:

START HBCU partnered with Prairie View A&M and its Research & Innovation (R&I) team to host Panthers Invent 2025. This event challenged students to solve real-world national security design problems in 48 hours, with mentorship from Sandia subject matter experts. This year's theme, **"Harnessing Technology to Address Emerging Threats,"** inspired the teams to apply their creativity and problem-solving skills to challenges in deep learning for anomaly detection, AI-powered phishing detection, data-driven acoustic emission analysis, and predicting radiation-induced damage in microelectronics. Team Abbott Elementary, consisting of Carl Simon, Christian Abbott, Donald Okonkwo, Jacob Range, Myles Martin, and Naji Potier, won 1st place for their earthquake detection system design, which provides early warnings by sensing abnormal ground vibrations and notifying communities in real time.

September

Thesis Presentations on Laboratory Directed Research Development Project (LDRD):

This joint research project, "Bulletproofing Bacteriophage Biomanufacturing," led by Sandia PI Kelly Williams and University PI Noushin Ghaffari, advanced our understanding of bacterial mobile DNA sequences. The initiative focused on clustering these sequences to explore their effects on bacterial phenotypes and to identify transposable DNA elements in *E. coli* and their impact on gene function. Their primary goal was to develop phages from mouse gut bacteria into gene-delivery vectors to address issues like lactose intolerance and enhance gut microbiomes. Dr. Ghaffari and her student team worked on applying software developed in core research to *E. coli*. This involved identifying new transposable elements, examining various clustering algorithms (including hierarchical clustering, HBDSCAN, and chunk-wise clustering), developing a reduction algorithm to streamline the input dataset, and discovering novel transposable elements.

Student contributions were invaluable, with Lijie Zhou and Rabeya Nazara completing their theses on the *E. coli* clustering project. Additionally, student Jason Martin engaged in a transposable element novelty study and implementing chunk-wise clustering techniques. The team's work gained recognition, with a publication titled "Transposon Discovery and Large-Scale Analysis of Relations Using Unsupervised Machine Learning Methods," authored by R. Nazara, J. B. Martin, and K. P. Williams, which was presented at the Galaxy Bioconductor Community Conference (GBCC) 2025 at Cold Spring Harbor Laboratory in June 2025. Although project funding has concluded, PIs Kelly Williams and Noushin Ghaffari will continue their work through the spring, with students remaining involved. Plans for additional publications and efforts to automate analysis for developing transposable elements in a more accessible format are underway.

September

Collaborative Initiative in Nuclear Security and Semiconductor Research:

The Texas A&M University System Nuclear Security Office (NSO) has initiated an effort to foster the development of research ideas at Prairie View A&M University, and Texas A&M University-College Station that align with the strategic priorities of Sandia National Laboratories and the TAMUS Semiconductor Institute. Following several collaborative discussions among the involved institutions, the NSO has funded two new research initiatives! These collaborations offer valuable opportunities for our university partners to engage in cutting-edge projects, including the Radiation Informed Phase Lock Loop project, which aims to create a radiation-hardened design, and the Improving TID Tolerance of 3D NAND Memory project, focused on enhancing tolerance for space systems. It is anticipated that the seed funding provided

by TAMU NSO will generate research outputs that will propel these outstanding collaborations to even greater opportunities. This effort once again demonstrates the effectiveness of our partnerships and the strategic alignment of our goals.

August

Visit from the TAMU's Nuclear Security Office:

Sandia National Laboratories was pleased to welcome Evelyn Mullen, the Associate Vice Chancellor for the Texas A&M University System (TAMUS) Nuclear Security Office (NSO), for her inaugural visit to the labs in this role. Hosted by Campus Partnership Manager Anthony Sanders and former Deputy Campus Partnership Manager James Headen, the visit underscored our partnership with Prairie View A&M University and facilitated discussions on pooling our institutional resources to enhance future collaborations among all three institutions. A key focus of the discussions was semiconductor technology and energy innovation, where aspirations were shared for seeding collaborative research opportunities, hosting internships, and creating workforce development activities for PVAMU students in these emerging fields.

July

Innovative Research in DNA Editing Enzymes (LDRD):

Prior to the latest developments shared in September, University PI Noushin Ghaffari from Prairie View A&M University presented her team's research on advanced algorithms for discovering new DNA-editing enzymes at the Galaxy Bioconductor Community Conference, held at Cold Spring Harbor Laboratory. This research was part of a Laboratory Directed Research and Development (LDRD) project in collaboration with Sandia PI Kelly Williams and six Computer Science graduate students from Prairie View A&M University. The project integrated computational techniques with biological research, enhancing the efficiency and accuracy of enzyme discovery while providing valuable training in computational biology, high-performance computing, and data analytics using R and Python.

Fall 2025-Spring 2026

Sandia's DREA²M Mission Campaign Supports FAMU Capstone Project:

As part of Sandia's LDRD Mission Campaign known as DREA²M (*Digitally Realized and Enabled Agile Advanced Manufacturing*), Sandia is sponsoring a senior design capstone project led by Dr. Tarik Dickens. This project will explore the feasibility of using Additive Manufacturing (AM) techniques, specifically laser powder bed fusion and directed energy deposition, to produce stainless steel components. The aim is to tackle the challenges of sourcing essential metal alloys, particularly 316 stainless steel, through traditional manufacturing methods. To support the students, Sandia engineers Robert Craig (former alumni) and Elliott Fowler, will serve as mentors, dedicating an hour each week to interact with the students and guide them throughout the project.

December

Artificial Intelligence Discussion at FAMU:

Florida A&M University took important steps to integrate artificial intelligence (AI) across its campus as part of its pursuit of R1 research status. President Marva Johnson hosted a forum with department heads to discuss AI research and implementation. Sandia contributed to this discussion, with Justin Newcomer from Sandia sharing insights on the lab's AI portfolio and its applications in national security to enhance collaboration and awareness. FAMU alumna Dr. Renata Rawlings-Goss, now the executive director of Georgia Tech's Institute for Data Engineering and Science, emphasized AI's role in improving efficiency and student services. Click here to read more.

November

Support on Advancing Materials Science Proposal:

Mohan Karulkar, the LDRD DREA²M Mission Campaign Manager - provided support for a proposal submitted by Dr. Tarik Dickens at Florida A&M University aimed at advancing research in materials science. This project, titled **"Dissimilar Interface Materials Accelerator,"** focuses on studying the interactions between metals and polymers while enhancing testing capabilities and educational opportunities in science, technology, engineering, and mathematics (STEM). Mohan's work with DREA²M focuses on resilience, ensuring that energy systems and manufacturing processes can withstand disruptions from natural disasters, cyber threats, and other challenges. The DREA²M campaign unites experts from diverse fields, including engineering, materials science, and data analytics, to develop innovative solutions that adapt to evolving conditions and demands. By fostering collaboration with academic institutions, industry partners, and government agencies, DREA²M aims to drive research and development that leads to practical applications and meaningful real-world impact.

November

Deputy Campus Partnership Manager (DCPM) Guest Lecture:

FAMU Deputy Campus Partnership Manager, Alex Belianinov from Sandia, collaborated with Dr. Tarik Dickens to deliver a guest lecture series for his Fall 2025 Industrial Engineering class at Florida A&M. His series explored the marvels of digital technology, offering students a deeper understanding of the latest advancements and a hands-on opportunity to experience how they can be applied in real-world scenarios.

September

A Visit from FAMU's Industrial and Manufacturing Engineering Department:

Our team also hosted a site visit for the Department Chair of the Industrial and Manufacturing Engineering Department at FAMU, Dr. Zeng. His visit included multiple tours of our facilities, showcasing the innovative work being done here at Sandia and at the Center for Integrated Nanotechnologies (CINT) Core Facility. The visit revealed strong partnership potential with worked pioneered within the FAMU/FSU Joint College of Engineering and teams in the Sensors and Textiles Innovatively Tailored for Complex, High-Efficiency Detection (STICH) lab at Sandia.

September

Advancements in Digital Manufacturing (LDRD):

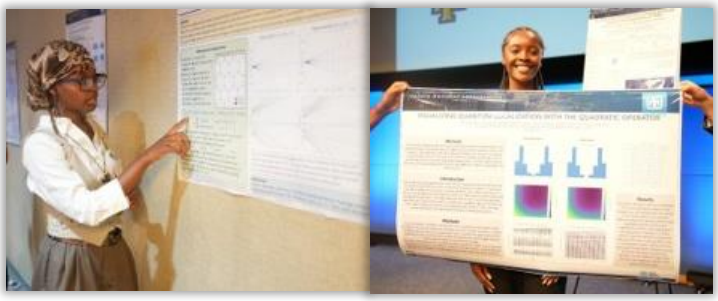
This Complementary LDRD project, **"Beyond Magic Barrels: Digital Manufacturing for Crystallization, Process Development, and Optimization of** Explosive Materials," was led by Sandia PI Rekha Rao and University PI Leo Liu, with contributions from students Uriah Philips (FAMU PhD), Connor Willis (FSU PhD), and Sinani Kperogi (Georgia Tech REU). The project investigated how materials crystallized when in motion, using advanced computational techniques that combined traditional modeling with machine learning. The research improved the understanding of crystallization processes, which can benefit both industrial applications and biological systems. Progress included a presentation at the Annual Meeting of The Society of Rheology, covering topics such as **"Suspension-Balance Neural Networks for Modeling Concentrated Suspension Rheology in Confined Flows"** and **"Thermodynamic Insights into Shear Flow-Mediated Crystallization."** Additionally, the project produced a published an article titled **"Unraveling the Determinant Mechanisms in Flow-Mediated Crystal Growth and Phase Behaviors"** which appeared in *Crystals 2025*. This study explored how different conditions affect crystal growth and identified important behaviors that could help control this process in industrial applications. The article can be accessed here.

September

Innovative Research in Pseudospectral Methods (LDRD):

Another Complementary LDRD project titled **"Pseudospectral Methods for Infinite-Dimensional Operators,"** achieved significant milestones in the field of mathematical physics. A paper on **"Multivariable Pseudospectrum in C-algebras,"** co-authored by Sandia PI Alexander Cerjan, University PI Vasile Lauric, and UNM Faculty Terry Loring, was published. This research explored pseudospectra associated with noncommitting tuples of Hermitian elements within a C*-algebra, providing insights into the stability and behavior of spectra under perturbations, which was crucial for understanding complex systems where operators do not commute. The paper can be accessed here. Another article focusing on the Clifford spectrum associated with three 2x2 matrices is nearing publication as well. A manuscript based on student work by Ajani Roberts from the summers of 2023-2024 has been completed. Furthermore, results from summer student projects in 2025, conducted by Olivia Hilton and Sarah Dubuisson, were presented at the START HBCU poster symposium at Sandia and may be submitted to conferences. Their presentation highlighted the significant contributions of students in this research area. The collaborative

efforts between LDRD PIs Alexander Cerjan and Vasile Lauric resulted in an additional LDRD-funded project titled "Structured Light from Superstructured Photonics."



September

Community-level Impacts of Infrastructure Service Disruptions (LDRD):

The Complementary LDRD project "More than Demographics: Community-Level Impacts of Infrastructure Service Disruptions in the U.S. Gulf of Mexico Region," led by Sandia PI Shruti Khadka Mishra and University PI Kassie Ernst, aimed to understand the effects of climate-related infrastructure disruptions on communities. As these disruptions become more frequent, the project investigated their cascading impacts to enhance community resilience. PhD student Taylor Howard contributed to the project by focusing on risk communication and stakeholder trust, and presented her findings at the 2025 NOAA Biennial Science and Education Forum. Postdoctoral researcher Ivanna Pengelley led knowledge product analysis, while former students Kandake Wallace and Aaliyah Harris conducted case studies and vulnerability analyses. Currently, five publications are under review.

August

Empowering Future Leaders at FAMU:

Sandia's Chief Research Office Director, Dan Sinars, delivered a virtual presentation titled "Your Reliability, Credibility, and Network" at Florida A&M's Scholarship Program Office Onboarding Institute. The session engaged 22 freshmen scholars, providing them with valuable insights into building their professional networks and enhancing their reliability and credibility in academic and career pursuits.

July

Unlocking Quantum Science for K-12 Educators:

The Quantum Science in K-12 Workshop, led by FAMU Deputy Campus Partnership Manager, Alex Belianinov and developed by Megan Ivory at Sandia's Quantum Systems Accelerator, occurred under the guidance of Ms. Dedra O'Neal and Dr. Tarik Dickens. This effort aimed to equip teachers from local schools, including Astoria Park Elementary, Raa Middle, Cobb Middle, Florida A&M University Developmental Research School, Godby High, and Oak Ridge Elementary, with innovative, bite-sized activities to introduce quantum science concepts in their classrooms The workshop featured a collection of activities designed to fit within 45–60-minute class periods, providing resources that have been developed and tested by the National Q-12 Education Partnership. Each activity included comprehensive lesson plans and guides for both teachers and students, fostering engagement and curiosity about quantum science. This workshop prepared the next generation of workers with the skills needed for future industries and inspire students to explore careers in quantum science.

July

Workshop on Technology Transfer and Entrepreneurship:

Mary Monson, Sandia's Senior Manager of Business Development, conducted an engaging workshop at Florida A&M on technology transfer and the S2 Edge initiative, which accelerates technology commercialization and innovation by providing essential resources and support for researchers and entrepreneurs to transform their ideas into viable products or services. Part of the NNSA Minority Serving Institutions Partnership Program (MSIPP) Research Experiences for Undergraduates (REU) summer program, the workshop focused on entrepreneurship and aimed to

educate students about the entrepreneurial aspects of their research. The central question guiding her discussion was, **"How can I turn my summer research into a marketable product or service?"** This workshop offered valuable insights, encouraging students to critically assess the commercial potential of their research and fostering an entrepreneurial mindset.

December

Sandia Fellow visits North Carolina A&T:

During a campus visit, Sandia representatives, including Campus Executive **Carl Rhinehart,** DCPM **Dennisa Thomas**, CPM **Anthony Sanders**, Technical Business Development Specialist **Breanna Gallegos-Schnedar**, and Sandia California BioScience Lab Fellow **Dave Chandler**, engaged in productive meetings with leadership and faculty at North Carolina A&T. Sandia Fellows are appointed to honor individuals who have made significant contributions to both the Labs and the nation. This respected title is awarded to those who have excelled in their fields and have reached the top of their profession. Sandia Fellows are recognized for earning international acclaim from their peers and for consistently demonstrating creativity and leadership in their work. **Dave Chandler** is 1 out of only 11 Sandia Fellows. Discussions with former Interim Research Vice Chancellor **Melissa Hodge-Penn** centered on partnership initiatives, highlighting recent accomplishments, and exploring new opportunities for the upcoming year. **Dave Chandler** provided an overview of Sandia's research initiatives in biofuels, bioengineering, combustion, and energy, and in turn, faculty shared insights into their ongoing research and capabilities at NC A&T. These collaborative discussions serve as a foundation for identifying potential partnership opportunities moving forward.

November

Guest Lecture at North Carolina A&T:

Sandian **Mo Payne** delivered a guest lecture at North Carolina A&T State to **Dr. Jeffers-Francis's seminar class on biological and energy issues.** During his technical talk, Mo highlighted the goals of nonproliferation and discussed the current challenges facing nonproliferation regimes. The lecture provided an engaging platform for students to ask questions and explore the implications of nonproliferation efforts in today's world. Mo's unique perspective from his work at Sandia fostered a dynamic conversation with the students.

October

Recognizing Student Excellence on a Laboratory Directed R&D Project (LDRD):

We are proud to highlight the accomplishments of **Daniel Boamah**, a student involved in the NCAT LDRD project focused on **developing field-deployable chemical sensors for tracking fluorochemical degradation**. This project is led by Sandia PI **Ryan Davis** in collaboration with University PI **Peng He**. Daniel recently received a travel award to present his research at an upcoming international conference, showcasing his work **on "Ultrasensitive PFAS Detection via Polymerization in Sensing."** Additionally, he earned a poster award at the Triangle Student Research Competition for his innovative research. Daniel's hard work underscores the impactful research made with our academic partners.

September

Autonomous Testing and Validation of Security Systems LDRD Project (LDRD):

This LDRD project titled **"Autonomous Testing and Validation of Security Systems,"** led by Sandia PI **Ashley Mayle** and University PIs **Ali Karimoddini** and **Hieu Nguyen**, addressed the growing complexity of engineering systems by testing the resilience of sensing systems used in networks of autonomous vehicles, particularly focused on how well these systems could withstand cyber-attacks. Progress included developing a security model for localization systems and creating KAN models to detect GPS-spoofing. The team also compared their performance against classical **ANN models** using real-world datasets. Additionally, the team established a use case for cooperative control of vehicles at roundabouts, enhancing connectivity and supporting better coordination among multiple vehicles. The project supported the mentorship of students **Anh Phuong Ngo, Fariha Tasnin, William Gray**, and **Justice Malcolm Watson**, as well as two design projects: one titled **"Control Dual Permanent Magnet Synchronous Motors using C200 Processors,"** with team members **Israel C. Barnes, De'Von C. Brown, Calex B. Ware**, and **Lionel A. Yates**, and another focused on **"Simulation-Based Software Verification of an Autonomous Car,"** with team members **Rafael Cruceta, David Daodu, Quintez Dunn, and Jalen Jerry.**

Notable conference presentations included research on "Assessing Economic, Environmental and Health Impacts of Integrating Carbon Pricing Border Adjustments into Security Constrained Economic Power Dispatch" at the 24th New England Science Symposium and participation in the AIAA Regional Student Conference. The project resulted in significant publications, including a study on multi-UAV tasking and coordination for monitoring agricultural farmland in the Journal on Autonomous Transportation Systems (here) and a paper by Fariha Tasnin and Hieu Nguyen on revisiting Fourier and Chebyshev spectral methods with physics-informed machine learning, presented at the IEEE Conference on Control Technology and Applications.

August

Following insightful team discussions during the START HBCU end of summer event, a letter of support was provided to North Carolina A&T State by Sandia Campus Executive and Sandia Chief of Staff Carl Rhinehart in support of their Ph.D. program in Bioengineering. We are proud to support this program and are optimistic about its potential to thrive and make significant contributions to the field of bioengineering.

August

Welcoming New North Carolina A&T Scholars to the HBCUNM Pathways Program:

We are excited to announce that two new scholars have joined the HBCUNM Pathways program, bringing the total to three participants. This program allows students to transition smoothly into the University of New Mexico's engineering graduate program after completing their undergraduate degree at HBCUs, while also interning at Sandia National Laboratories. Their technical work during the internship aligns with their graduate research. Eryal Rhinehart, a graduate of North Carolina A&T State University has joined the program alongside Mayah Drayton, also from North Carolina A&T, who is continuing her participation in the program.

June

Leadership Visit to North Carolina A&T University:

The leadership team from Sandia National Laboratories, including Academic Programs Senior Manager, Jim Redmond, Campus Partnership Manager, Anthony Sanders, Campus Executive Carl Rhinehart, Deputy Campus Executive Jeff Robinson, Deputy Campus Partnership Manager, Dennisa Thomas, and Mission Campaign lead Paul Thelen, visited North Carolina A&T State University for a productive leadership meeting. During their visit, they engaged in meaningful discussions with Melissa Hodge-Penn, the former Interim Research Vice Chancellor, and Engineering Dean Stephanie Luster-Teasley. Discussions focused on the current status of partnerships, recent accomplishments, and exploring potential opportunities for collaboration, as well as identifying areas where support is needed. The team also met with leaders from the College of Engineering, College of Science & Technology, and the Graduate School to discuss the Faculty Loan Program and its implementation at the university. Additionally, the visit included a tour of the Joint School of Nanoscience & Nanoengineering and the Engineering Research & Innovation Complex, which highlighted the university's current research ventures and the capabilities of its facilities.

Fall 2025-Spring 2026

DCPM Mentorship for AAMU Capstone Project:

We are excited to highlight the ongoing bonanza capstone Mechanical Engineering project for the fall 2025-spring 2026 academic year, with mentorship from Deputy Campus Partnership Manager (DCPM) Patrice Gregory in collaboration with Dr. Enrique Jackson. This design challenge invites teams of students, including Alasia Garcia, Abdoulie Bojang, LaDaisia McCarver, Jamari Parham, Day Von Burton, Kirsten Tigner, and Jhia'Nesha Edwards, to design, build, and test a Nondestructive Mechanical Counterfeit Bolt Detection System, aimed at ensuring

safety and quality in industrial applications. The project emphasizes the development of a system that is portable, efficient, nondestructive, cost-effective, and scalable, with the capability to accurately identify counterfeit bolts. This initiative provides students with both hands-on experience in mechanical engineering and addresses a critical need in the industry.

November

Spotlight on Engineering Excellence:

We would like to celebrate the achievement of Isaiah Thompson, a talented mechanical engineering student from Alabama A&M University, who completed a fulfilling internship at the Nonlinear Mechanics and Dynamics Research Institute—a dynamic collaboration between Sandia and the University of New Mexico. During his summer adventure, Isaiah showcased his impressive skills by simulating shock and tension load cases and conducting a thorough mesh convergence analysis. His hard work culminated in co-authoring a research paper and presentation titled "Bolted Joint Friction Modeling Under Shock." His work will be presented at the prestigious International Modal Analysis Conference 2026, hosted by the Society of Experimental Mechanics. Congratulations to Isaiah on this remarkable achievement!

September

Advances in Tomographic-Based Sensing for Large Area Monitoring (LDRD):

The project "Tomographic-Based Sensing for Large Area Monitoring," led by Sandia PI Gabe Birch and University PI Kenneth Sartor, aimed to develop a new sensing capability for detecting and localizing humans, vehicles, and ground robotic systems over large areas, incorporating machine learning to enhance target detection and localization. The Software Team, led by Detavein Walker, Lyric Sampson, and Da'Quandalon Daniel, made significant progress by developing Python algorithms using simulated data from Gabe's team. They created a platform-independent code to estimate object locations from tomographic images and identified effective AI/ML techniques for image reconstruction, addressing challenges with incomplete or noisy data. The Hardware Team, consisting of Braden Gant and Hunter Mullins, presented their work at a symposium, where they conducted hardware tests to model data by measuring signal changes as objects passed between radios. They collected over 20 datasets and developed a standard operating procedure for hardware setup. Additionally, the team analyzed radio signal drop-offs as part of their research. LDRD students from Alabama A&M University, the University of Alabama in Huntsville, and the University of Alabama at Birmingham engaged in facility tours and discussed their LDRD work during the START HBCU poster symposium at Sandia. The team planned to publish their findings at the SPEI Conference as the project concluded.

September

Enhancing Security Analysis with Vision Language Models (LDRD):

Led also by Sandia PI Gabe Birch and University PI Kenneth Sartor, this project worked to explore the potential of large language models (LLMs), vision language models (VLMs), and multi-agent LLM/VLM systems in the detection and assessment of security imagery. The primary objectives included evaluating whether these advanced algorithms can enhance detection rates compared to traditional machine learning object detection methods, assessing the expected false positive rates, and examining the explainability of these approaches. The ultimate goal was to improve accuracy, minimize false alarms, and provide human-readable context for automated security decisions.

Students Maya Magwood and Jordyn Johnson, engaged in various tasks such as dataset collection, baseline model evaluation, ground truth labeling, VLM algorithm testing, multi-agent system development, system evaluation, and final reporting. The students successfully generated visual language models to analyze security imagery using two different paradigms: OpenAI GPT-4 and Google Gemini. Notably, they discovered that OpenAI exhibited the lowest false alarm rate and demonstrated less confusion compared to Gemini for this dataset. Conversely, Google Gemini offered greater explainability for the cases it correctly identified. The team planned to publish their findings at the SPIE 2026 conference as well, inviting participation from students and faculty on a volunteer basis. Maya also participated in facility tours at Sandia and shared insights about their LDRD work during the START HBCU poster symposium at Sandia.

August

Sandia Welcome Alabama A&M University President, Dr. Daniel Wims!

Alabama A&M President Daniel Wims and Dean ZT Deng, of the College of Engineering, Technology, and Physical Science met with key leaders at Sandia National Laboratories. The attendees included Dan Sinars, Sandia Research and Development Associate Labs Director, Jim Redmond, Academic Programs Senior Manager, Anthony Sanders, Campus Partnership Manager, Ben Brodsky, previous Deputy Campus Partnership Manager, and Kevin Wyre, START HBCU Intern Institute Coordinator. The discussions focused on exploring collaborative opportunities and aligning strategies between Sandia and the university. Key topics included enhancing research capabilities, developing partnerships, and improving technology transfer processes. The conversation also emphasized building an innovation pipeline that facilitates access to talent, ideas, and research and development capabilities.

May

Strengthening Academic Ties with Alabama A&M University:

Representatives from Alabama A&M University visited Sandia National Laboratories to explore exciting collaboration opportunities that could benefit faculty and students alike. The visiting team, which included Dr. Andrew Scott, Dr. Kaveh Hiedary, Dr. Kenneth Sartor, Dr. Jonathon Lassister, and Mr. Justin Vaughner, began their visit with a tour of the Autonomy and Unmanned Systems Lab, led by Sandia team members Gabe Birch, Daniel McArthur, Dave Novick, Noah Jackson, and Jason Everett. This engagement aligns with an ongoing Complementary LDRD project involving AAMU faculty, highlighting potential funding avenues for innovative research initiatives. During their time at Sandia, the AAMU representatives met with the Research Assured Design and Testing for Electronics and Computational Hardening (RAD-TECH) Sandia Mission Campaign team, discussing joint research opportunities in key areas such as artificial intelligence (AI) and machine learning (ML), particularly focused on security in operational spaces. Additionally, the visitors toured another building that showcased Non-Destructive Environment & Diagnostics capabilities, organized by Sandian Mataya Archuleta and featuring insights from several Sandia experts.

May

AAMU Mechanical Engineering Students Create Advanced Inspection System:

The Focus Force team, made up of mechanical engineering students, developed an advanced inspection system for visual inspections and defect classification as part of their senior design project. Guided by Dr. Megougna Drabo from Alabama A&M University, and mentored by Patrice Gregory from Sandia National Laboratories, team members Aaliyah Taylor, Vanessa Nyochembe, Kermit Booker, and Luke Childrey designed and tested a system that inspects four different components with various shapes and weights. Their project emphasized modularity for easy maintenance and smooth rotation during inspections, along with interchangeable grasping mechanisms to reduce parts and changeover time. The team used engineering analysis tools, including modeling and simulation, and employed additive manufacturing for rapid prototyping. The system features semi-automated image capture, allowing operators to take pictures of components from specific angles and store them digitally. For more insights, check out their YouTube video here. Special thanks to Sandia's Michelle Pang and Karl Walczak for leading this multi-university design challenge.

December

Quantum Curriculum Development:

Sandian Mi'Kayla Word is actively assisting in the development of a quantum curriculum at Norfolk State University while exploring opportunities for joint appointments across all partner universities. This goal is to establish advisory boards and thesis committees to enhance academic collaboration and facilitate knowledge exchange. As part of this effort, a faculty loan outbound appointment was facilitated for Mi'Kayla who has a background in computational chemistry, quantum chemistry, and molecular modeling. She has secured an appointment with the Department of Chemistry at Norfolk State University, working under the direction of Department Chair Dr. George Miller.

October

Sandia Insights Presentation:

Sandian Charles Reinke delivered an engaging presentation to Dr. Ivy Jones' EEN 401 Electronics Engineering Seminar, where he shared his journey and valuable insights into the role of silicon photonics in national security. He highlighted its diverse applications in communication, sensing, computing, imaging, and quantum technologies. The students gained a deeper understanding of Sandia's capabilities in device design, fabrication, and testing, as well as our collaborative initiatives with government agencies, industry partners, and academic institutions. Charles also discussed the latest advancements in integrated photonics solutions, including optical interconnects, chip-scale beam steering, and metamaterials, inspiring students to appreciate how silicon photonics is shaping the future of technology.

September

Exploring the Superconducting Diode Effect in Topological Materials (LDRD):

The LDRD project titled "Search for Superconducting Diode Effect in Topological Materials," led by Sandian Wei Pan, University PI Doyle Temple, and student researcher Orrin Clarke-Delgado, aims to investigate the superconducting diode effect (SDE) in the Dirac semimetal BiSb. Previous studies have indicated that novel Josephson effects in this material are primarily influenced by the bulk Dirac cone states. This project not only explores an alternative material platform for realizing SDE but also seeks to provide complementary insights into the role of surface-bulk coupling in achieving zero-field SDE in Dirac semimetals. The project leverages Dr. Temple's expertise in quantum material growth at NSU, utilizing a floating zone furnace for BiSb growth, and benefits from NSU's extensive tools for characterizing material structural and optical properties. The research aims to enhance understanding of phase coupling between surface and bulk superconducting states in Dirac semimetal-mediated Josephson junctions (JJs) and superconducting quantum interference devices (SQUIDs).

Recent publications stemming from this project include:

- "Epitaxial aluminum layer on antimonide heterostructures for exploring Josephson junction effects", W. Pan, K.R. Sapkota, P. Lu, A.J. Muhowski, W.M. Martinez, C.L.H. Sovinec, R. Reyna, J.P. Mendez, D. Mamaluy, S.D. Hawkins, J.F. Klem, L.S.L. Smith, D.A. Temple, Z. Enderson, Z. Jiang, and E. Rossi, Materials Science and Engineering: B 318, 118285 (2025). These results clearly demonstrate the project has achieved growing high-quality epi-Al/antimonide heterostructures, a promising platform for the exploration of Josephson junction effects for quantum information science and microelectronics applications.
- "Lithography defined semiconductor moirés with anomalous in-gap quantum Hall states", W. Pan, D.B. Burckel, C.D. Spataru, K.S. Sapkota, A.J. Muhowski, S.D. Hawkins, J.F. Klem, L.S. Smith, D.A. Temple, Z. Enderson, Z. Jiang, K. Thirunavukkuarasu, L. Xiang, M. Ozerov, D. Smirnov, C. Niu, P.D. Ye, P. Pai, and F. Zhang, Nano Letters 25, 10536 (2025).

Joint University Engagement:

November

Georgia Tech HBCU Research Forum:

In a united effort, START HBCU partnered with Georgia Tech to host the Georgia Tech HBCU Research Collaboration Forum. This event aimed to foster generative AI research collaborations among Sandia National Laboratories, HBCUs, Georgia Tech, and other key partners. The forum featured engaging breakout session panels that showcased the expertise of various speakers. Sandian William Chapman discussed the transformative impacts of AI in the semiconductor industry and electronic design, while Sandian Thushara Gunda delivered a keynote address on energy, emphasizing the role of AI in advancing sustainable solutions. Madison Helmstetter also highlighted the implications of AI on infrastructure, infrastructure security, and cybersecurity, underscoring the critical need for innovation in these areas.

September

START HBCU leadership attends AIME Conference:

Sandia's Academic Programs team, including Jim Redmond, Academic Programs Senior Manager, Anthony Sanders, Campus Partnership Manager, and the START HBCU Deputy Campus Partnership Managers (DCPMs) participated in the Advancing Minorities' Interest in

Engineering (AIME) Conference, which brought together the Council of Engineering Deans from HBCUs, students, and engineering professionals. This event provided the team with an opportunity to engage with HBCU leadership, explore partnership models, and network across the engineering sector.

September

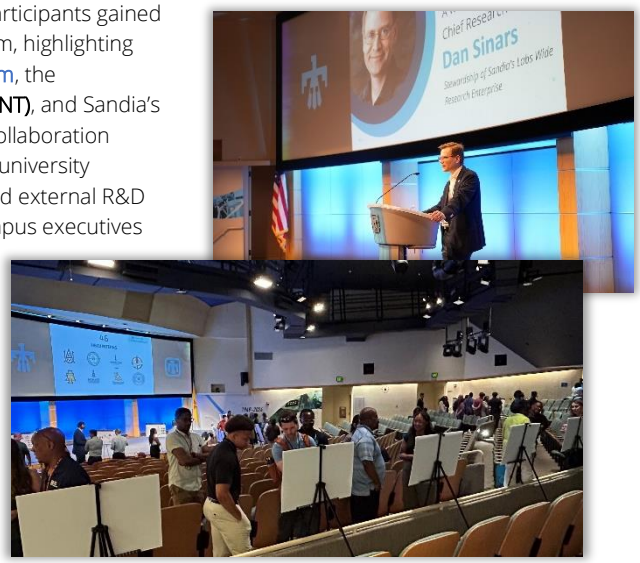
Successful Tracer FIRE Student Competition Across Three START Universities:

The Tracer FIRE student competition was successfully held at three of the five START Universities: Norfolk State University, North Carolina A&T State University, and Alabama A&M University. This event provided students with valuable insights into cybersecurity incident response through presentations on incident response tools followed by hands-on exercises where teams tackled real-world challenges. Sandian Kinsleigh Wong coordinated the event across the three universities, ensuring a seamless experience for all participants. As a result of the competition, there has been an increase in interest in cybersecurity-related internships at NSU and AAMU.

July

HBCU Faculty and Leadership Engage with Sandia:

Faculty and leadership from our partner schools visited Sandia to engage in collaborative activities aimed at enhancing continued partnerships. During the visit, participants gained insights into partnership opportunities through the START HBCU program, highlighting Sandia's Laboratory Directed Research and Development (LDRD) program, the Department of Energy (DOE) Center for Integrated Nanotechnologies (CINT), and Sandia's internal Office of Science (SC) program office to demonstrate research collaboration opportunities. Faculty members presented their research expertise and university capabilities to Sandia PIs, fostering potential collaboration for internal and external R&D projects. University leadership engaged in strategic discussions with campus executives and START HBCU support teams, focusing on strengthening relationships and gathering insights for improvement. The visit concluded with a celebration of the START HBCU Intern Institute, featuring summer program highlights and a poster symposium where Summer 2025 interns showcased their research accomplishments.



START HBCU Partnership Updates

The Deputy Campus Partnership Manager (DCPM) role at Sandia focuses on maintaining an on-campus presence to cultivate relationships with faculty and students, inspiring innovative research projects, and identifying exceptional students who can make significant contributions to Sandia's mission. In line with this commitment, we are excited to welcome two new DCPMs who will enhance our collaboration efforts and drive impactful initiatives at both institutions. Their leadership will be instrumental in advancing educational opportunities and fostering research excellence within our HBCU partnerships.

We would also like to acknowledge Ben Brodsky and James Headen, who both made significant strides in their roles as DCPMs for Alabama A&M and Prairie View A&M. As they both transition out of their positions, we wish them all the best in their future endeavors outside of Sandia.

Alabama A&M Deputy Campus Partnership Manager Update:

We are pleased to announce Dr. Patrice Gregory as the new Deputy Campus Partnership Manager for Alabama A&M University. With her impressive academic background, including an M.S. and Ph.D. in Mechanical Engineering from the University of Maryland College Park, along with a Bachelor of Science in Mathematics from Spelman College and a Bachelor of Science in Mechanical Engineering from Georgia Institute of Technology, Patrice is well-prepared to support the ongoing success of START HBCU and Alabama A&M. Her professional journey began with internships at NASA Ames Research Center, and she has spent over 14 years at Sandia, currently holding the position of Principal R&D Systems Surety Engineer, where she ensures the qualification of products across various nuclear deterrence programs. Patrice has made significant strides at AAMU as the Technical Recruiting Lead, where she has been instrumental in linking students to career opportunities. She has conducted impactful workshops aimed at equipping students with vital skills and has actively mentored AAMU students on capstone projects focused on engineering inspection systems. Additionally, her role as a judge during AAMU STEM Day reflects her dedication to inspiring students in the fields of science and technology. With her extensive experience and commitment to nurturing the next generation of engineers, Patrice is set to enhance research collaborations and advance STEM education, further solidifying our partnership with Alabama A&M University and other HBCUs.

Florida A&M Deputy Campus Partnership Manager Update:

We are also excited to announce Dr. Alex Belianinov as the new Deputy Campus Partnership Manager for Florida A&M University. Alex holds a Ph.D. in Analytical Chemistry from Iowa State University, where he conducted research under Prof. Patricia Thiel, and a B.S. in Chemistry from Case Western Reserve University. His impressive career began with a postdoctoral appointment at Oak Ridge National Laboratory, focusing on advanced microscopy techniques such as Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM). He later became a staff scientist at the Center for Nanophase Materials Sciences, expanding his expertise to include Helium Ion Microscopy (HIM) and Secondary Ion Mass Spectrometry (SIMS). Currently, as a Principal Member of Technical Staff at Sandia National Laboratories, Alex designs innovative imaging and spectroscopic capabilities for analytical platforms, applying machine learning to analyze complex data. His commitment to enhancing education and research opportunities within HBCUs, along with his outreach and mentorship efforts to inspire students in STEM careers, positions him as a valuable asset in strengthening our partnership with Florida A&M and advancing research collaborations.

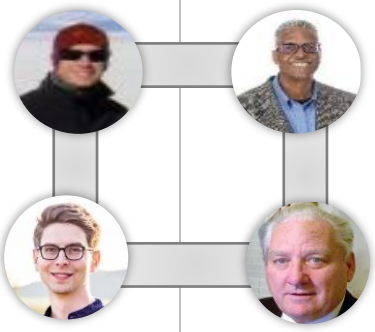
2025 LDRD Publications & New 2026 Complementary LDRD Proposals

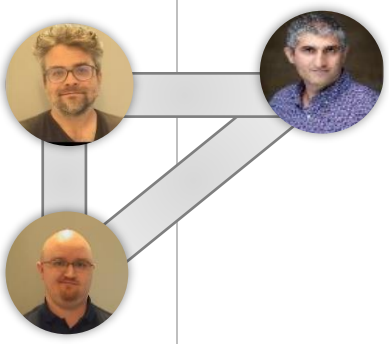
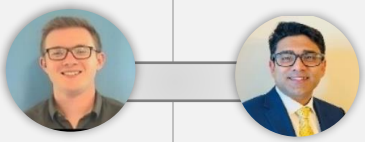
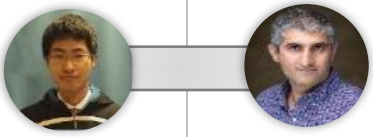
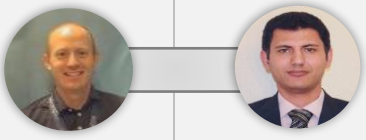
LDRD Publications in 2025:

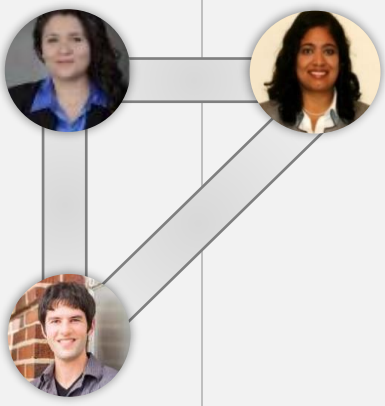
University	Authors	Publication Link
Florida A&M University	Alexander Cerjan, Vasile Lauric, Terry Loring	Link
Florida A&M University	Rekha Rao, Connor Willis, Tesua Janicki, Z. Leonardo Lio	Link
Norfolk State University	W. Pan, K.R. Sapkota, P. Lu, A.J. Muhowski, W.M. Martinez, C.L.H. Sovinec, R. Reyna, J.P. Mendez, D. Mamaluy, S.D. Hawkins, J.F. Klem, L.S.L. Smith, D.A. Temple, Z. Enderson, Z. Jiang, E. Rossi	Link
Norfolk State University	Wei Pan, D. Bruce Burckel, Catalin D. Spataru, Keshab R. Sapkota, Aaron J. Muhowski, Samuel D. Hawkins, John F. Klem, Layla S. Smith, Doyle A. Temple, Zachery A. Enderson, Zhigang Jiang, Komalavalli Thirunavukkuarasu, Li Xiang, Mykhaylo Ozerov, Dmitry Smirnov, Chang Niu, Peide D. Ye, Praveen Pai, Fan Zhang	Link

Newly Accepted Complementary LDRD Proposals:

We are excited to announce the acceptance of new **Complementary Laboratory Directed Research and Development (LDRD) proposals** for 2026. Below, you will find a list of the new projects and their significance to our mission at Sandia:

University	Core Investment Area	Title & Description	SNL PI	University PI
Alabama A&M	Computing & Information Sciences	**Hardware Yielding Smart Integrated Computing Systems:** Led by PIs W. Chapman, Z. Xiao, and S. Budak, this project investigates novel resistive random-access memory (ReRAM) arrays for physical neural network architectures. ReRAM device wafers will be fabricated and characterized to explore non-ideal device characteristics using cleanroom-based micro- and nano-fabrication techniques. The proposed devices possess intrinsic temporal properties, including responses in the radio-frequency (RF) regime. When integrated with the core LDRD computational framework, this research will enable physical neural network processing of RF signals, facilitating low signal-to-noise event processing when standard electronics or digital computers are non-viable. **Student Researchers:** Sydney Fleming and Baraka Chimba	William Chapman 	Zhigang Xiao, Electrical Engineering 
Alabama A&M	Earth Science	**Machine learning-based Classifiers for Arctic Domain Awareness using Distributed Acoustic Sensing Data**: Led by PIs M. Baker, L. Linville, & K. Sartor, this proposed research aims to exploit a unique seismoacoustic signal library by developing supervised classifiers that improve the identification of signals of interest in Arctic marine environments. Successful implementation of this research will result in benchmark detectors for phenomena of interest, enhance our understanding of Arctic marine processes, and advance mission capabilities that rely on distributed acoustic sensing (DAS). **Student Researchers:** Jeffrey Dulaney and Maya Magwood	Michael Baker & Thomas Luckie 	Kenneth Sartor, Research, Innovation, Science, & Engineering & Phil Bording, Electrical Engineering & Computer Science
Alabama A&M	Engineering Science	**Developing novel thermal qualification methods for components through laser probe thermal characterization:** Led by PIs M. Baker, L. Linville, & K. Sartor, this proposed research aims to exploit a unique seismoacoustic signal library by developing supervised classifiers that improve the identification of signals of interest in Arctic marine environments. Successful implementation of this research will result in benchmark detectors for phenomena of interest, enhance our understanding of Arctic marine processes, and advance mission capabilities that rely on distributed acoustic sensing (DAS). **Student Researchers:** Alejandro Rosa and LaDarrien McCall	John Tencer 	Satilmis Budak, Electrical Engineering, ,Z. Xiao, M. Drabo, and A. Kassu 

North Carolina A&T	Global Security	**Physical Security Threat Discovery using Modern Artificial Intelligence:** Led by PIs A. Patooghy & N. Fabian, this project aims to explore AI-driven cyber-physical attacks by combining large language models (LLMs) and reinforcement learning (RL). The project will generate novel attacks targeting vulnerabilities in smart physical security systems, with the goal of identifying blind spots in current security infrastructure. **Student Researchers:** Delvan Paulino and Khalil Hassan	Nathan Fabian & Chris White	Ahmad Patooghy, Computer Systems Technology 
North Carolina A&T	Global Security	**Foundation Models for Automated Nuisance, False, Valid Alarm Categorization Error Identification Using Zero-Shot Prompting:** Led by PIs K. Roy, J.P. Nelms, & C. Cheng, this project leverages large language models (LLMs) and natural language processing (NLP) to enhance mis-tag detection in security log data through automated analysis of operator comments and alarm assessments. By applying zero-shot and few-shot learning methods, the project aims to identify inconsistencies between human-entered assessments and system-generated alarms, thereby improving decision support and reliability in physical security systems. Successful outcomes will contribute to national security and strengthen collaboration between Sandia and North Carolina A&T State University. **Student Researchers:** Zachariah Lunsford	JP Nelms 	Kaushik Roy, College of Engineering
North Carolina A&T	Global Security	**Should Computers Observe or Decide? Human Factors in Security System Automation:** ed by PIs A. Patooghy and A. Hesu, this research explores facial expression recognition (FER) to analyze human factors in physical security systems. By generating multimodal datasets for decision performance analysis and integrating biometric monitoring technology, the project aims to validate human factors studies in national security contexts. This work will enhance automated systems that adapt based on user behavior, contributing to system effectiveness and advancing the university's research capabilities in this critical domain. **Student Researchers:** Eddie Coren and Jaquan Blanks	Alan Huang Hesu 	Ahmad Patooghy, Computer Systems Technology
North Carolina A&T	Global Security	**Simulation of Dynamic Adversarial Environments for Counter-Uncrewed Aircraft System Assessment and Optimization:** Led by PIs D. McArthur & A. Karimoddini, this project aims to develop a high-fidelity simulation platform for assessing the effectiveness of counter-uncrewed aircraft systems (CUAS). By incorporating mission planning and high-fidelity UAS models, the project seeks to enhance national security by improving UAS risk assessment and enabling more reliable CUAS operations against threats. **Student Researchers:** Azmol Fuad	Daniel McArthur 	Ali Karimoddini, College of Engineering

North Carolina A&T	Digital Assurance for High Consequence Systems	**Semi-Automated Vulnerability Exploration:** The Semi-Automated Vulnerability Exploration (SAVE) project seeks to use formal methods analysis to automate the search for potential vulnerabilities in high-consequence systems. NCA&T will assist Sandia National Laboratories with this project by helping to identify and formally model threats to the exemplar Spacecraft Identification and Localization system. This includes identifying threats that may propagate through hardware.	Andrew Cox 	Ahmad Patooghy, Computer Systems Technology 
Prairie View A&M	Nanodevices and Microsystems	**X-Ray Induced Degradation of III-V Semiconductor Detectors for Radiation Sensing:** Led by PIs L. Casias & M. Pulikkathara, this project involves collaboration between Sandia and PVAMU to utilize the X-ray source for preliminary (total ionization dose) TID experiments on III-V semiconductor materials, including InGaAs photodetectors for InAs/GaAs quantum-dot based scintillators and other relevant infrared (missions. The electrical characteristics, particularly dark current, will be monitored and recorded against total dose during irradiation. The core LDRD is focused on design, fabrication, and gamma-ray testing of III-V quantum-dot based InAs/GaAs scintillators with an integrated InGaAs photodetector. This collaborative Complementary funding research will complement the core LDRD by investigating the same III-V photodetector material and simple test devices in an X-ray radiation environment. Measuring radiation damage is crucial for predicting performance degradation in radiation detectors, particularly regarding radiation tolerance in new/improved radiation sensing capabilities for mission-relevant applications.	Lilian Karelly Casias & Evan Anderson 	Merlyn Pulikkathara, Physics
Prairie View A&M	Bioscience	**Machine Learning Analysis of Hyperspectral Confocal Fluorescence Microscopy Data:** Led by PIs J. Timlin & N. Ghaffari, this project seeks to utilize Sandia's expertise in hyperspectral imaging and multi-omics analysis to identify signatures of microbial community dynamics in sorghum. By fusing these signatures into a predictive model, PIs J. Timlin & N. Ghaffari, an Assistant Professor at Prairie View A&M University (PVAMU), aim to enable real-time analysis of the phytomicrobiome, which protects plants from stress. This innovative approach addresses the limitations of traditional methods, by employing Machine learning Techniques, facilitating early disease detection and advancing microbial community analysis through machine learning. **Student Researchers:** Marc Mata	Jeri Timlin 	Noushin Ghaffari, Computer Science

Highlights from the START HBCU Summer Intern Institute

Our Summer Intern Cohort:
The START HBCU Intern Institute serves as the student engagement branch of START HBCU, aimed at enhancing Sandia's talent pipeline by providing impactful opportunities for talented HBCU students. In summer 2025, the institute welcomed 46 interns from Alabama A&M, Florida A&M, Norfolk State, North Carolina A&T State, Prairie View A&M, Howard, Benedict College and Texas Southern University.

Throughout the summer, our interns participated in a comprehensive professional development program that included weekly seminars on graduate school planning, crafting statements of purpose, delivering effective presentations, and understanding postdoctoral opportunities. Each intern was paired with both a technical and a Complementary mentor, with over 100 Sandians supporting their development. Mentorship focused on fostering resilience, community, well-being, cultivating skills, personal growth, and navigating career aspirations.

To expose interns to career possibilities and Sandia's capabilities, they toured various facilities, including the Microsystems Engineering, Science and Applications Facility Complex, Solar Tower, Ion Beam Lab, Robotics Test Range, Shock Thermo-Dynamic Applied Research facility, and National Security Technology Gallery. Many interns also engaged in community service activities, volunteering with the Hands-On Minds-On Technologies (HMTech) summer program, led by Sandia's Employee Resource Group, the Black Leadership Committee (BLC). This program involved middle and high school students in hands-on science and engineering activities, allowing interns to inspire the next generation as volunteers, instructors, and teaching assistants. The internship program concluded with a poster symposium where HBCU interns presented their work and accomplishments to peers, Sandia leadership, and faculty attendees.

We are proud to share that three summer interns have transitioned into year-round interns, and two others have been accepted into our HBCUNM Pathways opportunity. This scholarship program empowers undergraduate students from HBCUs to seamlessly transition to the University of New Mexico's engineering graduate school with paid tuition, while offering invaluable real-world experience through a Sandia National Labs internship

We look forward to bringing our next cohort of talented START HBCU interns out for the summer of 2026! June!

Click on this video to learn more about Sandia's Internship program.

Looking Forward: What's Next for 2026

Upcoming Events & Actions to Keep on Your Rader:

Hiring for the Summer 2026 Intern Cohort:
As we look forward to the Summer 2026 internship program, we are excited to announce that we have begun the hiring process for our next cohort of interns. This is a fantastic opportunity for qualified HBCU students to gain hands-on experience, develop professional skills, and engage with cutting-edge research at Sandia National Laboratories.

START HBCUNM Graduate Pathways Program:
If you're interested in learning more about the HBCU Graduate Pathways Program, please email us at start_hbcu@sandia.gov, and we will connect with you regarding your interest. For additional details about the program, please refer to the flyer linked here.

Provide Your Research Summaries for Potential Collaborations:
To facilitate potential LDRD research collaborations, we encourage you to review our research needs and complete this form with your research summaries. Sandia staff will submit their ideas (intent to submit) from December 8, 2025 – February 9, 2026. After the idea review and selection process, invited proposals will be submitted from March 23, 2026 – April 27, 2026. If a Sandia researcher is interested in forming a research collaboration with you based on the input you've provided, collaboration discussions with occur prior to the April deadline.