FireAID: An Undergraduate Research Training Program to Develop Technologies to Fight Wildland Fire with Artificial Intelligence and Deep-Learning in Alaska

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In this project, the University of Alaska Fairbanks (UAF) will collaborate with Argonne National Laboratory (ANL) to develop an undergraduate-focused research training program, named "FireAID," to develop technologies to fight Wildland Fire with Artificial Intelligence and Deep-Learning in Alaska. The overarching research objective of this project is to combine remote sensing with microbial omics to unlock a new frontier in wildfire risk assessment utilizing the power of artificial intelligence (AI), big data analysis, and high-performance computing (HPC). Concurrently, the project’s training objective is to equitably cultivate a next-generation workforce capable of advancing these fields and enhancing diversity in science, technology, engineering, and mathematics, thereby enhancing Alaska's fire resilience.

Wildfires profoundly impact Earth's atmosphere, surface, and subsurface. To comprehensively understand these effects, the project integrates satellite imagery and microbial omics. Large-scale satellite data (e.g., Landsat, Sentinel2, and VIIRS) will be analyzed with deep neural networks to identify pre-fire indicators (vegetation stress, fuel loads) and post-fire impacts (burn severity, vegetation recovery). Meanwhile, soil microbial data from burned, re-burned, and unburned locations will undergo big data analytics, taxonomic classification, and time series analysis to reveal changes in soil microbiomes. Finally, by integrating these findings with advanced large language models, trainees will craft effective prompts using chain-of-thought reasoning to generate actionable knowledge for wildfire management.

This research was selected for funding by the Office of Advanced Scientific Computing Research (ASCR)

CREATE: Cyanobacteria Research for Enhancing Alabama-based Training and Education

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The energy sciences workforce faces a huge challenge in developing talents from academic institutions that have been historically underrepresented in the DOE research portfolio. The program is a comprehensive training and education program at Alabama State University (ASU), a Historically Black College and University (HBCU), to help address the vast challenge of recruiting the talents from academic institutions that have so far been underrepresented in the DOE research portfolio and support underrepresented students and early career researchers. The project aims to overcome barriers to recruitment and retention of underrepresented minorities with comprehensive training activities in microbiology and energy science. The training is integrated with research activities that focus on developing local resources and exploiting natural genetic variation. It is hypothesized that there exists a diversity of native algae and cyanobacteria in the Alabama and Gulf Coast regions with unique traits that can be useful to produce carbon-neutral fuels and biochemicals and for environmental services. The project proposes to identify native microalgae and cyanobacteria strains with robust inorganic carbon (Ci) uptake capability and seek potential biotech applications. The research activities will train and mentor underrepresented undergraduates and graduate students and postdoctoral researchers.

The project has three objectives. 1) Isolate microalgae and cyanobacteria strains in Alabama and the Gulf Coast region which involves the collection of microalgae and cyanobacteria strains in selected locations in Alabama and Gulf Coast regions, enrichment in liquid culture, isolation of strains using plates, screening by microscopy, and identification by 16S/18S rDNA PCR and DNA sequencing. 2) Measure metabolites secreted in the medium by isolated strains under various culture conditions and employ membrane-inlet mass spectrometry (MIMS) and a newly developed higher-throughput CO_2 monitoring system to monitor the kinetics of Ci uptake and quantitatively measure the Ci fixation and carbon concentrating mechanism (CCM) capabilities of the cells. The team will investigate energy regulation and management in algal strains by monitoring the metabolic end-products in the growth media and whole cells by bioanalytical techniques. Understanding the dynamic energy flows in cyanobacteria and microalgae will guide new strategies to produce biofuels and chemicals by controlling the energy and carbon sink. 3) Innovative teaching by integrating research activities into the curricula at ASU. The team plans to integrate research components into the classroom and teaching laboratories to extend the impact to more students at ASU. Students will take entry-level classes for credits at ASU to learn the literature, background, and methods related to the research project and conduct independent projects or case studies on focused themes in senior-level classes. Students will conduct research as interns at NREL and WUSTL in the summer months and return as advocates to interest other students in research projects. Students will present in the CARE workshop, Annual Research Fronter Symposium, and other professional conferences. The project will have a significant impact on underrepresented students and prepare a competitive and qualified workforce in the fields of energy, environmental science, and other related research careers. It will advance our fundamental knowledge of energy management in cyanobacteria and microalgae and yield potentially novel potential biotech applications.

This research was selected for funding by the Office of Biological and Environmental Research (BER)

Phage Pathways: STEM training to characterize bacterial resistance mechanisms towards phage and contribution to bioenergy production

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The "Phage Pathways" program aims to cultivate a new generation of scientists at the intersection of microbial ecology and renewable energy. A cohort-based approach will be used to support a vibrant community of growing scientists that will collaborate (through workshops and symposia), adopt course-based research (through science pedagogy) and engage in pathway programs (through internships and bootcamps at DOE national labs) to enhance learning and persistence in microbial ecology and renewable energy. The project's scientific objectives include: (1) characterizing bacterial resistance against phages and (2) assessing how these interactions affect methane production, thus influencing bioenergy efficiency. The project's training objectives include: (1) developing and implementing specialized modules in microbiology, genomics, and bioinformatics, (2) promoting interdisciplinary collaboration through internships and bootcamps and (3) disseminating research findings through curriculum, scholarly publications and community engagement. The project's mentoring, recruitment and accountability objectives include: (1) preparing a diverse group of students for careers in bioenergy and environmental sciences; and (2) continuously evaluating and refining educational methods to maximize learning and career preparation. Through a vertical integration of research and education, the project not only contributes to the intellectual growth in phage microbiology but also enhances the practical and analytical skills of participants, preparing them to lead future scientific inquiries and innovations in environmental and bioenergy sciences.

This research was selected for funding by the Office of Biological and Environmental Research (BER)

Resilience to Growing Extreme Natural Hazards: Developing a Northeast Hazards Workforce

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The research proposes a holistic and inclusive research and training program to the Department of Energy's Reaching a New Energy Sciences Workforce initiative (DOE RENEW) to provide students and early career scientists with opportunities to gain in-depth experience in understanding extreme natural hazards and solving the associated and expanding societal challenges caused by these events. The project aims to improve the knowledge of extreme natural hazards by quantifying and understanding the properties of floods, landslides, heatwaves, and multi-hazard impacts in the Greater New York metropolitan area. A synergistic approach that blends Artificial Intelligence and Machine Learning with traditional computational methods will be used to create more robust, scalable, and dynamic climate-informed natural hazard risk management tools for the next generation of energy science workforce. The project intends to prepare and promote well-trained, diverse graduates and postdoctoral scientists who will become part of the next generation in government, industry, and academia. The trainees will gain the skillsets necessary to immediately contribute to ongoing resilience and adaptation projects in a cost and schedule-driven environment and an increasingly AI-driven workplace. The project brings together a team of multidisciplinary researchers, including civil, environmental, and electrical engineering, climate, atmospheric, and ecosystem science, data science, as well as education and workforce training specialists. The team will work together to prepare a hazards-ready workforce in the Greater New York metropolitan area, one of the densest urban regions in the country and home to nearly 25 million people.

This research was selected for funding by the Office of Biological and Environmental Research (BER)

Building a Strong Workforce for Developing Functional Materials for Sustainable Energy in Texas through Holistic Collaborations and Partnerships

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There is an urgent need to develop a new science, technology, engineering, and mathematics (STEM) workforce capable of mitigating challenges related to producing and storing renewable domestic energy. In this project, students and early-career researchers at Southern Methodist University (SMU), a Carnegie R2 Emerging Research Institution (ERI) in Dallas, will work together with faculty at the University of Texas at El Paso (UTEP), a high-level research (R1) minority serving institute (MSI), and scientists at Pacific Northwest National Laboratory (PNNL) to understand hydrogen interactions and dynamics in atomically precise coinage metal-hydride clusters. Because of their well-resolved crystal structures, coinage metal-hydride clusters are attractive candidates for studying structure-property-function relationships in energy sciences with atomic precision. However, determining the hydride locations in their crystal structures is extremely challenging because of the difficulty in growing large and high-quality single crystals for neutron diffraction. This project aims to directly address these knowledge gaps by developing high-precision methods to synthesize and study the structures of coinage metal-hydride clusters by combining different approaches, including spectroscopic, X-ray, and neutron diffraction techniques. Overall, this multi-institute partnership will expose trainees at all levels (undergraduate, graduate, and postdoctoral fellows) at SMU to a holistic learning experience involving (a) synthesis and X-ray characterization of metal-hydride cluster nanomaterials, (b) training in cutting-edge techniques like mass spectrometry, ion soft landing, and spectroelectrochemistry, and (c) experience with neutron diffraction methods through student visits to PNNL in addition to lectures by PNNL and UTEP scientists to SMU students. Additionally, this project will (i) facilitate the development of research-informed courses wherein emerging concepts in interdisciplinary energy sciences will be incorporated in graduate- and undergraduate-level courses at SMU's Chemistry Department; (ii) broaden participation in STEM activities at an early stage by providing hands-on research exposure to SMU undergraduate students as well as students from Predominantly Undergraduate Institutions (PUIs) in the Dallas-Fort Worth Metropolitan area, and (iii) provide a unique training platform wherein graduate students and postdoctoral fellows at SMU are exposed to multiple different approaches used to answer complex research questions, thereby developing essential skills needed for leadership roles in STEM fields.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

Catalyzing Workforce Diversity in Photocatalytic Energy Science

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This project brings together researchers and trainees from Chicago State University (CSU), a Predominantly Black Institution (PBI), Norfolk State University (NSU), a Historically Black College and University (HBCU), Elmhurst University (EU), a Hispanic Serving Institution (HSI), and the Solar Energy Conversion Group at Argonne National Laboratory (ANL). Working collaboratively, this project seeks to increase the number of historically underrepresented groups in science, technology, engineering and math (STEM) fields while broadening the understanding of solar driven chemical reactions. The project will strengthen the research and scientific opportunities at the three MSIs in collaboration with ANL and provide 12 students annually opportunities to engage in high-impact research focused on questions surrounding artificial and biohybrid photosynthesis. Through a year-round training program, weekly group meetings, and an annual week-long full group meeting at ANL, participants will be provided with ample networking opportunities, culturally responsive mentoring, and professional development. By engaging students in a collaborative research project and culturally responsive mentoring, faculty will work to improve the sociocultural environment and remove obstacles for the advancement of a diverse workforce in the photochemical sciences.

This project builds upon complementary techniques to understand and improve hydrogen evolution reaction (HER) catalysts for solar fuel production. Nickel and cobalt molecular catalysts offer a promising opportunity for the development of new materials for solar fuel production as they are inexpensive, readily synthesized, and can be chemically modified to tune their properties. Computational modeling techniques will be utilized to understand the effect of structural changes on the catalysts. These results will aid in the design of improved biohybrid systems. Electron Paramagnetic Resonance spectroscopy will be utilized to characterize the charge-transfer events and electronic structure of the transition metal complexes and the biohybrid complexes. It is anticipated that the dual approach of an immersive inter-institutional research experience and culturally responsive mentoring as a means of effecting systemic change to support a diverse group of participants will lead to higher retention and persistence of a more diverse workforce.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

Characterizing Interfacial and Bulk Transport Phenomena in Viscous Microdroplets

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This exploratory RENEW project will provide structured support to a cohort of Master of Science (MS) students within the Department of Chemistry and Biochemistry at Texas State University (TXST) to pursue research into how charges and molecules diffuse through and on highly viscous materials. Molecular dynamics at the surfaces of viscous and glassy materials have been repeatedly observed to be significantly faster than those in the bulk material. This enhanced surface mobility affects numerous surface processes — including friction, adhesion, adsorption, self-healing, biological interactions, and heterogeneous catalysis — that have technological implications for processing and applications of highly viscous, glassy materials. Measurements of enhanced surface mobility typically probe the dynamics of the glass-forming units (e.g., as self-diffusion coefficients) and have not focused on the transport of small molecules within the material. To address this knowledge gap, this project will directly measure molecular and electron transport in viscous microdroplets by using contactless levitation to coalesce microdroplets with different compositions. This research addresses several key ***scientific questions***, such as: How do rates of interfacial transport compare to those in highly viscous bulk materials? How rapidly does a concentration gradient dissipate around a droplet? When do molecules and charges preferentially diffuse across the surface? The **first research objective** will explore how phase state affects the bulk and surface molecular transport in both Newtonian (glass-forming) and non-Newtonian (gel-forming) model systems. The **second research objective** will explore charge transport in viscous and glassy materials by measuring the timescale over which strong electrochemical gradients relax in coalesced microdroplets. This project will relate charge transport in highly viscous microdroplets to the diffusivity of small molecules and explore how regions of high diffusivity (e.g., at the surface) lead to enhanced diffusion of charge. Ultimately, this research will provide a fundamental insight into molecular and charge transport at interfaces and within viscous materials. Such insight can aid the development of heterogeneous catalysts, electrochemical systems, and membranes.

The colinear aim of this project is to increase the diversity of the physical sciences workforce by recruiting and training talented MS students from historically marginalized groups (HMGs) for high-quality PhD programs. As a result of systemic barriers to participation, there exists a persistent national shortage of scientists from HMGs entering the physical science workforce, with those that enter the workforce having disproportionately more educational debt than scientists from non-HMGs. To address this disparity, the activities of this RENEW program will recruit students from HMGs and provide them with scaffolded research training and professional development activities that are designed to ensure students graduate on-time and self-identify as researchers. These activities include: the development of a 'First-year review' for MS students, the development of a Scientific Programming Bootcamp, the opportunity for MS students to perform a research internship at Sandia National Laboratories and the Center for Integrated Nanotechnologies (CINT), weekly 'Chemistry Write Watchers' sessions to improve scientific communication, and participation in regional and national scientific conferences. Ultimately, the training objectives of this project are to 1) increase the diversity and inclusion of students from HMGs in the thesis-based chemistry MS program at TXST and 2) develop trainee skillsets to ensure the successful transition to PhD programs and for long-term professional success in physical science careers.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

Engaging Minorities and Promoting Opportunities with Education and Research for Circular Initiatives in Polymer Science (EMPOWER)

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The University of Massachusetts Lowell (UML), in partnership with the National Renewable Energy Laboratory (NREL), is leading a Reaching a New Energy Sciences Workforce (RENEW) project to understand how polyethylene (PE) plastic waste breaks down when treated during hydrothermal liquefaction (HTL) with sub-critical and super-critical water. By using state-of-the-art experiments and computational modeling, the project aims to gain insights that could lead to improved recycling methods for PE, which is a major component of global plastic production but is largely non-recycled. Specifically, the research aims to fill gaps in our understanding of how water, in its sub-critical and super-critical states, interacts with polymers like PE. These forms of water have unique properties that allow them to break down chemical bonds in plastics more effectively. However, how water and plastics interact at the molecular level, especially at the interface between water and polymer, remains unclear. This project will explore two main ideas: first, that sub-critical water can swell and mix polymer chains, helping to break them down; and second, that sub-critical and super-critical water can oxidize the polymer surface, leading to further breakdown of the material. The research will use advanced laboratory techniques and computer modeling to test these ideas.

As part of the RENEW program, which aims to promote diversity, equity, and inclusion (DEI) in basic energy research by providing training and professional development opportunities for students, postdoctoral researchers, and faculty from non-R1 minority-serving institutions (MSIs). Four PhD students and 18 undergraduate students, including those from underrepresented (UR) backgrounds such as racial and ethnic minorities, women, first-generation college students, and those with disabilities or from economically disadvantaged backgrounds, will participate in the program, with opportunities for hands-on research at UML and internships at NREL. PhD students will spend their first two years at UML, studying the interactions between plastic and water under different conditions. In the third year, they will intern at NREL to work on computational molecular simulations and analyze polymer samples. Each year, six undergraduate students will also take part in related research projects at UML, followed by a 10-week summer internship at NREL. These internships provide valuable networking opportunities and hands-on experience in the field. All students will receive professional development training, covering topics like research ethics, data management, DEI, career planning, and communication skills. By providing research opportunities and professional development for students from diverse backgrounds, this project aims to build a more inclusive community in basic energy sciences. It will help bridge educational and research gaps, creating new career pathways for students who might not otherwise have access to such opportunities. The partnership between UML and NREL also aims to establish lasting collaborations that will benefit both institutions in their efforts to advance polymer recycling and energy research.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

Quantum Computation of Chemistry and Material on Noisy Intermediate-Scale Quantum Hardware

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The program led by the University of California, Merced (UCM) and partnered with Lawrence Berkeley National Laboratory (LBNL) is to build the training capacity of graduate and undergraduate research and education on quantum information science and technology (QIST) at UCM, an R2 minority serving institution. Quantum science has transformed into a thriving industry with the urgent need for a new generation of skilled workforce. The goal of the program supported by the Department of Energy (DOE) Reaching a New Energy Sciences Workforce (RENEW) is to cultivate future leaders of under-represented and disadvantaged groups in QIST. The research will bridge the gap between currently available quantum computers prone to errors and prototypical error-correcting systems with applications from domain science to quantum hardware. Since programming in future error-correcting quantum computers requires quite different techniques compared to that in currently available hardware, the program will overcome these challenges by empowering the UCM trainees from physics, computer science (CS), chemistry, and material science with a combination of interdisciplinary skills of domain science, QIST, and CS to successfully program and benchmark current and near-future hardware. The research projects arise from the two pillars of quantum physics, namely quantum probabilities and correlations: (1) the spontaneous structural transitions in molecular systems and (2) quantum correlations between internal and external spaces relevant to quantum computation and communication. The former will showcase quantum computation for chemistry while the latter will explore novel materials with applications in QIST. The research will be complemented by artificial intelligence (AI)/machine learning (ML) and high-performance computing. The program will leverage the relationship with LBNL to teach and extend ML/AI techniques for quantum program development and verification, large-scale analyses, and extraction of relevant information. The research will prepare the UCM trainees for addressing QIST challenges and solving fundamental problems on quantum computers. The education efforts will begin with the recruitment of graduate students in physics, chemistry, CS, and material science by hosting tables at DOE and American Physical Society (APS) Graduate School Fairs, presenting at recruitment webinars, and distributing the opportunities via UCM program chairs. The program will provide in-depth training in QIST by developing and offering introductory QIST courses and seminars without prerequisites of quantum physics or programming, which serve as a channel to attract interested students to pursue QIST careers. The trainees will solve domain-science problems on cloud-based quantum platforms alongside access to the LBNL facilities and explore research opportunities at UCM and other universities, LBNL, and industrial partners. The program will feature weekly group meetings, peer-mentoring, close interactions, and workshops on professional development and career planning. The trainees will present their research in conferences and workshops and publish their results. Furthermore, the program aims to substantially promote inclusion in QIST and meet the goals of the DOE RENEW by giving the under-represented and first-generation students at UCM high priority to participate in the training and research as well as broadcasting via the partnership with the APS Bridge and CalBridge programs to students from non-traditional backgrounds. The program will prepare the UCM under-represented and disadvantaged trainees for successful careers in QIST and address urgent needs for energy conservation and efficient computation that align well with DOE missions.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

SPARTAN SPARK: Stimulating Passion, Advancement, Research, and Knowledge for Next-generation Engineers in Advanced Energy Systems

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The SPARTAN SPARK program will provide substantive, hands-on research experiences for undergraduate students in the multidisciplinary area of energy science and engineering. Twenty-five (25) undergraduate students will be recruited, from all engineering disciplines to the SPARTAN SPARK program each year. The students will undergo substantive, year-long training at SJSU and SLAC National Laboratory. The academic year training will lead to a fully paid, 10-week summer internship at SLAC National Laboratory. Recruitment for the SPARTAN SPARK program will focus on first-generation (FG), under-represented minorities (URM), and low-income (LI) students from the College of Engineering at SJSU. The selection will prioritize Juniors, based on recommendations, and engagement with the program. The SPARTAN SPARK program will start at the beginning of the academic year (mid-August). During the academic year, the students will receive training in research skills such as performing a literature review, analyzing data with Python, group collaboration and data standards, documentation of hardware designs, and using GitHub to make open-source software contributions public. Project management skills, conflict resolution, and teamwork strategies will also be taught. SLAC scientists and engineers will introduce summer research projects to the students, who will also visit SLAC and be introduced to the various departments and research opportunities through site tours. To support the students both academically and personally and to ensure a strong connection between each student and their peers, faculty, and community; the PI and co-PI will run small group meetings where non-research related topics will be discussed, such as STEM career paths, graduate school, progress toward graduation, and professional development. External speakers will be invited occasionally to attend these meetings. The small group meetings will be held monthly. The program's summer activities include a 10-week (June - August), fully paid internship at SLAC National Laboratory, where the participants will work 40 hours/week on-site. The students will work in small groups under the supervision and guidance of SLAC scientists or engineers on hands-on research projects. Some projects will be computational and suit students majoring in computer engineering, software engineering, and electrical engineering. Other hands-on projects will suit students majoring in chemical engineering, materials engineering, biomedical engineering, mechanical engineering, aerospace engineering, electrical engineering, and industrial systems engineering. The PI and co-PI will remain in contact with the participants throughout the summer through weekly check-ins and will help resolve any issues. At the end of the summer, the participants will submit a written report on their research project and present their work at the SPARTAN SPARK symposium. The students will also be encouraged to submit abstracts of their work to local and national conferences. The PI, co-PI, and research mentors will help support the abstract submission process. An external evaluator will conduct formative and summative evaluations throughout the program. Each student will receive a stipend for the academic year's activities, a fully paid summer internship, and housing support during the summer. The students will receive a laptop to support their research activities throughout the program and a Clipper Transportation Card to cover travel expenses from Bay Area communities to SLAC.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

TN-QuMat: Tennessee Quantum Materials Workforce Development and Training, an R2-HBCU-ORNL Partnership

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The Tennessee Quantum Materials Workforce Development and Training (TN-QuMat) program is a strategic partnership between Middle Tennessee State University, Tennessee State University, Fisk University, and Oak Ridge National Laboratory (ORNL), with additional collaboration from the University of Michigan. This project aims to increase participation of underrepresented groups in quantum materials research by providing comprehensive training, targeted mentorship, and hands-on research opportunities for undergraduate and graduate students, as well as postdoctoral fellows, from three non-R1 emerging research universities in Middle Tennessee.

The TN-QuMAT program will be organized around three primary research thrusts: (1) many-body theory and simulation of disordered quantum materials, (2) ab initio studies of topologically nontrivial quantum materials, and (3) synthesis and characterization of low-dimensional quantum structures. Each year, the program will recruit a cohort of diverse students from participating institutions and train them in theoretical, computational, and experimental skills aligned with DOE priorities. To meet training needs across educational levels, TN-QuMAT will offer initiatives such as the AMPLIFY Scholars Program for undergraduates, combining hands-on research, mentorship, and summer internships at ORNL. It will bridge classroom learning with practical research, building foundational quantum materials skills. Graduate students and postdocs will receive project-based training from both ORNL scientists and university advisors. This partnership enhances their technical skills and professional development by exposing them to national lab resources. Furthermore, faculty involvement will strengthen research expertise at the universities and foster closer ties between academia and national laboratory. TN-QuMat will also provide professional development opportunities for trainees, guiding them in career planning, effective communication, presentation skills, and applications for careers in academia, national labs, and industry, while offering networking opportunities that further equip them for successful STEM careers.

Through such an integrated approach that combines research, training, and mentorship, TN-QuMat will prepare diverse trainees from underrepresented groups in Middle Tennessee for impactful STEM careers, while simultaneously enhancing research capacity and expertise within partnering institutions. By establishing a collaborative infrastructure, TN-QuMat will foster sustainable research programs across these institutions. This project aligns directly with the DOE's BES-RENEW initiative, aiming to increase the participation of underrepresented groups in quantum science and cultivate a diverse, equitable, and inclusive research community.

This research was selected for funding by the Office of Basic Energy Sciences (BES)

Initiatives to Grow New Innovative Talent to Enable Fusion Energy (IGNITE Fusion Energy)

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The rapid advancements in fusion energy research underlines an urgent need for a strong workforce capable of driving future fusion engineering and technology developments. Recent achievements, such as the first experimental demonstration of fusion implosion with a target gain larger than unity at the National Ignition Facility, have unveiled the potential for fusion to serve as a sustainable energy source. These advancements, coupled with the White House's bold decadal vision for commercial fusion energy, highlight the pressing need to grow, diversify, and sustainably develop the talent pipeline in fusion engineering and technology. To address this critical demand, this RENEW project aims to leverage the collective strengths of six academic institutions, Oak Ridge National Laboratory (ORNL), and nearly ten private fusion companies to create workforce training initiatives and enhance curriculum development, thereby preparing a new generation of researchers for careers in fusion engineering and technology.

This initiative is developed around the following three objectives. (1) We will establish a mentoring program for undergraduate and graduate students through consecutive summer internships at ORNL and a private fusion company. The internship will be paired with continued mentorship during academic semesters. (2) We will collectively develop a series of new courses and special-topics modules to be implemented at participating universities, which will be shared publicly with the broader academic community. This curriculum development effort will be guided by private fusion companies and national lab leaders, reflecting the needs and recent advancements in fusion engineering and technology. (3) To promote the sustainability of the project efforts, we will create an inaugural entrepreneurship and innovation focused bootcamp – the Fusion Innovation Bootcamp – designed for sustained training and participation of students in fusion engineering. Student trainees will engage with fusion startup professionals, national lab researchers, and university faculties in a dynamic curriculum featuring lectures, panels, hands-on sessions, and pitch presentations. Key findings and insights from student mentorship, curriculum development, and bootcamp training in this RENEW project will be disseminated at a fusion engineering and technology workshop during a major national conference.

The integration of student mentoring, curriculum development, and bootcamp engagement ensures that the training and involvement of participants is sustained beyond the duration of this RENEW project and into the future of fusion engineering and technology. This RENEW project aims to sustainably improve workforce conversion and retention, increase representation of underrepresented and economically disadvantaged minorities in the fusion industry, enrich fusion engineering curricula across academia with vital course materials, and establish a sustainable talent pipeline from academic institutions to the public and private fusion sectors.

This research was selected for funding by the Office of Fusion Energy Sciences (FES)

Developing an Interdisciplinary Fusion Workforce Hub and building STAR_Lite at Hampton University

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Establishing STAR_Lite, a laboratory-scale stellarator experiment for fusion research and training at Hampton University (HU), a Historically Black College/University, will create a vital workforce hub to develop the next generation of fusion scientists and engineers. The hub will address critical workforce needs in fusion energy sciences through hands-on training of undergraduate and master's students from underrepresented groups. STAR_Lite's design and construction leverage the symmetry of magnetic fields for efficient plasma confinement in stellarators. The facility will serve as an educational and research platform where students can explore the basic principles of plasma physics and advanced fusion energy engineering concepts in a hands-on environment. Students will gain practical experience across four key areas: plasma physics, power systems, vacuum technology, and magnetic field design and optimization. This comprehensive approach ensures students develop theoretical understanding and practical skills essential for fusion energy research and development. The project is based on an apprentice training philosophy combining technical skills, engineering practices, and teamwork across different scientific fields - essential for developing future fusion power plants. Students will gain experience with advanced measurement equipment, data analysis techniques, and computer modeling tools used in fusion research. Partnerships with PPPL and NCSU offer students intensive summer training, mentorship opportunities, and exposure to large-scale fusion research facilities. Additionally, STAR_Lite's development will employ modern project management methods, preparing students for the complex and collaborative nature of real-world research and development projects. Once constructed, research activities at STAR_Lite will study magnetic field configurations and innovative approaches to plasma exhaust handling, advancing fundamental knowledge in fusion energy science. The facility will help researchers study how manufacturing precision affects the symmetry of magnetic fields and explore the concept of non-resonant divertors, a novel concept for exhaust. By creating a fusion research facility at an HBCU, developing new talent, and establishing a model for fusion science education, the project's impact extends beyond immediate research results, as it creates a clear path for underrepresented students to enter the fusion energy field and helps build a more diverse and inclusive fusion science community. This effort recognizes that practical fusion energy needs scientific breakthroughs and a skilled, diverse workforce, with STAR_Lite playing a pivotal role in preparing future fusion scientists and advancing the field.

This research was selected for funding by the Office of Fusion Energy Sciences (FES)

A Pathway Program for Talent Preparation for Modeling and Manufacturing of Novel Materials and Structures for Fusion Energy

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This project aims to foster research collaboration between two high education institutions and Oak Ridge National Laboratory (ORNL) and through this collaboration, to provide training opportunities and hands-on research experiences for students and postdoctoral researchers to form a nucleus of talented young scientists, engineers, and technicians with the critical skills and expertise needed to support the fusion energy science research and commercialization activities. The project facilitates joint research with a focus on additive manufacturing and material science for extreme environments expected in fusion reactors, through simulations, design optimization, and experiments. The expected outcome from this project is the creation of domestic talent pool and innovation opportunities in fusion energy science through the following training and research pathway programs: 1) Education Pathway Programs on Fusion Energy Materials and Manufacturing: The two partnering universities and ORNL will develop new courses for the Certificate Program in Energy Material and Manufacturing. The curriculum will encompass Modeling and Simulation, Introduction to Fusion Energy, Materials for Extreme Conditions, Material Property Characterization using Neutron Spallation, and Additive Manufacturing for Fusion Energy. We anticipate involving 20 college students in our education program each year. Annual exposure events will be organized to inspire 600 school students. 2) Engage and Retain Underrepresented Groups through Hands-on Research: The project engages and retains talent pool through real-world challenges and hands-on research experiences at hosting universities. Through joint student supervision, participants will learn about additive manufacturing of novel materials, about utilizing existing simulation tools to analyze radiation behavior in materials, and about experimental facilities that analyze materials under sophisticated and extreme fusion-like conditions. 3) Hands-on Training and Summer Internship at National Lab: The project leverages visiting faculty programs and summer internship programs at Oak Ridge National Laboratory, which provides exposure to cutting edge research infrastructure and opportunities to work with DOE scientists. These experiences will provide participants with essential connections and networks to enable access and integration to continue support beyond the program, via DOE-sponsored internships and fellowships and postdoctoral programs, providing a pathway for career opportunities at DOE.

This research was selected for funding by the Office of Fusion Energy Sciences (FES)

CREST: Collaborative Research in Energy Science Traineeships

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3: SLAC National Accelerator Laboratory, Menlo Park, CA 94025
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The Collaborative Research in Energy Science Traineeships (CREST), partners Wellesley College faculty with leading researchers at Brookhaven National Laboratory (BNL), the SLAC National Accelerator Laboratory, and the Massachusetts Institute of Technology (MIT), to support the scientific development of undergraduate researchers at Wellesley College, a liberal arts college for women and an Emerging Research Institution (ERI). The objective of the CREST program is to provide 16-month-long, thoughtfully mentored research experiences in High Energy Physics (HEP) and Basic Energy Science (BES) for Wellesley undergraduates. The CREST program aims to recruit a diverse cohort of Wellesley undergraduates in the spring of their sophomore or junior years. Joining the program, CREST trainees will participate in technical training and community building activities at Wellesley to ensure research readiness (e.g. domain knowledge, data analysis skills, research motivation) before traveling to BNL or SLAC for summer research experiences. Working at the national labs, CREST trainees will engage in cutting edge research matched to the students' interests and the strengths of the CREST community. Students will conduct research across the fields of neutrino physics, microwave and millimeter-wave detector design, and advanced materials characterization for optimization. They will conduct this work under the supervision of both on-site technical experts and remote Wellesley mentors to ensure students develop both the scientific and broader professional skills needed to be successful in a future scientific career. Upon returning to Wellesley the following fall, the trainees will continue with professional and community development activities, and either continue their research program remotely under the combined guidance of the National Lab PI and a local Wellesley mentor, or engage with a closely aligned research project at Wellesley or MIT. Returning CREST trainees will have the opportunity to share their research experiences with the broader Wellesley community and recruit the next cohort of CREST trainees, further supporting students' professional development and sense of science identity. Overall, the CREST program looks to meaningfully expand the future scientific workforce in the U.S. Through intentionally developed curricula, focused professional development, multi-faceted mentorship and opportunities in cutting-edge research at SLAC and BNL, the CREST program aims to support a diverse cohort of scientists with the skills and sense of identity to thrive in their future scientific careers.

This research was selected for funding by the Office of High Energy Physics (HEP)

Bay Area Accelerator Research Traineeship (BAART)

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The BAART (Bay Area Accelerator Research Traineeship), in partnership with California State University East Bay (CSUEB), San Jose State University (SJSU), Lawrence Berkeley National Laboratory (LBNL), and SLAC National Accelerator Laboratory offers a focused initiative designed to increase the size of the talent pool within the High Energy Physics (HEP) accelerator workforce. The recently released P5 Report envisions an ambitious plan to pursue a Higgs Factory followed by a 10 TeV collider. The current US accelerator workforce is not large enough to support these efforts and must be enhanced through the development of new workforce pipelines. The California State University system is the largest and most diverse 4-year public university system in the nation and with the local proximity of these two CSU campuses to these two DOE national laboratories, this program aims to support the pathway to connect a pool of untapped potential for the US accelerator workforce. Four students will be recruited annually from relevant STEM fields, with two students from CSUEB and two students from SJSU, both Minority Serving Institutions located in close proximity to the LBNL and SLAC facilities. Students who participate in BAART will receive hands-on research experience and training at world-class accelerator facilities, specifically the BELLA Center at LBNL and the FACET-II accelerator at SLAC, and will participate in projects consistent with the HEP mission. Through a curated series of workshops, both before and during the summer internship, participants will delve into key areas of accelerator physics, such as beam dynamics, and magnet technology, along with critical topics in scattering and instrumentation sciences. The students will join the SULI cohorts at SLAC and LBNL for their summer internships. As part of their onboarding, they will be trained with accelerator-specific skills, including software development for accelerator control systems. These skills are critical for their summer research. The program also emphasizes professional development, including resume writing, interview techniques, and communication skills. To ensure accessibility and encourage participation from a wide array of students, including those from underrepresented backgrounds, BAART will provide participants with a competitive, cost-of-living-appropriate stipend. Additionally, they will receive financial support for training prior to engaging in their summer Accelerator Physics projects, and also after their summer internship, to continue data analysis, research and manuscript preparation with their project PIs. This approach aims to support students while they gain valuable knowledge and skills, paving the way for future careers in science and engineering and contributing to the diversification and advancement of the field.

This research was selected for funding by the Office of High Energy Physics (HEP)

FLAIR: Preparing Future Leaders in Artificial Intelligence and Machine Learning

Dr. Claude Turner[1], Principal Investigator (Professor)
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FLAIR is designed to equip students at Norfolk State University (NSU) with essential skills in Artificial Intelligence and Machine Learning (AI/ML), focusing on key areas such as Quantum Machine Learning (QML), and trustworthy/responsible AI. The project's objectives include (1) enhancing technical research skills in AI/ML for undergraduate and graduate students; (2) offering learning opportunities through seminars and a distinguished lecture series; (3) facilitating mentorship opportunities for NSU students at Brookhaven National Laboratory (BNL); (4) introducing students to AI/ML topics via practical workshops, research, and internships; (5) creating two undergraduate courses in Machine Learning and Natural Language Processing; (6) establishing an AI/ML concentration within NSU's computer science program; (7) recruiting talented sophomores and first-year graduate students, especially those underrepresented in STEM, to engage in research; and (8) fostering professional identity through exposure to industry experts and career-building experiences. AI/ML skills are becoming increasingly crucial across scientific fields as industries face complex AI, cybersecurity, and data privacy challenges. FLAIR will be NSU's flagship program for building a new DOE-ready workforce. Of specific focus are: QML, which has become a vital area to explore as quantum computing continues developing as an area of both academic interest and national security; and trustworthy AI, which is key to using AI/ML in science, where the reliability of results is critical to the scientific process.
FLAIR aims to train a diverse cohort of future scientists and technologists with the skills needed for impactful careers in the US energy sector, providing foundational and specialized knowledge that meets real-world challenges. The program implements several strategies to achieve these objectives including: **Research Development, Internship Experience, Curriculum Development, Professional Development**, and **Mini-Semester Program.**

The program has the potential to produce highly qualified, diverse computing professionals who will bring valuable perspectives to the technology field. FLAIR aims to foster innovation and creativity in AI/ML and engineering by supporting African American students and those traditionally underrepresented in STEM. Its emphasis on technical expertise, hands-on learning, and professional development will prepare students for impactful careers, supporting a skilled, diverse future workforce. In summary, FLAIR seeks to create a supportive environment at NSU where underrepresented students can excel in AI/ML. Through research opportunities, internships, curriculum advancements, and professional development, the program is structured to help students achieve academic and career goals while equipping them to address critical challenges in AI/ML within science and industry.

This research was selected for funding by the Office of High Energy Physics (HEP)

Science and Engineering Student Apprenticeship Program in Accelerator R&D

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2. Accelerator Science and Technology Department/BNL/DOE

New York City College of Technology, a senior college and minority serving institution located in the heart of one of the largest metropolitan areas in the world, is combining its strong background in preparing the next generation of technical and scientific workforce with the success of its current collaboration with Brookhaven National Laboratory (BNL) in preparing students in the field of Accelerator Science and Technology. The program supports the training of 24 STEM students in Accelerator Research & Development (R&D) and the development of a self-sustainable academic minor at New York City College of Technology (City Tech), while addressing the technical developments at the Accelerator Science & Technology Department/Brookhaven National Laboratory/Department of Energy (ASTD/BNL/DOE).

The project builds foundations for research and training in Accelerator Research and Development (R&D) through a new partnership model and through supporting research and training applications that include project elements aimed at directly addressing barriers to participation through innovative recruiting and retain strategies focused on individuals from diverse backgrounds with clear and measurable outcomes.

The goals of the project are: 1. Recruiting a total of 24 STEM students; mentoring and teaching the recruited students one-on-one and through workshops, seminars, and specific scientific and engineering courses; and training the recruited students through a ten-week summer hands-on training program at BNL during each summer of the project; 2. Developing and offering three new courses in the Accelerator Science and Technology (AST) and a new Academic Minor in AST under the umbrella of the Electrical Engineering Technology program; 3. Conducting research in Accelerator Science and Technology alongside the ASTD scientists and engineers through a carefully designed summer program.

The scope of the proposed research is aligned with the goals the Office of Science Program at DOE, in general, and the RENEW program in particular. The proposed project is an ice-breaker for students and faculty at City Tech, as well as colleagues at Brookhaven National Laboratory. Additionally, the STEM curriculum and research arena at City Tech is approached from a new perspective, with new opportunities offered to students to deeply immerse themselves into a very applied field, shaping their careers very efficiently. The rather broad approach of the academic field is forced now into a very narrow field, allowing the students to gain extensive experience that would otherwise take a very long time to achieve. The proposed novel educational model, which bridges academia with the science labs, and the work/research results will be disseminated to the community via presentations in conferences, papers published in peer reviewed journals, project website at City Tech and BNL, seminars, and open house events.

The project benefits the Department of Energy by giving it the opportunity to offer long term collaboration prospects to the best performing students in the field of Accelerators R&D from a diverse population of highly trained STEM students.

This research was selected for funding by the Office of High Energy Physics (HEP)

New High Energy Physics Traineeship and Research Infrastructure for 17 MSI institutions in California in Collaboration with Fermi National Accelerator Laboratory to Improve Education and Advance Research in Dark Matter and Neutrino Physics

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2. Fermi National Accelerator Laboratory, Batavia, IL 60510

This project brings together 17 Minority Serving Institutions (MSI) in California in collaboration with the Neutrino Division and Cosmic Physics Center of Fermi National Accelerator Laboratory (FNAL) to create a new High Energy Physics traineeship and infrastructure at Fresno for these 17 MSI institutions. The proposed 3-year traineeship will benefit students from the 17 MSI institutions. Through close collaboration with FNAL, the traineeship will train physics majors from the 17 MSI institutions through two semesters of online particle physics courses followed by an 8-week summer research program at FNAL. At FNAL, each student will work with a FNAL mentor on daily basis to gain hand-on experience in data analysis and R&D for various efforts at FNAL's Neutrino Division and Cosmic Physics Center. This includes research with the Short-Baseline Neutrino (SBN) program, Deep Underground Neutrino Experiment (DUNE), and the characterization, testing of charge-coupled devices (CCDs), etc. Additionally, the proposed CCD facility at CSU Fresno will be used to train STEM students from the 17 MSI institutions in CCD R&D and testing activities.

The proposed summer research work by the participating students will advance the field of particle physics and contribute to the data analyses and successful running of FNAL experiments and research projects. The hands-on summer research at FNAL will prepare the students for their professional careers. Through close collaboration with the FNAL Cosmic Physics Center, the CSU Fresno postdoc will become a world expert on CCD and its applications in dark matter and astrophysics research. The online particle physics courses will reach about 200 physics majors at the 17 MSI institutions. Physics majors and STEM students will work on particle physics research during summers. This will attract more students to become physics and STEM majors. Through the CSU Fresno physics course every semester, CSU Fresno students will visit two new K-12 classrooms each week with a focus on 10th and 11th grades to teach K-12 students about particle physics research and the DOE RENEW program, encouraging them to pursue science. The proposed outreach efforts will reach large number of schools, their students, and students' families in the Fresno and Central Valley areas.

Additional Collaborating Institutes: California State University, Channel Islands, Camarillo, CA 93012, California State University, Chico, Chico, CA 95929, California State University, Dominguez Hills, Carson, CA 90747, California State University, Humboldt, Arcata, CA 95521, California State University, Long Beach, Long Beach, CA 90840, California State University, Los Angeles, Los Angeles, CA 90032, California State University, Northridge, Northridge, CA 91330, California State University, Pomona, Pomona, CA 91768, California State University, San Diego, San Diego, CA 92182, California State University, San Francisco, San Francisco, CA 94132, California State University, San Marcos, San Marcos, CA 92096, Clovis Community College, Fresno, CA 93730, Fresno City College, Fresno, CA 93741, Madera Community College, Madera, CA 93638, Modesto Junior College, Modesto, CA 95350, Santa Rosa Junior College, Santa Rosa, CA 95401

This research was selected for funding by the Office of High Energy Physics (HEP)

Experiencing Physics and Inspiring Communities (EPIC)

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The HEPPIE project supports a partnership between California State University San Bernardino (CSUSB) and Pacific Northwest National Laboratory (PNNL) for a program designed to promote a pathway towards STEM careers, broadly, with a focus on participation in high energy physics (HEP). HEPPIE builds upon a current partnership between the two institutions, which has successfully funded student traineeships both on-site at PNNL and remotely. CSUSB is a primarily undergraduate university and Hispanic Serving Institute (HSI) located in Southern California, which primarily serves the Inland Empire outside Los Angeles. This region is one of the most economically and educationally disadvantaged in the state. PNNL is a Department of Energy (DOE) lab, with facets of experimental design, instrumentation, detection, and analysis in nuclear and particle physics. CSUSB has programs focused on building experimental and instrumental skills in students, in particular the physics and computer engineering programs. As a result, students from these and other disciplines are well positioned to participate in research at PNNL. Major activities of this partnership will provide CSUSB students with research and STEM skill building opportunities at PNNL and on the CSUSB campus. Central to this proposal are research traineeships, where students participate in summer research at PNNL followed by remote continuation of their work at CSUSB during the academic year. Students will be supported throughout their traineeships by experienced mentors at CSUSB and PNNL. Prior to their time at the national lab, all students will participate in weekly pre-summer workshops designed to introduce them to HEP research at PNNL, working at a national lab, and preparing them to successfully reside outside the Southern California region (often for the first time), which is an essential part of networking for their futures. While at PNNL, students will participate in the lab's Gold Experience programs for interns, giving them access to professional development and community building activities. On their return to campus, students will be supported in continuing their projects remotely and disseminating their research at local, regional, and national venues, including outreach and recruitment events. The HEPPIE project will be able to substantially increase the number of CSUSB students who are able to participate in PNNL research and create new opportunities for future collaborators between the two institutions. We anticipate a range of HEP and STEM pipeline building outcomes will result from this partnership. In a short time, CSUSB students will gain hands-on experience with technical and scientific skills invaluable for participation in HEP and other STEM disciplines. Knowledge about and interest in careers at PNNL and DOE laboratories will increase, with a longer term goal of increasing the number of students from the region entering careers at DOE facilities.

This research was selected for funding by the Office of High Energy Physics (HEP)

Traineeship on secondary beams at Jefferson Lab

PI: Dr. Michael Kohl[1], Professor
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The experimental nuclear physics group of Professor Michael Kohl at Hampton University, a leading Historical Black College and University (HBCU) in Virginia, pursues forefront experiments at several international accelerator facilities with the goal to understand the structure of hadrons and physics beyond the Standard Model. The group offers research opportunities at laboratories around the world for postdoctoral researchers as well as for graduate and undergraduate students from the minority segments of society, in particular African Americans and women.
This award supports the group's continuing research at Jefferson Lab (JLAB), located near Hampton, by providing a traineeship program focused on development of a secondary beam facility generated by a high-intensity electron beam. These secondary beams of muons, neutrinos and possibly even dark matter particles are planned to be used in a variety of experiments. The Beam Dump eXperiment (BDX) plans to search for dark matter particles generated by the high-intensity 11-GeV electron beam used in Hall A during an upcoming prolonged period of beam operation. It is planned to excavate a vault behind the Hall A beam dump with a beam stopper and collimation system to enable, collimate, or stop the charged particles and photons. The vault enables the placement of trigger, calorimeter and tracking detectors to characterize the cone of secondary particles emitted by the Hall A beam dump. While in BDX mode all secondary particles are to be stopped, it is also of great interest to characterize the flux, particle composition and emittance of various secondary particles forming the beam. This RENEW program enables one graduate and one undergraduate student at Hampton University to be trained to learn simulation tools and to operate and analyze data from a variety of particle detection systems to characterize the secondary beam. It is envisioned that the students of this RENEW award will be trained with operation and analysis of modern Gas Electron Multiplier (GEM) detectors, which are particularly suited to be operated in harsh radiation environments.

This research was selected for funding by the Office of High Energy Physics (HEP)

Building a Regional AI Community Through Collaborative Research and Traineeship with Lawrence Berkeley National Laboratory

Dr. Guobin Xu[1], Associate Professor; Dr. Lin Deng[2], Associate Professor; Dr. Aijuan Dong[3], Professor; Dr. Silvia Crivelli[4], Program Manager
Co-PIs: Dr. Jin Guo[1], Dr. Wei Yu[2], Dr. Cheng Qian[3], Dr. Gunther H. Weber[4], Dr. Kelly Rowland[4]
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The commitment of the Department of Energy (DOE) to advancing cutting-edge technologies, including artificial intelligence (AI) and high-performance computing (HPC), is critical for maintaining the nation's competitive edge in science and industry. However, the U.S. faces significant challenges: many graduating students, particularly those from underrepresented groups, enter the workforce without the necessary skills, hands-on experience, and research expertise in AI and HPC. To address the challenges, this project aims to build a regional AI community through collaborative research and traineeship with Lawrence Berkeley National Laboratory (LBNL), to provide students with comprehensive training in AI with HPC. This project has 7 objectives: (i) Establish a regional community for sustainable traineeship collaboration between Maryland institutions and the DOE lab; (ii) Train and prepare students for the future AI workforce by providing students with hands-on research experience with DOE Lab's AI projects, fostering practical skills, expertise in real-world applications, and the ability to collaborate effectively within team settings; (iii) Provide students with opportunities to engage in meaningful research projects, guided by experienced faculty and DOE scientists; (iv) Facilitate students' professional development through workshops, seminars, hackathons, and training sessions that equip students with the latest AI technologies, industry-standard tools, and ethical considerations; (v) Enhance course contents and design new course modules at the participating institutions to reflect the latest advancements in AI and incorporate practical experiences that align with industry needs; (vi) Recruit and support students from underrepresented groups to participate in the program; (vii) Establish long-term research collaborations between students, faculty, and DOE scientists to address critical AI challenges and advance scientific knowledge. This project is anticipated to mentor and support around 27 students over three years. Working in teams, students will collaborate with scientists at LBNL, contributing to studies that advance AI and HPC. The student participants will receive comprehensive financial support throughout the academic year and summer. Faculty and DOE scientists will hold regular mentoring meetings with student research teams. The curriculum at the participating institutions will be improved through collaboration with LBNL scientists, integrating state-of-the-art research and projects to prepare students for careers in the AI workforce. This sustainable model ensures the long-term continuation of AI education excellence, aligning with the evolving needs in AI and HPC. This project's broad impacts will contribute to preparing a highly skilled workforce in AI to ensure that the U.S. maintains its global leadership. This project will establish a strong bridge between DOE labs and academic institutions. Students will learn about DOE labs, internships, and career opportunities, developing the skills and professional connections needed to apply for these opportunities. The success of this program will enhance student retention by building students' confidence in conducting AI-related research. The regional AI community model can be replicated and adapted by other institutions and labs, contributing to the broader ecosystem of science education and research.

This research was selected for funding by the Office of High Energy Physics (HEP)

TIROS-MC: Training in Research Opportunities in STEM-Monmouth College

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This proposal is focused on attracting new people into STEM research and enabling them to become successful researchers. Our RENEW plan is to engage three students intensely in a 10-week summer experience, including 8 weeks (during the summer) at our DOE partner at Fermilab as part of the Mu2e experiment, and 2 weeks on campus (one week before the time at Fermilab, one week after). Research experience for undergraduates is well-known to be an effective way of attracting students, getting them excited about a future in STEM and building a sense of belonging. By sending three students each year for two years, we are building a research cohort that will strengthen the participating students as well as students that are on campus when they return and join our other students.

We will focus on students with unrealized potential (who are often from groups that are underrepresented in Physics and Engineering). For these students, building a sense that they belong is the crucial step in keeping them in STEM and enabling them to blossom and succeed. With this intense mentoring in a continuing research experience with colleagues at Fermilab, we will attract more students to STEM from underrepresented groups and enable them to be more successful.

Our program has the following structure:
Selection: Select students by engaging faculty colleagues to find students who have potential but might not yet realize their potential.
Pre-Week 1: Prepare—build confidence by meeting (virtually or in person) with Mu2e scientists and start to develop skills.
Week 1: Spent at Monmouth College (a familiar place) developing any necessary skills for their upcoming research experience. These include technical skills, knowledge appropriate to working at Fermilab and discussing what the research environment looks like at a national laboratory.
Weeks 2-9: At Fermilab, students work on the Mu2e experiment directed by the Mu2e staff, doing technical build tasks, testing, data analysis and modeling, and other tasks that contribute to the project. The Monmouth PI meets weekly with the three students virtually and will visit Fermilab for one week during this period. This visit provides additional support for the students and provides additional background for the PI to supervise the students in the upcoming semesters back on campus.
Week 10: Students return to campus to get set up to continue their research during the upcoming fall and spring semesters, as well as participate with our on-campus pre-semester SOfIA program students (research teams of returning and incoming first year students before the semester begins). In this way, they become ambassadors for STEM.
Fall and Spring Semesters: RENEW students continue their research supervised by the PI and supported financially by the RENEW grant during the semester. The continuing experience benefits the students as it continues to build their confidence and belonging as well as providing a model and example for other students. RENEW Students present their work at a regional meeting as well as on campus as part of our regular Science Seminar class and Scholars' Day.
End of Spring Semester: Review of what can we do and change to make the program more effective at recruiting and retaining STEM students. We will be able to measure success by our ability to recruit, retain, and graduate students from our target group.

This research was selected for funding by the Office of High Energy Physics (HEP)

Fostering Opportunities in Research and Growth Through Engineering Traineeships (FORGE)

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The collaboration between Triton College and Fermi National Accelerator Laboratory (Fermilab) aims to address the increasing demand for skilled professionals in high-energy physics by establishing a pilot traineeship program. This program combines academic coursework at Triton College with practical experience at Fermilab, preparing students for careers in engineering and technical fields. The objectives of the Fostering Opportunities in Research and Growth Through Engineering Traineeships (FORGE) program include developing a specialized pre-engineering pathway and will support Triton College's efforts to develop its Associate in Engineering Science (AES) degree. The coursework will be coupled with hands-on training, real-world problem-solving experiences at Fermilab, and professional development and networking opportunities in Science, Technology, Engineering and Mathematics (STEM) fields. In year one of the program, six students will enroll in the inaugural class of Triton College's AES degree program, completing foundational coursework in mathematics, physics, and engineering principles. In the summer, they will transition to internships at Fermilab, integrating classroom learning with hands-on experience. For year two, students will complete their coursework while continuing their internships at Fermilab, further developing their technical and professional skills. Multiple levels of support will be available for the participants throughout their time in the program as students progress in their academic coursework and during their internships, providing any required technical training, multiple mentors, and guidance in pursuing additional internship opportunities as the students transfer to a four-year institution. The expected outcomes of the FORGE program include students gaining practical experience and technical skills needed for careers in engineering while enhancing the curriculum and new coursework developed at Triton College through the development of a sustainable partnership between Triton College and Fermilab, contributing to workforce growth in high-energy physics. The FORGE program represents a strategic effort to prepare pre-engineering students for advanced study and professional careers in STEM. By integrating academic learning with real-world experience, the program aims to produce skilled professionals ready to contribute to advancements in Fermilab's scientific mission.

This research was selected for funding by the Office of High Energy Physics (HEP)

Utilizing Variable Metal Organic Frameworks for f-element Separations

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A central goal of this partnership between Tennessee Technological University (TTU) and Oak Ridge National Laboratory (ORNL) is to develop a diverse and skilled workforce in separation science and isotope production. The collaboration is committed to fostering an inclusive and supportive research environment where students from diverse backgrounds can thrive. Leveraging existing programs at both institutions, the initiative will provide mentorship, hands-on training, and professional development opportunities to prepare students for careers in science, technology, engineering, and mathematics (STEM). Engaging undergraduates in authentic research experiences enhances their confidence, technical skills, and retention in STEM fields. Students will be involved in all aspects of the project, from experimental design to data collection and analysis, gaining invaluable insights and skills. Through this initiative, TTU and ORNL aim to shape the next generation of skilled scientists in isotope separation while advancing diversity, equity, and excellence in STEM. This project addresses the critical demand for highly pure lanthanide isotopes, which are essential for applications in medical imaging, space exploration, and other advanced fields. One of the primary scientific challenges in this area is the separation of adjacent lanthanides, which have nearly identical chemical properties and sizes. To meet this challenge, the research focuses on developing innovative separation techniques using metal-organic frameworks (MOFs). These three-dimensional structures, composed of organic linkers and metal nodes, form tunable pores that can be optimized for size-based separations. By systematically adjusting the pore dimensions of MOF structures, the project aims to identify optimal conditions for isolating neighboring lanthanides, with the potential to transform separation science and apply these methods to other complex separations.

This research was selected for funding by the Office of Isotope R&D and Production (IRP)

Capturing a New Diverse Workforce in Radionuclide Sequestration

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This program will fund an exploratory grant to establish a one-year research training period for undergraduate students that will take place at the Department of Chemistry at the University of Akron in collaboration with Oak Ridge National Laboratory. The research portion of the training program will investigate the development of new compounds for binding and sequestering uranium, a key nuclear fuel. The isolation of uranium and other nuclear fuels is essential for non-carbon based energy independence. These new fuel element sequestration strategies will be based on the chemistry of isoindoline-based molecules, which comprise a diverse set of compounds for metal binding. Isoindolines are inexpensive and non-toxic compounds that are frequently used to make dyes and pigments. This chemistry has not been appreciably investigated with the actinide elements such as uranium. Additionally, the electrochemical properties of the resultant compounds will be investigated since electrochemical separation is often used to isolate different actinide elements from mixtures. Promising sequestration candidates will be shared with Oak Ridge National Laboratory for further evaluation. The training component of the program seeks to increase workers in both nuclear chemistry and related fields, as well as prepare students for matriculation into chemistry graduate programs. The program will use a tiered mentoring system that will utilize interactions between the faculty mentors, graduate students, and the undergraduate cohort. The training curriculum will last a year, starting in January and lasting through December, and there will be two training periods during the exploratory program. In addition to regular research during the spring and fall semesters, there will be scheduled group meetings (covering conduct of science, scientific writing and presentations, and usage of the scientific literature), career and graduate school mentoring, and presentation of research data by students at university, regional, and national meetings. During the summer, the student cohort research will continue; participants will be supported with a stipend for a six-week research period and will participate in a trip to Oak Ridge National Laboratory. The goals for the program are that 75% of participants will either seek employment in nuclear chemistry or related careers or will continue their education in graduate programs.

This research was selected for funding by the Office of Isotope R&D and Production (IRP)

Nuclear Physics California Connection to Train Undergraduate Students (Nuclear Physics CACTUS)

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Nuclear Physics CACTUS is a partnership that seeks to develop a diverse and inclusive science and technology workforce by establishing a long-term scientific partnership and local ecosystem that promotes and supports early exposure to nuclear science careers. This collaborative effort takes advantage of synergies between faculty at two minority-serving, Northern California State University campuses, California State University Sacramento (CSUS) and California State University East Bay (CSUEB), and researchers at Lawrence Livermore National Laboratory (LLNL) to provide participants with either research experience in a field related to nuclear physics, or teaching/mentoring experience. Nuclear Physics CACTUS consists of two main tracks: Students of Undergraduate California Colleges and Universities Learning and Engaging in Nuclear physics Topics (SUCCULENT), a paid traineeship that will provide CSUS and CSUEB undergraduate students with academic training and hands-on research experience relevant to a career in nuclear science and technology; and New Opportunities for Postdoc Access to Lesson-building and Education of Students (NOPALES), a teaching track for LLNL postdocs to broaden and enhance their professional skills through teaching and mentoring undergraduate students. The SUCCULENT track includes training by faculty at the students' institution followed by a summer internship at LLNL where students will engage in cutting edge research at state-of-the-art facilities. Following their internship, students will continue to work in scientific research projects with faculty mentors at their home institution. Student research opportunities include studies in utilizing instrumentation/quantum sensors, computational astrophysics, and both experimental and theoretical nuclear physics. The NOPALES track provides opportunities for postdoctoral researchers at LLNL to teach and mentor students at CSUS. This direct exposure is crucial for postdocs that aim to become faculty at primarily undergraduate institutions, an experience that is not available to many postdocs at national labs. NOPALES postdocs will have the opportunity to teach classes at CSUS and receive teaching mentorship from experienced faculty. They will also have access to professional development programs offered by the university. Both the SUCCULENT and NOPALES programs include support for participants to be involved in outreach and help recruit subsequent cohorts for both programs. CSUS and CSUEB are minority serving institutions, both being designated as Hispanic Serving Institutions (HSI) as well as Asian American and Native American Pacific Islander-Serving Institutions (AANAPISI). Additionally, CSUS has been designated as a State of California Black Serving Institution. This project is thus ideally suited to achieve the objectives of the RENEW program to train a diverse workforce for energy sciences. The Nuclear Physics CACTUS will increase pathways to graduate programs in nuclear physics as well as strengthen the bridge between national laboratories and undergraduate teaching institutions, thus advancing scientific excellence and building a skilled, diverse workforce for energy sciences.

This research was selected for funding by the Office of Nuclear Physics (NP)

Engaging Indigenous women into nuclear physics

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The goal of this program is to build minority participation in nuclear physics by providing summer internship opportunities for indigenous women; historically one of the most underrepresented groups in STEM. This will be accomplished by extending a successful pilot program titled "Engaging Indigenous Women in Gluon Saturation Search in Nucleus" that formed a strategic partnership between Los Alamos National Labs (LANL) and Fort Lewis College (FLC). In this program students from FLC spend the summer engaged in paid nuclear physics research at LANL consisting in a combination of experimental design, physical modeling, and continued education in the underlying theory of particle and nuclear physics. In addition, students have the opportunity to visit the world's largest particle accelerators at Brookhaven National Lab (BNL), Fermilab and the European Organization for Nuclear Research (CERN) and interact with many of the fields leading scientists. The pilot program has proven effective at providing indigenous women with opportunities for both employment and post-baccalaureate education in physics and engineering. This proposal seeks to improve on the existing program through increased support of the students and an enhanced outreach component to recruit students from indigenous communities in the four corners region.

This research was selected for funding by the Office of Nuclear Physics (NP)

Diversifying Education and Adding Research Capacity for Nuclear Science at Morgan State University

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This project at Morgan State University (MSU), a R2 Historically Black College/University (HBCU) aims to provide research training, mentorship, and education in experimental nuclear science, specifically in heavy ion physics to undergraduate and graduate students. Emphasis is placed on training in high performance computing, simulations of nuclear effects, detector design, data science, technical writing, communication skills, and teamwork. This initiative aims to increase diversity within the future nuclear workforce by equipping MSU students with the necessary tools, skillsets and experiences to thrive in these demanding fields.

This project strengthens the research infrastructure for MSU faculty and students by supporting four key objectives aligned with the DOE-RENEW mandate for workforce development.
1) A partnership with the Brookhaven National Laboratory, a National Laboratory of the Department of Energy, will enable sustained undergraduate and graduate student research and training through research-focused collaborations centered on detector development and detector design.
2) Financial support will expand the principal investigators' current research, enabling them to expand their research, teaching capabilities, and student training effectively.
3) Undergraduate and graduate student engagement will be facilitated with training and outreach activities, thus promoting the interest and awareness of nuclear research carried out under the Department of Energy Nuclear Physics program and its user facilities.
4) Experiential learning opportunities will enable students from traditionally underrepresented minority groups to obtain hands-on experience in nuclear research, acquiring expertise in detector development (such as Monte Carlo Simulations) and cultivating the professional skills needed for careers within the DOE and STEM fields.
The impact of this project will be far reaching in establishing Morgan State University as a leader in research in experimental nuclear science, with a focus on preparing students from groups underrepresented in the field, for graduate school and the workforce.

This research was selected for funding by the Office of Nuclear Physics (NP)