



Universities
Space Research
Association

2024
Annual Report





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MISSION

Advance the space- and aeronautics-related sciences exploration through innovative research, technology, and education programs

Promote space and aeronautics policy

Develop and operate premier facilities and programs by involving universities, governments and the private sector for the benefit of humanity

VALUES

Passion—for science, technology, and education

Partnerships—with universities, governments, and the private sector

Professionalism—through excellence, accountability, and respect for others



*Cover Image:
The cover illustration depicts
how science is using artificial
intelligence to understand our
place in the universe.*

Image Courtesy: Forge Branding

Message from the President and Chief Executive Officer and the Chair of the Board of Trustees



Jeffrey A. Isaacson,
President and Chief Executive
Officer, USRA

Gen Lester A. Lyles (ret.),
Chair, Board of Trustees

2024 brought many important developments to USRA, including the election to membership of the University of Texas at San Antonio, the University of Padua, and the Polytechnic University of Turin. The USRA Council of Institutions also reinstated the University of Notre Dame, bringing the association to 121 members, and established a new Region X in Europe with nine universities and a new seat on the USRA Board of Trustees.

In May 2024, USRA formed E Street Technologies LLC, a wholly owned, small business subsidiary. "ESTech" is a for-profit legal entity established to augment USRA's mission to advance science and technology for the public good. Launched to bridge the gap between the broad capabilities of USRA and the targeted needs of small business growth in the aerospace sector, it offers services as a mentor and partner to small businesses while continuing to contribute to aerospace innovations and grow the aerospace economy. This strategic move underscores USRA's commitment to expand its service offerings and enhance customer satisfaction in the ever-evolving marketplace.

In addition, USRA's Center for Space Nuclear Research (CSNR) took occupancy of a new 18,000 square-foot facility in Idaho Falls, Idaho featuring 7,000 square feet of secure laboratory space. CSNR is now situated to host visiting researchers and industry partners as an innovation and connection hub to the western states' nuclear and aerospace enterprise, including Department of Energy laboratories in Idaho, Nevada, New Mexico, and California, and the U.S. Space Force and U.S. Space Command in Colorado.

Through the efforts of its dedicated staff, USRA achieved many other noteworthy accomplishments in 2024. Among these:

- USRA staff published 179 peer-reviewed research products and, across all programs,

executed a total of 632 research engagements with 274 organizations, including 97 research engagements with Minority-Serving Institutions.

- USRA made significant contributions to NASA's Rapid Analysis and Manufacturing Propulsion Technology (RAMPT) team, which won the agency's 2024 Invention of the Year award for advancing deep space exploration.
- USRA developed a proof-of-concept data clearinghouse named *The Portal to the Universe* that aims to solve multiple issues attendant to Time Domain and Multi-Messenger Astrophysics. The Portal will bring together ground-based and space-based data from different observatories covering different wavelengths and messengers and enable searching and retrieval of that data in the time domain.
- USRA administered or supported 522 interns this year, including 343 Air Force Research Laboratory (AFRL) Scholars.
- USRA's Earth from Space Institute (EfSI) provided scientific visualization developments for the NASA Earth Information Center, which is displayed at NASA Headquarters and the National Museum of Natural History in Washington, DC.
- A delegation from USRA attended the 2024 United Nations Climate Change Conference (COP29), held in Baku, Azerbaijan. The Conference of Parties (COP) is the decision-making body responsible for implementing the global climate convention, known as the United Nations Framework Convention on Climate Change (UNFCCC). At COP29, USRA co-hosted a side event, *Co-creating Action-Ready Climate Monitoring and Mitigation Information Using Earth Observations*, with partners including the Japan Aerospace Exploration Agency, the European Space

Agency, Optica, the Remote Sensing Technology Center of Japan, and the Government of Mozambique.

- USRA co-founded a Generative AI Lab for Science and Engineering in collaboration with Boston Consulting Group and NASA's Ames Research Center.
- USRA's Quantum Information Science team continues to execute a variety of projects for NASA, DARPA, DOE, and NSF sponsors. Notable results this year include multiple groundbreaking advances in designing primitive computational elements of quantum simulation algorithms for high-energy physics and one of the first design theory papers on quantum error correction, led by USRA scientists.
- In its first year of operations, the Lunar and Planetary Institute's Expanding NASA's Community of Planetary Sample Scientists (ENComPSS) program successfully laid the groundwork to support research with NASA's extraterrestrial samples by offering training in small sample handling, scanning electron microscopy techniques and analysis, and isotope geochemistry and cosmochemistry.

These highlights, and those that follow, illustrate how USRA fulfills its mission to advance space- and aeronautics-related sciences and exploration; promote space and aeronautics policy; and operate premier facilities and programs involving universities, governments, and the private sector. While these highlights can't capture everything, we hope they convey the passion we hold for science, technology, and education that has driven our success since 1969.

A handwritten signature in blue ink that reads "Jeffrey A. Isaacson".

Jeffrey A. Isaacson
President and Chief Executive Officer

A handwritten signature in blue ink that reads "Lester L. Lyles".

Gen Lester L. Lyles (ret.),
Chair, USRA Board of Trustees

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

The Research Institute for Advanced Computer Science (RIACS) is dedicated to equitably building national capacity for foundational and use-inspired research in artificial intelligence and quantum computing supporting public-good applications.

Research Institute for Advanced Computer Science (RIACS)

Artificial Intelligence Groups within USRA's Research Institute for Advanced Computer Sciences have made remarkable progress since their inception, in collaboration with government and industry partners.

RIACS was founded to address rapid advances being made in AI by industry in 1983. It developed the:

- First AI plan for NASA Ames in 1984
- First undersupervised machine learning to make published astronomical discovery in 1980's
- First AI to control a spacecraft in deep space in 1990's
- First AI to plan the work of robots on another planet in 2000's
- First AI to hold conversation with astronauts in space in 2000's
- Quantum AI Lab co-founded in 2012
- Deep neural network that validates 300+ new planets in 2021
- AI models used by airlines to reroute aircraft in order to reduce fuel use and emissions from 2022 to 2024
- GenAI Lab for Science & Engineering that was co-founded in 2024

Other Activities

Generative AI Lab for Science and Engineering

In April 2024, Universities Space Research Association announced a strategic collaboration involving the Boston Consulting Group (BCG) and NASA's Ames Research Center in California's Silicon Valley to launch a generative artificial intelligence (GenAI) lab for science and engineering. The lab is developing and evaluating GenAI

technologies for use cases related to Earth science, life sciences, and engineering. A major initial project is developing a foundation machine learning model using decades of global satellite data for multiple downstream use cases including Geostationary Operational Environmental Satellite (GOES) weather data. These collaborations harness the talents of a unique team of leading innovators from industry (BCG), government (NASA), and academia (USRA).

As part of the GenAI Lab, USRA, NASA and BCG X (the tech build and design unit of BCG), are conducting, developing, testing and evaluating GenAI technologies for science and engineering use cases using publicly available datasets. A major initial project is developing a foundation machine learning model using decades of global satellite data for multiple downstream use cases.

Collaborative Research in Innovative Technologies

Working with the USGS Water Resources Mission Area and the USGS National Innovation Center, RIACS staff develop AI algorithms to automatically detect features in remote sensing imagery from aircraft. In FY 2024 RIACS expanded its collaboration with USGS with a new award.

As part of this new project, RIACS staff are building upon the USGS Toolbox for River Velocimetry using Images from Aircraft (TRiVIA), converting the Matlab code to Python and introducing AI techniques to improve the overall remote sensing image analysis workflows.

AI Solutions for Sustainable Aviation

In 2024, USRA-NAMS staff conducted research on the application of Artificial Intelligence/Machine Learning (AI/ ML) for the aviation domain in support of multiple projects for the NASA Aeronautics Research Institute (NARI) and for the NASA Air Traffic Management - eXploration (ATM-X) Project, Digital Information Platform (DIP) Sub-Project.

DIP Project

The NAMS Team ATM-X DIP Subproject supported NASA's Sustainable Flight National Partnership (SFNP) through the Collaborative Digital Departure Rerouting (CDDR) technology in the ATM-X DIP Subproject. Using machine learning on aircraft data shared by the FAA, airports, and airlines, CDDR predicted the impact of current restrictions on flight plans, enabling airlines to choose the most efficient routes before departure. A field evaluation at Dallas/Fort Worth Airport in FY 2024, with the FAA and three airlines, resulted in measurable fuel, emissions, and delay reductions. The system, deployed in the cloud, was quickly extended to Houston, TX. Research was documented in DASC 2023 and AIAA SciTech Forum 2024 publications.

QUANTUM INFORMATION SCIENCE

The Quantum Information Sciences (QIS) team within USRA's Research Institute for Advanced Computer Science (RIACS) is advancing QIS while also developing the next generation of quantum scientists with the USRA Feynman Quantum Academy.

The Quantum Information Sciences Group within USRA's RIACS has made remarkable progress since its inception, in collaboration with its government and industry partners.

- ▶ The co-founding of the Quantum Artificial Intelligence Lab in 2012
- ▶ The achievement of quantum advantage in 2016
- ▶ The achievement of quantum supremacy in 2019
- ▶ Progress suppressing quantum errors in 2023

Quantum Approximate Optimization

Quantum Approximate Optimization has become one of the most studied and most frequently demonstrated quantum algorithms. Broadly speaking, it aims to find approximate solutions to various mathematical problems usually using multiple clever tricks and heuristics. Unfortunately, many modern quantum processors are currently strongly affected by various kinds of noise, which, without quantum error correction, limits the practical performance of many known optimization approaches.

USRA is building a framework to adaptively take advantage of the noise, rather than the errors being purely a detriment. After four years of work funded by DARPA under the ONISQ program, led by USRA, through multiple iterations involving seven different QPU platforms and thousands of QPU hours, USRA has developed a technique called "Noise-Directed Adaptive Remapping" (NDAR).

In a standard setting certain popular noise types can be detrimental to the quantum optimization performance. NDAR leverages controlled noise to improve the quality of solutions by iteratively transforming the noise-induced "attractor" state essentially turning noise from a hindrance to a possibly beneficial tool.

Our method takes advantage of a special state to carry out certain

calculations (gauge transforms) that help fine-tune the balance between the noisy environment and the problem being solved on a quantum device. It works by repeatedly adjusting the noise to align it with the best possible solutions, using the top candidate from the previous round of optimization as a guide.

The NDAR can be applied for noise types that are prevalent in contemporary superconducting quantum devices that, due to their speed of operation, are one of the leading candidates for the implementation of quantum approximate optimization.

Other Activities

- Groundbreaking advances in designing primitive computational elements of quantum simulation algorithms for high-energy physics
- Supporting Google in their groundbreaking experiments and multiple companies via the DARPA QB Program
- Working with North Carolina A&T - the largest Historically Black College and University in the country - on their NSF ExpandQISE program to support Quantum machine learning education and research

LUNAR AND PLANETARY SCIENCE

Research conducted by USRA scientists helps to advance our understanding of the solar system from its formation through its evolution to its current state.

Supporting NASA Planetary Sample Science

In its first year, the LPI's Expanding NASA's Community of Planetary Sample Scientists (ENComPSS) program successfully laid the groundwork to support research with NASA's extraterrestrial samples by offering training in small sample handling, Scanning Electron Microscopy (SEM) techniques and analysis, and isotope geochemistry and cosmochemistry.

The three-day Small Sample Handling Workshop focused on key skills for working with small particles (less than 100 micrometers across), including manual and micromanipulation transfer techniques, embedding samples in epoxy and sulfur, ultramicrotomy, and sample preparation using microtomy and Focused Ion Beam Scanning Electron Microscopy (FIB-SEM). These

techniques are essential for preparing and analyzing small extraterrestrial samples.

The three-day Modern SEM Techniques Workshop provided a mix of lectures and hands-on training, a format that participants found highly effective. The sessions covered key techniques in Scanning Electron Microscopy (SEM) and Energy-Dispersive Spectroscopy (EDS), with participants learning both theory and practical skills. They had the opportunity to work with their own samples, adding a personalized element to the training. The workshop concluded with participants applying advanced analysis methods and leaving with a comprehensive set of data for future use.

The three-day Isotope Geochemistry and Cosmochemistry Workshop provided training in isotope geochemistry and cosmochemistry techniques. Topics covered included volatiles geochemistry, trace elemental geochemistry, stable isotope geochemistry, and radiometric dating. Participants visited NASA Johnson Space Center's state-of-the-art laboratories, engaged with JSC and LPI experts, and received feedback on their research projects.



Workshop participants practicing microparticle manipulation using glass needles under a stereo microscope at the 6th Small Sample Handling Workshop. Image Courtesy: Lunar and Planetary Institute



Modern SEM Techniques Workshop participants in the LPI Sample Prep lab learning techniques of sample preparation for SEM analysis and operating the Leica carbon coater. Image Courtesy: Lunar and Planetary Institute

Lunar and Planetary Science Conference

The 55th Lunar and Planetary Science Conference (LPSC), co-chaired by Walter Kiefer (USRA/LPI) and Justin Filiberto (NASA JSC), was held as a hybrid event on March 11-15, 2024, at The Woodlands Waterway Marriott Hotel and Convention Center in The Woodlands, Texas. The conference experienced another year of strong participation with 1,904 total registrants (1,589 in-person [83%] and 315 virtual [17%]). Submitted abstract numbers totaled 1,794 from 43 countries. LPSC continues to be accessible and important to young scientists, with student participation at more than 31% of total registrants.

The plenary session on the afternoon of March 11th featured the Masursky Lecture, "The Secret Lives of Icy Moons," by Dr. Louise Prockter. During the NASA Headquarters Briefing, representatives from the Planetary Science Division of NASA's Science Mission Directorate addressed conference attendees.

In-person poster sessions were held and included topics covered in the oral sessions and topics in other areas such as education and public outreach. A dedicated virtual poster session was held for virtual and in-person attendees. All of the poster sessions offered an opportunity for participants to network and share science.



Conference attendees at the NASA Headquarters Briefing gain insights into the latest space exploration initiatives. Image Courtesy: Lunar and Planetary Institute



Dr. Louise Prockter, this year's Masursky Lecturer, delivered an engaging presentation on icy satellites. Image Courtesy: Lunar and Planetary Institute



Students and early-career researchers, who make up a significant portion of LPSC attendees, engage in discussions and network during poster sessions. Image Courtesy: Lunar and Planetary Institute



LPI Science Council

The Lunar and Planetary Institute (LPI) Science Council focused its efforts on the transition in LPI leadership and the start of NASA's Support for Planetary Sample Science (SPSS) cooperative agreement. Council members appointed by USRA include Dr. Amy Fagan (Chair) from Western Carolina University, Dr. Julie Castillo-Rogez, Jet Propulsion Laboratory; Prof. Martha Gilmore, Wesleyan University; Dr. Larry Nittler, Arizona State University; Dr. Alyssa Rhoden, Southwest Research Institute; and Prof. Meenakshi Wadhwa, Arizona State University.

SPACE NUCLEAR TECHNOLOGY

The Center for Space Nuclear Research (CSNR), a USRA Institute at the Idaho National Laboratory, investigates transformative applications for the use of nuclear energy in space. CSNR was established to foster collaboration with NASA, the Department of Energy, the Department of Defense, university and industry scientists and their research programs. The R&D efforts focus on advancing space nuclear propulsion and power systems, including Nuclear Thermal Propulsion (NTP); Nuclear Electric Propulsion (NEP); advanced radiator and thermal management technologies; directed energy transmission systems; and radioisotope power systems.

Space Nuclear Working Group

USRA has expanded its Space Nuclear Working Group (SNWG), a team of leading academic researchers and faculty focused on advancing space nuclear technologies. The SNWG plays a key role in identifying research gaps and proposing strategies for NASA and other agencies to engage academia in accelerating the R&D and infrastructure needed for nuclear-powered human and robotic space

exploration. In September 2024, the SNWG reviewed NASA's Space Nuclear Propulsion (SNP) Project alongside the National Academies of Science's 2021 roadmap, confirming USRA and industry cost estimates. These efforts will help guide NASA and federal lawmakers in advancing SNP technologies for a Mars mission in the 2040s.

CSNR's New Facility



The new CSNR facility in Idaho Falls, ID; Image Courtesy: 2024 USRA/CSNR

In June 2024, the CSNR moved into its new 18,000-square-foot facility, featuring 7,000 square feet of secure labs and computational space. The remaining space, spread across three floors, includes meeting rooms, offices, and amenities. The facility will soon reactivate security systems to support both controlled unclassified and classified R&D. Designed for growth, it has already hosted the 2024 CSNR Summer Fellowship Program and houses subcontractor

Sawtooth Simulation LLC. It will soon receive advanced materials processing equipment for NASA's Space Nuclear Propulsion Project. Conveniently located near Idaho Falls Regional Airport, the facility is a hub for collaboration with researchers, industry partners, and nearby Department of Energy labs, in Idaho, Nevada, New Mexico and California as well as Space Force and US Space Command in Colorado.

New Partnerships



CSNR Director Rob O'Brien (left) with MARS Director Ben Garcia and Weber State University executive staff Guy Lutendre and James Taylor following signing of MOU on July 1. Image Courtesy: USRA/CSNR

Key to the execution of the CSNR new business is partnership with industry, academia and government agencies. During 2024, USRA entered into several partnering and IP protection agreements with industry and laboratory partners that have already resulted in the successful submission of proposals sought by the government. One example includes the memorandum of understanding (MOU) between the CSNR and the Weber State University's Miller Advanced Research Solutions (MARS) center which is funded by the state of Utah to enable workforce development for aerospace and defense manufacturing. CSNR will collaborate with MARS staff to develop a mutual R&D portfolio focused on the manufacturing of composite ultra-high temperature materials and structural components for space nuclear and hypersonics systems. Building on the success of prior industry partnerships, CSNR will continue to develop collaborative partnerships that can support the resolution of workforce development while concurrently performing enabling research and development that can be afforded by the community of practice, and that provide novel approaches to accelerate access to key enabling technological solutions.

EMAD Facility

CSNR and USRA leadership have developed a community of practice position addressing the decline of national infrastructure, highlighted in a 2024 presentation by CSNR Director Rob O'Brien to the National Space Council User's Advisory Group. They've worked with key stakeholders to advocate for preserving the Engine Maintenance Assembly and Disassembly (EMAD) Facility—the last infrastructure from the ROVER/NERVA nuclear propulsion programs. EMAD plays a crucial role in ground testing nuclear engines, particularly for moderated reactor systems like those using High Assay Low Enriched Uranium fuel. It can remove and section fuel and components for postmortem analysis at Department of Energy labs, overcoming criticality

safety limits in traditional facilities by handling materials like zirconium hydride and yttrium hydride. With its vast capabilities, including one of the world's largest hot cells, EMAD can accommodate an entire Nuclear Thermal Propulsion engine. The facility, valued at \$14-19 billion by the National Nuclear Security Administration and the Department of Energy, has been spared from demolition for 18 months, thanks to CSNR's coordination with NASA's Space Nuclear Propulsion project. The pause allows for assessments on renovating EMAD at just 6% of the cost of new construction, with the potential to serve as a national hub for nuclear testing in support of NASA and Space Force programs.



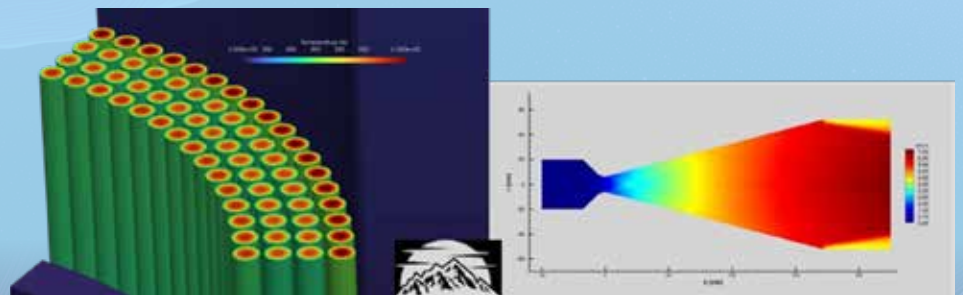
EMAD and NASA-CSNR-Industry assessment team initial visit. Image Courtesy: NNSA

Subscale Maturation of Advanced Reactor Technology (SMART) and NuPHASE Wind Tunnel

Through its grant from the NASA Space Nuclear Propulsion Project, CSNR and its subcontractors STARR Nuclear and Sawtooth Simulation LLC have led the continued development of the Subscale Maturation of Advanced Reactor Technology (SMART) reactor facility concept. The SMART reactor facility concept aims to enable NASA and other agencies to test nuclear fuel and moderator materials and subsystems within the nuclear and environmental conditions that are prototypical of nuclear thermal and nuclear electric propulsion systems. SMART may be of benefit to other nuclear materials testing for advanced terrestrial and space surface fission power systems. Following the Department of Energy's 413.3B planning and facility authorization processes, the

SMART reactor has graduated from the CD-0 stage into the CD-1 stage which includes completion of facility requirements and performing siting studies and financial cost estimation. In defining stakeholders and beneficiaries of SMART, the assessment team has identified complementary capabilities including NuPHASE, a game-changing wind tunnel technology that can

provide sustained exposure of materials and flight system models to high-Mach Number varied composition gas flow. NuPHASE can accelerate the acquisition of data for the hypersonics defense and civil aviation industries that are currently limited to very short-duration ground tests in existing wind tunnel facilities.



SMART and NuPHASE modeling and simulation analytical results performed by CSNR subcontractors for NASA. Image Courtesy: Sawtooth Simulation LLC

EARTH SCIENCE

USRA scientists strive to understand the Earth's natural processes, their propensity to change, and the linkages between human and natural systems. They also work across sectors and disciplines to apply Earth Observations for broad societal benefit.

Earth from Space Institute Offers a Solution to Existing Gaps in Global Emission Inventories

Urban areas generate over 70% of global greenhouse gas (GHG) emissions, and cities are increasingly taking action on sustainability issues like climate change. Global networks such as the C40 Cities Climate Leadership Group and the Global Covenant of Mayors are driving local climate action. However, city leaders face a major challenge—access to actionable data on fossil fuel pollution. Scientists from the Earth from Space Institute (EfSI) address this gap with the Open-sourced Data Inventory for Anthropogenic CO₂ (ODIAC), a high-resolution global emissions inventory (1 km x 1 km) that is actionable for cities.

ODIAC, developed at Japan's National Institute for Environmental Studies

(NIES) under the Greenhouse Gas Observing SATellite (GOSAT) project, integrates data from multiple sources, enabling detailed GHG budget analyses. EfSI, in partnership with NIES and NASA, is continuously updating ODIAC, which is freely available through the Global Environmental Database (<https://db.cger.nies.go.jp/dataset/ODIAC/>).

EfSI is also enhancing ODIAC's accuracy at higher (~30 meter) resolutions by incorporating advanced Earth observation data like NASA's Black Marble product. ODIAC aims to bridge the gap between scientific GHG emission analysis and policymaking, supporting cities in their transition to low-carbon smart cities of the future.



A high-resolution image of spatially-explicit CO₂ emission estimates over the Northeast U.S. CO₂ emissions reported by the Environmental Protection Agency were distributed using point source profiles and NASA's Black Marble nighttime product. Image Courtesy: Tom Oda/USRA

Universities Space Research Association's Delegation Attends the COP29 Conference in Azerbaijan

USRA participated in COP29 in Baku, Azerbaijan, in collaboration with Optica and the Japan Aerospace Exploration Agency (JAXA). Recognizing Earth Observation (EO) as essential for climate monitoring, mitigation, and adaptation, USRA co-hosted a side event titled *"Co-creating Action-ready Climate Monitoring and Mitigation Information Using Earth Observations."* The event showcased successful EO use cases and explored ways to enhance EO's impact.

Key partners included JAXA, Optica, the European Space Agency (ESA), the Remote Sensing Technology Center of Japan (RESTEC), and the Government of Mozambique. USRA President and CEO Dr. Jeffrey Isaacson delivered the opening remarks, welcoming participants in person and online. Speakers from Brazil, Cameroon, and Japan shared their EO applications. At the same time, Dr. Tomohiro Oda, Senior Scientist at EfSI, moderated a panel discussing gaps and opportunities for

co-creation with experts from the UK and India. Dr. Oda also participated in a panel at the Ocean Pavilion, hosted by the American Geophysical Union.

One of the main outcomes of COP29 was to triple the money to help developing countries adopt cleaner energy and cope with the effects of climate change. The wealthy nations pledged to reach \$300 billion per year in support by 2035, up from a current target of \$100 billion.

USRA's Data Visualization Team Supports NASA's Earth Information Center Exhibits

To better understand our planet, NASA created the Earth Information Center (EIC) drawing insights from its centers and federal partners. It offers real-time data on global changes, helping decision-makers develop tools to mitigate, adapt, and respond to those changes. By tracking key factors like global temperature, sea level rise, and greenhouse gases, the EIC informs policy makers, researchers, and communities on climate change,

biodiversity loss, and natural disasters. It delivers detailed, readily usable, scalable information to empower the public to understand the climate crisis and take action locally.

The Earth Information Center (EIC), with locations at NASA Headquarters and the National Museum of Natural History, showcases stunning displays created by USRA's data visualization team. Using satellite and sensor data,

the USRA scientific visualization team highlights how natural forces, climate change, and human activities shape the planet. Their work, presented on a giant video screen called the Hyperwall, features vivid visualizations of weather patterns, temperature shifts, mapping the spread of wildfires, and ice sheet changes. These dynamic displays are featured at both NASA Headquarters and the Smithsonian.



The USRA Data Visualization team in front of their exhibits at the Smithsonian. Image Courtesy: USRA

Kel Elkins

Trent Schindler

Helen-Nicole Kostis

Ernest Wright



Entrance to the COP 29 Conference in Baku, Azerbaijan. Image Courtesies: T. Oda, USRA



USRA President and CEO Jeff Isaacson delivering the opening remarks at the USRA's co-hosted side event, "Co-creating Action-Ready Climate Monitoring and Mitigation Information Using Earth Observations." Image Courtesy: T. Oda, USRA



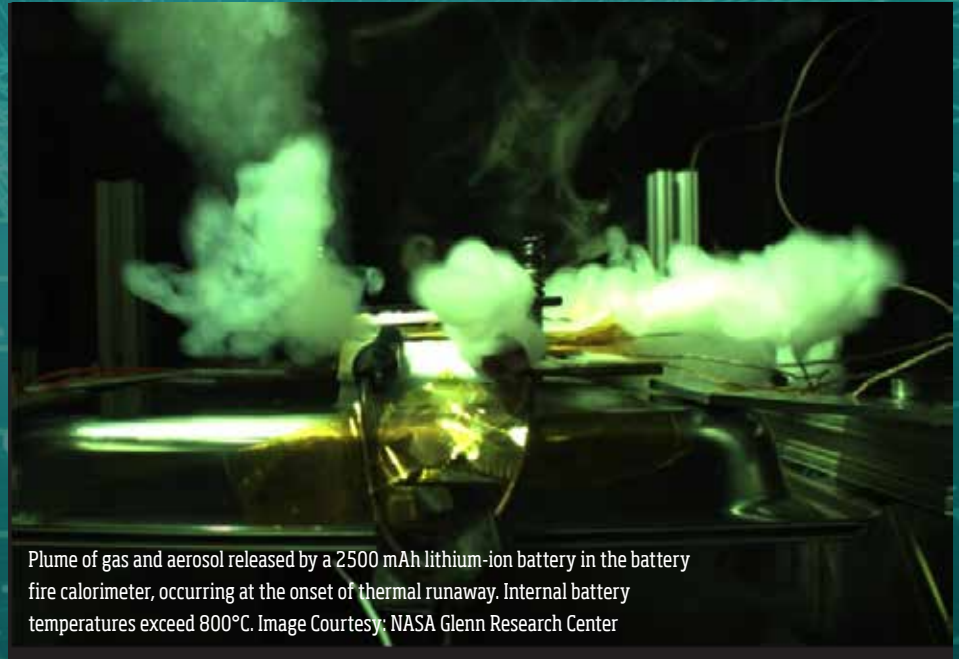
Post-event group photo (left to right): Toshi Kamei, Frank Martin Seifert, Anumita Roy Chowdhury, Stuart Brocklehurst, Mariko Harada, Angeline Ondeng'e, Muri Soares, Tomohiro Oda, Jeffrey Isaacson, and Roani Rajão. Image Courtesy: T. Oda, USRA

LOW GRAVITY SCIENCES

As members of NASA's Glenn Research Center microgravity science team, USRA scientists support the goals of the Science Mission Directorate's Biological and Physical Sciences (BPS) Division through the use of the International Space Station (ISS) as an experimental platform to understand the physical effects of microgravity on physical and biological systems. These investigations into how these systems respond to the effects of reduced gravity and radiation may someday lead to new discoveries that might reduce risks of prolonged space exploration and eventually benefit life on Earth.

Lithium-Ion Battery Fire Testing

USRA combustion scientists and engineers completed the construction of a battery fire calorimeter, validated it through testing with ethanol pan fires, and conducted initial tests on lithium-ion battery fires. This apparatus measures products released during the thermal runaway of lithium-ion batteries, providing data for realistic inputs into models of future space habitats. These models will inform plans for habitat operations, environmental monitoring, resilience, fire protection, and mitigation. The current apparatus measures the heat released. Upcoming enhancements in oxygen measurement, along with aerosol and gas chemical analysis, will further expand the calorimeter's capabilities.



Plume of gas and aerosol released by a 2500 mAh lithium-ion battery in the battery fire calorimeter, occurring at the onset of thermal runaway. Internal battery temperatures exceed 800°C. Image Courtesy: NASA Glenn Research Center

2024 NASA Invention of the Year Award

USRA made significant contributions to NASA's Rapid Analysis and Manufacturing Propulsion Technology (RAMPT) team, which won the agency's 2024 Invention of the Year award for advancing deep space exploration.

The RAMPT team was recognized for its 3D-printed, one-piece thrust chamber assembly (TCA), which eliminates complex bolted joints. This design, featuring a composite overwrap, reduces the TCA's mass by over 40%, allowing for increased payload mass, improved launch vehicle performance, and lower costs and lead times.

The TCA endures extreme conditions, including temperatures from -290°F to +6,000°F, pressures up to 6,000 psi, and demanding duty cycles. Its thin 0.02-inch walls require precise manufacturing and tight tolerances. Key innovations include NASA's GRCo-42 alloy, a laser powder bed fusion process, and a composite overwrap, which improve cooling, reduce material use, and optimize strength-to-weight ratios. The composite overwrap, designed with advanced modeling, reduces



weight while maintaining the necessary strength to handle operational pressures and loads.

Additive manufacturing enabled the creation of complex internal passages not possible with traditional methods.

Enhancements in material and manufacturing techniques led to a 45% increase in combustion chamber wall temperatures. Researchers used filament winding equipment to produce composite overwraps for small-scale chambers, which were hot-fire tested to verify their durability under extreme TCA conditions.

Radio Frequency Mass Gauging

USRA engineers played significant roles in developing the propellant gauging system for Intuitive Machines' Odysseus lander as part of the GRC Radio Frequency Mass Gauging (RFMG) project. RFMG technology measures the amount of propellant



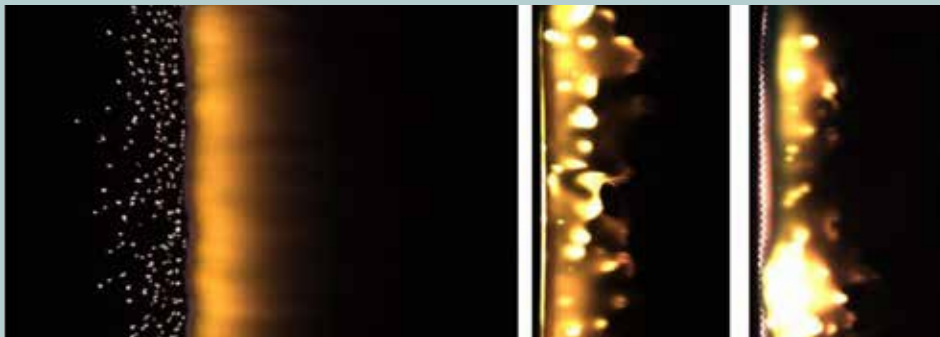
Intuitive Machines' Odysseus Moon Lander. Image Courtesy: NASA Glenn Research Center

in spacecraft tanks in a low-gravity environment. USRA engineers served as the lead innovators in developing an algorithm to match measured tank radio frequency spectra to simulation test results. Our work was used to determine the radio frequency eigenmode values specific to the Odysseus lunar lander propellant tanks, establishing the foundation for a database used during the mission in February 2024. Our algorithm enabled precise calibration and validation of the propellant gauging system, ensuring its reliability and accuracy. Our team contributed significantly to advancing the capabilities of space propulsion technology, ultimately enhancing the success and safety of future missions like Odysseus.

SAFFIRE - Spacecraft Fire Safety

SAFFIRE-VI, the final flight experiment as part of the Spacecraft Fire Safety Demonstration, operated aboard the Northrup Grumman Cygnus resupply vehicle NG-19 from December 22, 2024, to January 8, 2024. The overall experiment examined the scientific as well as practical effects of burning large fuel samples in the anticipated high oxygen concentration, low total pressure atmospheres of future long-duration space missions. USRA researchers and engineers were members of the science and operations team at GRC. The science and operations team guided the experiment through an initial vehicle volume estimate, followed by

depressurizing and adding oxygen to the spacecraft to approximate the anticipated future long-duration space mission environment. The experiment was then remotely commanded to sequentially burn a Nomex fabric sample, a composite cotton-fiberglass fabric blend (referred to as SIBAL fabric), and two thick polymethyl methacrylate (PMMA) samples, one with two-sided burning, the other with one-sided burning. All tests were successful, yielding scientific and practical information on the flammability and flame spread in microgravity and at scales appropriate for potential fire mishaps during a future long-duration space mission.



Representative front-view sample surface images for each Saffire VI test after the flame is well established. From left: SIBAL fabric (atm. pressure and 50 cm/s gas flow rate). Image Courtesy: NASA Glenn Research Center

Flammability of Materials on the Moon



Engineering Model of the Flammability of Materials on the Moon Experiment Hardware. Image Courtesy: NASA Glenn Research Center

USRA researchers are providing scientific expertise for the Flammability of Materials on the Moon (FM2) experiment, a groundbreaking study assessing the flammability of solid materials under lunar gravity. Multiple samples will be burned in various atmospheres to gather critical data, including flame images, radiant emissions, temperatures, and combustion product gas concentrations. These tests will provide essential guidance for evaluating and rating materials intended for future lunar missions.

This research will enhance the safe and reliable selection of materials for structures, habitats, and equipment designed for the Moon's unique environment. The FM2 team recently achieved a key milestone by visiting the payload developer to inspect the nearly completed FM2 Engineering Model hardware.

Designed as a self-contained experiment with its own environmental control system, FM2 will investigate the effects of lunar gravity on fire spread over extended durations, offering vital insights into extraterrestrial fire safety. Originally planned for a Commercial Lunar Payload Services (CLPS) lander, FM2 is now set to fly aboard the SpaceX Human Lander System demonstration flight.

ASTROPHYSICS AND HELIOPHYSICS

USRA scientists, in collaboration with scientists around the world, are contributing to our understanding of a wide array of current astrophysical problems, using nearly the full range of the electromagnetic spectrum. Current work enabled by USRA includes the turbulent youth and explosive death of stars, the largest gravitationally bound structures in the universe, the behavior of matter under the most extreme conditions, the origin of gravitational waves and high-energy cosmic rays, and the creation of the universe itself.



StarBurst Mission Patch. Image Courtesy: Dan Kocevski;
Background Image NASA MSFC

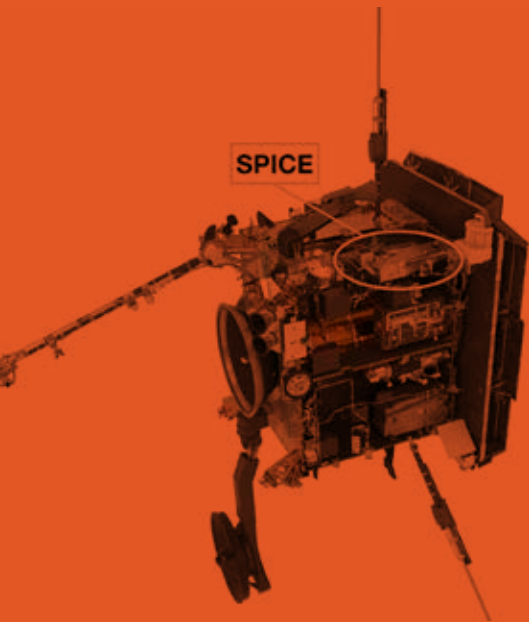
StarBurst Multi-messenger Pioneer

The StarBurst Multi-messenger Pioneer is an in-development SmallSat designed to detect Gamma-ray Bursts (GRBs) produced from binary neutron star mergers. StarBurst is designed to be 5-7 times more sensitive than the Fermi Gamma-ray Burst Monitor to produce as many joint detections of GRBs with gravitational waves as possible during the LIGO fifth observing run, expected to begin in 2027.

USRA-STI scientists and engineers are responsible for developing and operating the StarBurst Science Operations Center (SOC). The SOC will

be able to receive rapid alert telemetry from StarBurst whenever there is an onboard detection of a GRB, and the SOC will promptly deliver that alert to the community so that telescopes all over the world can search for counterpart signals. The SOC will then process all science and ancillary data and promptly deliver that data to the NASA archives for public use. Finally, the SOC will be able to produce the science analysis tools for StarBurst, which will be based on the Gamma-ray Data Toolkit that is also led by USRA-STI scientists and engineers. Recently, StarBurst successfully completed its Critical Design Review.

Investigation of Plasma Composition Variations in the Solar Atmosphere Using Spectroscopic Data from the Solar Orbiter SPICE Instrument



SPICE Instrument.
Image Courtesy: NASA MSFC

The elemental composition of the plasma in the solar corona shows variations over spatial scales and in time. No variations are observed in the elemental composition of the solar photosphere below. Therefore, understanding what is happening to the plasma on its way from the photosphere to the corona that could drive these composition changes is one of the big mysteries in modern solar physics. In addition to being an important unanswered question on its own, it is believed that the processes driving these variations are tightly linked to the processes that heat up the Sun's corona to millions of degrees and those that accelerate the solar wind into the heliosphere. Gaining insight into what drives the plasma composition variations has significant potential in contributing to

our understanding of these other two fundamental solar physics questions.

USRA's STI is developing methods to process spectroscopic data from Solar Orbiter SPICE with the aim of characterising plasma composition variations in the Sun's corona. STI is currently working on analyzing observations taken during Solar Orbiter's Major Flare Watch Observing Campaign which took place in March-April 2024. These observations capture a few large solar flares as well as the active region which produced the flares. In previous studies, the largest composition variations were registered in active regions and solar flares, making this dataset ideal for studying this phenomenon.

Time Domain and Multimessenger, USRA's Portal to the Universe

The 2020 Astrophysics Decadal Survey, commissioned by the National Academies, identified several issues with current astrophysics archives regarding support for Time-Domain and Multi-messenger astrophysics investigations. These problems include the siloing of archives by wavelength/messenger, the inability to uniformly search datasets in the time domain,

and the inability to bring together data collected in space and data collected on the ground. The Portal to the Universe is a proof-of-concept data clearinghouse that aims to solve these issues and brings together ground-based and space-based data from different observatories covering different wavelengths and messengers and enables searching and retrieval of

that data in the time domain.

The Portal both houses observatory data and connects to existing archives to retrieve and offer up external data alongside internal holdings. The prototype clearinghouse hosts one year of data from the Fermi Gamma-ray Burst Monitor (in-orbit gamma-ray observations), the LIGO and Virgo gravitational-wave observatories (on-ground gravitational-wave observations), and it connects to the public archive for the Zwicky Transient Facility (on-ground optical telescope observations) for up to one year of data. Users can search for data associated with astrophysical events or query for data availability based on time and, optionally, location on the sky. The USRA-STI-developed Portal to the Universe is a first step to make USRA-STI a key leader in the burgeoning field of multi-messenger astronomy.



Screenshot of the main page of the Portal to the Universe. Image Courtesy: STI/USRA

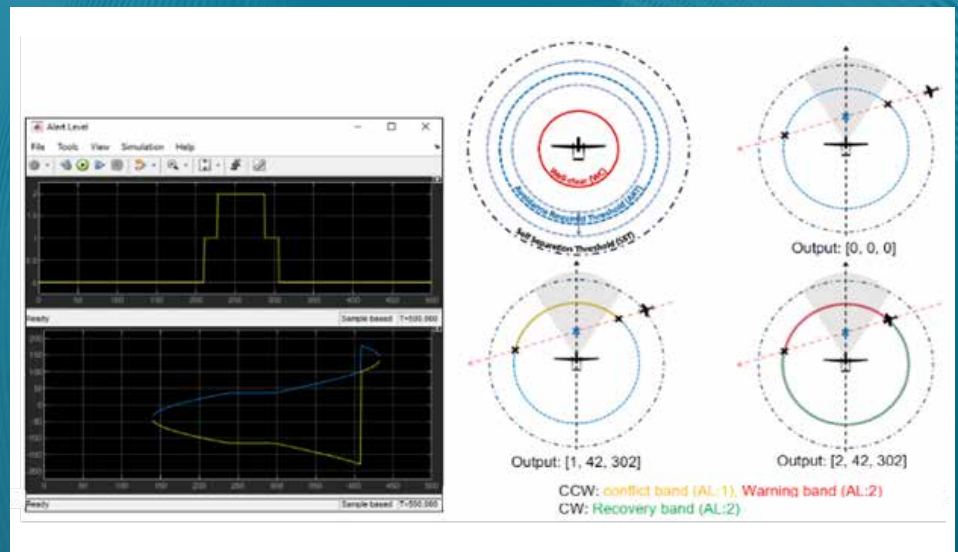
AERONAUTICS RESEARCH AND DEVELOPMENT

USRA works closely with NASA, universities and industry in developing advanced aeronautical technology concepts. Its mission is to advance aeronautics technologies for the benefit of humanity.

Unmanned Aerial Systems (UAS) Research for Public Safety Applications

During FY 2024, the Unmanned Aerial Systems (UAS) Research for Public Safety Applications program continued to make excellent progress with the research tasks. The objective of this five-year project is to conduct research on UAS use in a broad range of public safety applications over land and maritime environments. USRA has partnered with the Alliance for System Safety of UAS through Research Excellence (ASSURE) led by Mississippi State University (MSU) to collaborate on this program. While USRA provides management oversight to the program, the subject matter experts from the ASSURE coalition perform direct research to fulfill the technical requirements for this project. The tasks included areas of: navigation and command/control (C2) communication approaches for radio frequency degraded or denied conditions, open source weather forecasting systems for low altitude UAS operations, multi-vehicle to operator management of small/medium size UAS operators, safety cases development for beyond line-of-sight (BVLOS) operations, detect and avoid (DAA) and communication technologies for small UAS (sUAS), spectrum considerations for UAS traffic management (UTM), and display requirements for UAS operators flying BVLOS operations.

An initial version of the BVLOS (beyond line of sight) safety case Detect-and-Avoid (DAA) simulation was successfully integrated into the user interface (UI). The figure illustrates the



The Detect-and-Avoid Simulation showing four displays representing different encounter scenarios. Image Courtesy: USRA

DAA algorithm integration's current state, highlighting various detect-and-avoid system components. The figure shows four displays representing different encounter scenarios. These displays include the ownship (center aircraft symbol), intruder aircraft (smaller aircraft symbols), and various alert zones indicated by concentric circles. The color-coded bands around the perimeter of these displays represent conflict zones (red) and recovery zones (green), providing visual guidance for maintaining separation.

The primary goal of the associated human factors research is to determine the optimal way to present DAA information to UAS pilots, enabling them to effectively detect potential conflicts and maintain separation from



SOAR Simulator DAA Display User Interface with integrated displays overlaying on a satellite map. Integrated displays incorporate the DAA algorithm in the pilots' visual interface to enhance situational awareness and decision-making during flight operations. Image Courtesy: Mississippi State University, Raspet Flight Research Laboratory

other aircraft. The plans are to develop and test multiple DAA display concepts with varying levels of information

and automation, experimenting with different arrangements of key data elements across multiple screens. The figure on the previous page, (column three), presents a screenshot of one of the user interfaces (UIs) with the avoidance algorithm integrated. This display combines various elements essential for UAS navigation and conflict detection, including a prominent heading indicator, a map overlay of the surrounding area, and representations of intruder aircraft. The integration of these elements demonstrates how the DAA algorithm information is being incorporated into the pilot's visual interface to enhance situational awareness and support decision-making during flight operations.



In addition, autonomous flight tests with the Albatross UAS were conducted, achieving a significant milestone in June with the first fully autonomous flight on the south field of the George M. Bryan Airport in

Starkville, MS (KSTF). Despite some initial challenges with software update and some GPS/ground station related connection issues encountered in flight, the flight test was largely successful.

USRA Wins ARPA-E Project to Mitigate Environmental Impact of Aviation Contrails with NASA

USRA's Research Institute for Advanced Computer Science (RIACS) began development of a "Physics and Machine Learning Based Contrail Prediction and Observation System" to mitigate the environmental impact of aviation contrails, after its proposal to ARPA-E was selected this year.

The project brings together the RIACS experts in artificial intelligence with NASA experts in the Science Directorate of NASA's Langley Research Center and in the Aeronautics Directorate of NASA's Ames Research Center. As part of the project, the team is developing a real-time contrail

prediction and observation system to support airspace operations through new satellite-derived atmospheric data services and ensemble modeling approaches. The system is advancing an existing satellite data fusion capability of NASA with novel machine learning approaches for predicting and observing the formation and evolution of persistent contrails.



The contrails of an airbusA340 jet, over London, England. Image Courtesy: Adrian Pingstone

This project is sponsored under the aegis of the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) Predictive Real-time Emissions Technologies Reducing Aircraft Induced Lines in the Sky (PRE-TRAILS) Exploratory Topic, which aims to develop new pioneering technologies and tools aimed at reducing the environmental impact of aviation.

STEM WORKFORCE DEVELOPMENT

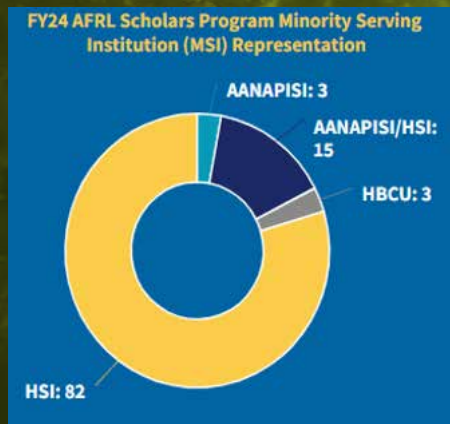
USRA's extensive workforce development pipeline provides immersive and experiential learning opportunities for undergraduate, and graduate students, as well as postdoctoral fellows and early career professionals.

USSF and AFOSR Internships

USRA collaborated with the Air Force Office of Scientific Research (AFOSR) and the U.S. Space Force (USSF) to launch a pilot internship program to accelerate AFOSR's research transition and enhance USSF's mission. The program connected university students with the Space Operations Command (SpOC) and Space Systems Command (SSC) to develop algorithms for Space Domain Awareness (SDA). This partnership demonstrated AFOSR's commitment to innovative, mission-focused solutions for USSF.

Scholar's Program

USRA was awarded a cooperative agreement to manage the Air Force Research Laboratory (AFRL) Scholars Program, AFRL Scholars Professionals, and the University Research and Engagement Program (UREP) portfolio on behalf of Kirtland AFB. In July 2024, AFRL issued a period-of-performance extension through March 2027.



A total of 103 scholars from the FY 2024 group attended MSIs. Image Courtesy: USRA

USRA also received an extension to administer the AFRL Scholars Program through a cooperative agreement which funds placements at Eglin AFB in Valparaiso, Florida, and the Pentagon.

During FY 2024, a total of 343 scholars were placed among 11 Technical Directorates (TDs) across 10 AFRL sites. Of the 343 scholar participants, 45% were underrepresented in STEM, including females, Hispanic/Latino males, Black/African American males, Native American/Alaska Native males, Native Hawaiian/Pacific Islander males, and individuals with disabilities.

University Consortium Research Opportunity (UCRO)/Space Strategic Technology Institute (SSTI)

At the request of the United States Space Force (USSF) management, USRA executed sub-agreement extensions to ten University Consortium Research Opportunity (UCRO) members.

Lunar and Planetary Institute Internships



The LPI Summer Intern Program includes enrichment activities that support student research, such as tours of JSC facilities like the Lunar Sample Laboratory. Image Courtesy: Lunar and Planetary Institute

The LPI continues to play a vital role in attracting, training, and nurturing future planetary scientists through the

LPI Summer Intern Program, which has been offered since 1977. This year's 10-week program took place at the LPI and NASA's Johnson Space Center. The 2024 class included 11 undergraduate students from India, Ireland, Netherlands, the United Kingdom, and the United States. Interns worked one-on-one with LPI and NASA scientists on research projects, culminating in abstracts and presentations for upcoming science conferences like the Lunar and Planetary Science Conference (LPSC).

Exploration Science Summer Intern Program (Graduate)



Class of 2024 Exploration Science Summer Interns. Image Courtesy: Lunar and Planetary Institute

Led by USRA, the Center for Lunar Science and Exploration (CLSE) Exploration Science Summer Intern Program hosted graduate students in geology, planetary science, and related fields to support NASA's Artemis program and the planned 2026 human landing on the Moon. This year, one team studied volatile resource abundances in candidate Artemis landing regions, while another assessed potential hazards. Their results will be presented at the 2025 LPSC and published in a peer-reviewed journal article.

Feynman Quantum Academy Internship Program

USRA funded the Feynman Quantum Academy to help train the next generation of quantum information scientists. Interns focus on research in noisy intermediate-scale quantum computing (NISQ) within the areas of theory, optimization, machine learning, and benchmarking.

Since launching in 2016, the Feynman Quantum Academy has hosted over

59 students from top international universities. Students have performed research across a wide array of quantum architectures. Students and staff work collaboratively on projects, which often leads to opportunities for publication or conference presentations. In 2024, the Feynman Academy supported 14 internship programs.

DHS Partnership to Increase Equity in Emerging Technology Research

In FY 2024 the “Integrative Research in Emerging Technologies for DHS Use Cases” initiated projects with funding from the DHS Office of University Programs (OUP) in the DHS Science & Technology Directorate. These projects focus on engaging students and faculty from minority-serving institutions in a portfolio of integrated research projects for emerging technologies that include artificial intelligence/machine learning, quantum information science, and advanced air mobility. The program supported 19 internships and 5 faculty fellows from Minority Serving Institutions (MSIs).

In addition, an in-person workshop was held at NASA Ames Research Center, at the end of the first year. The event was attended by faculty who provided support, DHS and MSRDC sponsors, and NASA Ames Center Director Dr. Eugene Tu. This first annual workshop/meeting was intended to highlight the current research efforts of students and faculty from MSIs that are funded by NASA and DHS S&T. In March 2024, students presented their research and accomplishments over the last seventeen months.

NAMS R&D Student Program

USRA NAMS R&D Student Program continued to engage a diverse set of students from colleges and universities, including MSIs, Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCU), and students in underserved communities. This year, 76 virtual and on-site student internships were completed. The interns enriched their educational experience by participating in career development activities and technical review meeting skills by participating in branch meetings and presenting their research projects.

The internship projects spanned various NAMS Technical areas including Aeronautics, Quantum Computing, Data Science, and High-Performance Computing (HPC).

University of California Berkeley

USRA continued the collaboration with University of California Berkeley student organization, NewSpace. The organization provides UC Berkeley students with the tools and knowledge needed to succeed in the NewSpace industry, including a course in NewSpace Entrepreneurship which offers students essential knowledge about entrepreneurship. In FY 2024, USRA mentors supported three student projects on Artificial Intelligence with Remote Sensing Imagery for Disaster Response. The USRA mentors and seventeen UC Berkeley students collaborated to develop the assigned projects, and the teams presented their research to NASA and USRA.

2024 CSNR Summer Fellowship Program

2024 marked the successful completion of the Center for Space Nuclear Research (CSNR)'s 19th Fellowship program. The program was made possible through sponsorship from NASA Marshall Space Flight Center and NASA Space Technology Mission Directorate's Space Nuclear Propulsion Project. The Fellows focused on studies on advanced space nuclear power and propulsion concept technology development. In addition to technical studies, they participated in complementary skills development workshops including

advanced manufacturing, modeling and simulation tool usage for nuclear systems design and analysis, and practical skills development including radiological worker training with personal protective equipment, reactor operations and subcritical experiments.



2024 CSNR Summer Fellows. Image Courtesy: Victor Orozco, CSNR

GOVERNANCE AND MEMBER UNIVERSITIES



Front Row: (left to right) - Jed Hancock, COI Vice Chair; Jeffrey Isaacson, President and CEO; Lester Lyles, At-Large Trustee and Chair; Berrien Moore, Region VIII Trustee and Vice Chair; Joan Ramage, COI Chair

Second Row: (left to right) - Lesa Roe, At-Large Trustee; Kathleen Howell, Region VI Trustee; Truell Hyde, Region VII Trustee; Neil McCasland, At-Large Trustee; Robert McCoy, Region IX Trustee; Sean Solomon, Region II Trustee; Christopher Damaren, Region V Trustee; Richard Ambrosi, Region X Trustee; Daniel Hastings, Region I Trustee; Kim Williams, At-Large Trustee; Elizabeth Lada, Region IV Trustee

Missing: Wayne Scales, Region III Trustee

USRA, an association of 121 distinguished doctoral degree-granting universities, is dedicated to advancing research and education in space and aeronautics. Through its membership, USRA ensures a broad and effective system of public oversight, reinforcing its nonprofit mission to drive practical applications of space-related science, technology, and engineering.

Board of Trustees

The Board of Trustees serves as USRA's governing body, charged with appointing corporate officers, setting policy, and conducting oversight. The Board convenes three times annually.

Council of Institutions

Comprising representatives from member universities, the Council of Institutions plays a pivotal role in shaping USRA's strategic direction. At the 2024 Annual Meeting, the Council approved new memberships for the

University of Padua, the University of Texas at San Antonio, and the reinstatement of the University of Notre Dame. Additionally, the Council created a European region for member universities, subsequently welcoming the Polytechnic University of Turin to this newly established Region X.

In 2024, the Council hosted three regional meetings to foster deeper collaboration and dialogue among members. Highlights included:

- Region VIII Meeting (March 22, 2024, in conjunction with the Annual Meeting)
- Region IX Meeting (August 22, 2024, at the University of Washington, Seattle)
- Region X Inaugural Meeting (October 23, 2024, at the Polytechnic University of Turin)

Science Councils

USRA's science councils provide independent guidance to the President, Board of Trustees, and institute directors, serving as a bridge to the broader research community. They offer critical input on current initiatives and strategic directions.

Lunar and Planetary Institute (LPI) Science Council

Chaired by Amy Fagan (Western Carolina University), the LPI Science Council remained active in FY 2024, and focused its activities in 2024 on recruiting the new LPI Director.

HBCU Science and Technology Council

This council fosters collaboration between USRA and Historically Black Colleges and Universities (HBCUs), supporting institutional capacity building and emerging trends in science and technology. Chaired by Dr. Victor McCrary (Vice President for Research, University of the District of Columbia), the council includes senior leaders from nine HBCUs. In 2024, the council convened in February and August, discussing partnership opportunities with USRA and federal funding prospects for HBCUs.

USRA's governance framework reflects a commitment to inclusivity, collaboration, and scientific excellence, enabling member universities and their communities to thrive within the dynamic fields of space and aeronautics.

USRA Member Universities

Alabama A&M University
Arizona State University
Auburn University
Baylor University
Boston College
Boston University
Brandeis University
Brown University
California Institute of Technology
Case Western Reserve University
Colorado School of Mines
Columbia University
Cornell University
École Polytechnique Fédérale de Lausanne
Embry-Riddle Aeronautical University
Florida Institute of Technology
Florida State University
George Mason University
Georgetown University
Georgia Institute of Technology
Hampton University
Harvard University
Howard University
Indiana University
Indian Institute of Space Science and Technology
Iowa State University
Johns Hopkins University
Korea Advanced Institute of Science and Technology
Lehigh University
Louisiana State University
Massachusetts Institute of Technology
Michigan Technological University
Mississippi State University
Montana State University
New Jersey Institute of Technology
New Mexico State University
New York University
North Carolina A&T State University
North Carolina State University
Northwestern University
Ohio University
Oklahoma State University
Old Dominion University
Polytechnic University of Turin
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rice University
Rochester Institute of Technology
Seoul National University
Stanford University
Stony Brook University, SUNY
Technion - Israel Institute of Technology
Tel Aviv University
Texas A&M University
Texas Tech University
The Chinese University of Hong Kong
The George Washington University
The Ohio State University
The Pennsylvania State University
The Rockefeller University
The University of Alabama in Huntsville
The University of Arizona
The University of British Columbia
The University of Iowa
The University of Kansas
The University of New Mexico
The University of Oklahoma
The University of Sheffield
The University of Sydney
Tufts University
University at Buffalo, SUNY
University of Alaska - Fairbanks
University of Arkansas
University of Bern
University of California, Berkeley
University of California, Los Angeles
University of California, San Diego
University of California, Santa Barbara
University of Canterbury
University of Central Florida
University of Chicago
University of Cologne
University of Colorado Boulder
University of Connecticut
University of Delaware
University of Denver
University of Florida - Gainesville
University of Hawaii
University of Houston
University of Illinois at Urbana-Champaign
University of Leicester
University of Maryland
University of Michigan
University of Minnesota
University of Nebraska - Lincoln
University of New Hampshire
University of Notre Dame
University of Padua
University of Pittsburgh
University of Rochester
University of Southern California
University of Stuttgart
University of Tennessee, Knoxville
University of Texas at Arlington
University of Texas at Austin
University of Texas at Dallas
University of Texas at El Paso
University of Texas Medical Branch at Galveston
University of Texas at San Antonio
University of Toronto
University of Virginia
University of Washington
University of Wisconsin - Madison
University of Zurich
Utah State University
Vanderbilt University
Virginia Polytechnic Institute & State University
Washington University in St. Louis
William & Mary
Yale University

COUNCIL OF INSTITUTIONS

The USRA Council of Institutions (COI) ensures USRA is embedded within the broad university community involved in space science and aerospace technology and that USRA serves its public purpose. The COI elects new universities to membership and the Trustees that constitute the governing board and sets corporate bylaws.

COI Annual Symposium

The COI held its 2024 Annual Symposium on March 21, focusing on “Space Nuclear Technology: Research and Development for Evolving Space Missions.” Hosted by the Universities Space Research Association (USRA) and the Space Policy Institute (SPI), the event brought together experts from government, academia, and industry to discuss the critical role of space nuclear technology in advancing science, exploration, and national security. Franklin Chang-Díaz, founder of Ad Astra Rocket Company, delivered the Frederick A. Tarantino Memorial Address. Panels featured discussions on federal agency perspectives on a roadmap for space nuclear technology, industry perspectives on technology gaps, and the needs for infrastructure, regulation, and workforce development.



Franklin Chang-Díaz, founder of the Ad Astra Rocket Company, giving the keynote address at the USRA-GWU Symposium, “Space Nuclear Technology: Research and Development for Evolving Space Missions.” Image Courtesy: USRA/Aaron Clamage

COI Working Groups

Through the COI Science and Technology Working Groups the university research community provides technical expertise to USRA on topics of specific interest to federal agencies for planning and implementing research strategies and new technology development. The Space Nuclear Working Group (SNWG) was established to address issues with regard to development of nuclear propulsion and nuclear electric power, issues of importance in planning future human missions to Mars. Working as a community of practice, the SNWG provided input on the topic for the 2024 Annual COI Annual Symposium, and through extensive discussions provided input on space nuclear priorities for the FY 2026 NASA budget, and specifically to support the Space Nuclear Propulsion program at Marshall Space Flight Center.

COI Conference Calls

The COI hosts conference calls periodically with the Executive leadership of various organizations. Most recently, the COI heard from Pamela Melroy, Deputy Administrator, NASA on August 12.

Issues and Program Committee

The USRA Issues and Program Committee (IPC) operates under the Council of Institutions as an influential voice in public policy. The Committee consists of esteemed professors from each USRA region. It is tasked with crafting policy stances, liaising with congressional members and their aides, providing expert testimony, and spearheading the annual symposium in alignment with the COI meeting. The USRA leadership of the IPC is under Professor Joan Ramage, COI Chair, Lehigh University.

UNIVERSITY ENGAGEMENT

Collaboration with universities, and/or service to the university community, is a defining thread that runs through USRA institutes and programs.

Collaborations with Universities by USRA Institutes and Programs

Type of Organization	Number of Organizations	Number of Engagements
Universities - USRA Members	80	241
Universities - Non-Members	112	170
Total Universities	192	411
Other Research Orgs	82	221
Total	274	632

USRA's institutes and programs engage with universities and other organizations in research collaborations. These engagements are carried out in two ways. Engagements occur at the individual investigator level, where USRA scientists pursuing independent research submit joint proposals and publish papers with colleagues in academia and other organizations in the outside community. Larger engagements occur at the programmatic level, where USRA forms teams with universities to leverage the existing capabilities and resources present in the community in order to execute the operation of a large activity.

FY 2022 - 2024 Minority-Serving Institutes (MSI)	Collaborations		
	FY 2022	FY 2023	FY 2024
Historically Black Colleges and Universities (HBCUs)	6	14	27
Hispanic-Serving Institutes (HSIs)	60	76	49
Asian American and Native American Pacific Islander-serving Institutes (AANAPISIs)	28	31	21
TOTAL - MSI Collaborations	94	121	97

USRA DISTINGUISHED UNDERGRADUATE AWARDS

Established to honor the service and memory of individuals who made significant contributions to their fields and to USRA, these awards are made possible by financial contributions, including those made by USRA employees.

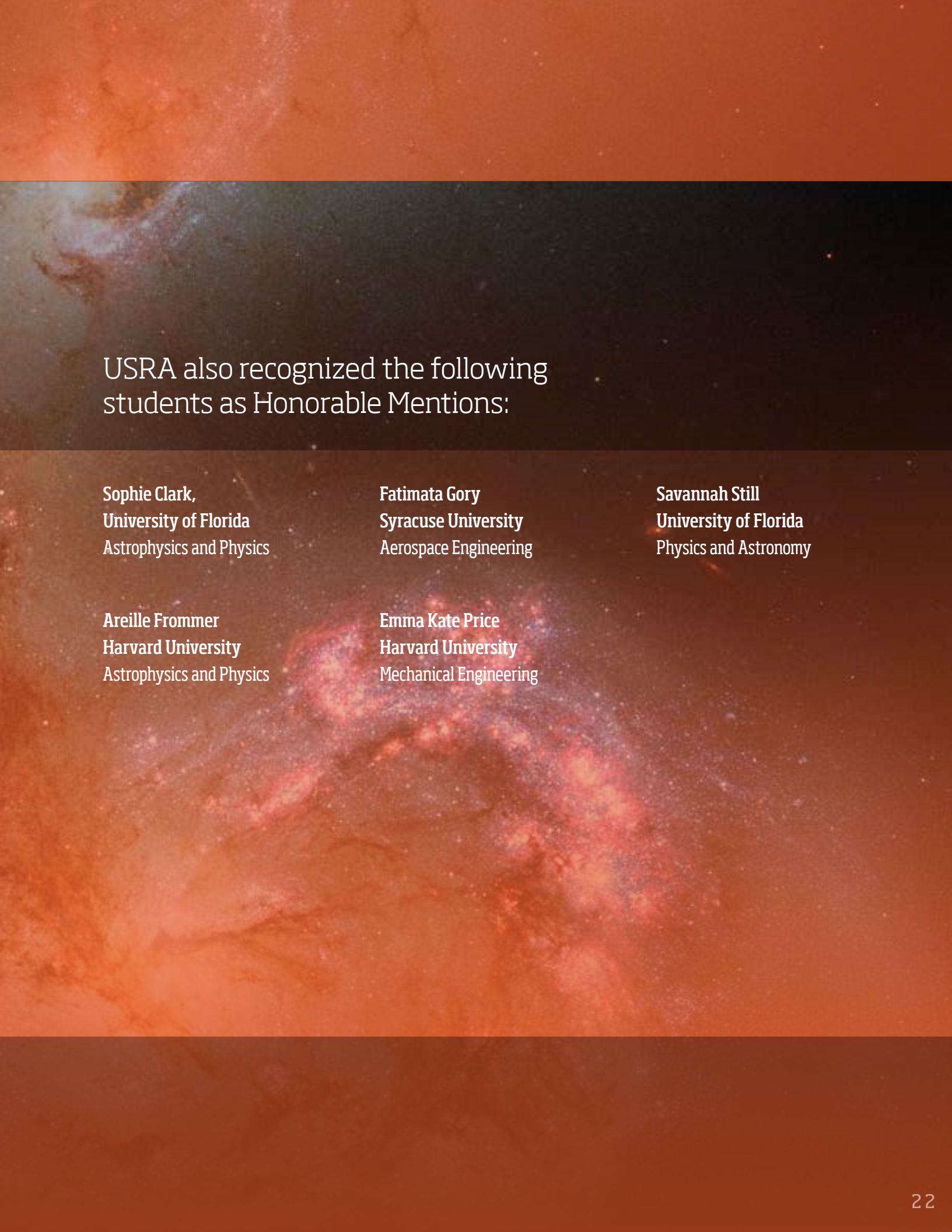
The USRA Distinguished Undergraduate Awards recognize undergraduate juniors and seniors who excel in space science and aerospace pursuits and show promise for leadership in their fields. Each award consists of a \$5,000 scholarship, named in honor of individuals who have made significant contributions to USRA and to their fields of study. The awards are made possible by financial contributions, including those made by USRA employees through payroll deductions. Applications are reviewed by representatives from the USRA Council of Institutions and

other faculty from USRA member universities, who make award recommendations to the USRA President.

In 2024, USRA received 89 eligible applications from students at 54 different universities, including 2 applications from USRA non-US members. Applicants self-report demographic information. Of those who did, 28% of the U.S. applicants were minority students.

USRA is pleased to recognize and support the careers of these winners of the 2024 Awards:





USRA also recognized the following students as Honorable Mentions:

Sophie Clark,
University of Florida
Astrophysics and Physics

Fatimata Gory
Syracuse University
Aerospace Engineering

Savannah Still
University of Florida
Physics and Astronomy

Areille Frommer
Harvard University
Astrophysics and Physics

Emma Kate Price
Harvard University
Mechanical Engineering

E STREET TECHNOLOGIES LLC (ESTECH)

In 2024, USRA established a wholly owned subsidiary, E Street Technologies LLC (ESTech), located at the corner of 3rd and E Street, SW, in Washington, D.C. This strategic move underscored USRA's commitment to expand its service offerings and enhance customer satisfaction in the ever-evolving marketplace.

Universities Space Research Association Announced Strategic Expansion with Establishment of a New Subsidiary – E Street Technologies LLC (ESTech)



E Street Technologies *a subsidiary of USRA*

In 2024, USRA established a wholly owned subsidiary, E Street Technologies LLC (ESTech), located at the corner of 3rd and E Street, SW, in Washington, D.C. This strategic move underscored USRA's commitment to expand its service offerings and enhance customer satisfaction in the ever-evolving marketplace.

ESTech is a for-profit legal entity with small business status established to augment USRA's mission to further advance science and technology for the public good. Launched to bridge the gap between the broad capabilities

of USRA and the targeted needs of small business growth in the aerospace industry, it offers services as a mentor and partner to small businesses while continuing to contribute to aerospace innovations and growing the aerospace economy.

ESTech leverages USRA's leading-edge technology and innovative solutions to meet client needs. With a dedicated team of experienced professionals, it aims to deliver high-quality services and products that align with the values and standards of USRA.

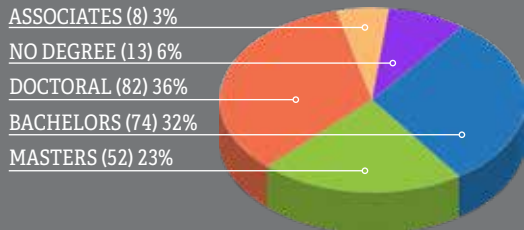
"Establishing ESTech is an important development," said Dr. Jeffrey A. Isaacson, Chair of the ESTech Board, and President and CEO of the parent company, USRA. "The new subsidiary will enable us to strengthen our collaborations with industry, mentor small-business partners, and offer more opportunities to serve our long-standing customers. We are excited about the opportunities ahead and confident that ESTech will open new avenues for innovation in aerospace."

ESTech's mission is to deliver integrated R&D, O&M, and engineering services and solutions for various markets including Aerospace, AI/Machine Learning, Big Data/Data Analytics, Cybersecurity, Education/Workforce Development, Environment, Nuclear Technology, and Quantum Information Science.

Dr. Carol Kory, President of ESTech stated, "We are thrilled to launch ESTech and advance science and technology for the betterment of society. Our team provides exceptional services and products, harnessing the latest technologies and industry insights. We look forward to setting new standards in the aerospace sector, adapting to changing market dynamics, and contributing to the overall success of our mission and to our customers' missions."

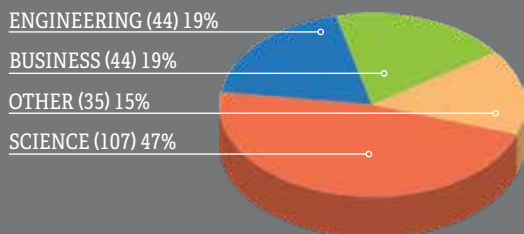
USRA's Diversified Workforce

Employee Distribution by Degree



Approximately 36 percent of USRA's workforce hold Doctoral degrees and another 23 percent hold Masters' degrees.

Employee Distribution by Areas of Study



Approximately 66 percent of USRA's workforce comprises scientists and engineers.

Financial Highlights

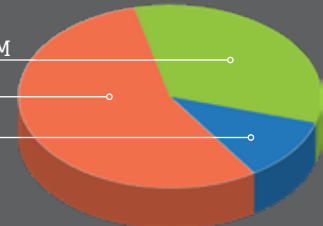
FY 2024 Revenue Distribution

TOTAL REVENUE \$63M

COOPERATIVE AGREEMENTS: \$21M

CONTRACTS: \$35M

GRANTS: \$7M



USRA's FY 2024 revenue was \$63 million. USRA continues to improve its overall cost position and working capital compared with prior years. In FY 2024, the company increased its overall unrestricted liquidity by 19 percent compared with FY 2023 and 51 percent compared with FY 2022. By continuing to strengthen its balance sheet and working capital position, USRA is better positioned to make strategic investments in its non-profit mission.

Total Assets : 46M

Net Asset Value: 29M

Absent a small lease obligation for the Company's corporate headquarters, USRA does not have any long-term debt obligations.

USRA Annual Report Editorial Board

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Suraiya Farukhi

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**Universities Space
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