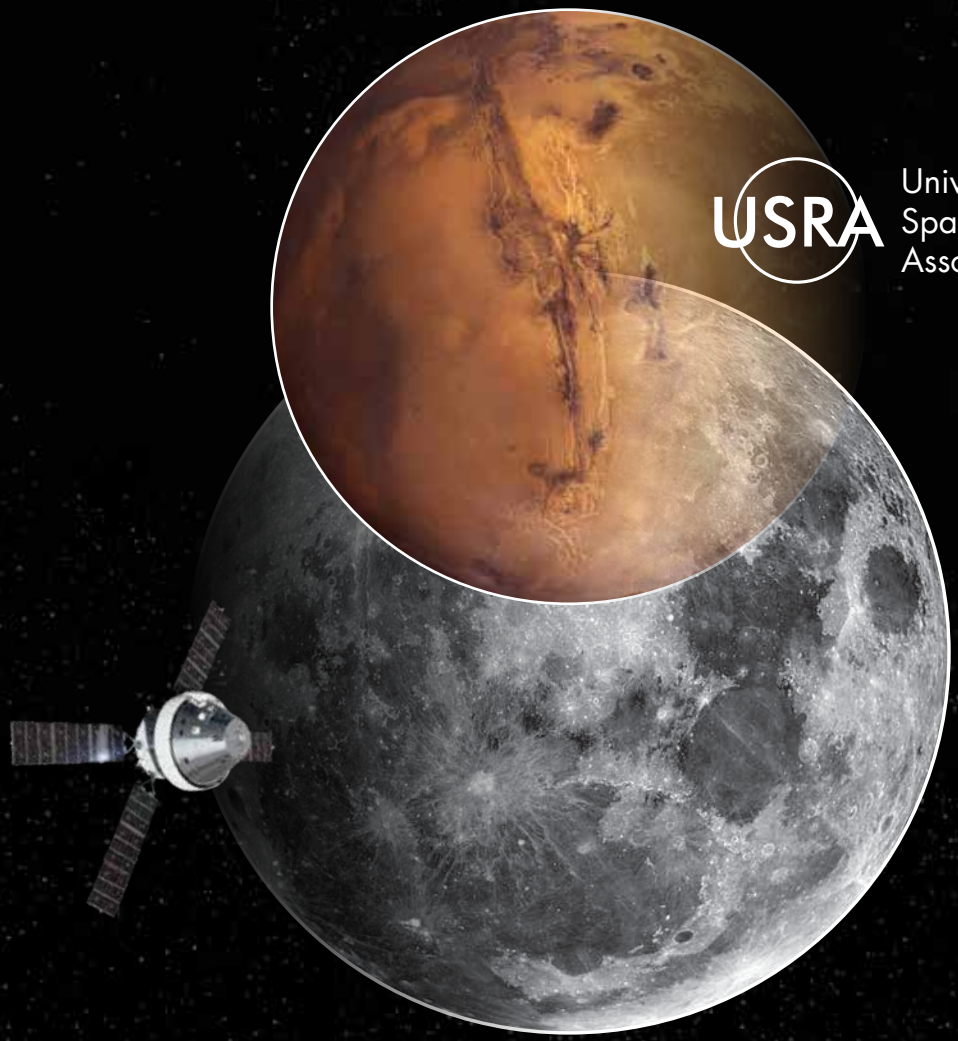


USRA Universities Space Research Association

2025 ANNUAL REPORT

TABLE OF CONTENTS

MISSION

Advance space and aeronautics-related science and technology through innovative research and workforce development programs

Promote space and aeronautics policy

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

VALUES

Partnerships—Advancing shared goals through collaboration with universities, government agencies, and the private sector

Discovery—Driving progress and understanding through science, technology, and education

Innovation—Fostering high standards, shared responsibility, and respect for every voice

Cover Image: Showcasing USRA's commitment to advancing NASA's ambitious journey from the Moon to Mars. Image Courtesy: Forge Branding

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

Dr. Elsayed R. Talaat
President and Chief Executive Officer

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

This past year has been one of extraordinary scientific achievements and transition. The dedication and brilliance of our scientists, engineers, and staff have continually inspired us. Across every discipline—from astronomy and astrophysics to Earth sciences, heliophysics, quantum computing, and artificial intelligence—our teams have demonstrated what is possible when discovery meets collaboration.

Together, we are building on a legacy of discovery to accelerate innovation for the future. This year's advances in multimessenger astronomy are redefining how we explore the universe, while our breakthroughs in AI applications in Earth and space observation are transforming how we monitor and protect our planet. Our researchers continue to make strides in materials science and quantum technologies that will shape the next generation of tools for exploration and sustainability.

Beyond these scientific milestones, we are proud of how our organization continues to foster collaboration—uniting government agencies, academic institutions, and industry partners to tackle society's most complex challenges. We are not only conducting research but also developing the talent and technologies that will drive progress for decades to come. Our workforce development programs continue to train and prepare future generations for leadership in space science and technology.

This year USRA established Huna Research Associates (HRA), a joint venture between HunaTek Operations Services, LLC, a certified 8(a), Alaska Native Corporation–owned entity, and E Street Technologies (ESTech), under the Small Business Administration Mentor-Protégé Program. This strategic alliance combines HunaTek's deep government contracting experience with USRA/ESTech's cutting-edge R&D and engineering legacy, creating a nimble, mission-focused team equipped to deliver innovation, agility, and trusted results to our customers. E Street Technologies is a for-profit, wholly owned small business subsidiary of USRA.

USRA also established its presence in the United Kingdom under a new initiative, USRA-UK. This effort began with a focus on quantum computing and artificial intelligence—fields where nearly half of the world's processors and start-ups are located abroad. It has since expanded into a broader vision of bringing USRA's diverse expertise in space and aeronautics to new global partners. By building collaborations with UK scientists, universities, and industry, and by pursuing opportunities to compete for regional contracts, USRA-UK will strengthen international ties while creating new sources of revenue to support our mission.

Some highlights of 2025 include the following:

- USRA staff published 159 peer-reviewed research products across all programs, executed a total of 582 research engagements with 267 organizations.
- USRA administered or supported 584 interns this year, including 461 Air Force Research Laboratory (AFRL) scholars.
- USRA's Research Institute for Advanced Computer Science (RIACS) and the Boston Consulting Group's BCG X AI Science Institute completed the open-source release of GAIA (Geospatial Artificial Intelligence for Atmospheres), a foundation model developed in collaboration with NASA. Artificial Intelligence is now embedded across all USRA Institutes and moving toward operational use with end users.
- A USRA delegation participated in the 2025 United Nations Climate Conference (COP30) in Brazil, continuing the organization's longstanding role in advancing global climate initiatives and policy discussions.
- USRA staff and student Fellows conducted mission studies to explore how a new hybrid propulsion system that combines nuclear thermal and nuclear electric power could dramatically improve spacecraft performance. They also examined performance of different materials.
- Throughout 2025, the Center for Space Nuclear Research has led and supported numerous nuclear propulsion and power advocacy efforts.
- In Astrophysics, USRA scientists in the Fermi-GBM collaboration received the prestigious *Cocconi Prize for Advancing Gamma-Ray Astronomy* recognizing their groundbreaking contributions to the field.
- The Quantum Team continued to support flagship DOE Centers at Fermi National Laboratory and Brookhaven National Laboratory with algorithmic R&D, while strengthening collaboration between NASA and Google. USRA's quantum research is transitioning from foundational studies to real-world optimization applications at scale.
- The Lunar and Planetary Institute's discovery of Grand Canyons on the Moon drew international attention from top-tier media outlets, continuing USRA's standing as a leader in lunar science.

As we look ahead, our mission is clear: to amplify our impact through innovation, partnership, and education. We will continue to pursue bold science that expands knowledge, serves humanity, and inspires the next generation of explorers. Together, we are advancing discovery and turning knowledge into progress for a better, more resilient world.

Dr. Elsayed R. Talaat
President and Chief Executive Officer

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 responsibly building national capacity for foundational and use-inspired research in artificial intelligence and quantum computing supporting public-good applications.

Artificial Intelligence / Machine Learning

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 discoveries in 1980s
- First AI to control a spacecraft in deep space in 1990s
- First AI to plan the work of robots on another planet in 2000s
- First AI to hold conversation with astronauts in space in 2000s
- Quantum AI Lab co-founded in 2012
- Deep neural network that validates over 300 new planets in 2021
- AI models used by airlines to reroute aircraft in order to reduce fuel use and emissions during 2022-2024
- GenAI Lab for Science & Engineering co-founded in 2024
- Geospatial foundation models for landmass and weather

Earth AI for Weather

USRA develops geospatial AI foundation models for weather forecasting using decades of high-resolution global satellite data, testing and evaluating these models for a range of downstream use cases. These include forecasting weather to predict the formation and persistence of aviation contrails and to monitor and track extreme weather events including tropical cyclones, atmospheric rivers, and precipitation.

AI for Aviation Weather

RIACS developed a "Physics and Machine Learning Based Contrail Prediction and Observation System" with funding from the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E). The project built a geospatial AI model using a unique global high resolution rapid refresh dataset of satellite remote sensing data of the atmosphere. The dataset was developed by NASA's Langley Research Center that fuses global data from geostationary VIS/IR/NIR imagers plus microwave and hyperspectral IR sounders in polar orbit operated by NOAA, the Japan Meteorological Agency, and EUMESTAT. The geospatial AI model has very high spatial resolution in latitude, longitude, and altitude which is critical for aviation use cases. Combined with air traffic data, USRA's geospatial AI model is able to forecast whether air traffic will produce persistent contrails with a 0.81 F1 score.

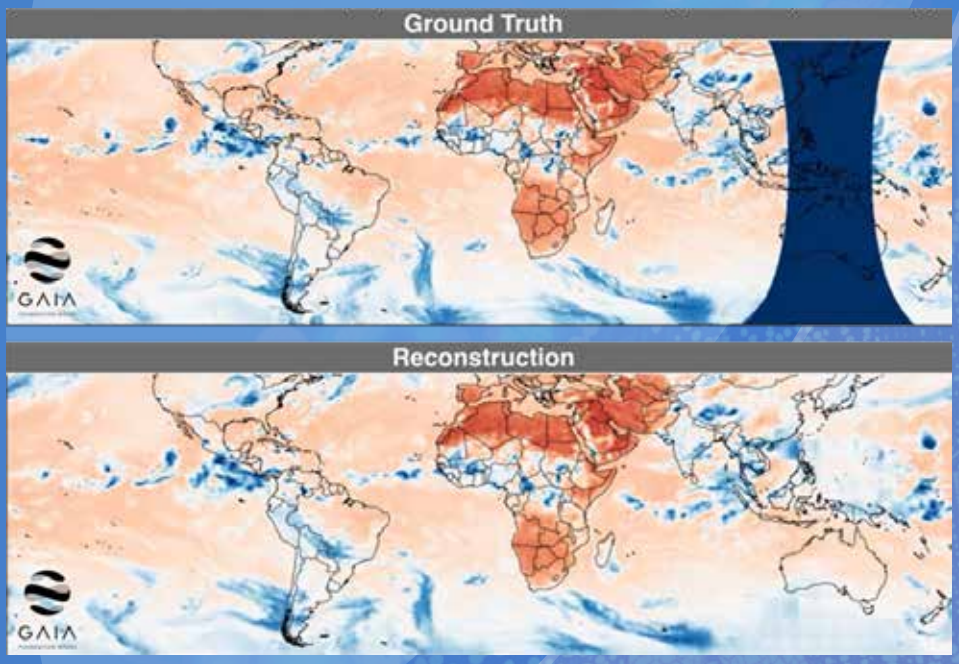
AI-Detected Contrails. Image Courtesy: USRA

AI for Extreme Weather

RIACS developed the GAIA (Geospatial Artificial Intelligence for Atmospheres) Foundation Model, in collaboration with the Boston Consulting Group's BCG X AI Science Institute and NASA. The GAIA foundation model advances the state-of-the-art with a new approach for balancing attention of the model across local and global features in geospatial data. The model was trained and tested on 25 years of data from the Geostationary Operational Environmental Satellites (GOES), as well as data from the European Meteosat (EUMETSAT) and Japanese Himawari weather satellites for global coverage. The initial release includes downstream applications for filling gaps in satellite data coverage and for precipitation, and the second release supports tracking tropical cyclones, atmospheric rivers and other extreme weather phenomena in support of disaster preparedness, response and recovery as well as other use cases.

Earth AI for Land

USRA develops AI solutions to analyze land in support of a portfolio of downstream use cases working in partnership with NASA, USGS and others. As part of the NASA Interagency Implementation and Advanced Concepts Team (IMPACT), three USRA institutes collaborated with NASA's Marshall Space Flight Center and others to develop and release the Prithvi Earth Observation 2 (EO-2) AI foundation model. The EO-2 foundation model built with Harmonized Landsat and Sentinel2 (HLS) imagery, supports downstream tasks in the domains of disaster response (flood

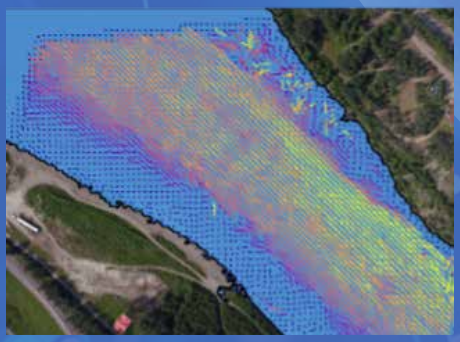


GAIA Filling Gaps in GOES+ Data. Image Courtesy: BCG/USRA/NASA

detection, wildfire scar detection, building damage assessments, burn scar intensity, and landslide detection). For Prithvi EO-2, USRA supported foundation model and downstream task development, testing and evaluation.

Earth AI for Water

USRA recently developed a fine-tuned version of Meta's Segment Anything Model 2 (SAM2) foundational model for identification of water in satellite imagery (SAM2-Water), as part of a collaboration with the USGS Water Resources Mission Area. The fine-tuned model was applied to two projects focused on developing methods for improved water monitoring.



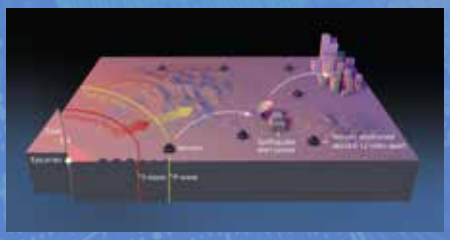
River velocity vectors with USRA's Python version of USGS's TRiVIA software with Meta's SAM2. Image Courtesy: USRA/USGS

Black Marble AI

USRA's Earth from Space Institute leads the Black Marble AI project with RIACS support, developing AI solutions that transform NASA's Earth at Night data for decision support tools related to gas flares and fire detection, as well as electricity and the energy grid including support for disaster recovery.

Image Courtesy: USRA/RIACS

AI for Earthquake Early Warning



Shake Alert® Earthquake Early Warning System. Image Courtesy: USGS

RIACS data scientists support the development of enhanced algorithms and software for the U.S. Geological Survey (USGS) ShakeAlert Earthquake Early Warning System, which issues alerts to provide critical seconds of warning through direct integration with Google's Android operating system and Apple's iPhones and other pathways to collectively protect millions of people. A key challenge in earthquake detection is rapidly processing data from high-precision GPS stations to measure ground displacement.

RIACS staff are applying advanced machine learning techniques to analyze these GPS data streams in real-time. This AI-driven approach is designed to instantly distinguish between minor, insignificant data anomalies (like signal noise) and the true, sudden ground movements that signal a significant earthquake. By more accurately identifying these earthquake signals, USRA's work aims to improve the positioning data used by the production ShakeAlert system.

SmartAlert® Earthquake Early Warning illustration. Image Courtesy: USGS.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CONTINUED

Image Courtesy: Firefly Aerospace

Space Telescope AI

RIACS has applied unsupervised machine learning techniques to space sciences since its inception in the 1980s. Presently, in partnership with the University of Colorado Boulder and NASA's Ames Research Center, a RIACS scientist is leading the development of a next-generation science data analysis pipeline. This pipeline integrates machine learning workflows directly into science analyses for signal extraction. Simulated studies for upcoming radio telescopes demonstrate that these neural networks significantly boost signal modeling efficiency, achieving unprecedented speed and accuracy in emulating complex astrophysical processes.

This pipeline is currently being tested for Lunar Surface Electromagnetics Experiment-Night (LuSEE-Night), which is a payload for the upcoming Blue Ghost Mission 2, as part of NASA's Commercial Lunar Payload Services (CLPS) initiative. Scheduled to be deployed on the far side of the Moon in 2026, LuSEE-Night is a robotic radio telescope involving a collaboration among the Space Sciences Laboratory (SSL) at UC Berkeley, the DOE, and NASA. The experiment will measure the low-frequency radio sky (0.1–50 MHz) and characterize the Moon's unique electromagnetic environment in this frequency band.

Sample Science AI with Spectrometry Data

Building on USRA's Lunar and Planetary Institute's historic role, begun in 1968, in leading the scientific community's use of samples returned from the Moon's surface, LPI has recently developed advanced machine learning techniques. LPI has developed these techniques to analyze chemically complex spectral data including high resolution mass spectrometry, Raman spectroscopy, and Laser Induced Breakdown Spectroscopy (LIBS) of samples to accurately identify minerals and organic materials in support of space exploration and space science. These new techniques are key enablers for future missions to the Moon and Mars.

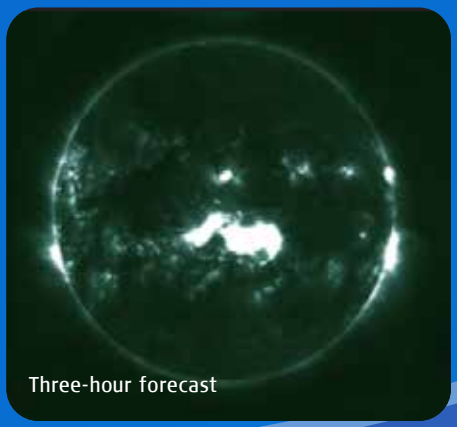
In support of scaling the benefits of sample science AI among the broader community, LPI held a workshop in 2025 on the "Astrobiology Spectral Database" which is being developed to enable users to access raw and pre-processed mass spectral and NMR data of abiotic organics, organic reactions, and astromaterial organic extracts. For the 57th Lunar and Planetary Science Conference (LPSC) in 2026, LPI will also lead a training session on "Machine Learning for Sample Science" with support from USRA's RIACS, and will chair a special session on machine learning.

Space Weather AI

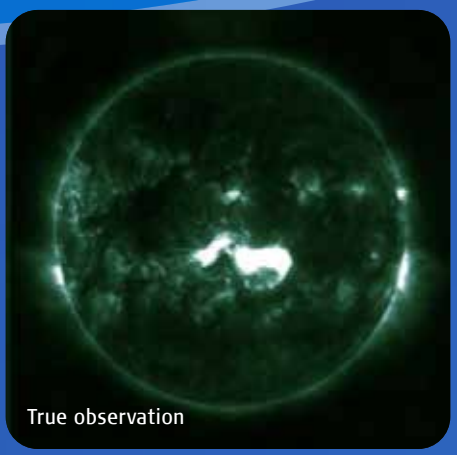
USRA is part of the team that has developed the Surya Space Weather AI Foundation Model using nine years of data from NASA's Solar Dynamic Observatory (SDO), which was recently released as open source. Surya's performance was tested for the following:

- Active Region Emergence Forecasting
- Solar Flare Forecasting
- Solar Wind Speed Prediction
- EUV Spectra Prediction

These achievements are significant as major solar storms in the last two years alone have caused loss of tens of millions of dollars of satellites during launch as a result of atmospheric drag from space weather, and caused loss of hundreds of millions of dollars of crops in the Midwest as a result of GPS errors from space weather.



Three-hour forecast



True observation

Image Courtesy: NASA/SDO/ODSI IMPACT AI Team

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.

Center for Space Nuclear Research

Advocacy and public education of space nuclear propulsion and power at the 2025 World Energy Congress held in August 2025. Image Courtesy: USRA's Center for Space Nuclear Research

Throughout 2025, CSNR had led and supported numerous nuclear propulsion and power advocacy activities in collaboration with industry, national laboratories, and NASA centers. This included an international invitation for the CSNR director to chair sections of the 2025 World Energy Congress, reflecting on in-space manufacturing that can be realized with nuclear energy, leading panels at the Space Symposium 2025, and hosting educational events for congressional staff and representatives.

Mission Analysis

CSNR staff and student Fellows conducted mission studies to explore how a new hybrid nuclear propulsion system – which combines nuclear thermal and nuclear electric power – could dramatically improve spacecraft performance. This approach performs high efficiency delta-V maneuvers over extended mission periods using electric thrust and impulsive maneuvers. It also allows spacecraft to carry out both long, efficient maneuvers over extended missions and short, powerful bursts of speed when needed. For missions traveling between Earth, the Moon, Mars, and Cis-lunar maneuvers, this innovative technological approach demonstrates far greater advantages than relying on a single propulsion technology alone offering unparalleled flexibility and performance.

As the United States faces some of its toughest challenges in space exploration and security, these solutions from CSNR may represent the fastest pathway to deploying transformative and game-changing nuclear capabilities in space. Future work will also look at how these technologies can speed up the development of nuclear surface power for use on the Moon or Mars, as well as enhance and support national security applications like expanding the Missile Defense Agency's Golden Dome capabilities.

Materials Analyses

In addition, staff and student Fellows performed Design and Multiphysics analyses on potential materials, the configuration of fuel and advanced reflector systems, and power cycles for a mass optimized hybrid gaseous core reactor system for nuclear thermal and nuclear electric propulsion and power.

Their research examined how different materials perform, the challenges of manufacturing them, and options which are most practical for real-world use. The studies also looked at innovative designs for fuel, reflector systems, and power cycles that would maximize efficiency in a hybrid nuclear reactor. These findings will help guide the next steps toward building and testing future systems – whether through laboratory demonstrations or partnerships with industry.

The analyses revealed the practicalities and limitations of conceptual design schemes and the performance envelopes for the selected materials. Material characteristics and manufacturing methodologies were examined with recommended solutions that may be pursued under practical or experimental demonstrations of gaseous reactor systems or by industrial partners looking to further reduce the concept to practice.

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.

USRA UN COP30 Delegation Highlights the Role of Earth Observation

USRA sent its delegation to the 30th United Nations Climate Change Conference (COP30), held at the Hangar Convention Centre in Belém, Brazil, from November 10-21, 2025. USRA has served as an observer to the U.N. Framework Convention on Climate Change (UNFCCC) since 2021. USRA Fellow and EfSI Interim Director Dr. Tomohiro Oda led the COP30 delegation.

While the U.S. was absent from COP30 at the high-level, NGO observers played unique and critical roles in upholding scientific integrity and advancing the application of science to climate policy and action.

USRA co-hosted an official UNFCCC side event, "Earth Observations for Forest Monitoring in the Amazon: Ongoing Efforts and Upcoming Opportunities." Selection for UNFCCC official side events is highly competitive, and USRA's proposals have been chosen four years in a row. This year's event was co-hosted with the Japan Aerospace Exploration Agency (JAXA), the Remote Sensing Technology Center of Japan (RESTEC), the Japan International Cooperation Agency (JICA), and the American Geophysical Union (AGU).

At the event, USRA President and CEO Dr. Elsayed Talaat delivered opening remarks, highlighting how Earth observations and AI can drive climate action solutions. Distinguished speakers from Brazil, Peru, Japan, and USRA's Dr. David Bell presented use cases on current Earth-observation for forest monitoring in Brazil and Peru. Dr. Bell also showcased USRA's AI-focused work, including foundation model development and emerging opportunities in Earth Observation–AI integration. Dr. Oda moderated a panel discussion on challenges and future opportunities with experts from Brazil, Japan, the UK, and Dr. Bell.

The USRA delegation also attended Earth Science–related official side events and pavilion sessions. Dr. Talaat engaged potential collaborators and sponsors, while Drs. Bell and Oda met with JAXA to discuss AI-powered climate satellite data product development. Dr. Oda also monitored science-relevant negotiations throughout COP30.

Entrance to the COP30 Meeting Venue. Image Courtesy: USRA/T. Oda

High Resolution Greenhouse Gas (GHG) Modeling for Climate Monitoring and Action

ODIAC is a global high-resolution computer model that simulates emission from CO_2, the important heat trapping greenhouse gas. ODIAC has been developed and maintained by Dr. Oda, and his collaborators since 2009. ODIAC is known as "the most beautiful global CO_2 map" and it has been used by NASA and world's leading institutions in support of critical analyses.

Dr. Oda and his international team continue to develop and upgrade the ODIAC model and the emission product. ODIAC has been used for NASA's global high-resolution CO_2 simulation, performed at NASA's Goddard Space Flight Center. Under the new funding from NASA, Dr. Bell and his RIACS team members have joined the project to further expand the modeling capability using data science approaches. The Science Visualization Studio team led by EfSI's Helen-Nicole Kostis worked with the project team and produced CO_2 visual products. The groundbreaking CO_2 scientific visualization took center stage during one of the plenary sessions.

In collaboration with NASA, ODIAC will continue serving as a primary input data for World Meteorological Organization's new initiative Greenhouse Gas Watch for GHG monitoring and Nationally Determined Contribution planning.

Science Visualization Studio

The Science Visualization team, which is part of USRA's Earth from Space Institute develops data-driven scientific visualizations to explain and showcase NASA's research efforts. The team provides visualization expertise by producing and developing visual media in multiple formats and resolutions.

The team produced and developed visualization content for the Earth Information Center Hyperwall and Science On a Sphere exhibits. During FY 25 two new sites of the Earth Information Center opened to the general public: The Earth information Center at the Smithsonian National Museum of History (November 2024) and the at the Kennedy Space Visitor Center (July 2025). In addition, one of the team members serves as the visualization lead for the Artemis II mission and trains astronauts on lunar illumination.

The work of the team is viewed by thousands of visitors at the three Earth information Centers and online.

The USRA Data Visualization Exhibit at the Smithsonian. Image Courtesy: USRA

LUNAR AND PLANETARY SCIENCE

Research conducted by USRA scientists at the Lunar and Planetary Institute (LPI) helps to advance our understanding of the solar system from its formation through its evolution to its current state.

Artistic rendering of astronauts standing on the edge of the Vallis Schrödinger canyon. Image Courtesy: Lunar and Planetary Institute/Michael Carroll.

Grand Canyons of the Moon

In a discovery led by LPI and published in *Nature Communications*, two immense canyons on the far side of the Moon are similar in width and depth to the Earth's Grand Canyon. Using images and elevation data from NASA's Lunar Reconnaissance Orbiter spacecraft, researchers identified Vallis Schrödinger and Vallis Planck, which are 20 to 27 kilometers wide (12-17 miles), 2.7 to 3.5 kilometers deep (1.7–2.2 miles), and 270 to 860 kilometers (168–534 miles) long.

These canyons formed nearly four billion years ago, when an asteroid or comet flew over the lunar south pole and struck the surface. Traveling nearly 55,000 kilometers per hour (35,000 miles per hour), the impactor produced the enormous 320 kilometer diameter (200 mile wide) Schrödinger impact basin and propelled the rocky debris that carved the canyons in under 10 minutes, unlike the Grand Canyon's slow evolution over millions of years.

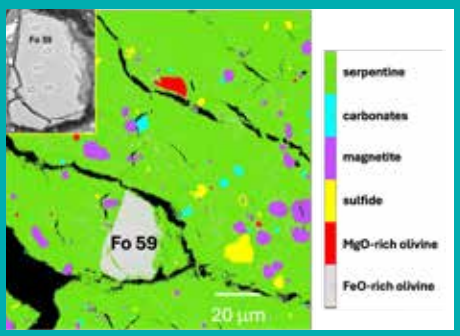
Because the south polar region was not buried by debris, Artemis astronauts will have easier access to geologic samples from an even older epoch in lunar history, including ancient rock that once lay deep beneath the lunar surface.

Orbital view of the Schrödinger peak-ring impact basin and two radiating canyons carved by impact ejecta. Image Courtesy: NASA/SVS/Ernest T. Wright

Studying Samples from the Early Solar System

In September 2023, NASA's OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer) mission returned 120 grams of carbonaceous regolith from the asteroid Bennu, which is just half a kilometer across. The Japanese Hayabusa 2 mission previously recovered 5.4 grams of similar material from the asteroid Ryugu. These samples are among the most pristine samples ever recovered from any asteroid, providing evidence of conditions during the earliest stages of geological activity on planetesimals in our solar system. They contain amino acids and other organic material, as well as clay minerals, carbonates, salts, magnetite, and sulfides that attest to the action of water reacting with primordial minerals on the parent asteroids of Bennu and Ryugu. They also contain presolar grains that preserve signatures of now-dead stars that once existed near Earth's Sun.

Scientists at LPI are leading studies of the mineralogy and the chemical and isotopic composition of these materials using scanning electron microscopy, electron microprobe analysis, transmission electron microscopy, secondary ion mass spectrometry, and infrared spectroscopy. In addition, LPI hosted a workshop in early October 2025, which discussed the results of studies of these samples by scientists from around the world.



Expanding NASA's Community of Planetary Sample Scientists

In its second year, LPI's Expanding NASA's Community of Planetary Sample Scientists (ENComPSS) program strengthened the planetary sample science community through hands-on workshops, virtual sessions, and topical symposia.

In partnership with NASA, a virtual series, "How to Become Part of the NASA Planetary Sample Science Community," introduced NASA's astromaterials collections, the Planetary Sciences Enabling Facilities program, and the proposal process.

ENComPSS continued hands-on training in small sample handling and scanning electron microscopy techniques and added a new workshop on tomography of planetary materials. Topical sessions highlighted recent developments in NASA's OSIRIS-REx mission and JAXA's Hayabusa and Hayabusa2 sample return missions.

Participants receive hands-on training during the Small Sample Handling Workshop held in May 2025 in West Lafayette, Indiana, at Purdue University. Courtesy: Lunar and Planetary Institute.

The 2025 undergraduate interns with LPI Director, Dr. Walter Kiefer. Image Courtesy: Lunar and Planetary Institute.

Lunar and Planetary Science Conference

The 56th Lunar and Planetary Science Conference (LPSC), co-chaired by Dr. Walter Kiefer (USRA/LPI) and Dr. Justin Filiberto (NASA JSC), was held as a hybrid event on March 10–14, 2025, in The Woodlands, Texas. The conference kicked off with a Welcome Event featuring check-in and registration, networking opportunities, refreshments, and live Mariachi music. A concurrent Student and Early-Career Mixer allowed young researchers to network with colleagues before an intense week of scientific sessions.

Planetary researchers from 37 countries participated in 52 scientific sessions with over 530 oral presentations. Approximately 1,300 in-person and virtual posters were presented during three poster sessions. Plenary sessions included the Masursky Lecture, "Minerals on the Martian Surface and the Future of Planetary Mineralogy," by Dr. Elizabeth Rampe, sessions led by NASA's Planetary Science Division, and a session dedicated to NASA's Early-Career Award Winners. The conference concluded with an excursion to Space Center Houston and the LPI, including a tour and a reception. USRA's sponsorship enabled this event, the live music, the early-career mixer, and the creative center.

USRA's Lunar and Planetary Institute: Advancing Planetary Science for Over 50 Years

Since 1968, the Lunar and Planetary Institute has advanced planetary science in partnership with NASA. Established during the Apollo era, the LPI remains USRA's flagship program, serving as a central hub for the planetary community.

In FY 25, notable publications by LPI scientists included work published in *Nature Communications*, describing the discovery of two immense canyons on the Moon's far side comparable in width and depth to Earth's Grand Canyon, and in *Science Advances*, which explored why Venus evolved without plate tectonics and developed a hostile, greenhouse atmosphere.

LPI delivered core services that foster idea exchange and connect the planetary community. Professional meeting coordinators organized a broad range of topical meetings, workshops, and conferences, including NASA's Advisory Groups, with support from in-house communications, design, and web teams. The library maintained a curated collection of over 63,000 items and provided access to more than 300 journals and newsletters, supporting research in space science, astronomy, and geology. LPI provided professional development programs for students and early-career researchers to broaden participation in planetary science.

LOW GRAVITY SCIENCES

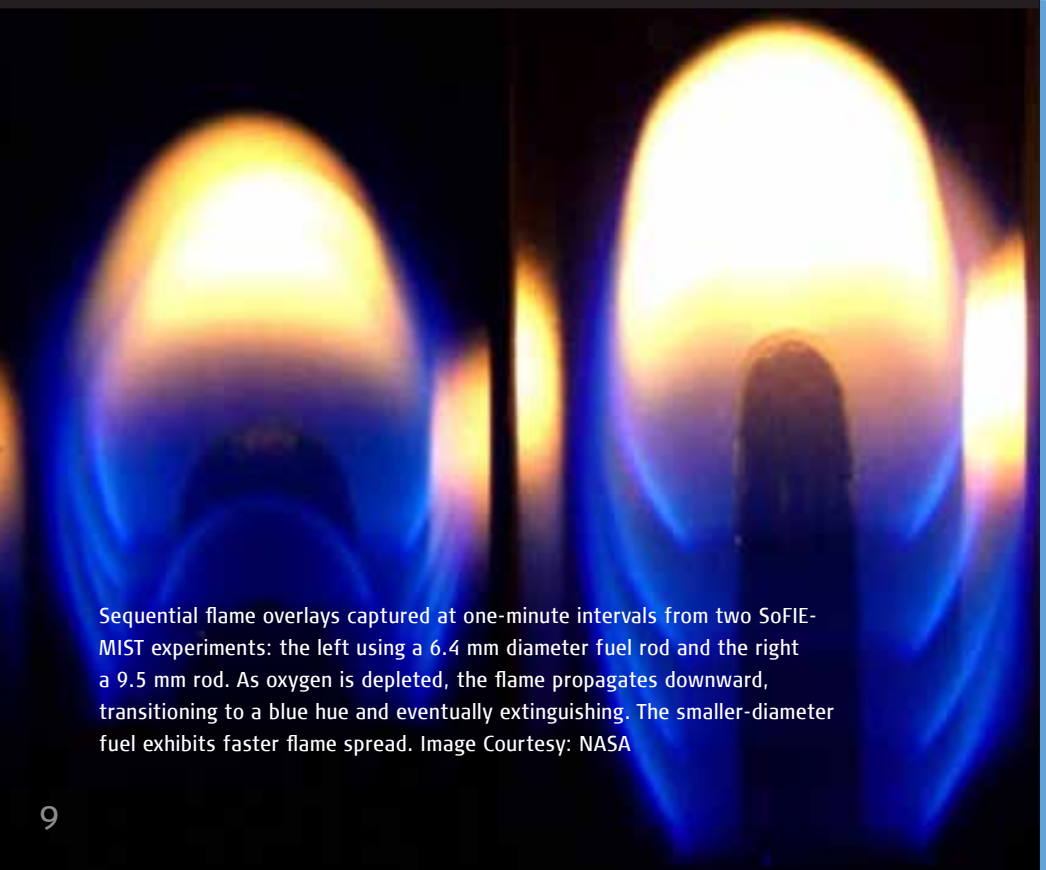
As members of NASA's Glenn Research Center microgravity science team, USRA scientists support the goals of the Science Mission Directorate's Biological and Physical Sciences (BPS) Division through the use of the International Space Station (ISS) as an experimental platform to understand the physical 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.

Advancing Fire Safety in Space and on Earth

USRA personnel play a key role in NASA's Solid Fuel Ignition and Extinction (SoFIE) project through the Material Ignition and Suppression Test (MIST), the third in a series of five SoFIE investigations conducted in the Combustion Integrated Rack aboard the International Space Station.

MIST is designed to deepen scientific understanding of fire behavior in microgravity; specifically, how flames ignite, spread, and are extinguished under variable conditions. Using acrylic rod samples, the investigation explores how external radiant heat affects flame spread and how one burning object can ignite another nearby. These insights simulate realistic fire scenarios in spacecraft, with the goal of informing fire prevention, detection, and suppression for future missions.

Beyond its spaceflight applications, MIST contributes to improved fire safety on Earth by advancing knowledge of early-stage fire growth and enhancing predictive combustion models. The findings support the development of more fire resistant materials, better fire detection systems, and more effective post-fire cleanup procedures. This research is funded by NASA's Biological and Physical Sciences Division.



Sequential flame overlays captured at one-minute intervals from two SoFIE-MIST experiments: the left using a 6.4 mm diameter fuel rod and the right a 9.5 mm rod. As oxygen is depleted, the flame propagates downward, transitioning to a blue hue and eventually extinguishing. The smaller-diameter fuel exhibits faster flame spread. Image Courtesy: NASA

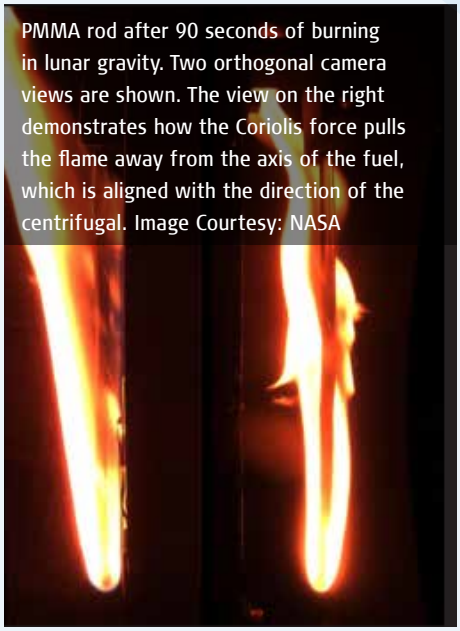
Driving Innovation Through Miniaturized Science

The future of commercial space exploration hinges on fast, reliable, and compact scientific tools. Under the Commercially Enabled Rapid Space Science (CERISS) Initiative, USRA researchers achieved a major breakthrough: the development of a miniaturized Differential Dynamic Microscopy (DDM) system, complete with an advanced image analysis algorithm, small enough to be deployed onboard a CubeSat.

This compact system led to a surprising scientific discovery. USRA researchers observed particle clusters forming with unexpected anisotropic behavior when studying colloidal particles suspended in polymer solutions that mimic biological fluids. Molecular dynamics simulations later confirmed the phenomenon, revealing fundamental insights into particle interactions in complex fluids. This finding carries significant implications. Blood clotting in microgravity remains a major concern for astronaut health. The DDM platform offers a promising solution by enabling real-time monitoring of blood behavior in space and serving as a potential point-of-care diagnostic tool here on Earth. It also opens new avenues for studying soft matter, bio-soft materials, and biological fluids in ways that were previously out of reach.

This success underscores the core vision of CERISS: that transformative space science does not require large, costly instruments. By pairing foundational science with bold commercial collaboration, USRA is accelerating the pace of discovery with tools that are both powerful and practical. This research is funded by NASA's Biological and Physical Sciences Division.

USRA Advances Fire Safety Research for Lunar Missions with LUCI



PMMA rod after 90 seconds of burning in lunar gravity. Two orthogonal camera views are shown. The view on the right demonstrates how the Coriolis force pulls the flame away from the axis of the fuel, which is aligned with the direction of the centrifugal. Image Courtesy: NASA

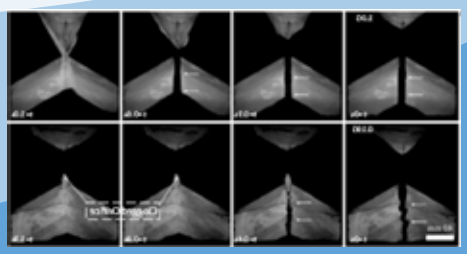
USRA played a central role in the Lunar Combustion Investigation (LUCI), which launched aboard Blue Origin's 29th New Shepard mission in February 2025. Led by USRA's Dr. Paul Ferkul in collaboration with NASA's Glenn Research Center and Voyager Space, LUCI provided critical knowledge for the design and safety of future Artemis habitats by investigating how common materials ignite and burn in lunar gravity.

To simulate lunar gravity, the capsule entered freefall and rotated at 11 RPM, triggering LUCI's combustion sequence. The payload tested two representative materials—cotton fiberglass fabric and a plastic rod—measuring flame spread, heat release, and gas emissions to assess fire risk in one-sixth gravity.

Initial results confirmed successful ignition and nominal performance of all systems. Early data suggest that materials considered fire-safe on Earth may exhibit significantly different behavior in lunar conditions.

LUCI builds on earlier microgravity combustion research and demonstrates the power of suborbital platforms to accelerate mission-critical science. USRA's scientific leadership was instrumental in achieving this milestone toward safer, crewed exploration of the Moon. This research is funded by NASA's Biological and Physical Sciences Division.

Understanding Lunar Soil: Pioneering Granular Flow Research for ISRU



Photographs showing JSC-1A lunar regolith simulant flowing through a macroscopic quasi-2D hourglass (hopper angle 60°) at (A *top*) 1.0G and (B *bottom*) 0.19G. at ZARM drop tower (Bremen, Germany). Image Courtesy: German Aerospace Center (DLR)

USRA researchers are advancing foundational science to support NASA's future In-Situ Resource Utilization (ISRU) efforts—essential for sustained human presence on the Moon and Mars. Long-duration missions will rely on local resources like regolith to reduce dependence on Earth resupply, but managing granular materials in reduced gravity poses major challenges.

To address this, USRA scientists are studying how regolith simulants behave under varying gravity conditions. Experiments at the ZARM drop tower in Germany, informed by USRA models, showed a key finding: JSC-1A simulant flows easily on Earth but clogs severely at lunar gravity.

Building on this, the USRA team developed a simulation framework that predicts granular flow under different gravity levels and material properties. This tool is shaping the design of ISRU systems for the Moon and Mars and may benefit terrestrial industries.

USRA's work is part of an effort to understand space dust behavior, in collaboration with NASA, JAXA, and Toyota to inform the design of the Pressurized Rover (Lunar Cruiser) for future missions. This research is funded by NASA's Biological and Physical Sciences Division.

ClothBot: Advancing Lunar Dust Science for Safer Human Exploration

USRA is helping NASA tackle a major challenge for future Artemis missions: lunar dust. A USRA research engineer is Principal Investigator for ClothBot, a novel experiment that studies how dust behaves when astronauts remove their spacesuits in reduced gravity.

ClothBot is a compact, autonomous robot that simulates suit doffing inside a pressurized lunar habitat. It disperses lunar regolith simulant onto the spacesuit fabric, then performs controlled mechanical motions to mimic astronaut movements. As dust is agitated, a laser-illuminated imaging system captures particle behavior, while onboard sensors track particle size and concentration.

These data will help validate computational models that predict dust movement in lunar landers—especially in airlocks, workspaces, and crew quarters. ClothBot flew aboard Blue Origin's New Shepard rocket, providing a key window of lunar gravity in a sealed, pressurized environment.

This successful flight marks a major step in understanding dust suspension and dispersion in confined spaces, directly supporting the design of dust mitigation strategies and life-support systems for safe, long-duration lunar missions.

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.

Fermi-GBM Collaboration Awarded Prestigious Cocconi Prize for Advancing Gamma-Ray Astronomy

Dr. Adam Goldstein accepting the Cocconi Prize. Image Courtesy: CPPM (Centre de Physique des Particules de Marseille).

The Fermi Gamma-ray Burst Monitor (GBM) Collaboration, which includes a team at Universities Space Research Association's Science and Technology Institute, has been awarded the 2025 Giuseppe and Vanna Cocconi Prize by the European Physical Society (EPS). The prize recognizes the team's pioneering contributions to Multi-Messenger astrophysics. The prize was also awarded to the Fermi Large Area Telescope (LAT) Collaboration for its achievements in gamma-ray astronomy.

USRA team members Dr. Adam Goldstein, Dr. Corinne Fletcher, and Dr. Oliver Roberts were the recipients of this prestigious award.

The EPS cited the Fermi-GBM team "for its groundbreaking contributions to the study of transient gamma-ray phenomena and Multi-Messenger astronomy.... The Fermi-GBM has also played a central role in cataloging and understanding Gamma-ray bursts (GRBs), contributing essential data for unveiling the physics of these powerful cosmic explosions."

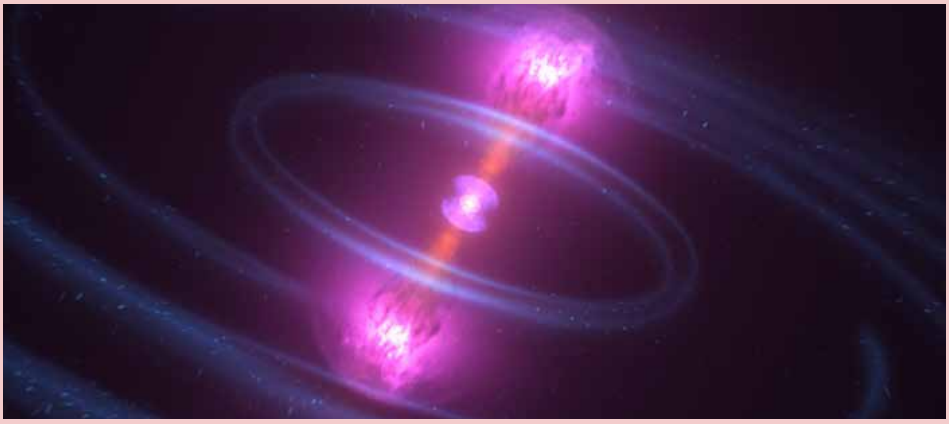
The Fermi-GBM has significantly advanced the study of transient gamma-ray phenomena. Since its launch, it has detected over 3,000 GRBs, enabling key discoveries about both short and long-duration bursts. A defining milestone was the 2017 detection of the electromagnetic counterpart to the gravitational wave event GW170817. This event confirmed that neutron star mergers can produce short GRBs, opening a new era in multimessenger astrophysics by linking gravitational wave and gamma-ray observations for the first time.

The Cocconi Prize is the EPS's highest honor in astroparticle physics and is comparable in prestige to the American Astronomical Society's Rossi Prize.

EPS also awarded the honor to the Fermi-LAT Collaboration for "its exceptional achievements in gamma-ray astronomy" including the first ever detection of "an electromagnetic counterpart to a high-energy neutrino, emitted by the blazar TXS 0506+056, marking a cornerstone in the era of multi-messenger astronomy."

The award was presented at the European Physical Society Conference on High Energy Physics, on July 7–11 in Marseille, France. USRA astrophysicist Dr. Adam Goldstein accepted the award on behalf of the collaboration during the ceremony at the historic Palais du Pharo.

The success of the Fermi mission, including both the GBM and the LAT, reflects the dedication of scientists and engineers from across Europe, the United States, and beyond. Their collaborative efforts in instrument development, operations, and data analysis have transformed our understanding of the high-energy universe.



This animation captures phenomena observed over the course of nine days following the neutron star merger known as GW170817, detected on Aug. 17, 2017. They include gravitational waves (pale arcs), a near-light-speed jet that produced gamma rays (magenta), expanding debris from a kilonova that produced ultraviolet (violet), optical and infrared (blue-white to red) emission, and, once the jet directed toward us expanded into our view from Earth, X-rays (blue). Image Courtesy: NASA's Goddard Space Flight Center/CI Lab.

Findings from IXPE Data Reveal Key Insights on Corona Around Black Holes

Using data from NASA's Imaging X-ray Polarimetry Explorer (IXPE), researchers have uncovered the first direct clues to the shape of a black hole's corona—a superheated region of plasma responsible for most of its X-ray emissions. The study, led by USRA postdoctoral researcher Dr. Lynnie Saade at USRA's Science and Technology Institute and conducted at NASA's Marshall Space Flight Center, marks a major step in understanding black hole environments.

Black holes are surrounded by swirling accretion disks of gas and debris, but the structure of their coronas has remained largely theoretical—until now. IXPE's unique ability to measure X-ray polarization revealed that in all black holes observed, the corona is extended in the same direction as the accretion disk. This rules out earlier models placing the corona directly above or below the black hole, or at the base of a jet.

An illustration of material swirling around a black hole highlights a particular feature, called the "corona," that shines brightly in X-ray light. In this depiction, the corona can be seen as a purple haze floating above the underlying accretion disk and extending slightly inside of its inner edge. Image Courtesy: NASA/Caltech-IPAC/Robert Hurt

The findings, based on observations of 12 stellar-mass and supermassive black holes—including Cygnus X-1 and LMC X-1—suggest similar disk geometry across vastly different black hole sizes.

These insights will help scientists refine models of how black holes generate and release energy, advancing our knowledge of some of the universe's most extreme objects and shaping future research.

Portal to the Universe: Prototype Completed

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 that is collected in space and data that are collected on the ground.

USRA's 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

Examples of the Portal Web GUI (a) main page, (b) selection of an astrophysics event, and (c) data availability for different observatories during the time of the astrophysical event. Image Courtesy: NASA/Caltech-IPAC/Robert Hurt

from different observatories covering different wavelengths and messengers and enables searching and retrieval of that data in the time domain. The prototype was completed in September 2024 and is available to the community, and now includes NASA Fermi Gamma-ray Burst Monitor data (in-orbit gamma-ray observations), NSF 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). Users can search for data associated with astrophysical events or query for data availability based on time and, optionally, location on the sky.

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.

Air Traffic Management and Control Systems

USRA has been the lead contractor supporting NASA to develop, test and deploy advanced air traffic management solutions in all classes of airspace. These range from low altitude UAS Traffic Management (UTM) to Upper Class E Traffic Management (ETM) above 60,000 feet and Space Traffic Management (STM). USRA is developing and enabling multi-year operational use of systems in field demonstration tests by commercial airlines, FAA's air traffic control, and other industry partners maturing technology readiness levels towards full-scale implementation. This includes leading an aviation data science initiative at NASA, and developing and deploying multiple AI models used to recommend reroutes of commercial aircraft operated by major airlines. During field demonstrations where airlines took suggested reroutes and received approval from air traffic control, benefits of the reroutes were measured in terms of fuel and time saved, and emissions and costs reduced.

USRA also has experience with unmanned aircraft systems (aka drones), including development of federated and distributed approaches for command and control integrating numerous real-time data feeds to enable a robust interconnected network of "service suppliers." The work includes conflict resolution algorithms, scheduling systems, and machine learning models for anomaly detection and trajectory prediction, all of which contribute to enhanced situational awareness and operational efficiency.

USRA also works at the intersection of aeronautics and Earth Science. This includes significant research advancing the use of machine learning to forecast weather with high resolution temporally and spatially (latitude, longitude, and altitude) to predict and monitor the formation and persistence of aviation contrails, and significant research advancing the use of machine learning to analyze remote sensing data captured from sensors onboard airborne platforms including drones (e.g. for preparedness, response and recovery as it relates to natural disasters).

QUANTUM INFORMATION SCIENCES

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.

Quantum Efforts in 2025

During this fiscal year, the team continued to support the flagship DOE centers for the National Quantum Initiative SQMS at Fermi National Laboratory and Co-design Center for Quantum Advantage (C2QA) at Brookhaven National Laboratory with algorithmic R&D. Both centers have leveraged extensively USRA's competence on Quantum Simulation and Error Correction, which will be instrumental for the next phase of the centers, starting in FY 26. These direct contributions to two flagship centers of the National Quantum Initiative demonstrate USRA's leadership in developing essential tools (simulation, error correction) that will enable practical quantum computing in the next phase (FY 26 and beyond).

Collaboration between Google and NASA

Additionally, our scientists continue to nurture the collaboration between NASA and Google, which dates back to the inception of our quantum team and the Quantum Artificial Intelligence Lab in 2012. This collaboration positions the team as a central player in some of the most high-profile public–private quantum collaborations.

Connecting Foundational Research to Real-World Applications

The work on quantum optimization, initially seeded by the previous USRA DARPA Optimization with Noisy Intermediate-scale Quantum (ONISQ) award, is now advancing to the next level with the kickoff of the DOE-sponsored project at NASA. This project is led by Oak Ridge National Laboratory, Algorithms for Quantum Utility: Intelligent, Robust, and Efficiently Distributed (AQUIRED), and by a USRA award by AFRL on Functional Exploitation of Noise in Utility-Scale Quantum Optimization. This effort will provide a disciplined approach to bridge foundational research to real-world applications in optimization at scale.

Quantum Industry Engagement and Quantum Sensing

USRA engagement with the quantum industry continued to grow with two established European startups (Pasqal and Oxford Ionics), bringing to the table technologies that have been traditionally underexplored and underutilized by USRA and NASA (atomic quantum processors). These Partnerships with Pasqal and Oxford Ionics expand USRA's reach into cutting-edge atomic quantum processor technologies, diversifying the technical portfolio and strengthening ties with international innovators. Leveraging USRA's Independent Research and Development investment, we also jump-started a quantum sensing effort focused on the intersection of quantum sensing and quantum computing theory and techniques.

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.

AFRL Future Scholars and STEM Workforce Development Programs

Working collaboratively with the Air Force Research Laboratory (AFRL), USRA has managed the AFRL Scholars Program for more than 10 years. Included in the Department of War's workforce development portfolio are two other programs, Scholars Professionals (SPs) and the University Research and Engagement Program (UREP).

Kirtland Air Force Base AFRL Scholars summer 2025 cohort gathered at Rio Grande Credit Union Field at Isotopes Park in Albuquerque, New Mexico, on June 11, 2025, for a minor league baseball game, which served as the internship kick-off networking event. Image Courtesy: USRA

AFRL Scholars Program

Interest in the AFRL Scholars Program increased significantly during 2025, realizing an increase in applications of more than 50 percent over 2024. Ultimately, a total of 371 interns representing 141 academic institutions were placed among 10 Technical Directorates (TDs) across 10 AFRL sites. The program expanded this year to include Space Systems Command -Communications, Guidance and Navigation (SSC-CGN) located at the Naval Base Point Loma facility in San Diego, California. Additionally, Eglin AFB set a new placement record for their scholar cohort by successfully supporting 101 students.

With the goal of forming deeper, lasting partnerships with both industry and academia, the AFRL Scholars Program at Kirtland AFB established a new Industry/Academia Pilot Program during summer 2025 to place interns. The inaugural program between USRA and the University of New Mexico (UNM) supported four students, two at the senior undergraduate level, one at the master's level, and one doctoral student.

USRA's President and CEO, Dr. Elsayed Talaat, delivered closing remarks at both the Eglin AFB and Kirtland AFB summer 2025 Scholar Poster and Presentation Sessions held on July 28-30 and August 5-6 respectively.

Artificial Intelligence and Machine Learning Internships

Though the NAMS R&D Student Program ended early FY 25, RIACS continued to host student interns on the various RIACS Principal Investigator awards. Four ARPA-E interns worked on the contrail project with the USRA PI. The interns working on the Boston Consulting Group collaboration for AI Foundation Model for Extreme Weather contributed to the development of the GAIA Foundation Model that was released in May.

Exploration Science Summer Intern Program (Graduate)

The Center for Lunar Science and Exploration's (CLSE) summer intern program, led by LPI's Dr. David Kring, is designed to host 5 to 10 graduate students who have a keen interest in assisting NASA and its international partners in examining options for a new era of robotic and human exploration using the Orion crew vehicle, Human Landing System, and other assets being developed for missions beyond low-Earth orbit. The Exploration Science Summer Intern program is open to graduate students in geology, planetary science, planetary astronomy, and related programs.

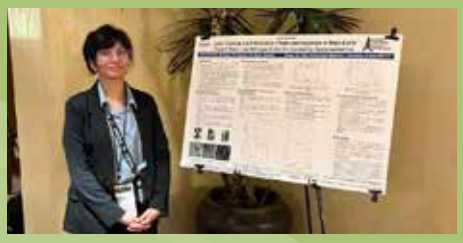
The intern program has recently been motivated by the Artemis program and plans for a human landing circa 2028. We hosted two Exploration Science Summer Intern teams this year, 10 students in total. In late July, students briefed their results to the LPI and NASA's Johnson Space Center communities. Their results will be incorporated into abstracts for the 57th Lunar and Planetary Science Conference in 2026 and a full-length, peer-reviewed journal article.

Dr. Kring describing lunar surface mobility capabilities to the Exploration Science Summer Interns. Image Courtesy: Lunar and Planetary Institute

University Research and Engagement Program (UREP)

Under the University Research and Engagement Program (UREP) umbrella is the U.S. Space Force (USSF) University Consortium Research Opportunity (UCRO), later renamed the Space Strategic Technology Institute(s). Through this program USRA has awarded science and technical (S&T) research subagreements to 11 single or lead universities, investing more than $9.5 million to date. Institutions funded during 2025 include the Georgia Institute of Technology- Principal Investigator (PI) Dr. Chandra Raman, Texas State University- PI Dr. Anthony Torres; the University of Central Florida- PI Dr. Michael Kinzel; the University of New Mexico- PI Dr. Marek Osinski; the University of Tennessee- PI Dr. Siamak Farhad; the University of Texas at Austin- PI Dr. Brandon Jones; the University of Colorado Boulder consortium- PI Dr. Marcus Holzinger; and the Virginia Polytechnic and State University consortium- PI Dr. Shane Ross.

To date, 20 posters have been developed, 26 technical presentations were delivered, 15 abstracts have been submitted, and 23 papers have been written regarding this highly esteemed research.



University of New Mexico Ph.D. student, Shruti Ishwarchandra Gharde, part of UCRO 1.0/SSTI 0, discussing her research progress. Image Courtesy: USRA

Lunar and Planetary Institute Summer Intern Program

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 summer, the 10-week summer intern program was held at LPI and JSC. The 2025 class includes nine undergraduate students from the United Kingdom, and across the United States, competitively selected from 212 qualified undergraduate applicants. Each intern worked one-on-one with scientists at the LPI and NASA JSC to conduct a comprehensive research project, culminating in a final LPSC-style abstract and presentation. We are anticipating that these projects will be presented at the Lunar and Planetary Science Conference in March. In addition, there were seven research seminars on various planetary science topics.

The LPI Summer Intern Program includes enrichment activities that support students' research. Image Courtesy: LPI

CSNR Summer Fellowship Program

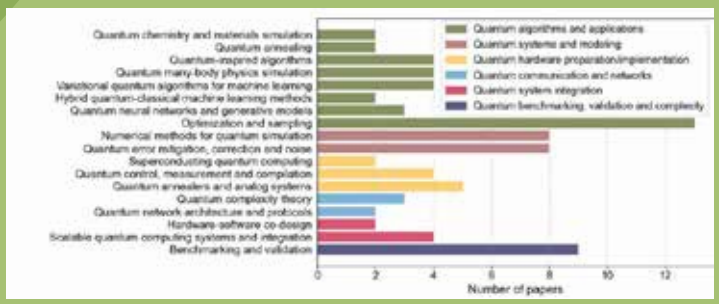
In 2025, CNSR hosted its 20th Summer Fellowship Program. Staff and student Fellows conducted design and multiphysics analyses on potential materials, configuration of fuel and reflector systems, and power-cycle options for a hybrid gaseous-core reactor. Fellows also studied how combining nuclear thermal and nuclear electric propulsion could significantly improve spacecraft performance.

Scholars Professionals

USRA successfully onboarded a second Scholars Professional (SP) participant during October 2024. The SP participant, Dr. Jacob Williamson, graduated from the Georgia Institute of Technology with a Ph.D. in physics, and currently works at the Kirtland AFB Quantum Sensing and Timing Office under the guidance of Dr. Spencer Olson. The work performed during Jacob's one-year appointment focuses on deploying compact fiber cavity quantum electrodynamics to develop compact, lightweight, and power-efficient quantum sensing and networking solutions using neutral atoms.

Jacob Williamson previously worked under the guidance of Dr. Chandra Raman, Principal Investigator for the Georgia Institute of Technology UCRO 1.0/SSTI 0 research effort. Image Courtesy: Jacob Williamson

Feynman Quantum Academy



Breakdown of published papers by subject. Image Courtesy: USRA

The USRA Feynman Quantum Academy had two student interns this past fiscal year working on NSF Expeditions in Computing. The team worked on a wide array of research projects targeting theory and analysis of near-term architecture and algorithms. A white paper was published this year that documents the impact and journey of more than 50 students who went through the program since its inception.

GOVERNANCE AND MEMBER UNIVERSITIES

Front Row: (left to right), Dr. Joan Ramage Macdonald (COI Chair), Gen Lester Lyles, USAF (Ret.) (Chair of the Board of Trustees), Dr. Elsayed R. Talaat (Ex Officio and Executive Committee), Ms. Lesa B. Roe (At-large), Ms. Kim Williams (Ret.) (Audit & Finance Chair and At-large)

Back Row: (left to right) Dr. Sean C. Solomon (Region II), Maj Gen William N. McCasland (Ret.) (Compensation Committee Chair and At-Large), Dr. James L. Garrison (Region VI), Dr. Robert McCoy (Region IX), Dr. Wayne A. Scales (Region III), Dr. Christopher J. Damaren (Region V), Dr. Elizabeth A. Lada (Region IV), Dr. Richard Ambrosi (Region X).

Not pictured:

Dr. Jed Hancock (Vice Chair, COI)

Dr. Moriba K. Jah (Region VII)

Dr. Vernon R. Morris (Region VIII)

Dr. Daniel E. Hastings (Region I)

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. The 2025 Annual Meeting included a workshop at which COI Representatives discussed methods and strategies for closer collaboration among the member universities and with USRA, as well as suggested topics for advocacy and possible working groups.

In 2025, the Council hosted two regional meetings to foster deeper collaboration and dialogue among members. These included:

Region I Meeting (May 29, 2025 at Boston University)

Region II Meeting (October 2, 2025 at University of Pittsburgh)

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 Dr. Amy Fagan (Western Carolina University), the LPI Science Council met in July 2025 to review the ongoing activities and strategies for LPI's continued success under its Support for Planetary Sample Science program with NASA. The Council also welcomed new members Dr. Lisa Gaddis (LGC), Dr. Tammy Dickinson (Science Matters Consulting), and Benjamin Weiss (MIT).

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 2025 the council met in February and subsequently initiated monthly online tag-ups to discuss appropriate actions in response to Presidential executive orders affecting science and engineering research at 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.

Public Policy Advocacy

The Issues and Program Committee (IPC) serves as the voice of the university space research community on key public policy issues. Comprised of representatives from each of USRA's ten regions, the committee develops policy positions, engages with members of Congress, and provides testimony as needed. It is also responsible for planning the USRA Annual Symposium program.

IPC Membership

Chair: Joan Ramage Macdonald, Lehigh University | **Vice Chair:** Jed Hancock, Space Dynamics Lab, Utah State University | **Region I:** Josh Grindlay, Harvard University | **Region II:** Joan Ramage Macdonald, Lehigh University | **Region III:** Wayne Scales, Virginia Tech | **Region IV:** Iso Ero-Johnson, Hampton University | **Region V:** Chris Damaren, University of Toronto | **Region VI:** Neil Cornish, Montana State University | **Region VII:** Truell Hyde, Baylor University | **Region VIII:** Steve Stochaj, New Mexico State University | **Region IX:** Bob McCoy, University of Alaska Fairbanks | **Region X:** Richard Ambrosi, University of Leicester | **Observer:** David Canales Garcia, Embry-Riddle Aeronautical University

Advocacy Efforts

In 2025, the IPC led targeted advocacy to restore full funding for NASA's Science Mission Directorate (SMD), which faced a proposed 47.5% reduction in the FY 26 budget. USRA leadership coordinated congressional outreach, sent letters to appropriators, and met with key lawmakers. The IPC continued promoting university-led small satellite missions for their workforce and research value, while also helping to organize a "Save NASA Science" Day of Action on October 6, which mobilized the university and

Dr. Talaat meets with Sen. Van Hollen (D-MD).
Image Courtesy: USRA

science community advocates to urge congressional support for NASA science.

The FY 26 House Commerce, Justice, Science (CJS) Appropriations Report for NASA continues to include language drafted by the IPC supporting this investment.

From the FY 26 House CJS Report:
University Small Satellite Missions.– The Committee supports NASA's collaborative efforts with U.S. colleges and universities to conduct research through small spacecraft missions, including CubeSat and SmallSat missions. The Committee believes these competitively selected projects led by principal investigators at higher education institutions help train the next generation of scientists and provide much-needed research. The Committee directs NASA to provide not less than $30 million for these missions.

Federal Impacts Survey: Elevating University Voices

In May 2025, USRA surveyed its 121 Council of Institutions (COI) members to assess how federal policy changes were affecting university space research. With 36 responses, the survey found widespread challenges, including hiring freezes, reduced enrollment, and grant difficulties, 83% cited negative impacts from NASA actions, and 92% reported challenges for junior faculty. USRA shared these findings with Congress to stress the need to safeguard research funding and workforce stability.

USRA Bicameral Capitol Hill Briefing on Space Nuclear Propulsion

On May 14, 2025, USRA hosted a bicameral Hill roundtable on space nuclear propulsion, featuring USRA's Dr. Elsayed Talaat, GW University's Dr. Scott Pace, USRA's Bernie Seery and Dr. Rob O' Brien, and Joseph Cassady from L3 Harris. The discussion emphasized the strategic importance of space nuclear power for exploration and national security, highlighting progress in thermal nuclear propulsion and workforce development.

Dr. Talaat with Rep. Don Bacon (R-NE)
Image Courtesy: USRA

UNIVERSITY ENGAGEMENT

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

Type of Organization	Number of Organizations	Number of Engagements
Universities – USRA Members	73	214
Universities – Non-Members	116	158
Total Universities	189	372
Other Research Orgs	78	210
Total	**267**	**582**

Table represents collaborations among individual investigators and does not include the larger, programmatic level engagements.

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.

Emil Atz, a former AFRL scholar, describing the LEXI experiment during the Boston University lab tour.Image Courtesy: USRA

USRA's Dr. Carol Kory and Dr. Elsayed Talaat with University of Pittsburgh Representative Prof. Peyman Givi at a meeting at the Cathedral of Learning on the campus of the University of Pittsburgh. Image Courtesy: USRA

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 their fields of study. The awards are made possible by financial contributions, including those made by USRA employees through payroll deductions.

In 2025, USRA received 130 eligible applications from students at 71 different universities. The applications were reviewed by faculty members at USRA's member universities, who made their recommendations to the USRA President and CEO based on the applicants' career goals, accomplishments, leadership abilities, and efforts to give back to their community. Seven awardees and five honorable mentions were selected from the applicants.

USRA proudly recognizes the following students and supports the careers of these winners:

Leah Balakrishnan
Stanford University

Thomas R. McGetchin Memorial Scholarship, which honors McGetchin's contributions to planetary science.

Isabelle Connor
University of California, Santa Cruz

James B. Willett Education Memorial Scholarship, which honors Willett's contribution to astrophysics.

Catherine Franco
Auburn University

John R. Sevier Memorial Scholarship, which honors Sevier's contributions to aerospace engineering.

Aidan Guerra
University of California, Davis

Frederick A. Tarantino Memorial Scholarship, which honors Tarantino's contributions to USRA and his commitment to education.

Bradley Hutchinson
Indiana University

Judith L. Pipher Memorial Scholarship, which honors Pipher's contributions to infrared astronomy.

Eirik Mulder
Auburn University

John R. Sevier Memorial Scholarship, which honors Sevier's contributions to aerospace engineering.

Olivia Nippe-Jeakins
George Washington University

James B. Willett Education Memorial Scholarship, which honors Willett's contribution to astrophysics.

Honorable Mentions:

Nico Bers
Northwestern University

Shreya Chandra
University of California, Davis

Raven Cilley
University of Michigan

Marylin Loritsch
University of California, San Diego

Tyrston Schmitt
Georgia Institute of Technology

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.

Driving Future Growth: USRA Forms Joint Venture with Huna Research Associates

USRA now has three entities under the corporate umbrella contributing to USRA's growth and success. USRA, a 501(c)(3) nonprofit association; E Street Technologies (ESTech), a for-profit small business wholly owned subsidiary of USRA; and Huna Research Associates (HRA) Joint Venture (JV), LLC, a certified 8(a), Alaska Native Corporation (ANC)-owned entity.

New to the fold and established in 2025, HRA is a JV between protégé HunaTek Operations Services, LLC (HTOS), a certified 8(a), Alaska Native Corporation (ANC)-owned entity, and mentor ESTech under the Small Business Administration (SBA) mentor-protégé program. This strategic alliance combines HunaTek's deep government contracting experience

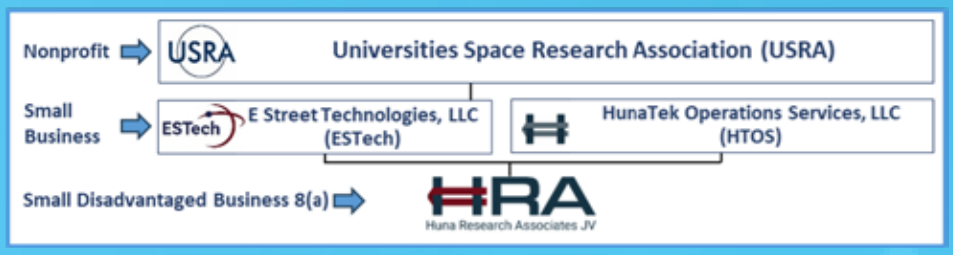


Image Courtesy: USRA

with ESTech's cutting edge R&D and engineering legacy, creating a nimble, mission-focused team equipped to deliver innovation, agility, and trusted results to our customers.

Combined core competencies include Scientific R&D and Engineering Services; Operations and Maintenance (O&M); Cybersecurity and Information Assurance; Big Data and Advanced Analytics; AI/Machine Learning Integration; Quantum Information Science; Nuclear Technology Support; Environmental and Space Sciences; and Education and Workforce Development.

The SBA 8(a) Business Development Program provides federal agencies with an efficient, low risk contracting option while supporting small and disadvantaged businesses.

Expanding USRA's Global Reach

The Evolutionary Arc of the Universities Space Research Association. Image Courtesy: USRA

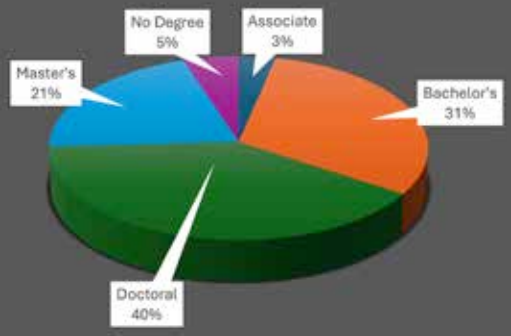
Founded in 1969 as a consortium of 49 universities, USRA has grown into an international association with 121 member institutions and multiple research institutes across the U.S. Today, USRA is preparing for its next chapter: establishing a presence in the United Kingdom through a new initiative, provisionally named "USRA-UK".

This effort began with a focus on quantum computing and artificial intelligence—fields where nearly half of the world's processors and start-ups are located abroad. It has since expanded into a broader vision of bringing USRA's diverse expertise in space and aeronautics to new global partners. By building collaborations with UK scientists, universities, and industry, and by pursuing opportunities to compete for regional contracts, USRA-UK will strengthen international ties while creating new sources of revenue to support our mission.

This milestone marks an exciting step in USRA's evolution—extending our reach, deepening collaboration, and advancing discovery on a global scale.

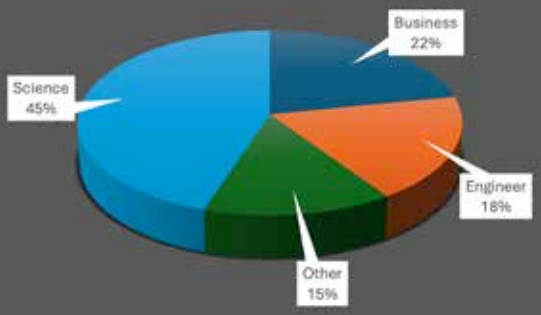
USRA'S WORKFORCE

Employee Distribution by Degree



USRA's workforce reflects exceptional educational attainment, with more than half holding advanced degrees in STEM disciplines aligned with USRA's mission priorities. Among our staff, approximately 38% (≈68) hold Doctorates, 32% (≈57) hold Master's degrees, 28% (≈50) hold Bachelor's degrees, and 2% (≈3) hold Associate or Certificate credentials—demonstrating the depth of academic achievement that supports USRA's scientific and technical excellence.

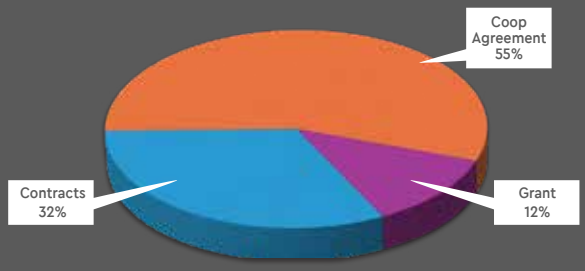
Employee Distribution by Areas of Study



Pertaining to professional disciplines, USRA's staff hold an extraordinary breath of expertise across several scientific, technical and professional disciplines as outlined in this report. From Astronomy, and Astrophysics to Artificial Intelligence and Quantum computing, USRA experts drive innovation at every level. Their work reflects pioneering research in various disciplines that reveal the diverse and interdisciplinary foundation that powers USRA's mission of advancing science, technology and exploration. Supporting these technical areas are a wide range of business disciplines spanning 14 functional areas.

USRA'S FINANCIAL HIGHLIGHTS

FY 25 Revenue



USRA's FY 25 revenue was $50 million, reflecting a decline from the prior year primarily due to the completion of one major contract. Despite this reduction, the company strengthened its cash position by approximately 9 percent compared with FY 24, supported by disciplined working capital management and investment gains.

Unbilled receivables declined by nearly 40 percent, reflecting progress in billing accuracy, project closeouts, and overall working capital efficiency, while billed receivables remained stable year-over-year.

USRA's Total Net Asset Value decreased modestly, reflecting intentional investments in core capabilities and expanded business development efforts designed to position the organization for long-term growth. With a debt-free balance sheet and strong liquidity, USRA remains well positioned to make the strategic investments necessary to advance its non-profit mission and continue effectively serving its government and commercial partners.

Total Assets:	**$39M**
Net Asset Value:	**$27M**

USRA LOCATIONS

○ Idaho Falls, ID

CSNR
Center for Space Nuclear Research

○ Mountain View, CA

RIACS
Research Institute for Advanced Computer Science

○ Cleveland, OH

Low Gravity Sciences
Glenn Research and Engineering Support

NSF Engines
Science Park Accelerator & Regional Catalyst Ohio (SPARC Ohio)

○ Greenbelt, MD

PHaSER
Partnership for Heliophysics and Space Environment Research

○ Houston, TX

Workforce Development
U.S. Air Force Research Laboratory Scholars

U.S. Air Force Research Laboratory Scholars Professionals

University Consortium Research Opportunity

LPI
Lunar and Planetary Institute

○ Huntsville, AL

STI
Science and Technology Institute

☆ Washington, D.C.

USRA Headquarters

EfSI
Earth from Space Institute

E Street Technologies (ESTech)
A Subsidiary of USRA

Huna Research Associates (HRA) JV
A Joint Venture between HunaTek Operations Services (HTOS) and ESTech

USRA Annual Report Editorial Board
Bernie Seery
Suraiya Farukhi

Art and Design
Forge Branding

Managing Editor
Suraiya Farukhi

Copy Editing
Erin Senoz
James Lochner
Julie Tygielski
Rachel Berrios

Send Correspondence to:

Director, Communications
Universities Space Research Association

425 3rd St SW, Suite 950
Washington DC 20004
www.usra.edu

USRA Universities Space Research Association

USRA OFFICES

USRA Corporate Headquarters
425 3rd Street, SW
Suite 950
Washington, DC 20024
www.usra.edu

Lunar and Planetary Institute
3600 Bay Area Blvd
Houston, TX 77058

E Street Technologies, LLC
425 3rd Street, SW
Suite 955
Washington, DC 20024