National Aeronautics and Space Administration

Success Stories & Finding Opportunities within the Mission Directorates

NASA SBIR/STTR Program

Dr. Quenton Bonds & Mr. Bob Jones | September 17, 2020

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Space Technology Mission Directorate (STMD)

- STMD engages and inspires thousands of entrepreneurs, researchers and innovators, creating a community of America's best and brightest working on the nation's toughest challenges. Space technology research and development take place at NASA centers, universities and national labs.
- STMD leverages partnerships with other government agencies as well as commercial and international partners. Our current technology portfolio spans a range of discipline areas and technology readiness levels.
- STMD is focused on advancing technologies and testing new capabilities at the Moon that will be critical for crewed missions to Mars.
- Investments in revolutionary, American-made space technologies provide solutions on Earth and in space. NASA technology turns up in nearly every corner of modern life. We make our space tech available to commercial companies to generate real world benefits – everything from creating jobs to saving lives.

https://www.nasa.gov/directorates/spacetech/home

Success Stories: STMD

3D Printing in Zero Gravity at the International Space Station

PHASE III SUCCESS: **$1.5M from NASA**

MADE IN SPACE – Moffett Field, CA

SNAPSHOT: The first company to successfully manufacture in space, Made in Space is partnering with NASA to bring 3D printing and plastics reuse and recycling to the International Space Station.

Lightweight Carbon Nanotube Technology for Building Spacecrafts

PHASE III SUCCESS: **$8.1M from NASA Game Changing Development**

NANOCOMP TECHNOLOGIES, INC – Merrimack, NH

SNAPSHOT: Received Phase III funding from the NASA SBIR/STTR program for the continued improvement of lightweight Miralon™ carbon nanotube technology to replace heavier materials on spacecraft. This technology was originally developed under Air Force and received Phase III funding per NASA's needs.

Science Mission Directorate (SMD)

The Science Mission Directorate develops and operates an overall program of science and exploration. Objectives include the following:

- Study planet Earth from space to advance scientific understanding and meet societal needs;
- Understand the Sun and its effects on Earth and the Solar System;
- Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space and
- Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

https://science.nasa.gov/about-us/smd-vision

Success Stories: SMD

Deformable Mirrors for Telescopes

PHASE III SUCCESS: **$875K from NASA; $2M revenue annually**

IRIS AO, INC – Berkeley, CA

SNAPSHOT: Since the first exoplanet discovery in 1995, NASA has dedicated resources to develop deformable mirrors for telescopes to explore possible signs of life outside our solar system. IRIS AO's SBIR-funded products, such as their mirrors, are now commercially sold worldwide.

CubeSat Measuring First Ice Cloud Map for Climate Research

PHASE III SUCCESS**: $45M in commercial sale of components attributed to results of NASA SBIR funds**

VIRGINIA DIODES, INC – Charlottesville, VA

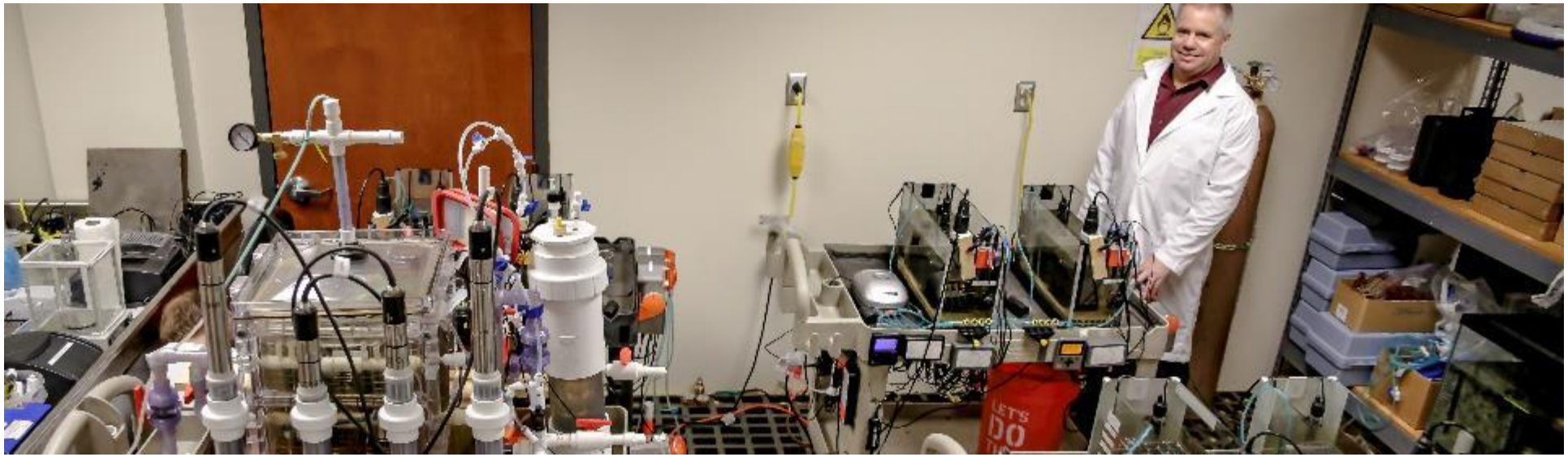
SNAPSHOT: VDI received NASA SBIR awards for research and development of terahertz wave technology. Their work led to NASA ESTO funding, resulting in the IceCube CubeSat, which captured the world's first ice cloud map contributing to our understanding of the Earth's climate

Human Exploration Mission Directorate (HEOMD)

- NASA's Human Exploration Mission Directorate (HEOMD) provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low-Earth orbit.
- HEOMD is responsible for Agency leadership and management of NASA space operations related to Launch Services, Space Transportation, and Space Communications in support of both human and robotic exploration programs.
- The International Space Station, currently orbiting the Earth with a crew of six, represents the NASA exploration activities in low-Earth orbit.
- Exploration activities beyond low-Earth orbit include the management of Commercial Space Transportation, Exploration Systems Development, Human Space Flight Capabilities, Advanced Exploration Systems, and Space Life Sciences Research & Applications.

https://www.nasa.gov/directorates/heo

Success Stories: HEOMD



Space-based Biomanufacturing Facility for Vascular Grafts, Tissues, and Organs

POST-PHASE II SUCCESS**: $1.5M in CCRPP investment from the ISS National Lab**

TECHSHOT – Greenville, IN

SNAPSHOT: Techshot developed a BioFabrication Facility (BFF) originally under DARPA, received a $1.5M CCRPP from the NASA SBIR/STTR Program supported by the ISS National Lab. BFF the first-ever 3Dprinter capable of manufacturing human tissue in the microgravity condition of space.

Water Recycling System for Space Exploration

PHASE II SUCCESS: **$885K from NASA**

PANCOPIA – Hampton, VA

SNAPSHOT: Up to 92% of the costs to sustain operations in space are for water. Pancopia is developing a water treatment that will save costs by recycling 95% of wastewater into drinking water by reverse osmosis. This treatment will be usable on the ISS and on Earth. Pancopia received a National Excellence in Technology Transfer Project Award for this technology.

Aeronautics Research Mission Directorate (ARMD)

- NASA's Aeronautics Research Mission Directorate (ARMD) expands the boundaries of aeronautical knowledge for the benefit of the Nation and the broad aeronautics community, which includes the Agency's partners in academia, industry, and other government agencies.
- ARMD is conducting high-quality, cutting-edge research that will lead to revolutionary concepts, technologies, and capabilities that enable radical change to both the airspace system and the aircrafts that fly within it, facilitating a safer, more environmentally friendly, and more efficient air transportation system.
- At the same time, we are ensuring that aeronautics research and critical core competencies continue to play a vital role in support of NASA’s goals for both manned and robotic space exploration.

https://www.nasa.gov/aeroresearch

Success Stories: ARMD

Advanced Unmanned Aerial Vehicles for Improved Communications

PHASE III SUCCESS: **Up to $6.9M from NASA & DHS**

HIGHER GROUND, LLC – Palo Alto, CA

SNAPSHOT: Higher Ground, LLC is expanding the reach of UAVs to fly beyond the visual line of sight with developments including UAV tracking, even in network-deficient areas, and enabling UAVs to detect and avoid oncoming traffic; working with the NASA SBIR Program resulted in additional work with DHS to enhance response functions of UAVs.

SCEPTOR Distributed Electric Propulsion Aircraft

PHASE III SUCCESS: **$8M from NASA**

EMPIRICAL SYSTEMS AEROSPACE, INC – Pismo Beach, CA

SNAPSHOT: California-based ESAero has a rich history with NASA SBIR program and has tied together several Phase I and II projects to deliver a new suite of electric aircraft propulsion system designs and tools to its government clients.

National Aeronautics and Space Administration

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Finding Opportunities within STMD

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National Aeronautics and Space Administration

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Space Technology Research Grants (STRG) Program Overview

Space Technology Mission Directorate

Claudia Meyer, Program Executive | claudia.m.meyer@nasa.gov | September 17, 2020

SBIR·STTR America's Seed Fund™ POWERED BY NASA

Space Technology Research Grants: Opportunities to Propose

Engage Academia: *tap into spectrum of academic researchers, from graduate students to senior faculty members, to examine the theoretical feasibility of ideas and approaches that are critical to making science, space travel, and exploration more effective, affordable, and sustainable.*

NASA Space Technology Graduate Research Opportunities (NSTGRO)

- Graduate student research in space technology; research conducted on campuses and at NASA Centers and not-for-profit R&D labs

Early Career Faculty (ECF)

- Focused on supporting outstanding faculty researchers early in their careers as they conduct space technology research of high priority to NASA's Mission Directorates

Early Stage Innovations (ESI)

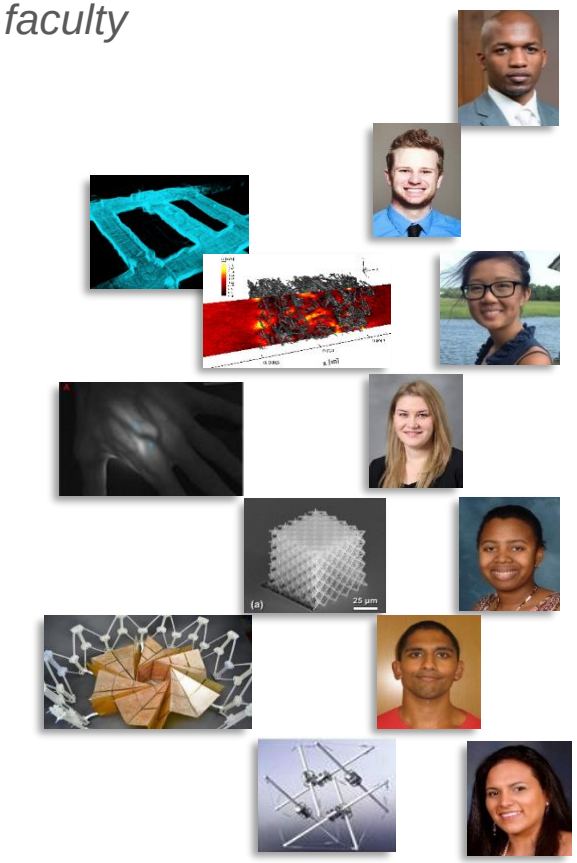
- University-led, possibly multiple investigator, efforts on early-stage space technology research of high priority to NASA's Mission Directorates
- Paid teaming with other universities, industry, and non-profits permitted

Lunar Surface Technology Research (LuSTR) Opportunities

- University-led efforts addressing high priority lunar surface challenges
- Short duration, high value grants with emphasis on technology development and potential infusion
- Paid teaming with other universities, industry, and non-profits encouraged

Space Technology Research Institutes (STRI)

- University-led, integrated, multidisciplinary teams focused on high-priority early-stage space technology research for several years

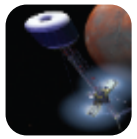


Accelerate development of groundbreaking high-risk/high-payoff low-TRL space technologies

Space Technology Research Grants: Investments Across U.S., Universities, & Technology Areas

TA01
Launch Propulsion
24 Awards

TA02
In-Space Propulsion
71 Awards



TA03
Space Power &
Energy Storage
39 Awards

TA04
Robotics &
Autonomous Systems
112 Awards

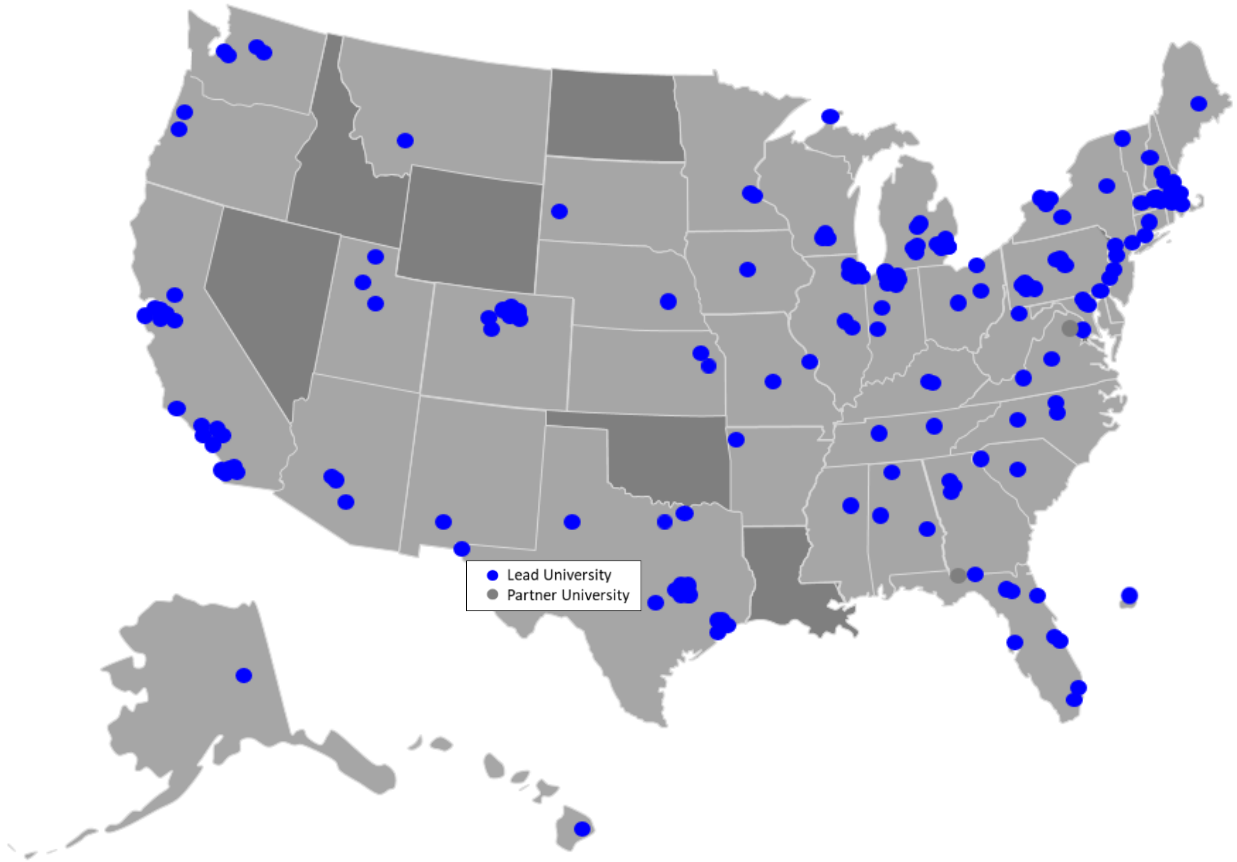
TA05
Communications, Navigation
&
Orbital Debris Tracking
82 Awards

TA06
Human Health, Life Support &
Habitation
55 Awards

TA07
Human Exploration
Destination Systems
28 Awards

773 Awards **118 Universities**

45 States **1 Territory** (PR)



300+ Active Awards

TA08
Science Instruments,
Observatories and
Sensor Systems
88 Awards

TA09
Entry, Descent & Landing
76 Awards

TA10
Nanotechnology
40 Awards

TA11
Modeling, Simulation, IT &
Processing
32 Awards

TA12
Materials, Structures,
Mechanical Systems &
Manufacturing
95 Awards

TA13
Ground & Launch Systems
1 Award

TA14
Thermal Management
30 Awards

STRG Opportunities to Propose - *NSTGRO*

Highlights

- For current and prospective doctoral and master's students (full requirements in solicitation)
- Up to $80,000 per year
- $36,000 annual stipend plus support for tuition, health insurance, conference attendance, and the faculty advisor
- Support for onsite tenure at NASA Centers across the country
- Up to four years of support are possible for doctoral students

Recipients will collaborate with leading NASA space technology experts

Proposal Components

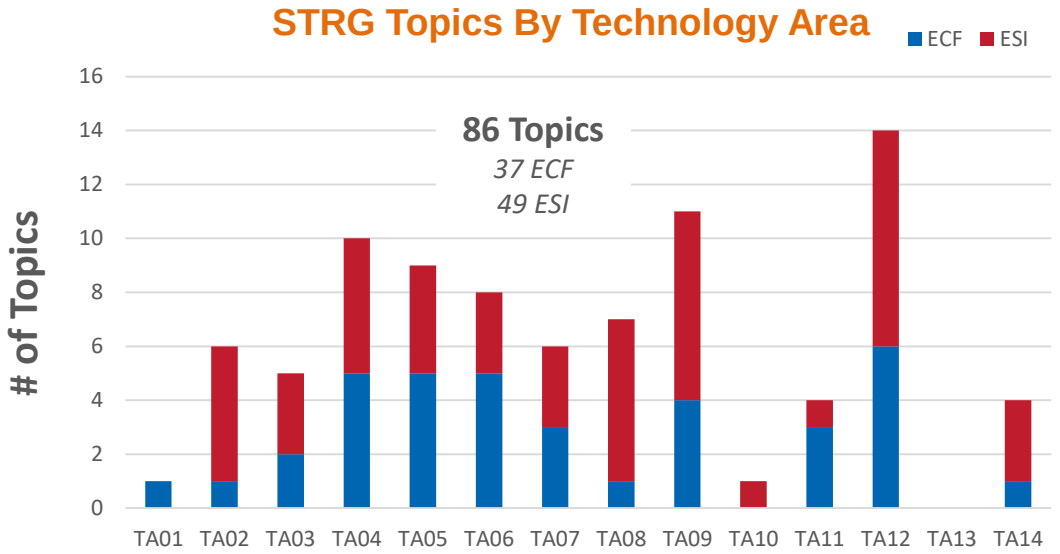
1. **Proposal Cover Pages** (incudes Program Specific Data Questions)
2. **Personal Statement**
3. **Project Narrative**
4. **Degree Program Schedule**
5. **Curriculum Vitae (CV)**
6. **Transcripts**
7. **Three Letters of Recommendation**

Most recent solicitation:
https://tinyurl.com/NSTGRO21

STRG Opportunities to Propose – *ECF & ESI*

Technical Characteristics

- Unique, disruptive or transformational space technologies
- Low TRL
- Specific topics tied to Technology Area Roadmaps and the NRC's review of the roadmaps
- Big impact at the system level: performance, weight, cost, reliability, operational simplicity or other figures of merit associated with space flight hardware or missions



- Seeking the best ideas from anywhere -

http://tinyurl.com/NASA-16ECF http://tinyurl.com/NASA-17ECF http://tinyurl.com/NASA-18ECF http://tinyurl.com/NASA-19ECF https://tinyurl.com/NASA-ECF20
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PI Eligibility Summary

Both ECF and ESI proposals must be submitted by accredited U.S. universities

Early Career Faculty

- Untenured assistant professor and on tenure track
- U.S. citizen or permanent resident
- No current or former Presidential Early Career Awards for Scientists and Engineers (PECASE)
- No Co-Investigators

Early Stage Innovations

- Tenured or tenure-track faculty from proposing university
- Co-Investigators are permitted
- ≥ 50% of the proposed budget must go to the proposing university
- ≥ 70% of the proposed budget must go to universities

Lunar Surface Technology Research (LuSTR) Opportunities

University-led efforts to develop and mature technologies that address high-priority lunar surface challenges

Technical Characteristics

- Unique, disruptive or transformational lunar surface technology development: *in situ* resource utilization, sustainable surface power, extreme access, extreme environments, surface excavation and construction, and lunar dust mitigation
- Low to mid Technology Readiness Level (TRL): TRL 2-5
- Post-award infusion opportunities

Eligibility

- Organization submitting proposal must be an accredited U.S. university
- PI must be a professor at the submitting university; co-Is are permitted
- ≥ 60% of budget must go to accredited U.S. universities
- Up to 40% paid teaming with other universities, industry and non-profits encouraged

Award Information

- Expected duration: **2 years**
- Anticipated awards (inaugural solicitation): **10-15 awards** valued at up to **$1-2M** each
- Oversight: Annual reviews and semi-annual briefings at LSIC meetings
- Award instrument: Grants
- Inaugural Release Date: **July 15, 2020**

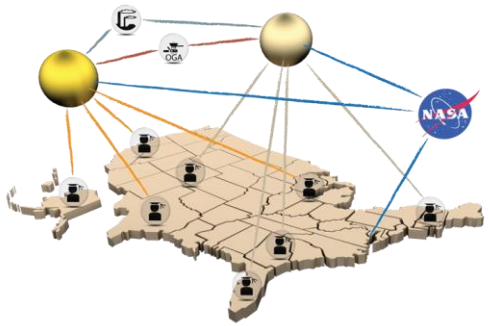
https://www.nasa.gov/strg/new_nasa_lunar_tech_funding_opportunity_for_us_universities

The Appendix: https://tinyurl.com/NASA-2020LuSTR

Email questions to: hq-LuSTR@mail.nasa.gov

STRG Opportunities to Propose - STRI

- Only U.S. universities may submit proposals
- Creative teaming arrangements are sought
  - Other universities (required) – 2+
  - Non-profits
  - Industry
- Co-Investigators are required
- Institute leadership or participation from Historically Black Colleges and Universities (HBCUs) or other Minority Serving Institutions (MSIs) is strongly encouraged
- 70% of the budget must go to U.S. universities



Award Information

- Expected duration: **5 years**
- Award amount up to **$3M per year** ($15M over 5 years)
- Award instrument: grants
- Institutes expected (and *empowered*) to implement their own review processes
- NASA oversight – annual reviews and brief quarterly status reports

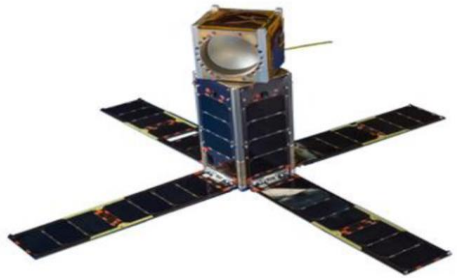
Key Features

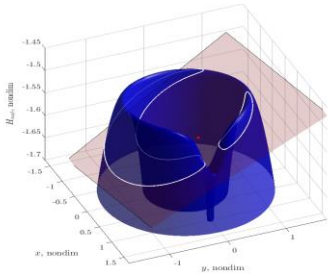
- **Empowered** university-led team
- Guiding Vision with ***resilient*** research strategy
- Specific research objectives with **credible expected outcomes** in next 5 years
- **Multidisciplinary** research program – synthesis of science, engineering and other disciples
- Innovative approaches for accelerated progress
- **Leveraging** SOA capabilities (likely created by OGA investments)
- Talented, **diverse**, cross-disciplinary, fully-integrated team; HBCU and MSI participation encouraged
- Student involvement in research
- Low to mid TRL
- **Publications** (many) and **open source** access to results
- ***Research products*** *tied to the research institute's Vision and research objectives.*

http://tinyurl.com/NASA-STRI20

STRG Highlights & Plans

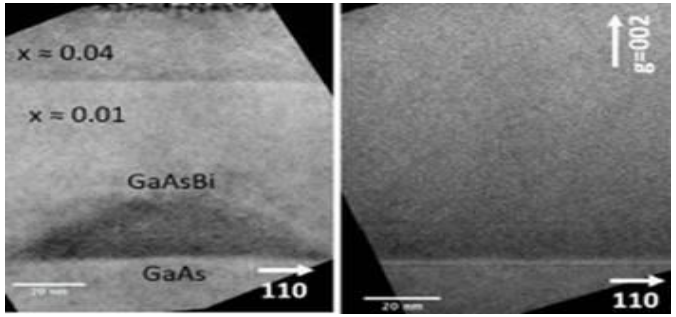
TA08- Angie Crews, MIT: Demonstrated a new validation process for MicroMas-2A (MM-2A) microwave CubeSat Sensor; developed new solar/lunar calibration algorithm for TROPICS blackbody and boresight corrections.

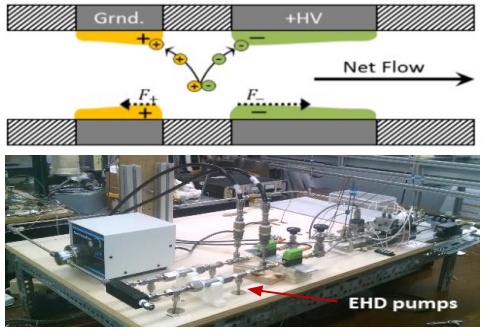




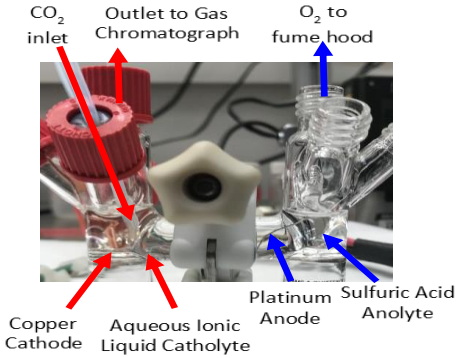
TA11- Andrew Cox, Purdue: Developed new algorithms to optimize low-thrust trajectories around celestial bodies. These trajectories are being applied to several upcoming NASA mission designs including the Lunar IceCube, JWST, WFIRST, as well as proposal designs for the Interstellar Mapping and Acceleration Probe (IMAP).

TA03- Margaret Stevens, Tufts: Developed improved Bizmuth semi-conductor coatings for Thermophotovoltaic (TPV) cells; increased bizmuth saturation by 18% by rotating the samples and growing on buffered InGaAs layers (vice GaAs).



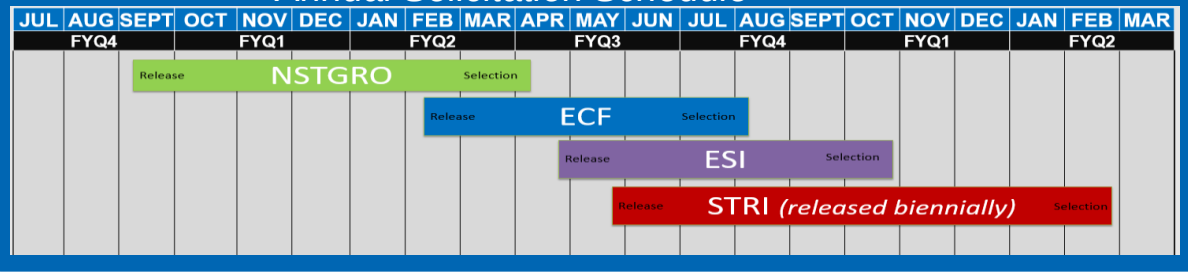


TA14- Michal Talmor, Worcester Polytechnic Institute: Developed predictive electrohydrodynamic models and discovered that differences in pressure generation between different conduction pumps were a function of the working fluid temperature. This was a new finding and, with her new model, led to the conclusion that small (micro-scale) EHD conduction pumps increase performance in low temperature areas, whereas larger pumps increase performance in high temperature areas.



TA07- Mike Lotto, CU Boulder: Developed a new low cost method to simultaneously generate methane and oxygen for prolonged missions using Ionic liquids, a promising In-Situ Resource Utilization (ISRU) technology. Ionic liquids have high CO2 absorption rates and remain stable under the environmental conditions found on other planets and the Moon, reducing the cost, complexity, and risk of crewed missions on Mars.

Annual Solicitation Schedule



- FY20 was inaugural release for LuSTR, this solicitation is still being incorporated into schedule
- NSTRGO21 is currently open [**https://tinyurl.com/NSTGRO21**]
- FY20 schedule impacted by COVID-19

National Aeronautics and Space Administration

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NASA Innovative Advanced Concepts (NIAC) Program Overview

Space Technology Mission Directorate

Jason Derleth, Program Executive | hq-niac@mail.nasa.gov | September 17, 2020

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What is NIAC?

NASA Innovative Advanced Concepts

NASA Innovative Advanced Concepts

A program to support early studies of innovative, yet credible, visionary concepts that could one day "change the possible" in aerospace.

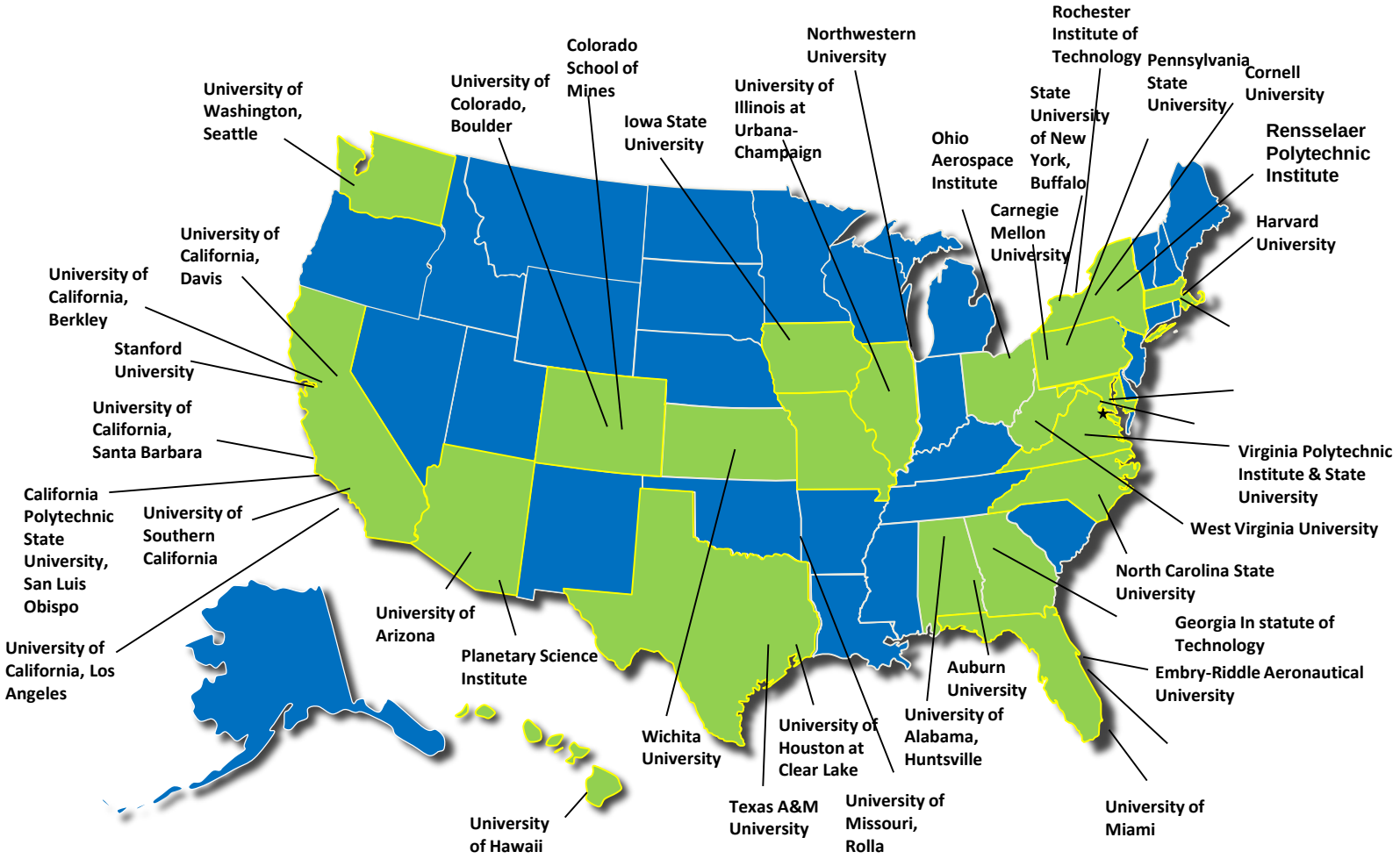
NIAC Awards, Scope, & Criteria

- **NIAC awards support 3 phases of study:**
  - **Phase I**: up to **$125K**, **9 mos**, explores viability/advances Technology Readiness (TRL) of visionary concepts
    - **Proposal Submission & Selection Process**: Two-step Process; Step A is fully open; Step B by Invitation; Independent Peer Review. TRL 2 or lower at start of award.
  - **Phase II**: up to **$500K**, **2 years**, prepares a roadmap for further development of NIAC concepts, but not expected to fully advance the technologies to a level required for program or commercial transition.
  - **Phase III**: up to **$2M**, **2 years**, designed to strategically transition the most promising NIAC concepts to NASA programs, other gov't agencies, or commercial partners.
  - **Eligibility:** All categories of U.S organizations may apply. Non-U.S. organizations may partner in, or lead, NIAC studies on a no-exchange of funds basis, and subject to NASA's policy on foreign participation.
  - **Anticipated NIAC 2022 Phase I Key Dates for New Proposers:**

    Solicitation Release: June 2021 — **Step A Proposals Due**: September 2021

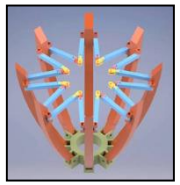
    Step B Proposals Due: December 2021 — **Selection Announcements:** Feb 2022
  - **How to Apply**: (https://www.nasa.gov/content/apply-to-niac)
- **NIAC concepts must have these elements:**
  - **Aerospace architecture**: Activities related to space/aeronautics. Multiple systems with concept of how they're used together to achieve mission goals.
  - **Mission Context**: Achieves one or more clear objectives (e.g. advancing exploration, science, aerospace ops). Examines potential mission to contextualize innovation for development and analysis. Highlights innovation and potential in comparison to alternative approaches. Could be hypothetical.
  - **Innovative and Offer High Potential Impact**: Could be a new mission, improved execution, great leap in capabilities, breaks new ground, or existing technology applied to significantly new mission.
  - **Credible**: sound scientific/engineering basis and plausible implementation.

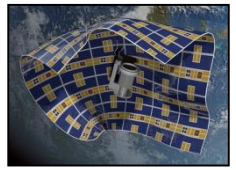
NIAC Awards: Educational Institutions

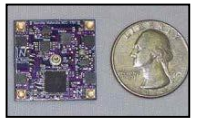


UNIVERSITY PARTNERS: Inspiring Our Nation's Innovators

Just a Few Examples of NIAC Successes







Partnership with World Book. Proceeding with a 2nd Book Series and a Challenge Competition

SPIN OFF

Prof. Christopher Walker, Univ. Arizona- Large Balloon Reflector – NIAC concept directly led to the NASA GUSTO mission, planned for launch in 2020. A new Arizona company, *FreeFall Aerospace*, has been formed based on his NIAC study, *FreeFall* develops next generation in-space telecom and remote sensing systems. www.freefallaerospace.com/

Dr. Jonathan Sauder- Very successful Mechanical Maker Challenge – *Exploring Hell: Avoiding Obstacles on a Clockwork Rover* for his NIAC study, AREE. To explore the daunting surface of Venus, the challenge seeks an innovative obstacle avoidance sensor for a mechanical clockwork rover. The challenge winner was an engineer from Egypt.

Stephanie Thomas, Princeton Satellite Systems- developed an invention, HQN-11484-1 Magnetic Dipole Cancellation for Space Devices Requiring Extremely High Magnetic Fields. Recently received a $1.25M ARPA-E grant.

Prof. Berok Khoshnevis, Univeristy of Southern California- Partnering with Quikrete and using his concept based on In Situ Resource Utilization (ISRU) to battle homelessness in Los Angeles.

Prof. Philip Lubin, University of California, Santa Barbara- was invited to Capitol Hill to meet with members of Congress/staffers. The $100M private funding created for his NIAC directed energy interstellar concept continues to advance and has notable media coverage in Science, Space.com, Scientific American, and the Discovery Channel. He presents his photonics work nationwide.

Questions?

Visit our Website
www.SBIR.NASA.gov

Sign up for our Newsletter
https://sbir.nasa.gov/info

Contact the Help Desk
301.937.0888