National Aeronautics and Space Administration

Space Technology Mission Directorate

Overview for the National Council of Space Grant Directors

Presented by:
John (Jay) Falker, PhD
Program Executive
Space Technology Mission Directorate

February 27, 2015

Why Invest in Space Technology?

- Enables a **new class of NASA missions** beyond Low Earth Orbit.
- **Delivers innovative solutions** that dramatically improve technological capabilities for NASA and the Nation.
- Develops technologies and capabilities that make NASA's missions **more affordable and more reliable.**
- Invests in the economy by **creating markets and spurring innovation** for traditional and emerging aerospace business.
- **Engages the brightest minds** from academia in solving NASA's tough technological challenges.

Value to NASA **Value to the Nation**

Addresses National Needs

A generation of studies and reports (40+ since 1980) document the need for regular investment in new, transformative space technologies.

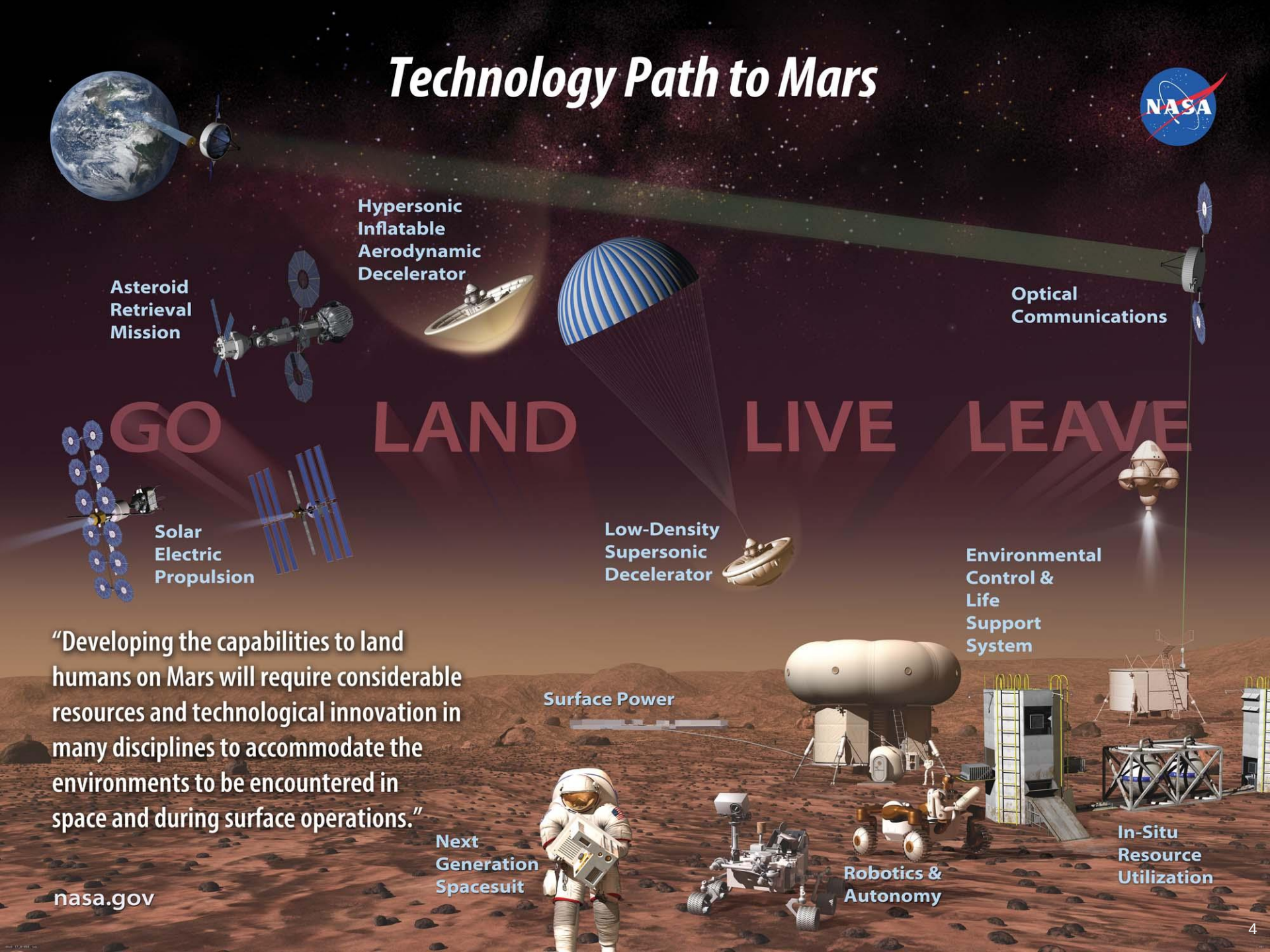
Who:

The NASA Workforce
Academia
Industry & Small Businesses
Other Government Agencies
The Broader Aerospace Enterprise

Space Technology Strategic Themes

- ***Go There***: Improve the Nation's capabilities for access and travel through space
- ***Land There***: Develop and demonstrate technologies that enable landing more mass, more accurately, in more locations throughout the solar system
- ***Live There***: Develop and demonstrate technologies to live and work in deep space and on planetary bodies
- ***Observe There***: Develop and demonstrate technologies that transform the ability to observe the universe and answer the profound questions in earth and space sciences

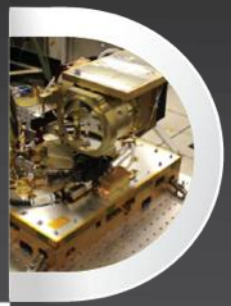
Technology Path to Mars



Space Technology Portfolio

Transformative & Crosscutting Technology Breakthroughs

Technology Demonstration Missions (TDM) bridges the gap between early proof-of-concept tests and the final infusion of cost-effective, revolutionary technologies into successful NASA, government and commercial space missions.



Small Spacecraft Technology Program (SSTP) develops and demonstrates new capabilities employing the unique features of small spacecraft for science, exploration and space operations.

Game Changing Development (GCD) seeks to identify and rapidly mature innovative/high impact capabilities and technologies that may lead to entirely new approaches for the Agency's broad array of future space missions.

Pioneering Concepts/Developing Innovation Community

NASA Innovative Advanced Concepts (NIAC) nurtures visionary ideas that could transform future NASA missions with the creation of breakthroughs—radically better or entirely new aerospace concepts–while engaging America's innovators and entrepreneurs as partners in the journey.

Space Technology Research Grants (STRG) seeks to accelerate the development of "push" technologies to support future space science and exploration needs through innovative efforts with high risk/high payoff while developing the next generation of innovators through grants and fellowships.

Center Innovation Fund (CIF) stimulates and encourages creativity and innovation within the NASA Centers by addressing the technology needs of the Agency and the Nation. Funds are invested to each NASA Center to support emerging technologies and creative initiatives that leverage Center talent and capabilities.

Creating Markets & Growing Innovation Economy

Centennial Challenges directly engages nontraditional sources advancing technologies of value to NASA's missions and to the aerospace community. The program offers challenges set up as competitions that award prize money to the individuals or teams that achieve a specified technology challenge.

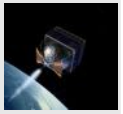
Flight Opportunities facilitates the progress of space technologies toward flight readiness status through testing in space-relevant environments. The program fosters development of the commercial reusable suborbital transportation industry.

Small Business Innovation Research (SBIR) and **Small Business Technology Transfer (STTR)** Programs provide an opportunity for small, high technology companies and research institutions to develop key technologies addressing the Agency's needs and developing the Nation's innovation economy.

STMD Partners with Universities to Solve the Nation's Challenges

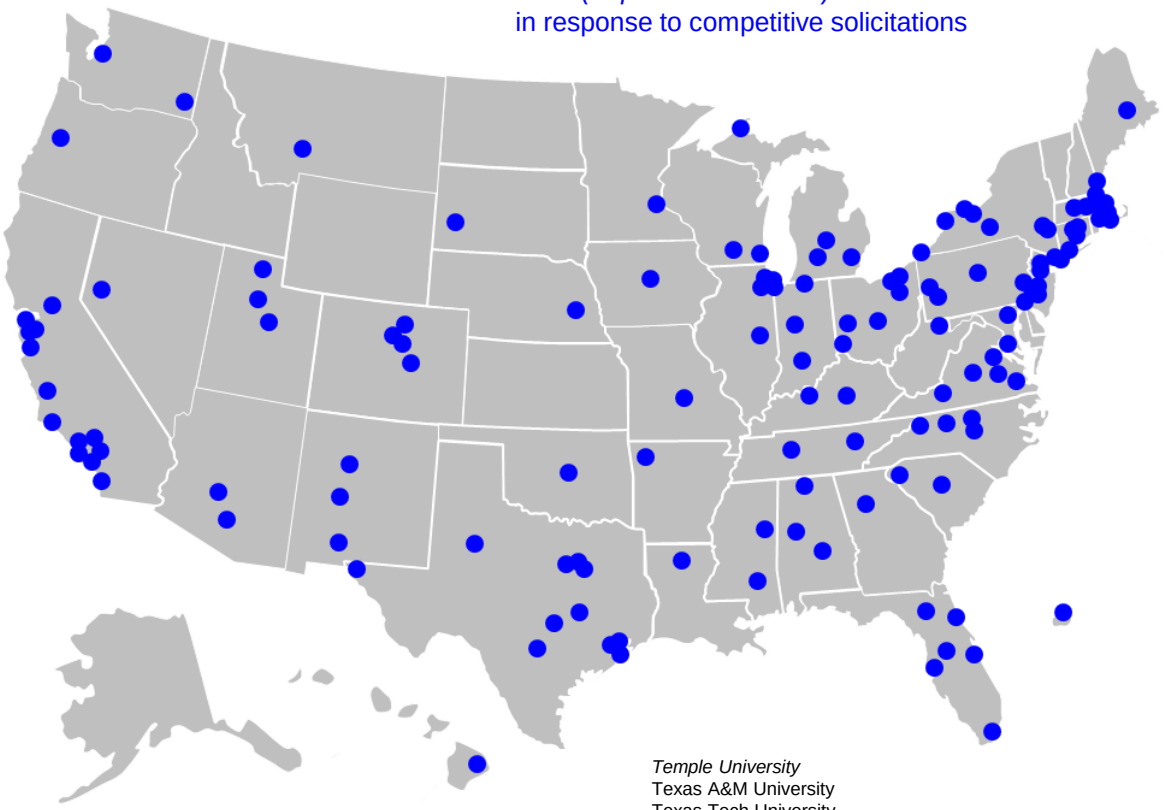
U.S. Universities have been *very* successful in responding to STMD's competitive solicitations

- STMD-funded university space technology research spans the entire roadmap space
- More than **130** U.S. universities have led (*or are STTR partners on*) more than **550** awards since 2011
- In addition, there are many other partnerships with other universities, NASA Centers and commercial contractors

Program	# awards	# University-led awards	Upcoming Opportunities
Space Technology Research Grants	284	284	• Early Career Faculty • Early Stage Innovations • NASA Space Technology Research Fellowships — ***Annually***
NASA Innovative Advanced Concepts	93	26	• NIAC Phase I • NIAC Phase II — ***Annually***
Game Changing Technology Dev	37	14	Various topics released as Appendices to SpaceTech-REDDI — ***Annually***
Small Spacecraft Technology 	22	13	Smallsat Technology Partnerships Cooperative Agreement Notice every two years, with the next opportunity in 2015
Flight Opportunities	117	50	Tech advancement utilizing suborbital flight opportunities – NRA to U.S. Universities, non-profits and industry are planned. — ***Twice Annually***
Space Business Technology Transfer	*192*	*181 w/ univ partners*	*Annual STTR solicitation*
Centennial Challenges	*3 Challenges (1 university-run)*	*54 teams (15 univ-led, 2 univ-led winner)*	• *One or more challenges annually* • ***Challenge competitions*** *with a* ***procurement track*** *to fund* ***university teams*** *via grants*

Space Technology Engages Academia

Lead *(or partner for STTR)* on STMD-funded awards in response to competitive solicitations



Appalachian State University
Arizona State University
Auburn University
Boston University
Brigham Young University
Brown University
California Institute of Technology
California Polytechnic State University
California State University – Northridge
Carnegie Mellon University
Carnegie Mellon University-Silicon Valley
Carthage College
Case Western Reserve University
Clemson University
College of William and Mary
Colorado School of Mines
Colorado State University
Columbia University
Cornell University
Drexel University
Duke University
Embry-Riddle Aeronautical University
Florida Institute of Technology
Gannon University
George Mason University
Georgia Institute of Technology
Harvard University
Illinois Institute of Technology
Indiana University, Bloomington
Iowa State University
John Carroll University
Johns Hopkins University
Kent State University
Louisiana Tech University
Massachusetts Institute of Technology
Michigan State University
Michigan Technological University
Mississippi State University
Missouri University of Science & Technology
Montana State University
New Jersey Institute of Technology
New Mexico Institute Of Mining And Technology
New Mexico State University
North Carolina State University
Northeastern University
Northwestern University
Ohio State University
Oregon State University

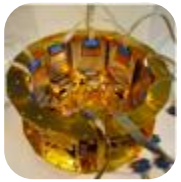
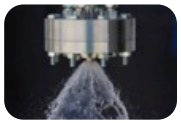
Pennsylvania State University
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rochester Institute of Technology
Rutgers University
South Carolina Research Foundation
South Dakota School of Mines and Technology
Southern Methodist University
Stanford University
State University of New York at Buffalo
State University of New York, College of Nanoscale Science & Engineering
State University of New York at Stony Brook

Temple University
Texas A&M University
Texas Tech University
United States Air Force Academy
University of Akron
University of Alabama, Huntsville
University of Alabama, Tuscaloosa
University of Arizona
University of Arkansas
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, San Diego
University of California, Santa Barbara
University of California, Santa Cruz
University of Central Florida
University of Cincinnati
University of Colorado, Boulder

University of Connecticut
University of Delaware
University of Florida
University of Hartford
University of Hawaii
University of Houston
University of Houston Clear Lake
University of Illinois at Urbana-Champaign
University of Kentucky
University of Louisville
University of Maine
University of Maryland
University of Massachusetts
University of Massachusetts, Amherst
University of Massachusetts, Lowell
University of Miami
University of Michigan
University of Minnesota
University of Nebraska, Lincoln
University of Nevada
University of New Hampshire
University of New Mexico
University of Notre Dame
University of Oklahoma
University of Pennsylvania
University of Pittsburgh
University of Puerto Rico, Rio Pedras
University of Rochester
University of South Florida
University of Southern California
University of Southern Mississippi
University of Tennessee
University of Texas at Austin
University of Texas at Dallas
University of Texas at El Paso
University of Texas, Arlington
University of Texas-San Antonio
University of Utah
University of Virginia
University of Washington
University of Wisconsin-Madison
Utah State University
Vanderbilt University
Villanova University
Virginia Commonwealth University
Virginia Tech
Wake Forest University
Washington State University
West Virginia University
Western Michigan University
William Marsh Rice University
Worcester Polytechnic Institute
Wright State University
Yale University

Space Technology Research Grants

Engage Academia: *tap into the talent base, challenging faculty and graduate students 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 Research Fellowships

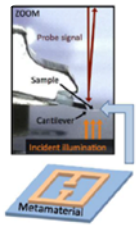
- Graduate student research in space technology; research conducted on campuses and at NASA Centers and not-for-profit R&D labs.

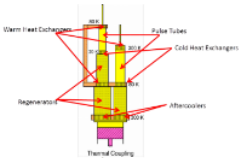
Early Career Faculty

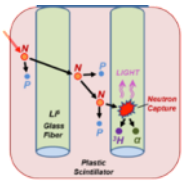
- Focused on supporting outstanding faculty researchers early in their careers as they conduct space technology research of high priority to NASA's Mission Directorates

Early Stage Innovations

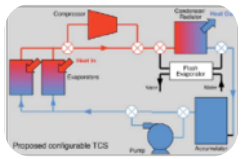
- University-led, possibly multiple investigator, efforts on early-stage space technology research of high priority to NASA's Mission Directorates
- Paid teaming with other universities, industry and non-profits and collaboration with NASA, OGAs and FFRDCs permitted

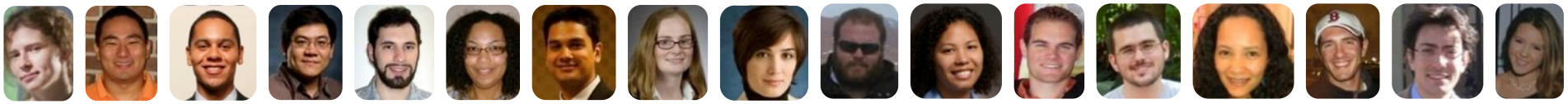






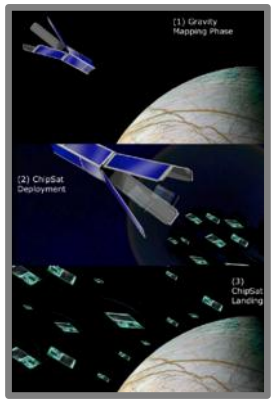
Reinvigorate the pipeline of high-risk/high-payoff low-TRL space technologies



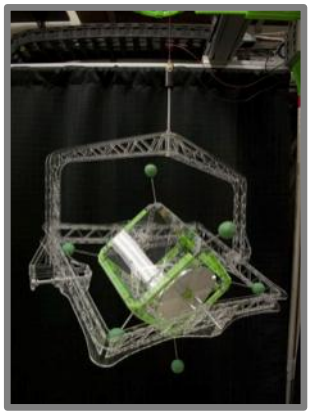


NASA Innovative Advanced Concepts
Current University-Led Studies

UNIVERSITY PARTNERS: Inspiring Our Nation's Innovators



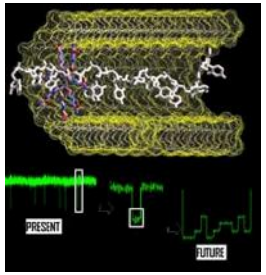
NIAC Fellow	Proposal Title	Organization
Atchison, Justin	Swarm Flyby Gravimetry	**Johns Hopkins University**
Cash, Webster	The Aragoscope: Ultra-High Resolution Optics at Low Cost	**University of Colorado**
Miller, Timothy	Using the Hottest Particles in the Universe to Probe Icy Solar System Worlds	**Johns Hopkins University**
Pavone, Marco	Spacecraft/Rover Hybrids for the Exploration of Small Solar System Bodies	**Stanford University**
Streetman, Brett	Exploration Architecture with Quantum Inertial Gravimetry and In Situ ChipSat Sensors	**Draper Laboratory**
Walker, Christopher	10 meter Sub-Orbital Large Balloon Reflector (LBR)	**University of Arizona**
Wettergreen, David	Nomadic Exploration: Following routes of solar sustenance and temperate climate	**Carnegie Mellon University**
Winglee, Robert	Sample Return Systems for Extreme Environments: Phase II	**University of Washington, Seattle**
Yoo, S. J. Ben	Low-Mass Planar Photonic Imaging Sensor	**University of California, Davis**

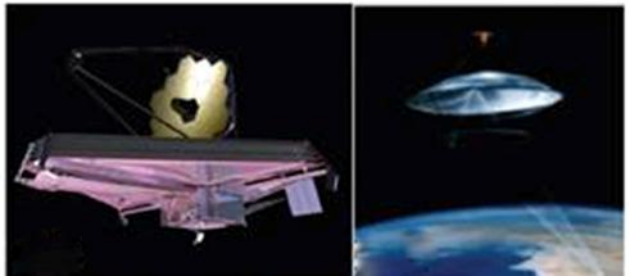


University Research Addresses Game Changing Challenges

- **160 students** and professors from **34 universities** are actively engaged in the Game Changing Development (GCD) program tackling the agency's toughest challenges

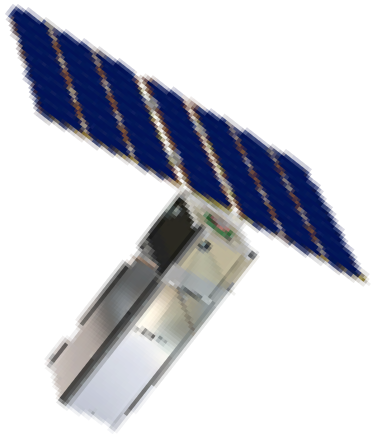
- Low mass energy storage
  - Selected 4 energy storage concepts focused on *doubling* the specific energy
  - Two awarded to universities: University of Maryland, Indiana University
- Efficient life support systems
  - Selected 4 technologies capable of recovering greater than 75% of oxygen from a spacecraft cabin
  - Four selections announced October 2014, One awarded to UT-Arlington
- Areas of interest in FY 2015
  - Ultra lightweight cores for structural applications – Due December 2014
  - High performance computing
  - GCD anticipates university responses as either leads or collaborators





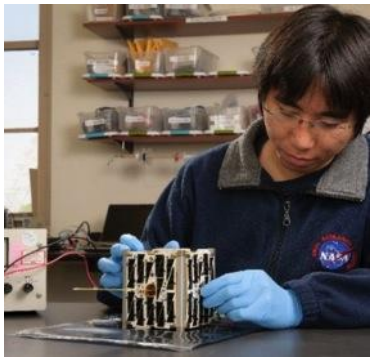
Smallsat Technology Partnerships

Cooperative Agreements between NASA and Universities for collaboration in developing new technologies and capabilities for small spacecraft. NASA provides $100K/year to each university and up to one FTE in civil service support per project.



Motivation

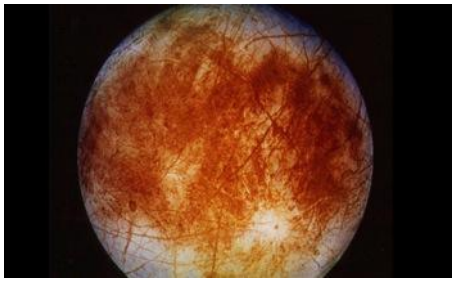
- To support development of new technologies and capabilities for small spacecraft
- To support training of students in technology development and demonstration
- To encourage greater collaboration and mutual exchange of expertise between NASA and US universities
- To encourage appropriate infusion of the rapid, agile, and affordable “smallsat culture” into NASA projects



Future Plans

- In FY14-15: 13 two-year projects with 17 universities and 7 NASA centers investment opportunity : $3.5M/year
- Plan to issue a new cooperative agreement opportunity in 2015 for FY16-17 projects

Centennial Challenges Program- University Dual Track Challenges



- New Centennial Challenge structure couples traditional unfunded open track challenges with a parallel funded track of competitors. See RFI Info at http://go.usa.gov/9Dm4
- Domestic universities could received funding for their participation in the challenge
  - Unsuccessful proposers to the funded track could still participate in the unfunded open track.
  - The Challenge would operate on a yearly basis up to 4 years
- Potential challenge concepts for this new competition structure:
  - **Europa Ice Challenge**: Demonstrate innovative, scalable solutions to penetrate a very thick, low-temperature, surface ice layer found on Europa
  - **Cache Capture Challenge**: Ground based robotics competition demonstrating autonomous detection, rendezvous, and capture of orbiting sample cache
  - **Space Robotics Challenge**: Demonstrate, ground based, humanoid robotics control performing various tasks prior to human arrival on a planetary surface
  - **Cube Quest:** Design, build and deliver flight-qualified, small spacecraft capable of advanced operations near the moon and beyond

Flight Opportunities For Universities

Goals of the program

- Matures technologies by providing affordable access to space environments
- Facilitates the development of the commercial reusable suborbital transportation industry.

Flights

- **Four companies** on contract to provide integration and flight services aboard commercial reusable sub-orbital vehicles.
- Uses NASA C9 for parabolic flights to carry payloads in reduced gravity and near the boundary of space.

Over 50% of Payloads Developed by Universities

- **Examples**
  - Wireless Strain Sensing System for Space Structural Health Monitoring, Haiying Huang **-** University of Texas, Arlington
  - Effects of Microgravity on Intracranial Pressure, Benjamin Levine - University of Texas Southwestern Medical Center Research Institute
  - Noninvasive Hemodynamic Monitoring in Microgravity, Phase II (Arterial Stiffness) - Stanford University
  - Reduced Gravity Flight Demonstration of SPHERES INSPECT- Massachusetts Institute of Technology

FY 2015 Tentative Solicitation Schedule

STMD Program	Solicitations	FY 2015 Targeted Release			
		Q1	Q2	Q3	Q4
NASA Innovative Advanced Concepts (NIAC)	NIAC Phase I	X			
	NIAC Phase II		X		
Space Technology Research Grants (STRG)	Early Career Faculty (ECF)		X		
	Early Stage Innovations (ESI)			X	
	NASA Space Technology Research Fellowships (NSTRF)-Fall 2015	X (Sept)			
Game Changing Development (GCD)	GCD Technology Topics	X			
	GCD Technology Topics			X	
Technology Demonstration Missions (TDM)	Technology Demonstration Mission Topics				X
Small Spacecraft Technology (SST)	SST Development and Demonstration		X		
	SST Partnerships		X		
Flight Opportunities Program (FOP)	FOP Technology Topic	X (Sept)		X	
Small Business Innovative Research (SBIR)	SBIR/STTR Phase I	X			
	SBIR/STTR Phase II	X			

National Aeronautics and
Space Administration

Space Technology Research Grants (STRG) Program

Space Technology Mission Directorate

Claudia Meyer
STRG Program Executive

Space Technology Research Grants

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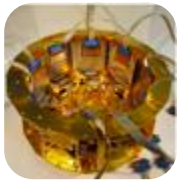
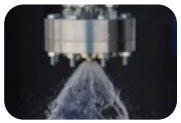

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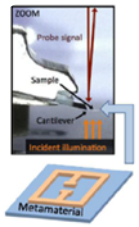
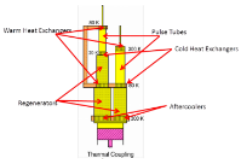
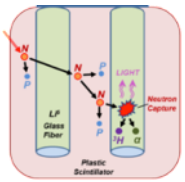
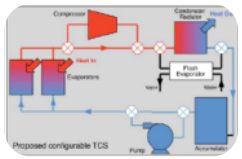
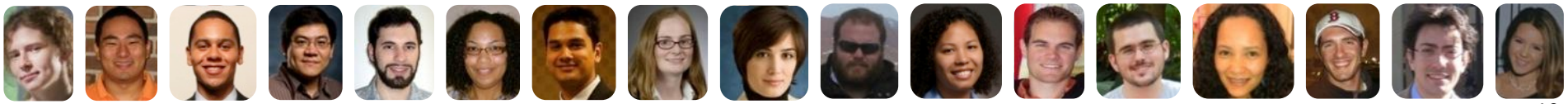






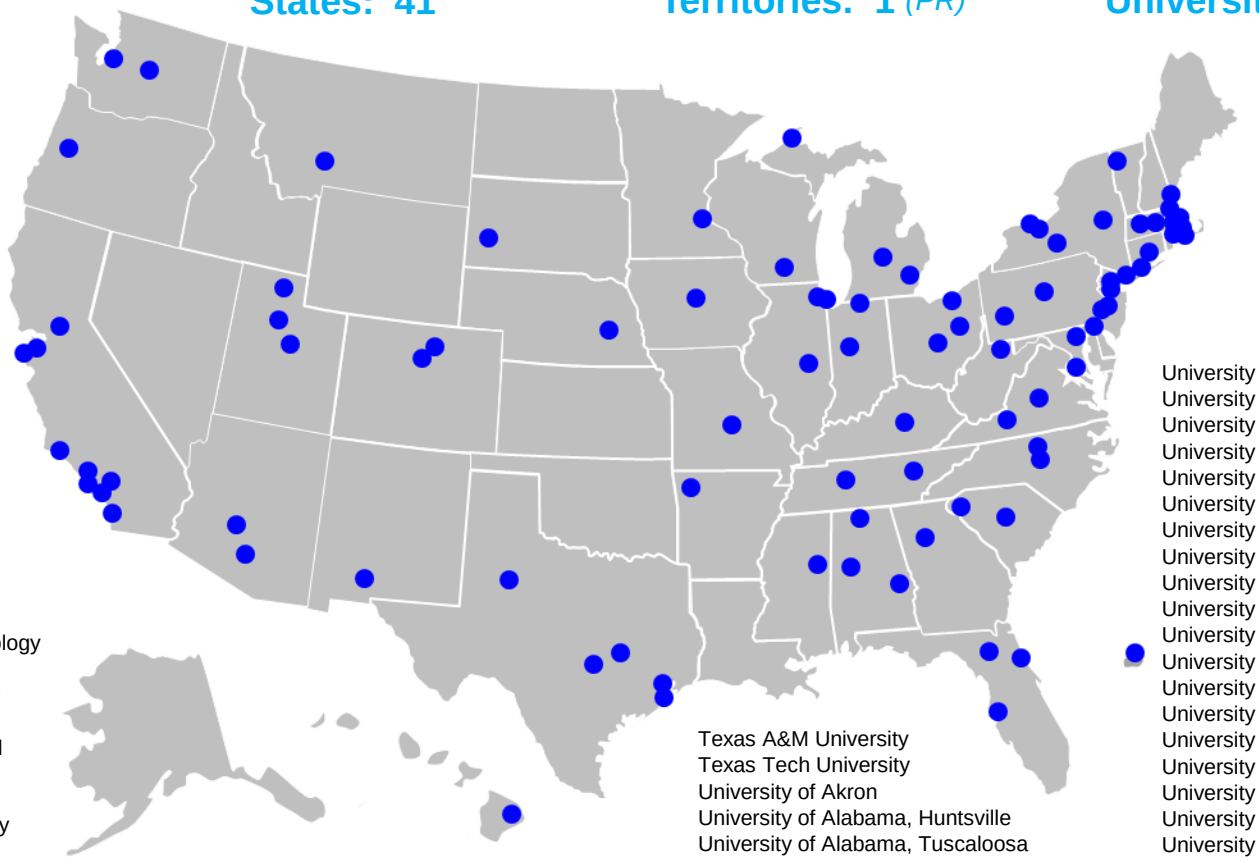
Reinvigorate the pipeline of high-risk/high-payoff low-TRL space technologies





STRGP Universities

Awards: 295 **States: 41** **Territories: 1** *(PR)* **Universities: 90**



Arizona State University
Auburn University
Boston University
Brigham Young University
Brown University
California Institute of Technology
Carnegie Mellon University
Case Western Reserve University
Clemson University
Colorado State University
Columbia University
Cornell University
Duke University
Florida Institute of Technology
Georgia Institute of Technology
Harvard University
Illinois Institute of Technology
Iowa State University
Johns Hopkins University
Massachusetts Institute of Technology
Michigan State University
Michigan Technological University
Mississippi State University
Missouri University of Science and Technology
Montana State University
New Jersey Institute of Technology
New Mexico State University
North Carolina State University
Northeastern University
Northwestern University

STRGP Element	To-date	Currently Active
NSTRF	247	201
ECF	17	17
ESI	31	30

Ohio State University
Oregon State University
Pennsylvania State University
Princeton University
Purdue University
Rochester Institute of Technology
Rutgers University
South Dakota School of Mines and Technology
Stanford University
State University of New York, College of Nanoscale Science & Engineering
State University of New York, Stony Brook

Texas A&M University
Texas Tech University
University of Akron
University of Alabama, Huntsville
University of Alabama, Tuscaloosa
University of Arizona
University of Arkansas
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, San Diego
University of California, Santa Barbara
University of Colorado, Boulder
University of Delaware
University of Florida
University of Hawaii
University of Houston

University of Illinois, Urbana-Champaign
University of Kentucky
University of Maryland
University of Massachusetts, Amherst
University of Massachusetts, Lowell
University of Michigan
University of Minnesota
University of Nebraska, Lincoln
University of New Hampshire
University of Notre Dame
University of Pennsylvania
University of Puerto Rico, Rio Pedras
University of Rochester
University of South Carolina
University of South Florida
University of Southern California
University of Tennessee
University of Texas, Austin
University of Utah
University of Vermont
University of Virginia
University of Washington
University of Wisconsin, Madison
Utah State University
Vanderbilt University
Virginia Polytechnic Institute & State University
Washington State University
West Virginia University
William Marsh Rice University
Worcester Polytechnic Institute
Yale University

NSTRF15 Solicitation Overview

Eligibility Requirements for NSTRF15

1. Pursuing or seeking to pursue advanced degrees directly related to space technology.
2. Are U.S. citizens or permanent residents of the U.S.
3. Are or will be enrolled in a full-time master's or doctoral degree program at an accredited U.S. university in fall 2015.
4. Are early in their graduate careers.

NSTRF**15**: http://tinyurl.com/NSTRF2015.
NSTRF**14**: http://tinyurl.com/NSTRF14.
NSTRF**13**: http://tinyurl.com/NSTRF13.
NSTRF**12**: http://tinyurl.com/NSTRF12-OCT.
NSTRF**11**: http://tinyurl.com/NSTRF11-OCT.

Application Components

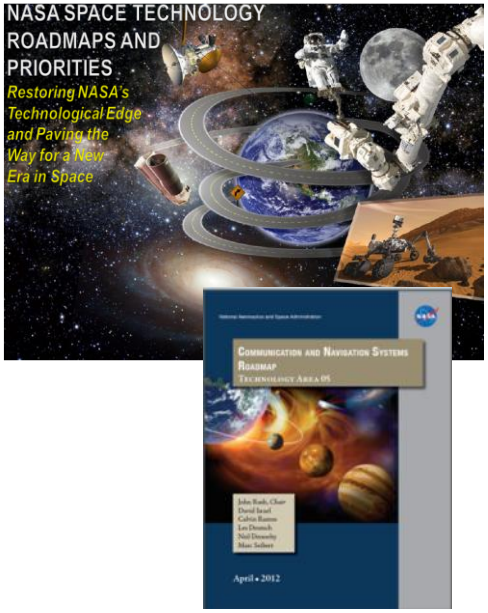
1. **Proposal Cover Page** (Program Specific Data Questions)
2. **Personal Statement**
3. **Project Narrative**
4. **Degree Program Schedule**
5. **Curriculum Vitae**
6. **Transcripts**
7. **GRE General Test Scores**
8. **Three Letters of Recommendation**

Award Value

Fellowship Budget Category	Max value
Student Stipend	$36,000
Faculty Advisor Allowance	$10,000
Visiting Technologist Experience Allowance	$10,000
Health Insurance Allowance	$1,000
Tuition and Fees Allowance	$17,000
TOTAL	**$74,000**

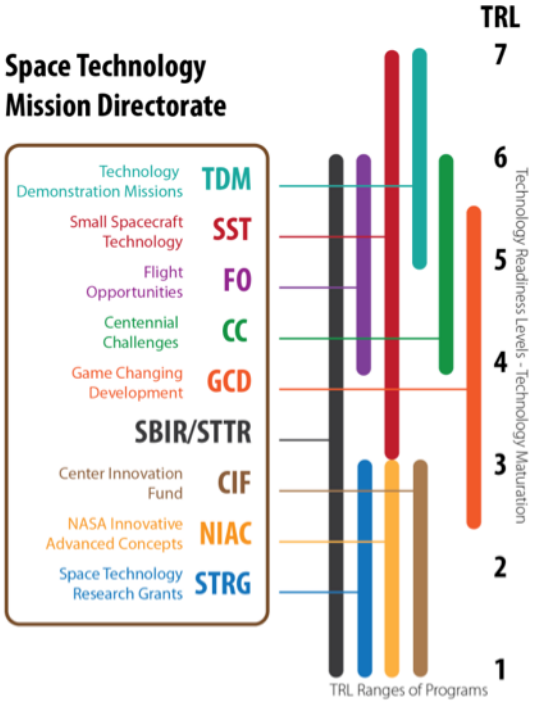
Procurement Sensitive – Do Not Distribute

STRGP Solicitations: ECF and ESI



Technical Characteristics:

- Unique, disruptive or transformational space technologies
- Low TRL
- Specific topics tied to Technology Area 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



http://tinyurl.com/NASAECF http://tinyurl.com/NASA-14ECF http://tinyurl.com/NASAESI http://tinyurl.com/NASA-13ESI http://tinyurl.com/NASA-14ESI

Eligibility Summary:

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

- Early Career Faculty
  - PI must be recent Ph.D. (last 7 years)
  - Untenured assistant professor and on tenure track
  - U.S. citizen or permanent resident
  - No co-investigators
- Early Stage Innovations
  - PI must be from proposing university
  - At least 50% of the proposed budget must go to the proposing university
  - At least 70% of the proposed budget must go to universities
  - Co-investigators are permitted

Solicitation Schedules

NSTRF15, ECF15

NSTRF15

Event	Date
Call for applications released	September 17, 2014
Applications due from students (Phase A)	November 13, 2014 at 6 PM ET
Selection notification to students	April 10, 2015 (target)
Student intent to accept	April 30, 2015 (target)
Phase B packages due from universities	May 21, 2015 (target)
Start date of fellowships	August 1, 2015 (target)

Open Now ! **ECF15** http://tinyurl.com/NASA-15ECF

Event	Date
Appendix released	February 25, 2015
Notices of Intent Due	March 20, 2015
Proposals Due	April 17, 2015
Selection Announcement	August 19, 2015 (target)
Award Date	October 2, 2015 (target)

National Aeronautics and Space Administration

Small Business Technology Transfer (STTR) Program

Space Technology Mission Directorate

Robert L. Yang
SBIR/STTR Program Executive

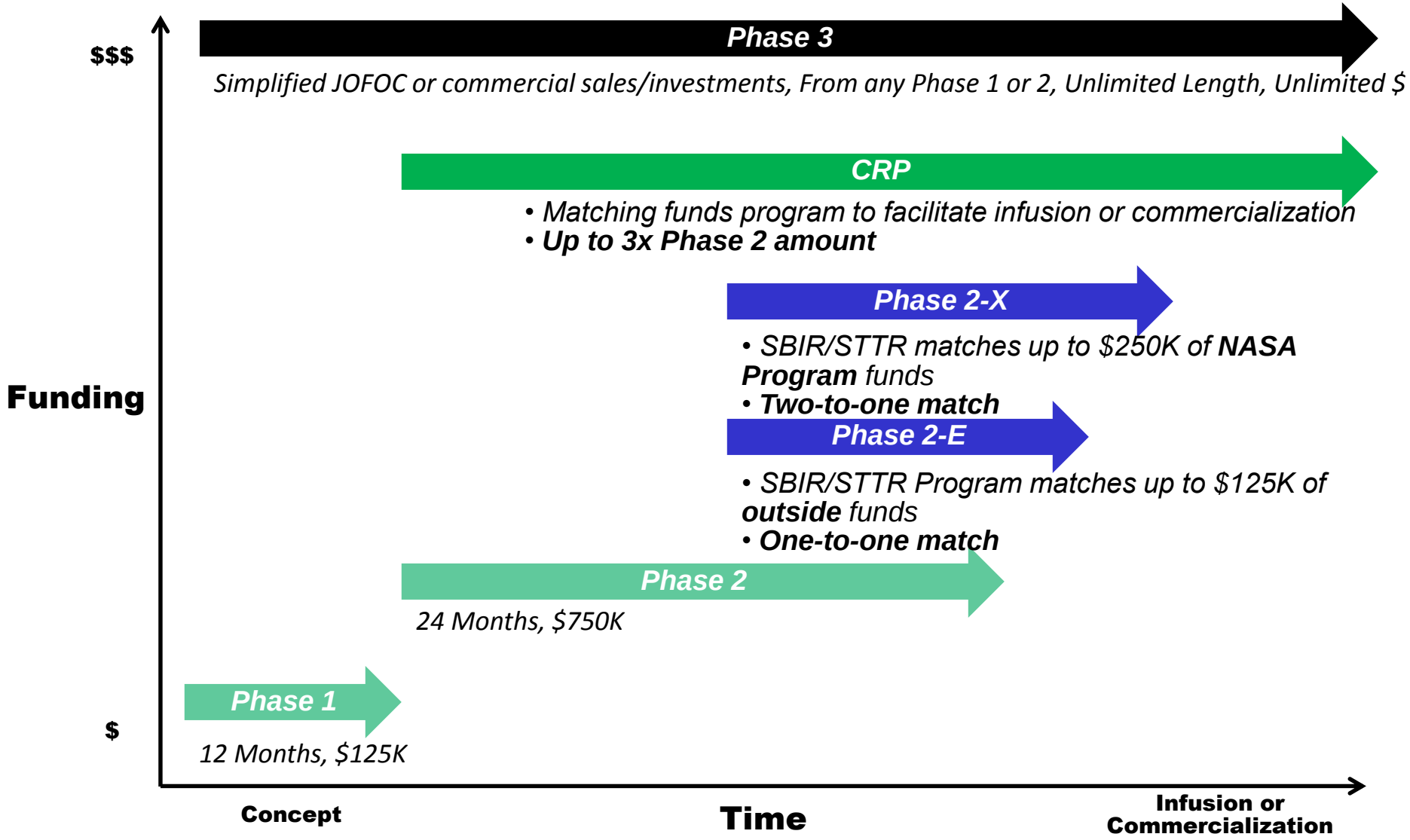
NASA's Small Business Technology Transfer (STTR) Program

- The Small Business Technology Transfer (STTR) Program expands funding opportunities in the federal innovation arena. Central to the program is the expansion of the public/private sector partnership to include joint venture opportunities between small businesses and nonprofit research institutions.
- STTR's most important role is to bridge the gap between performance of basic science and commercialization of resulting innovations.
- For an STTR award, the small business must perform at least 40% of the work and the single partnering research institution must perform at least 30% of the work. STTR requires the Small Business Concern (SBC) and its partnering institution to establish an intellectual property agreement detailing the allocation of intellectual property rights and rights to carry out follow-on research, development or commercialization activities.

- STTR is a 3 Phase Program:
  - Phase 1 is the opportunity to establish the scientific, technical, and commercial feasibility of the proposed innovation in fulfillment of NASA needs.
  - Phase 2 is focused on the development, demonstration and delivery of the proposed innovation.
  - Phase 3 is the commercialization of innovative technologies, products, and services resulting from either a Phase 1 or Phase 2 contract. Phase 3 contracts are funded from sources other than the SBIR and STTR programs and may be awarded without further competition.

- The NASA SBIR/STTR Program currently has in place several initiatives for supporting its small business partners past the basic Phase 1 and Phase 2 elements of the program that emphasize opportunities for commercialization.

STTR Integrated Pipeline



2015 STTR Topics

STTR Topic Title	No. of Proposals
T1 Launch Propulsion Systems	7
T3 Space Power and Energy Storage	5
T4 Robotics, Tele-Robotics and Autonomous Systems	12
T5 Communication and Navigation	4
T6 Human Health, Life Support and Habitation Systems	10
T8 Science Instruments, Observatories and Sensor Systems	12
T9 Entry, Descent and Landing Systems	7
T11 Modeling, Simulation, Information Technology and Processing	16
T12 Materials, Structures, Mechanical Systems and Manufacturing	29
T13 Ground and Launch Systems Processing	1

National Aeronautics and
Space Administration

NASA Innovative Advanced Concepts (NIAC) Program

Space Technology Mission Directorate

John (Jay) Falker, PhD
NIAC & CIF Program Executive

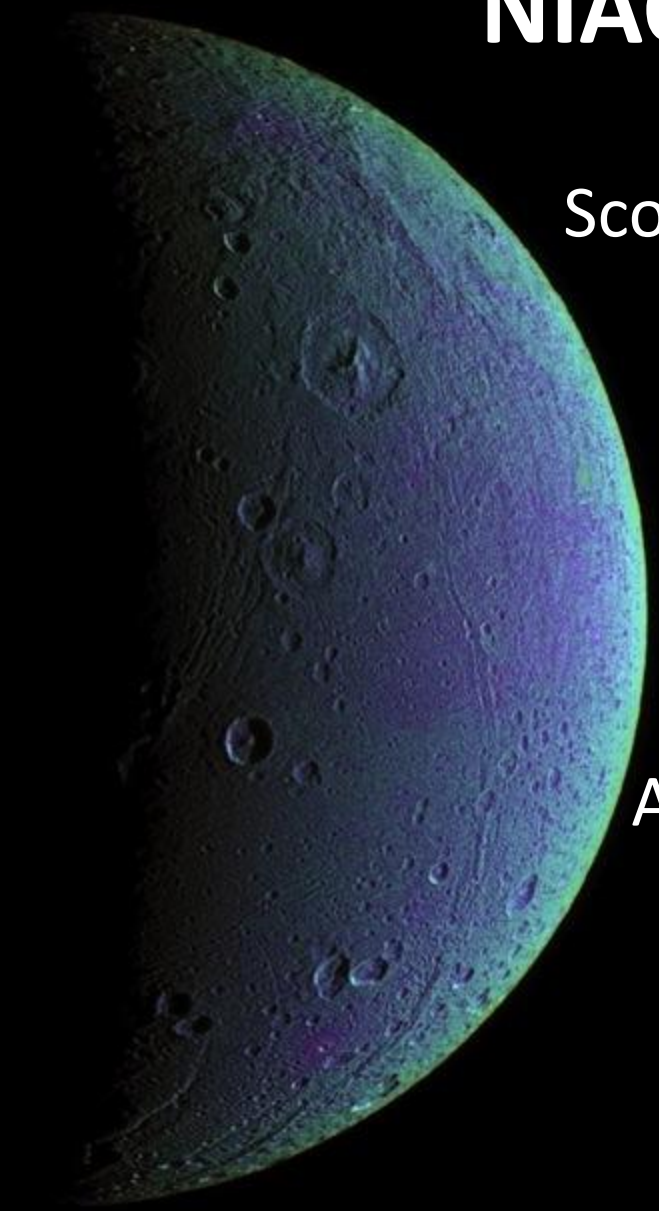
What is NIAC?

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 Scope & Awards



Scope of NIAC studies:

- **Aerospace *architecture, mission, or system*** concepts
- **Exciting**: potential new missions or revolutionary improvement
- **Unexplored**: novel, basic feasibility and properties unclear
- **Credible**: sound scientific/engineering basis and plausible implementation

Awards support 2 phases of study:

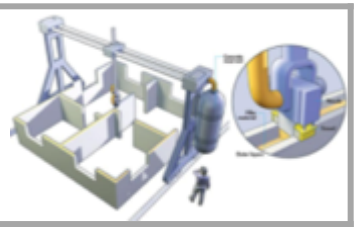
- **Phase I**: up to $100K, ~9 months for concept definition and initial analysis
- **Phase II**: up to $500K, 2 years to further develop the most promising Phase I concepts

Inspiring Wider Benefits:

NIAC Benefits to the NATION

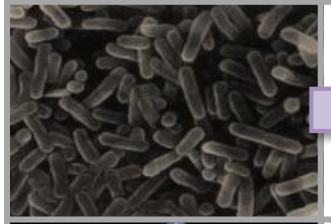
3-D Printing the Home of the Future

Emergency Construction for natural disasters, eradicate slums in developing countries



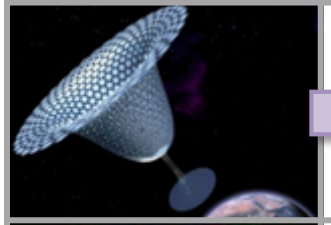
Improving Health With Spacesuit Technology

Medical rehabilitation and physical therapy for individuals affected by stroke, spinal cord injuries, brain injuries, and the elderly.



Bacterial Batteries

Novel Energy Source: Bacterial Microbes to power up robots



Space-Based Solar Power

Power transmission to Earth for use during power outages, after natural disasters, to those in remote areas or by the military.

Navigation

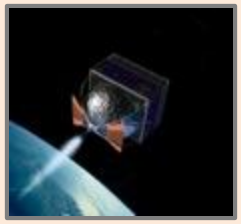
Gravitational waves on the atomic level could lead to technology for better steering of military submarines or aircraft

Space Technology Portfolio

Transformative & Crosscutting Technology Breakthroughs

Game Changing Development

Technology Demonstration Missions



Small Spacecraft Technologies

Pioneering Concepts/ Developing Innovation Community

Space Technology Research Grant

NASA Innovative Advanced Concepts

Center Innovation Fund

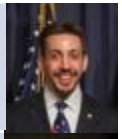
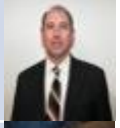
Creating Markets & Growing Innovation Economy

Centennial Challenges

Small Business Innovation Research & Small Business Technology Transfer

Flight Opportunities Program

STMD Program Executives

Program	Program Executive	Contact Info	
Center Innovation Fund & NIAC	Jay Falker	202-358-4545 jfalker@nasa.gov	
Centennial Challenges	Sam Ortega *(Acting)*	256-544-9294 sam.ortega@nasa.gov	
Flight Opportunities	LK Kubendran	202-358-2528 laguduva.r.kubendran@nasa.gov	
Game Changing Development Program	Ryan Stephan	832-289-5533 ryan.a.stephan@nasa.gov	
SBIR/STTR	Bob Yang	202-358-0143 robert.l.yang@nasa.gov	
Small Spacecraft Technology Program	Andy Petro	202-358-0310 andrew.j.petro@nasa.gov	
Space Technology Research Grants	Claudia Meyer	216-509-5606 claudia.m.meyer@nasa.gov	
Technology Demonstration Missions	Timothy Chen	202-322-9855 timothy.t.chen@nasa.gov	

Space Technology Technical Areas

TA01 • LAUNCH PROPULSION SYSTEMS

TA02 • IN-SPACE PROPULSION TECHNOLOGIES

TA03 • SPACE POWER & ENERGY STORAGE

TA04 • ROBOTICS, TELE-ROBOTICS & AUTONOMOUS SYSTEMS

TA05 • COMMUNICATION & NAVIGATION

TA06 • HUMAN HEALTH, LIFE SUPPORT & HABITATION SYSTEMS

TA07 • HUMAN EXPLORATION DESTINATION SYSTEMS

TA08 • SCIENCE INSTRUMENTS, OBSERVATORIES & SENSOR SYSTEMS

TA09 • ENTRY, DESCENT & LANDING SYSTEMS

TA10 • NANOTECHNOLOGY

TA11 • MODELING, SIMULATION, INFORMATION TECHNOLOGY & PROCESSING

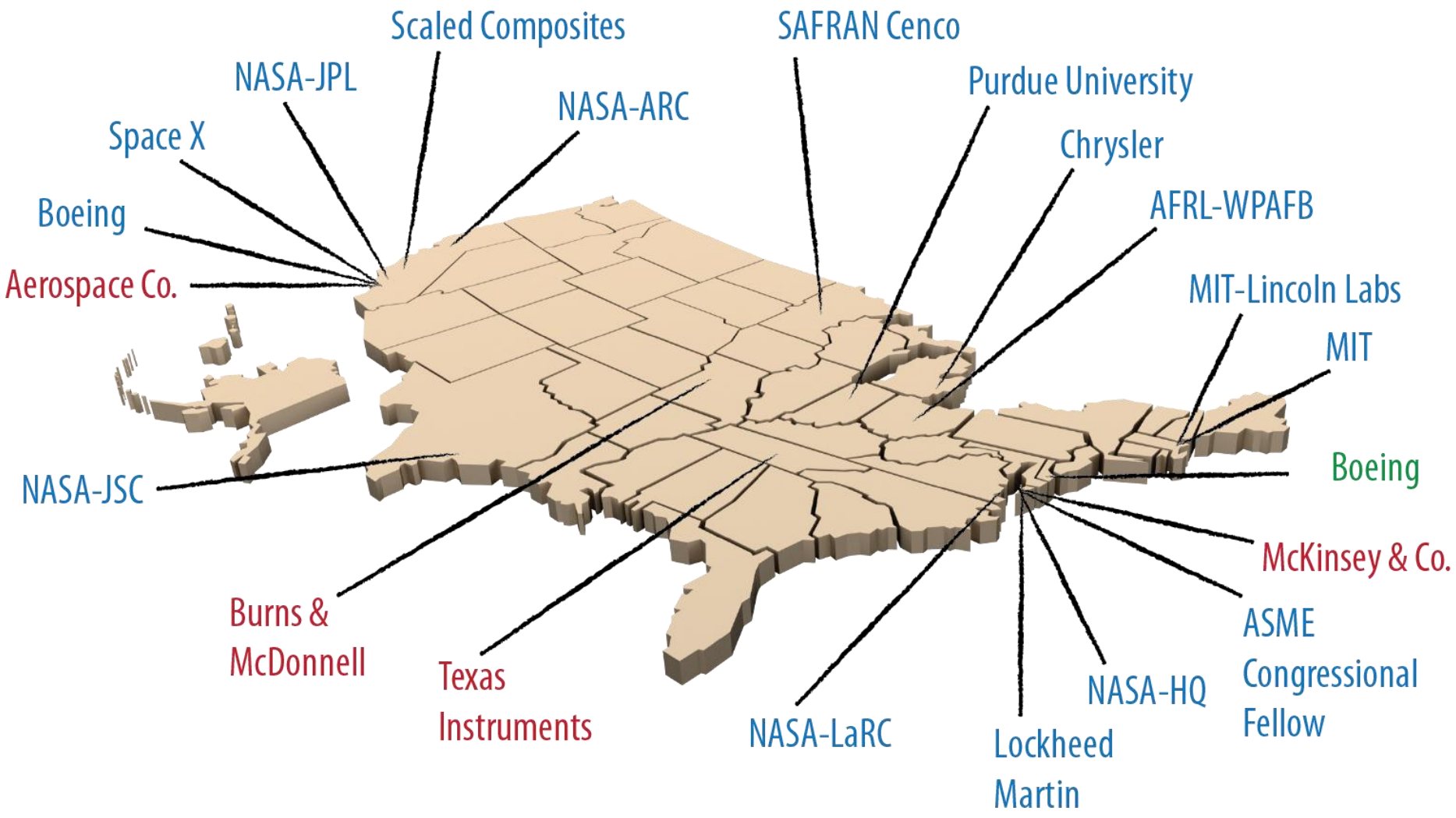
TA12 • MATERIALS, STRUCTURES, MECHANICAL SYSTEMS & MANUFACTURING

TA13 • GROUND & LAUNCH SYSTEMS PROCESSING

TA14 • THERMAL MANAGEMENT SYSTEMS

Top 16 Technologies
Electric Propulsion
Nuclear Thermal Propulsion
Solar Power Generation (Photovoltaic and Thermal)
Fission (Power)
Extreme Terrain Mobility
Long-Duration (Crew) Health
Detectors & Focal Planes
(Instrument and Sensor) Optical Systems
High-Contrast Imaging and Spectroscopy Technologies
In Situ (Instruments and Sensor)
Active Thermal Control of Cryogenic Systems
Radiation Mitigation for Human Spaceflight
Lightweight and Multifunctional Materials and Structures
Environmental Control and Life Support System
Guidance, Navigation, and Control
Entry, Descent, and Landing Thermal Protection Systems

STMD is Developing Our Nation's Aerospace Leaders

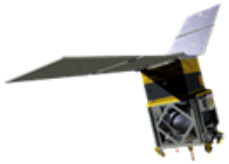


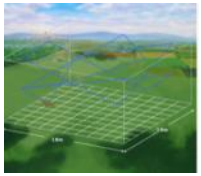
Working with Other Government Agencies

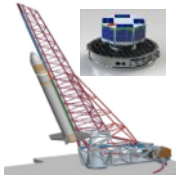
Currently, significant engagements include:

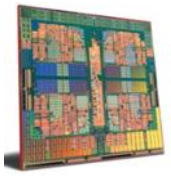
- Green Propellant Infusion Mission partnership with **Air Force Research Laboratory (AFRL)** propellant and rideshare with **DoD's Space Test Program (STP)**
- **AFRL** collaboration Phase I of a High Performance Space Computing for a low power multi-core processor increasing performance by 100 fold.
- UAS Airspace Operations Prize Challenge coordinated with **FAA and AFRL**
- Working with the **USAF Operationally Responsive Space Office (ORS)** for launch accommodations for the Edison Demonstration of Smallsat Networks (EDSN) mission
- Partnership with **DARPA** on "Next Generation Humanoid for Disaster Response"
- Collaboration with **ARPA-e/Dept. of Energy** in new battery chemistries to aide in battery tech development
- Collaboration with **Space Missile Command** developed a Hosted Payload IDIQ contract mechanism for low cost access to space

STMD has ***45 activities*** with ***43 other government agencies***, and ***10 activities*** with ***14 international organizations***. STMD is sharing rides for ***13 activities***.



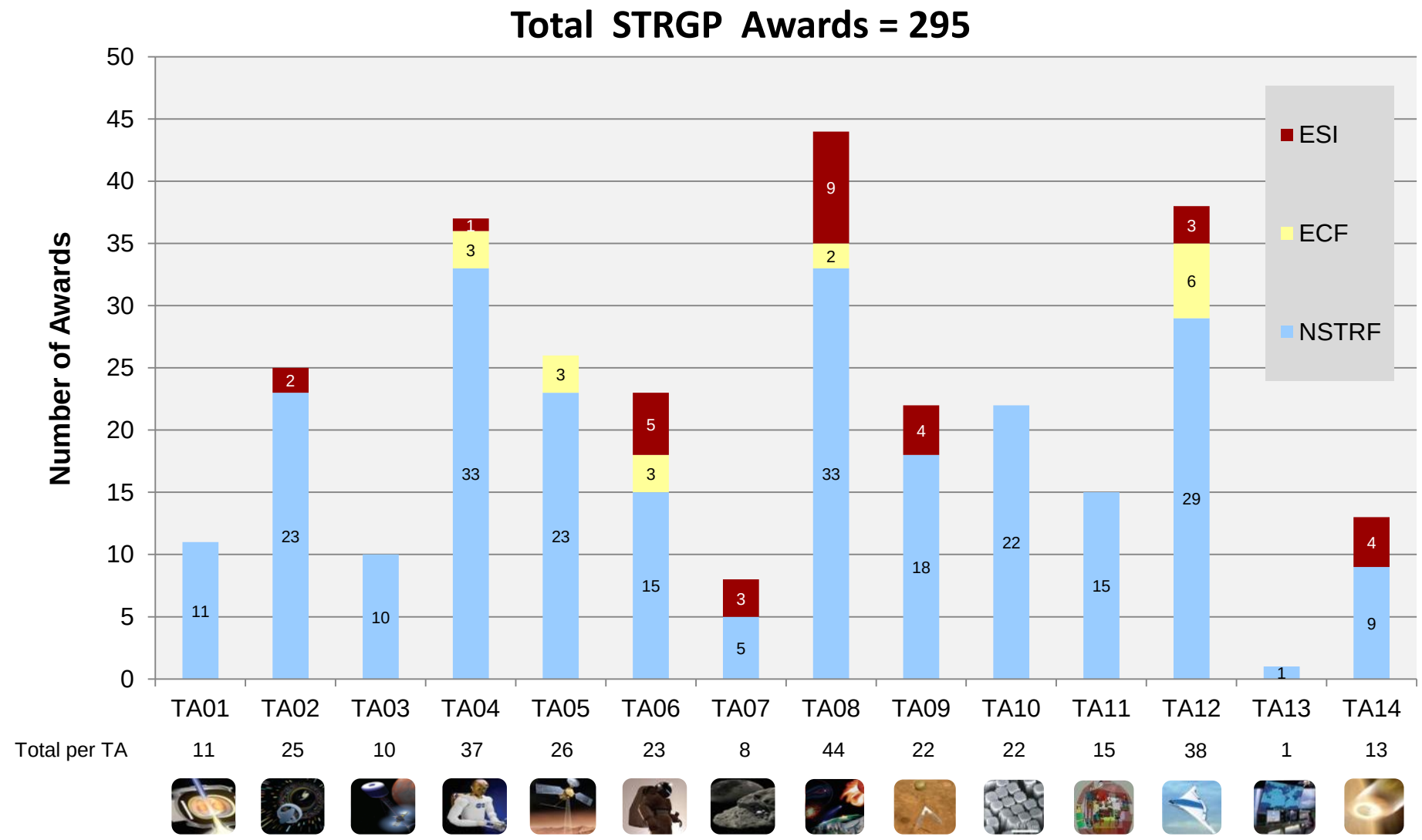






STRGP ESI and ECF Topics

Topic Title	NRC Top	ECF	ESI
TA02: In-Space Propulsion Systems			
Improved Understanding of Cryogenic Propellant Physics (2.4.2)	83		2
TA04: Robotics, Tele-Robotics and Autonomous Systems			
Technologies for soft machines (4.2, 4.3)	83	3	
Mobile Robotic Surface Probe Concepts for Planetary Exploration (4.2.1)	16		1
TA05: Communication and Navigation Systems			
Low SWaP lasers for deep space optical communication applications (5.1.3)		2	
Adaptive Network Topology (5.3.2)	83	0	
Timekeeping and Time Distribution (5.4.1)	83	3	
Onboard Autonomous Navigation and Maneuvering Systems (5.4.3)	16	0	
TA06: Human Health, Life Support, and Habitation Systems			
Oxygen Recovery Technology (6.1.1)	16		1
Environmental Control & Life Support Systems: Waste Management (6.1.3)	16	3	
Habitation (6.1.4)	16	1	
Radiation Protection Systems (6.5.3)	16	0	1
Radiation Monitoring Technology (6.5.5.)	16	0	3
TA07: Human Exploration Destination Systems			
Technologies for In Situ Utilization of Asteroid Materials (7.1.)	83		3
In-Situ Resource Utilization (ISRU) Resource Acquisition (7.1.2)	83	0	
ISRU Products/Production , Manufacturing & Infrastructure (7.1.3, 7.1.4)	83	0	
Advanced Technology Habitat System Design (7.4)	83		0

Topic Title	NRC Top	ECF	ESI
TA08: Science Instruments, Observatories and Sensor Systems			
Asteroid Detection, Remote Characterization, and Impact Avoidance (8.1)			3
Optical Coatings and Thin-film Physics (8.1.3)	16		2
Active Wavefront Control (8.1.3)	16		1
Grazing-Incidence Optical Systems (8.1.3)	16		1
Low SWaP lasers for remote sensing applications (8.1.5)	83	0	
Technologies for In Situ Instruments (8.3.3)	16		2
TA09: Entry, Descent and Landing Systems			
Advanced Thermal Protection Materials Modeling (9.1)	16		3
Kinetic Penetrators for Icy Moons (9.3.1)			1
TA12: Materials, Structures, Mechanical Systems, & Manufacturing			
Computational Materials Technology (12.x)	83		3
Materials: Lightweight Structure (12.1.1)	16	3	
Structures: Lightweight Concepts (12.2.1)	16	0	
Structures: Design and Certification Methods (12.2.2)	16	0	
Mechanical Systems Reliability/Life Assessment/Health Monitoring (12.3.5)	83	0	
Science-based digital materials and manufacturing (12.4.2)	83	2	
TA14: Thermal Management Systems			
Active Thermal Control of Cryogenic Systems (14.1.2)	16		1
Heat Rejection (14.2.3)			3

STRG Program Portfolio
Awards by Technology Area