National Aeronautics and Space Administration

OFFICE OF THE CHIEF TECHNOLOGIST

SPACE TECHNOLOGY RESEARCH FELLOWSHIPS

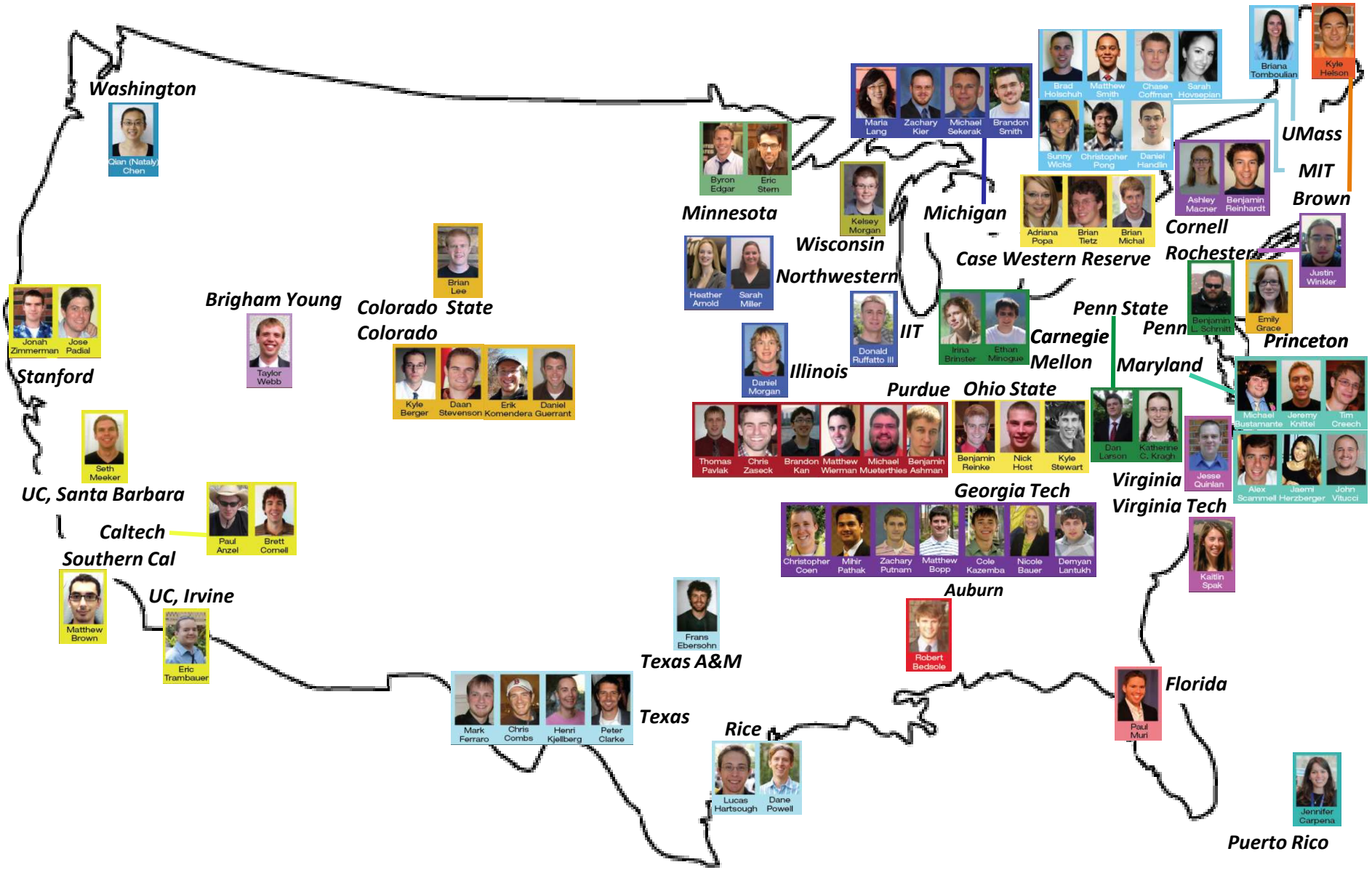
Presentation at the NASA Advisory Council Technology and Innovation Committee Meeting

November 18, 2011

Claudia Meyer
Space Technology Research Grants Program Executive

National Asset: The Inaugural Class of NSTRF

80 Students - 37 Universities - 22 States and U.S. Territories



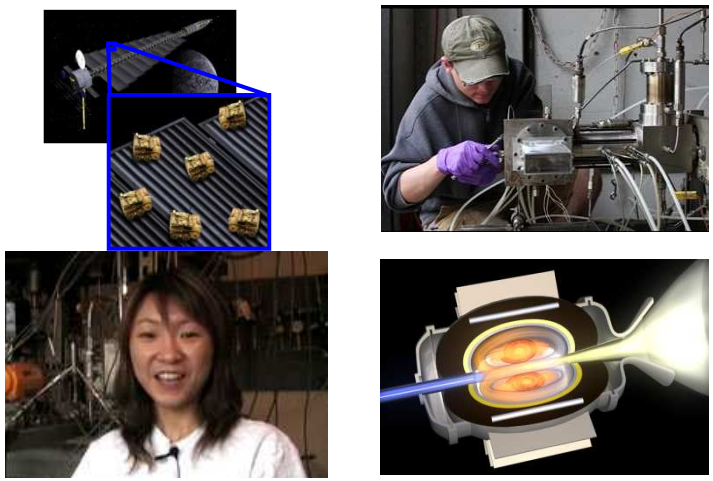
NSTRF Core Values

"NASA Space Technology Fellows will perform innovative space technology research while building the skills necessary to become future technological leaders."

July 27, 2011
RELEASE : 11-246
NASA Awards Space Technology Research Fellowship Grants
http://www.nasa.gov/home/hqnews/2011/jul/HQ_11-246_STRF_Awards.html

Space Technology Research Grants - Program Overview

Level II Program Office: GRC



Objective: Accelerate the development of push technologies through innovative efforts with high risk/high payoff

- **Early Stage Innovation -Space Technology Research Opportunities (ESI-STRO):** Low TRL technology portfolio for groundbreaking research in advanced space technology
- **NASA Space Technology Research Fellowships (NSTRF):** Competitive selection of U.S Citizen / permanent resident graduate students developing promising technologies in support of future NASA missions and strategic goals

Acquisition Strategy

- **ESI-STRO**: NRA solicitation expected annually. Awards are grants, cooperative agreements, contracts or intra-agency transfers.
- **NSTRF:** Annual solicitation consistent with academic calendar. Awards are training grants to accredited U.S. universities. Selected candidates perform graduate student research on their respective campuses, at NASA Centers and not-for-profit Research and Development (R&D) labs.

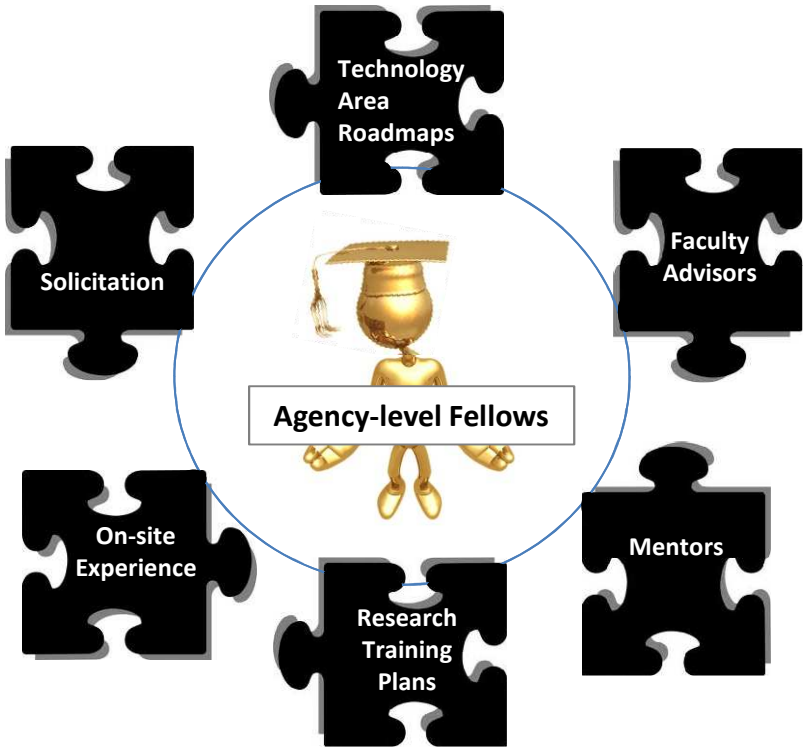
Awards

- **ESI-STRO**: Typical 12 months awards at $250K. 100+ per year.
- **NSTRF:** 80 Fellows in inaugural year. NSTRF12 released on 11-4-11

Collaboration

- **ESI-STRO:** Proposals welcome from all sources, including academia, industry, all U.S. government agencies and non-profit organizations; teaming encouraged
- **NSTRF:** Each student is matched with a professional advisor at NASA Centers or R&D Lab

The “Pieces” of the NASA Space Technology Research Fellowships



The Solicitation - *Introduction*

NASA SPACE TECHNOLOGY RESEARCH FELLOWSHIPS (NSTRF) -
Fall 2012 Fellowship Start

Call for applications	November 4, 2011
Applications due	January 11, 2012 at 6:00 PM ET
Fellowship selection notifications	Late April 2012 (target)
Fellowship acceptance deadline	Notification + 7 days
Start date of fellowships	August 1, 2012 (target)

The solicitation is available by

- *opening the NASA Research Opportunities homepage at http://nspires.nasaprs.com/,*
- *selecting "Solicitations,"*
- *then selecting "Open Solicitations," and,*
- *finally, selecting "NSTRF12."*

Minimum Eligibility Requirements for NSTRF12

1. **Pursuing or seeking to pursue advanced STEM degrees.**
2. **U.S. citizens or permanent residents of the U.S.**
3. **Have or will have a Bachelor's degree prior to the fall of 2012.**
4. **Are or will be enrolled in a full-time Master's or Doctoral degree program at an accredited U.S. university in fall 2012 (awards may not be deferred).**
5. **Have completed no more than twenty-four months of full-time graduate study as of August 1, 2011. Full-time graduate study is as defined by the universities attended. Applicants who have completed part-time graduate study must have completed no more than 30 semester hours or 45 quarter hours, or their equivalent, as of August 1, 2011; this credit hour limit applies to part-time graduate students.**

*NSTRF**11** (inaugural year) documents are available at http://tinyurl.com/NSTRF11-OCT.*

The Solicitation – *Application Components*

The student shall be the principal author of the Educational Research Area of Inquiry and Goals, with minimal assistance from the current/prospective faculty advisor.

1 Educational Research Area of Inquiry and Goals

- summary of educational program objectives
- research interests with associated relevant hypotheses and possible approaches
- benefits of proposed research
- benefits of on-site R&D lab experience

2 Schedule of degree program

- proposed start and completion dates
- anticipated milestones

3 Curriculum Vitae (one page)

- faculty advisor
- student

4 Statement from faculty advisor (one page)

- planned use of faculty advisor allowance
- If applicable, brief description of ongoing or pending research awards from NASA that are related to the student's Educational Research Area of Inquiry and Goals.

5 Three signed letters of recommendation

- from academic advisor
- from other faculty members or professionals with detailed knowledge of student's abilities

6 Transcripts

- undergraduate
- graduate

7 GRE general test scores

The Solicitation - *Basis for Inspiration*

TA01 • LAUNCH PROPULSION SYSTEMS

Solid Rocket Propulsion Systems
- Propellants
- Case Materials
- Nozzle Systems
- Hybrid Rocket Propulsion Systems
- Fundamental Solid Propulsion Technologies

Liquid Rocket Propulsion Systems
- LH_2/LOX Based
- RP/LOX Based
- CH_4/LOX Based
- Detonation Wave Engines (Closed Cycle)
- Propellants
- Fundamental Liquid Propulsion Technologies

Air Breathing Propulsion Systems
- TBCC
- RBCC
- Detonation Wave Engines (Open Cycle)
- Turbine Based Jet Engines (Flyback Boosters)
- Ramjet/Scramjet Engines (Accelerators)
- Deeply-cooled Air Cycles
- Air Collection & Enrichment System
- Fundamental Air Breathing Propulsion Technologies

Ancillary Propulsion Systems
- Auxiliary Control Systems
- Main Propulsion Systems (Excluding Engines)
- Launch Abort Systems
- Thrust Vector Control Systems
- Health Management & Sensors
- Pyro & Separation Systems
- Fundamental Ancillary Propulsion Technologies

Unconventional / Other Propulsion Systems
- Ground Launch Assist
- Air Launch / Drop Systems
- Space Tether Assist
- Beamed Energy / Energy Addition
- Nuclear
- High Energy Density Materials/Propellants

TA02 • IN-SPACE PROPULSION TECHNOLOGIES

Chemical Propulsion
- Liquid Storable
- Liquid Cryogenic
- Gels
- Solid
- Hybrid
- Cold Gas/Warm Gas
- Micro-propulsion

Non-Chemical Propulsion
- Electric Propulsion
- Solar Sail Propulsion
- Thermal Propulsion
- Tether Propulsion

Advanced (TRL <3) Propulsion Technologies
- Beamed Energy Propulsion
- Electric Sail Propulsion
- Fusion Propulsion
- High Energy Density Materials
- Antimatter Propulsion
- Advanced Fission
- Breakthrough Propulsion

Supporting Technologies
- Engine Health Monitoring & Safety
- Propellant Storage & Transfer
- Materials & Manufacturing Technologies
- Heat Rejection
- Power

TA03 • SPACE POWER & ENERGY STORAGE

Power Generation
- Energy Harvesting
- Chemical (Fuel Cells, Heat Engines)
- Solar (Photo-Voltaic & Thermal)
- Radioisotope
- Fission
- Fusion

Energy Storage
- Batteries
- Flywheels
- Regenerative Fuel Cells

Power Management & Distribution
- FDIR
- Management & Control
- Distribution & Transmission
- Wireless Power Transmission
- Conversion & Regulation

Cross Cutting Technology
- Analytical Tools
- Green Energy Impact
- Multi-functional Structures
- Alternative Fuels

TA04 • ROBOTICS, TELE-ROBOTICS & AUTONOMOUS SYSTEMS

Sensing & Perception
- Stereo Vision
- LIDAR
- Proximity Sensing
- Sensing Non-Geometric Terrain Properties
- Estimating Terrain Mechanical Properties
- Tactile Sensing Arrays
- Gravity Sensors & Celestial Nav.
- Terrain Relative Navigation
- Real-time Self-calibrating of Hand-eye Systems

Mobility
- Simultaneous Localiz. & Mapping
- Hazard Detection Algorithms
- Active Illumination
- 3-D Path Planning w/ Uncertainty
- Long-life Extr. Enviro. Mechanisms
- Robotic Jet Backpacks
- Smart Tethers
- Robot Swarms
- Walking in Micro-g

Manipulation
- Motion Planning Alg., High DOF Sensing & Control
- Robot Arms (light, high strength)
- Dexterous Manipul., Robot Hands
- Sensor Fusion for Grasping
- Grasp Planning Algorithms Robotic Drilling Mechanisms
- Multi-arm / Finger Manipulation
- Planning with Uncertainty

Human-Systems Integration
- Crew Decision Support Systems
- Immersive Visualization
- Distributed Collaboration
- Multi Agent Coordination
- Haptic Displays
- Displaying Range Data to Humans

Autonomy
- Spacecraft Control Systems
- Vehicle Health, Prog/Diag Systems
- Human Life Support Systems
- Planning/Scheduling Resources
- Operations
- Integrated Systems Health Management
- FDIR & Diagnosis
- System Monitoring & Prognosis
- V&V of Complex Adaptive Sys's
- Automated Software Generation
- Software Reliability
- Semi Automatic Systems

Auton. Rendezvous & Docking
- Rendezvous and Capture
- Low impact & Androgenous Docking Systems & Interfaces
- Relative Navigation Sensors
- Robust AR&D GN&C Algorithms & FSW
- Onboard Mission Manager
- AR&D Integration & Standardiz.n

RTA Systems Engineering
- Human safety
- Refueling Interfaces & Assoc. Tools
- Modular / Serviceable Interfaces
- High Perf., Low Power Onboard Computers
- Environment Tolerance
- Thermal Control
- Robot-to-Suit Interfaces
- Common Human-Robot Interfaces
- Crew Self Sufficiency

TA05 • COMMUNICATION & NAVIGATION

Optical Comm. & Navigation
- Detector Development
- Large Apertures
- Lasers
- Acquisition & Tracking
- Atmospheric Mitigation

Radio Frequency Communications
- Spectrum Efficient Technologies
- Power Efficient Technologies
- Propagation
- Flight & Ground Systems
- Earth Launch & Reentry Comm.
- Antennas

Internetworking
- Disruptive Tolerant Networking
- Adaptive Network Topology
- Information Assurance
- Integrated Network Management

Position, Navigation, and Timing
- Timekeeping
- Time Distribution
- Onboard Auto Navigation & Maneuver
- Sensors & Vision Processing Systems
- Relative & Proximity Navigation
- Auto Precision Formation Flying
- Auto Approach & Landing

Integrated Technologies
- Radio Systems
- Ultra Wideband
- Cognitive Networks
- Science from the Comm. System
- Hybrid Optical Comm. & Nav. Sensors
- RF/Optical Hybrid Technology

Revolutionary Concepts
- X-Ray Navigation
- X-Ray Communications
- Neutrino-Based Navigation & Tracking
- Quantum Key Distribution
- Quantum Communications
- SQIF Microwave Amplifier
- Reconfigurable Large Apertures

TA06 • HUMAN HEALTH, LIFE SUPPORT & HABITATION SYSTEMS

Environmental Control & Life Support Systems & Habitation Sys.
- Air Revitalization
- Water Recovery & Management
- Waste Management
- Habitation

Extravehicular Activity Systems
- Pressure Garment
- Portable Life Support System
- Power, Avionics and Software

Human Health & Performance
- Medical Diagnosis / Prognosis
- Long-Duration Health
- Behavioral Health & Performance
- Human Factors & Performance

Environmental Monitoring, Safety & Emergency Response
- Sensors: Air, Water, Microbial, etc.
- Fire: Detection, Suppression
- Protective Clothing / Breathing
- Remediation

Radiation
- Risk Assessment Modeling
- Radiation Mitigation
- Protection Systems
- Space Weather Prediction
- Monitoring Technology

TA07 • HUMAN EXPLORATION DESTINATION SYSTEMS

In-Situ Resource Utilization
- Destination Reconnaissance, Prospecting, & Mapping
- Resource Acquisition
- Consumables Production
- Manufacturing & Infrastructure Emplacement

Sustainability & Supportability
- Logistics Systems
- Maintenance Systems
- Repair Systems

"Advanced" Human Mobility Systems
- EVA Mobility
- Surface Mobility
- Off-Surface Mobility

"Advanced" Habitat Systems
- Integrated Habitat Systems
- Habitat Evolution

Mission Operations & Safety
- Crew Training
- Environmental Protection
- Remote Mission Operations
- Planetary Safety

Cross-Cutting Systems
- Modeling, Simulations & Destination Characterization
- Construction & Assembly
- Dust Prevention & Mitigation

TA08 • SCIENCE INSTRUMENTS, OBSERVATORIES & SENSOR SYSTEMS

Remote Sensing Instruments / Sensors
- Detectors & Focal Planes
- Electronics
- Optical Components
- Microwave / Radio
- Lasers
- Cryogenic / Thermal

Observatories
- Mirror Systems
- Structures & Antennas
- Distributed Aperture

In-Situ Instruments / Sensor
- Particles: Charged & Neutral
- Fields & Waves
- In-Situ

TA09 • ENTRY, DESCENT & LANDING SYSTEMS

Aeroassist & Atmospheric Entry
- Rigid Thermal Protection Systems
- Flexible Thermal Protection Systems
- Rigid Hypersonic Decelerators
- Deployable Hypersonic Decelerators
- Instrumentation & Health Monitoring
- Entry Modeling & Simulation

Descent
- Attached Deployable Decelerators
- Trailing Deployable Decelerators
- Supersonic Retropropulsion
- GN&C Sensors
- Descent Modeling & Simulation

Landing
- Touchdown Systems
- Egress & Deployment Systems
- Propulsion Systems
- Large Body GN&C
- Small Body Systems
- Landing Modeling & Simulation

Vehicle Systems Technology
- Architecture Analyses
- Separation Systems
- System Integration & Analyses
- Atmosphere & Surface Characterization

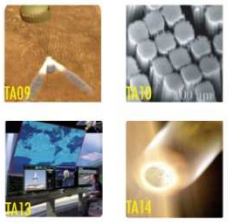
TA10 • NANOTECHNOLOGY

Engineered Materials & Structures
- Lightweight Structures
- Damage Tolerant Systems
- Coatings
- Adhesives
- Thermal Protection & Control

Energy Generation & Storage
- Energy Storage
- Energy Generation

Propulsion
- Propellants
- Propulsion Components
- In-Space Propulsion

Sensors, Electronics & Devices
- Sensors & Actuators
- Nanoelectronics
- Miniature Instruments



TA11 • MODELING, SIMULATION, INFORMATION TECHNOLOGY & PROCESSING

Computing
- Flight Computing
- Ground Computing

Modeling
- Software Modeling & Model-Checking
- Integrated Hardware & Software Modeling
- Human-System Performance Modeling
- Science & Engineering Modeling
- Frameworks, Languages, Tools & Standards

Simulation
- Distributed Simulation
- Integrated System Lifecycle Simulation
- Simulation-Based Systems Engineering
- Simulation-Based Training & Decision Support Systems

Information Processing
- Science, Engineering & Mission Data Lifecycle
- Intelligent Data Understanding
- Semantic Technologies
- Collaborative Science & Engineering
- Advanced Mission Systems

TA12 • MATERIALS, STRUCTURES, MECHANICAL SYSTEMS & MANUFACTURING

Materials
- Lightweight Structure
- Computational Design
- Flexible Material Systems
- Environment
- Special Materials

Structures
- Lightweight Concepts
- Design & Certification Methods
- Reliability & Sustainment
- Test Tools & Methods
- Innovative, Multifunctional Concepts

Mechanical Systems
- Deployables, Docking and Interfaces
- Mechanism Life Extension Systems
- Electro-mechanical, Mechanical & Micromechanisms
- Design & Analysis Tools and Methods
- Reliability / Life Assessment / Health Monitoring
- Certification Methods

Manufacturing
- Manufacturing Processes
- Intelligent Integrated Manufacturing and Cyber Physical Systems
- Electronics & Optics Manufacturing Process
- Sustainable Manufacturing

Cross-Cutting
- Nondestructive Evaluation & Sensors
- Model-Based Certification & Sustainment Methods
- Loads and Environments

TA13 • GROUND & LAUNCH SYSTEMS PROCESSING

Technologies to Optimize the Operational Life-Cycle
- Storage, Distribution & Conservation of Fluids
- Automated Alignment, Coupling, & Assembly Systems
- Autonomous Command & Control for Ground and Integrated Vehicle/Ground Systems

Environmental and Green Technologies
- Corrosion Prevention, Detection, & Mitigation
- Environmental Remediation & Site Restoration
- Preservation of Natural Ecosystems
- Alternate Energy Prototypes

Technologies to Increase Reliability and Mission Availability
- Advanced Launch Technologies
- Environment-Hardened Materials and Structures
- Inspection, Anomaly Detection & Identification
- Fault Isolation and Diagnostics
- Prognostics Technologies
- Repair, Mitigation, and Recovery Technologies
- Communications, Networking, Timing & Telemetry

Technologies to Improve Mission Safety/Mission Risk
- Range Tracking, Surveillance & Flight Safety Technologies
- Landing & Recovery Systems & Components
- Weather Prediction and Mitigation
- Robotics / Telerobotics
- Safety Systems

TA14 • THERMAL MANAGEMENT SYSTEMS

Cryogenic Systems
- Passive Thermal Control
- Active Thermal Control
- Integration & Modeling

Thermal Control Systems
- Heat Acquisition
- Heat Transfer
- Heat Rejection & Energy Storage

Thermal Protection Systems
- Entry / Ascent TPS
- Plume Shielding (Convective & Radiative)
- Sensor Systems & Measurement Technologies

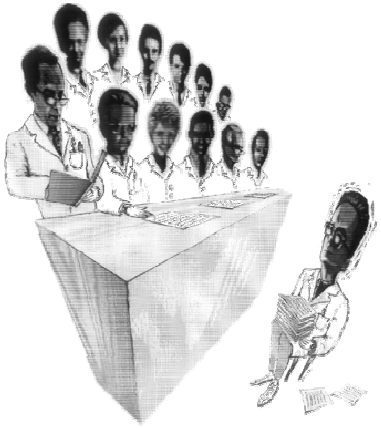
Space Technology Roadmaps **STR • TABS**

TECHNOLOGY AREA BREAKDOWN STRUCTURE

http://www.nasa.gov/offices/oct/strategic_integration/technology_roadmap.html

The Solicitation –
Application Evaluation and Selection

All eligible fellowship applications will undergo a review by technical experts.



Criteria for Evaluation

Merit of the Applicant's Proposed Educational Research Area of Inquiry and Goals

- technical merit as appropriate to the candidate's educational level
- research area description, knowledge of relevant research literature and plans for student/advisor/mentor partnership

Relevance of the proposed research to NASA's Space Technology Roadmaps

Academic excellence and Potential

- Organizational and analytical skills
- scientific curiosity, creativity, acumen, and success in research appropriate to his/her educational level

NOTE: Subsequent to the technical review, candidates deemed excellent will be submitted to the Office of the Chief Technologist at NASA Headquarters for final consideration and selection.

Annual Award Values

Category	Maximum value *
Student Stipend	$36,000
Faculty Advisor Allowance	$9,000
On-site NASA Center/R&D lab experience Allowance	$10,000
Health Insurance Allowance	$1,000
Tuition and Fees Allowance	$10,000
TOTAL	**$66,000**

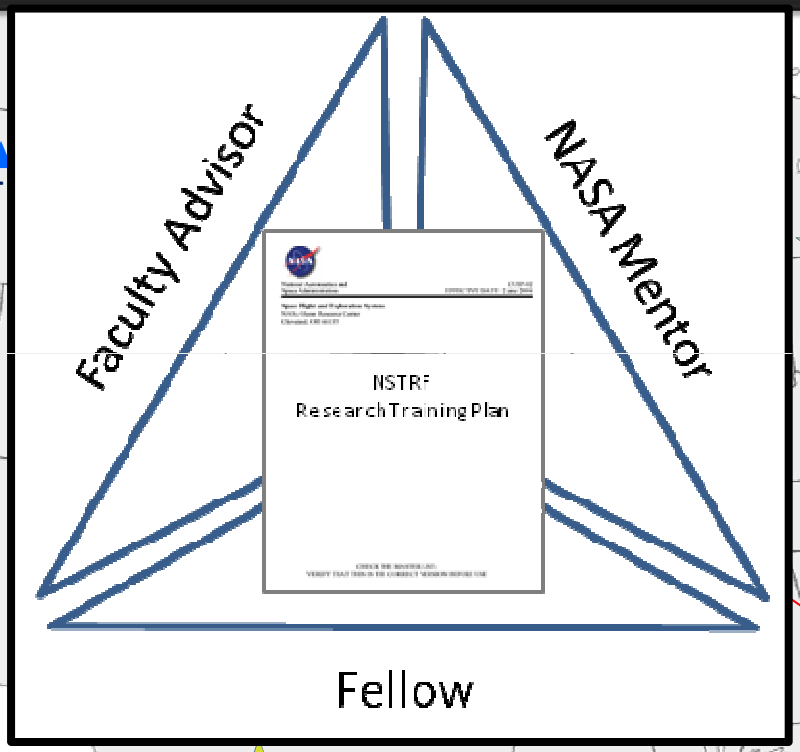
** from NSTRF12 solicitation*

- A fellowship award is issued as a training grant to the student's host university.
- Separate from the awards, the Program has allocated resources to cover mentor time and costs associated with hosting/interacting with the Fellow.

Completing the Vision: Mentors

Lining the future space technology stars up with the best mentors…

Space Technology Research Fellowships:
A Nationwide Community of University Students, Professors, and R&D Lab Mentors



NIST

Ames

Dryden

Aerospace Corp.

JPL

Glenn

Goddard

Langley

Marshall

Johnson

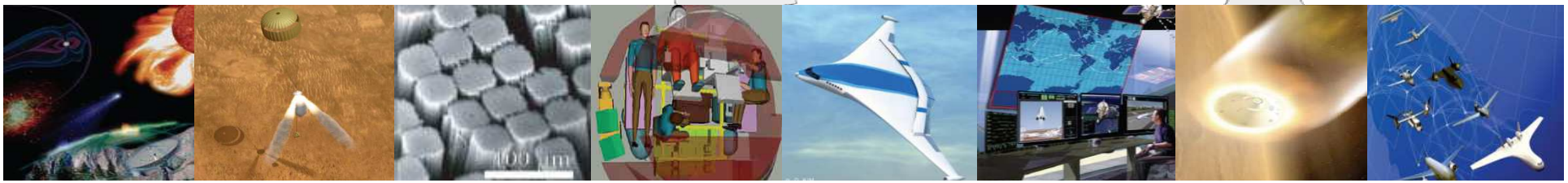
Stennis

Kennedy

Locations of hypothetical Fellow host universities

NASA Center

Non-profit R&D lab hosting NSTRF11 Fellows

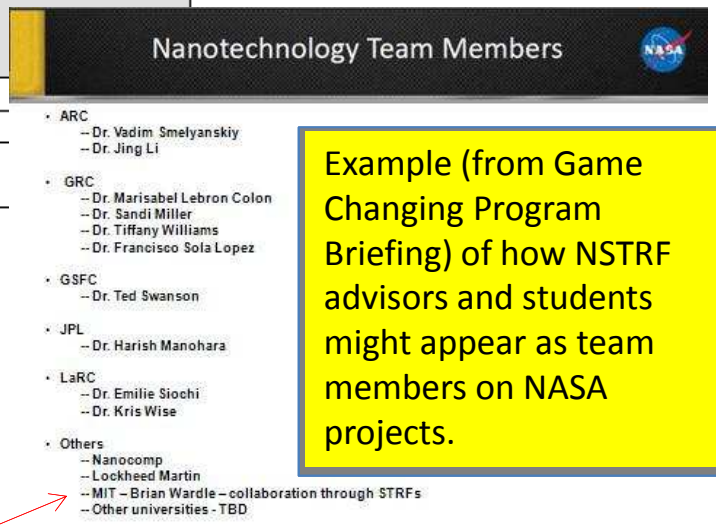


Tying it All Together: Research Training Plan

NSTRF Research Training Plan for **NASA Grant #NNX0000000** Title University Name	
Space Technology Fellow	First Last
Academic Advisor (PI)	First Last
Mentor	First Last NASA Center

Key Elements of Research Training Plan

- Cover page (including Abstract)
- Research Description
  - Introduction
  - Goal
  - Background
  - Approach/Methodology
  - Expected Outcome(s)
  - References
- Relevance to NASA
- On-site Experience(s)
- Conferences
- Schedule



Example (from Game Changing Program Briefing) of how NSTRF advisors and students might appear as team members on NASA projects.

***This section is expected to have significant input from the mentor** in identifying and elaborating on the ties to not just the Technology Areas and Grand Challenges, but also documenting relevance to on-going activities in NASA's Mission Directorates.*

Research Training Plan: Required by a NASA Space Technology Research Fellowship (NSTRF)

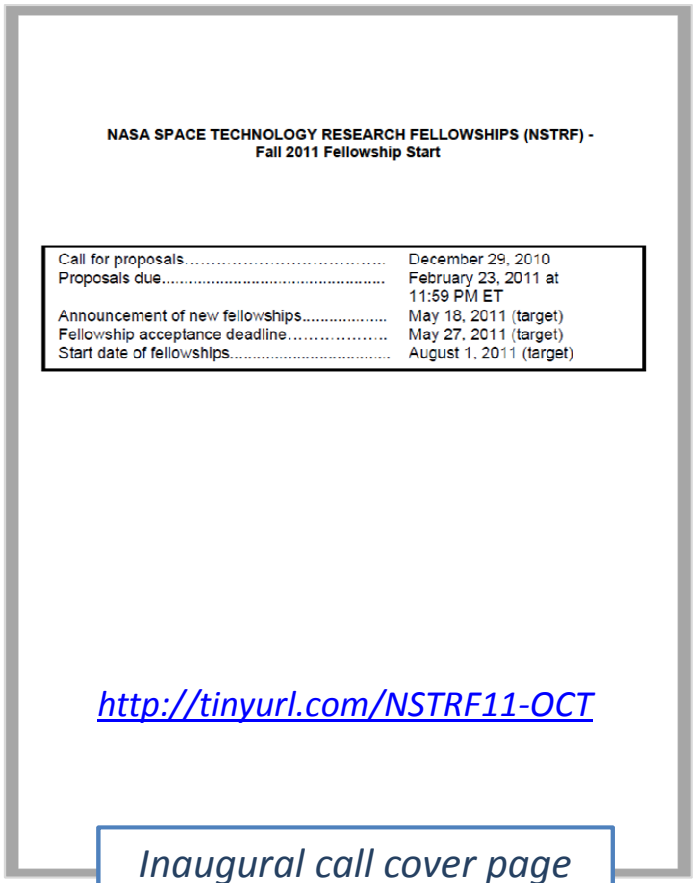
Purpose:
Will be used by the Program for both internal (to NASA) and external reporting and advocacy.

Sharing portions of these plans fosters an awareness of the variety of activities that are being sponsored within each technology area.

Instructions and Considerations

> Should be developed collaboratively by the student Fellow, Academic Advisor, and NASA mentor.
> Should be based on the original proposal.
> Intended to tie the student's research being performed on campus, as part of his/her degree program, with the research to be conducted at the NASA Center or R&D lab.
> Submitted (by student) before end of the fall academic term.

NSTRF11 Results



NASA SPACE TECHNOLOGY RESEARCH FELLOWSHIPS (NSTRF) -
Fall 2011 Fellowship Start

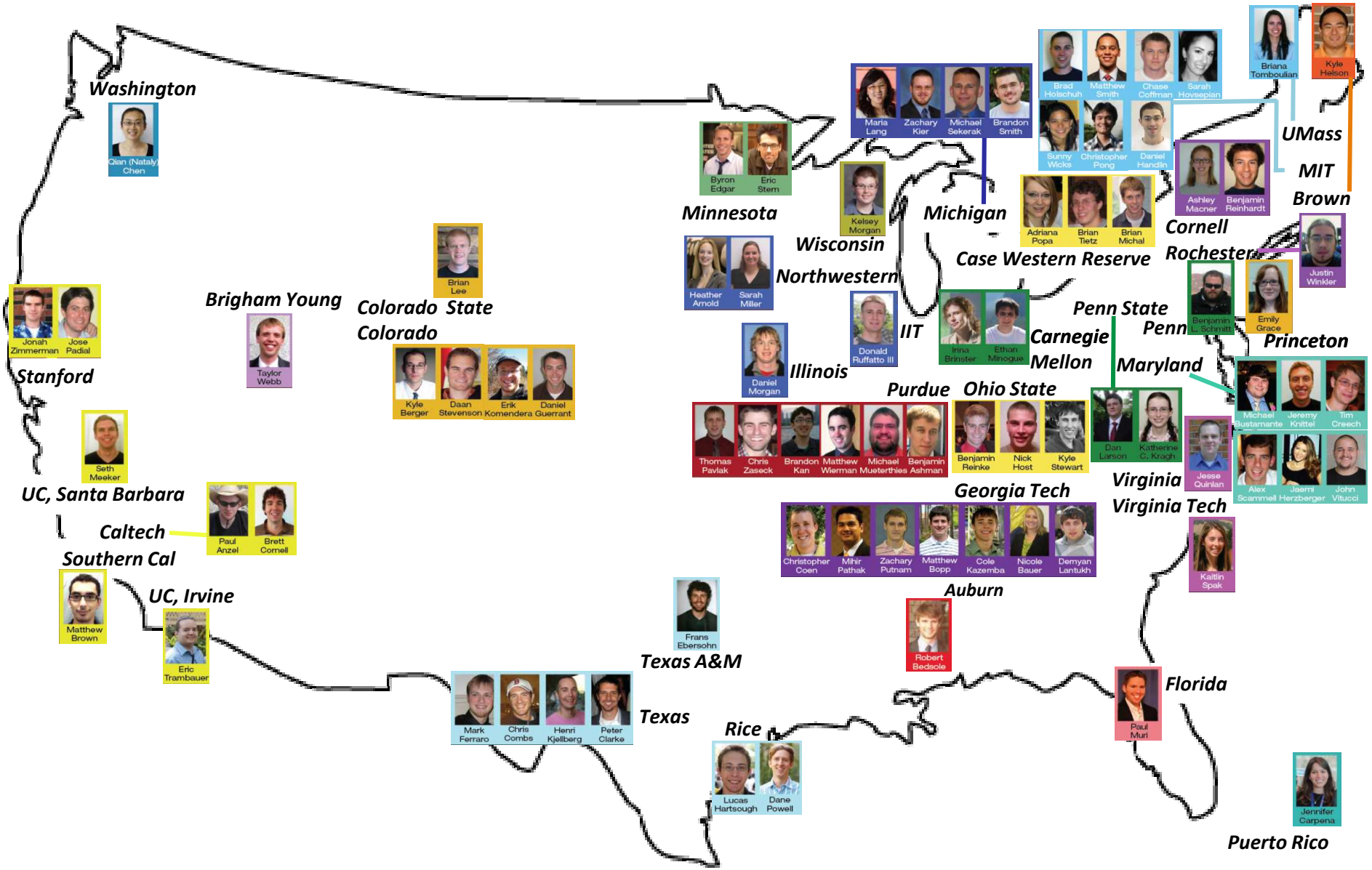
Call for proposals	December 29, 2010
Proposals due	February 23, 2011 at 11:59 PM ET
Announcement of new fellowships	May 18, 2011 (target)
Fellowship acceptance deadline	May 27, 2011 (target)
Start date of fellowships	August 1, 2011 (target)

http://tinyurl.com/NSTRF11-OCT

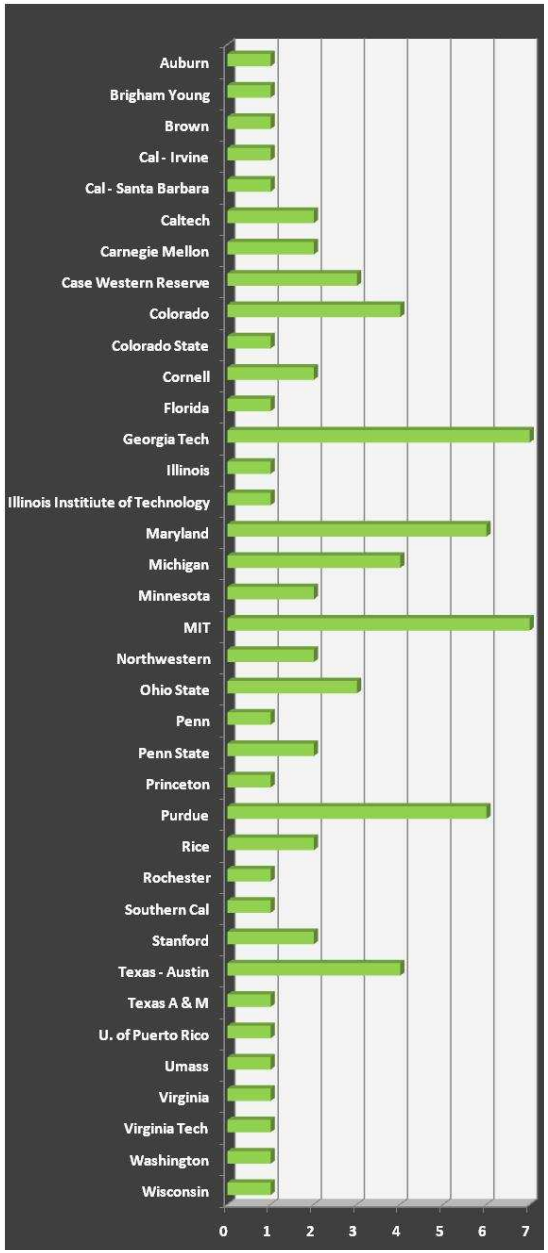
Inaugural call cover page

National Asset: The Inaugural Class of NSTRF

80 Students - 37 Universities - 22 States and U.S. Territories

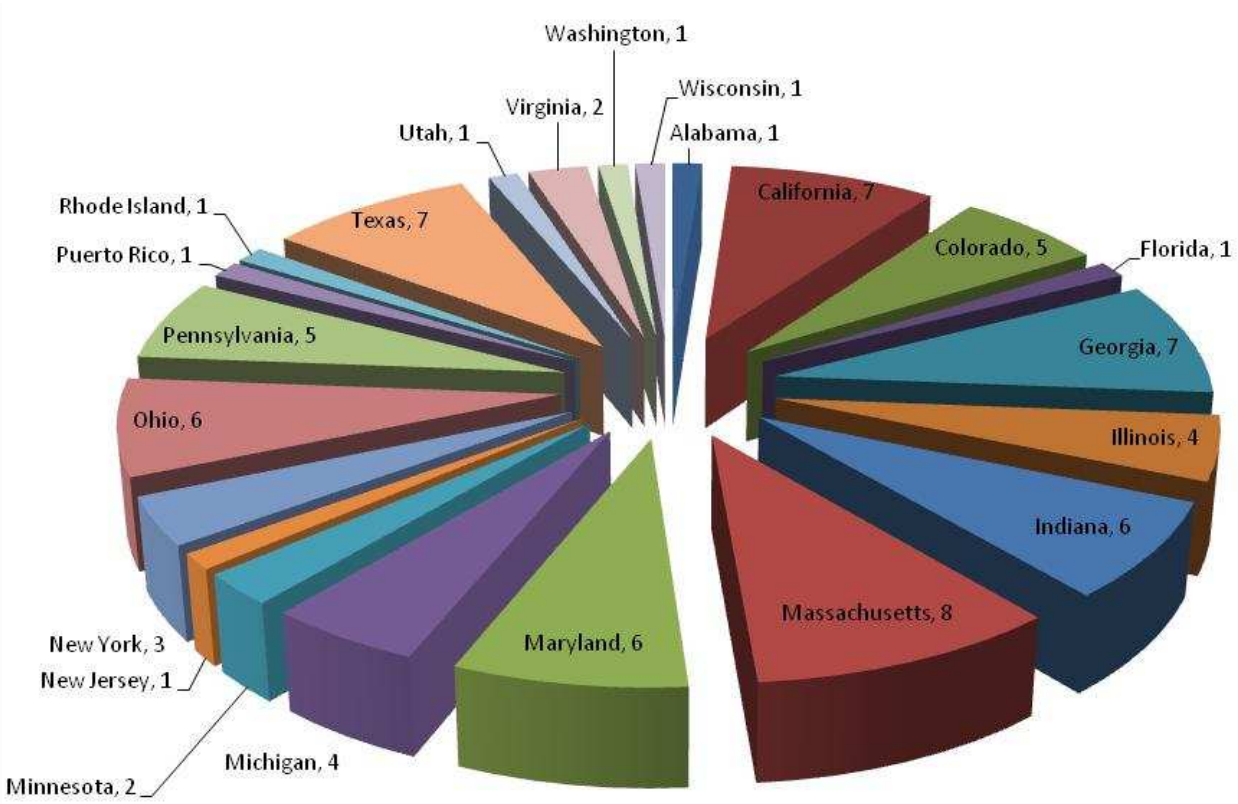


NSTRF11 Awards by University and State



Number of Awards by University

Number of Awards by State



NSTRF11 Awards by Technology Area







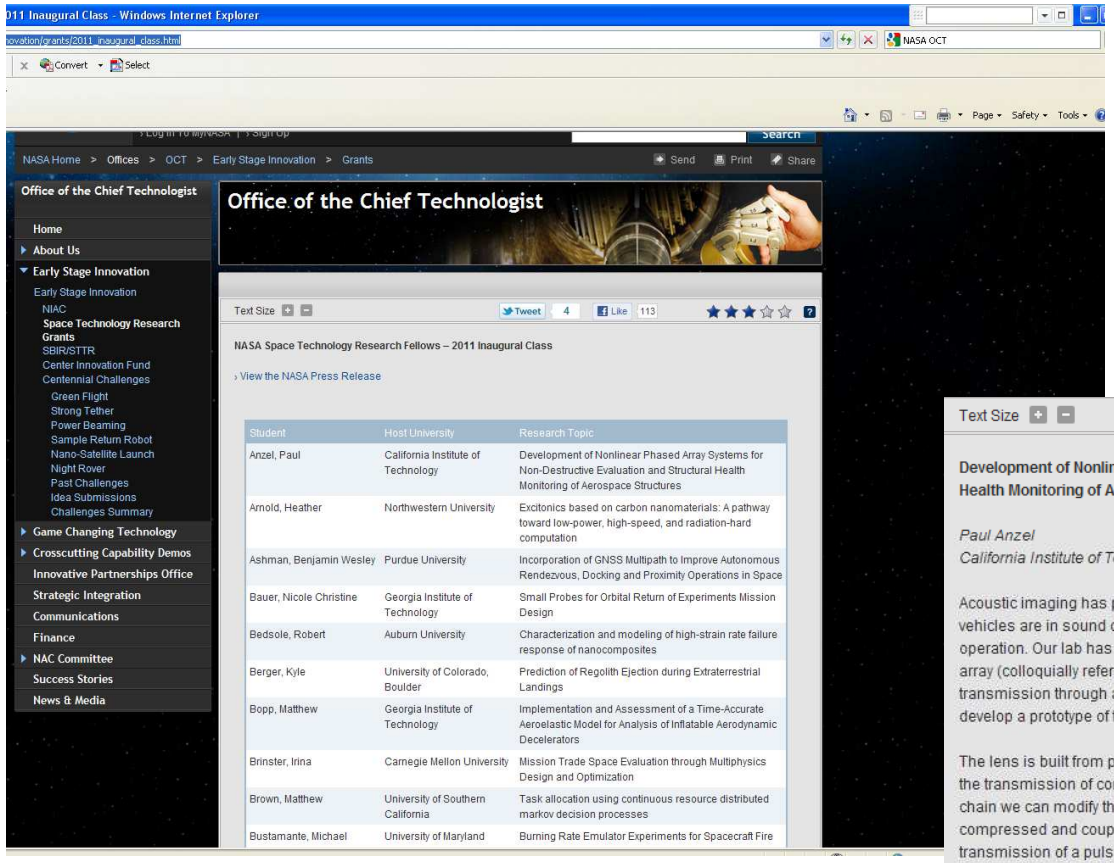


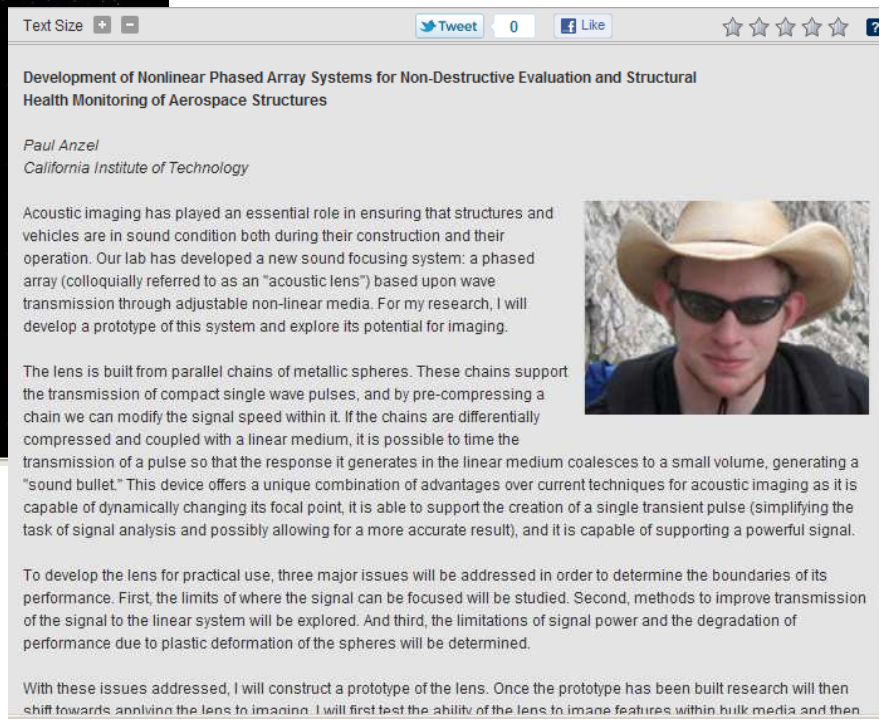





TA:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Launch Propulsion	In-Space Propulsion	Space Power/Storage	Robotics	Comm./Navigation	Human Health	Human Expl. Dest.	Sci. Instr./Sensors	EDL	Nanotechology	Modeling/Simulation	Materials/Structures	Ground Operations	Thermal

Find Out More About the NSTRF11 Awards





Developing the technological foundation for NASA's future science and exploration missions…providing the nation with a pipeline of highly skilled engineers and technologists to improve U.S. competitiveness.

The full listing of NSTRF11 awarded proposals with abstracts is available on the NASA OCT website at http://www.nasa.gov/offices/oct/early_stage_innovation/grants/2011_inaugural_class.html

Summary

- Inaugural class is in place – *impressive credentials*
- Roadmaps are the basis for collaboration
- Research partnerships are being formed
- NSTRF12 solicitation is open – we look forward to welcoming the next class of Space Technology Research Fellows