Exploration Research and Technology Overview

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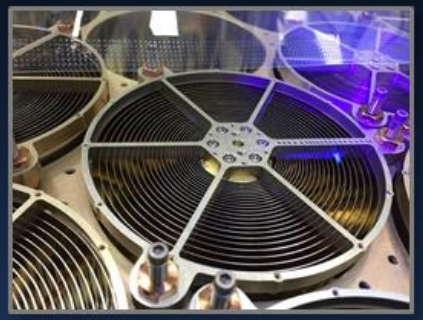
FY 18 Accomplishments

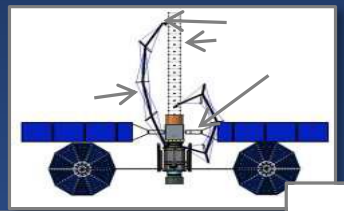
Small Spacecraft

Two small spacecraft (Integrated Solar Array and Reflect Antenna and CubeSat Proximity Operations Demonstration) missions were successfully launched aboard Orbital ATK's Cygnus spacecraft.



Station Explorer for X-ray Timing and Navigation Technology (SEXTANT)

Aboard ISS demonstrated fully autonomous X-ray navigation in space — a capability that could revolutionize NASA's ability in the future to pilot robotic spacecraft to the far reaches of the solar system and beyond.



In Space Robotics Manufacturing Assembly

All 3 contractors completed design, build and test/demo phases in year 1 successfully

Solar Electric Propulsion

Completed preliminary design review for Power & Propulsion Element qualification system

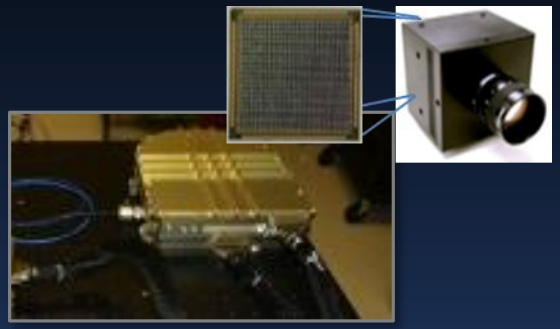
Kilopower

Testing began on 1 kW ground demonstration system- could be used for an affordable fission nuclear power system to enable long-duration stays on planetary surfaces.

FY 18 Accomplishments (Cont.)

Laser Communication Relay Demonstration

Successfully entered into the implementation phase and began system I&T to support a 2019 launch on STPSat-6



Deep Space Optical Communication

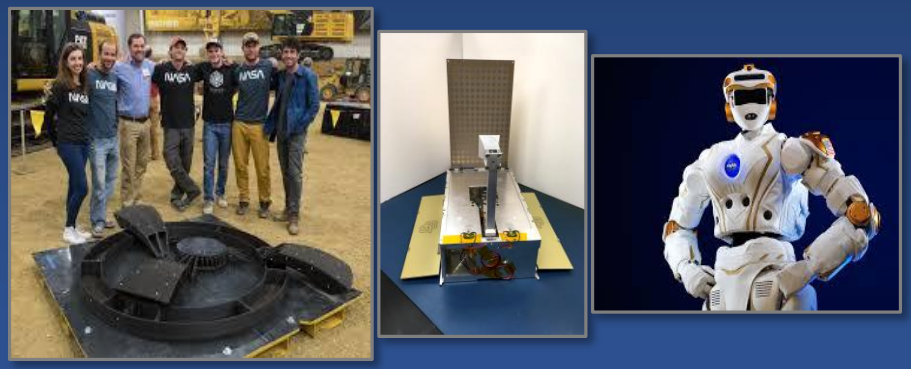
Completed ground testing to retire risk for its demonstration flight and began formulation for flight demonstration on the Psyche mission

SBIR/STTR Industry Day

Over 450 innovators from across the country participated in 2nd workshop

Flight Opportunities Testing for Precision Landing Technologies

Successful flight test of a Navigation Doppler Lidar and Lander Vision System for future robotic and crewed missions

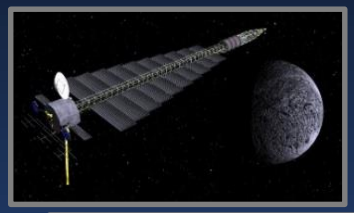


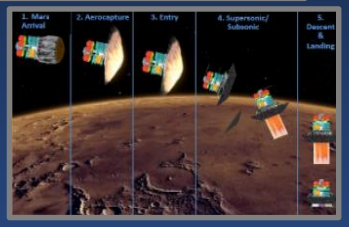
Centennial Challenges Program

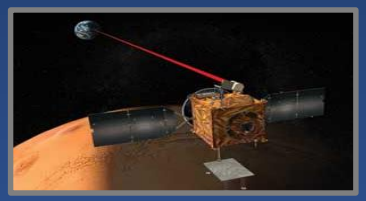
Awarded more than $1.5 million for technology solutions toward the Cube Quest, 3D Printed Habitat and the Space Robotics Challenges.

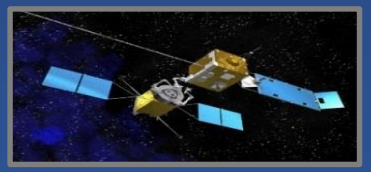
ER&T Key Technology Focus Areas

- Advanced environmental control and life support systems and In-Situ Resource Utilization
- Power and propulsion
- Advanced communications, navigation and avionics
- In-space manufacturing and on-orbit assembly
- Advanced materials
- Entry, Descent and Landing
- Autonomous operations
- Research to enable humans to safely and effectively operate in various space environments





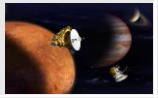
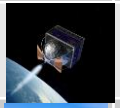




Partnering with Universities to Meet National Technology Needs

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
- In addition, there are many other partnerships between academia and NASA Centers and/or commercial entities through the below Programs and other STMD Programs such as Center Innovation Fund and SBIR.
- **Hundreds** of universities have participated!

Program	# awards	# University-led awards	Opportunities to Propose
Space Technology Research Grants	539	539	• Early Career Faculty • Early Stage Innovations • NASA Space Technology Research Fellowships Space Technology Research Institutes (biennial)
NIAC 	158	45	• NIAC Phase I • NIAC Phase II
Game Changing Technology Dev	73	19	Various topics released as Appendices to SpaceTech-REDDI
Small Spacecraft Technology 	50	38	Smallsat Technology Partnerships Cooperative Agreement Notice every one-two years.
Flight Opportunities	185	83	Tech advancement utilizing suborbital flight opportunities – NRAs to U.S. universities, non-profits and industry are planned.
STTR	434	*414 university partners*	*Annual STTR solicitation*
Centennial Challenges	*7 Challenges (2 university-run)*	*77 university teams out of 157 registered*	• *One or more challenges annually* • *Open to university faculty and students*

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 exploration as well as space travel and science 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 Exploration and other Mission Directorates**

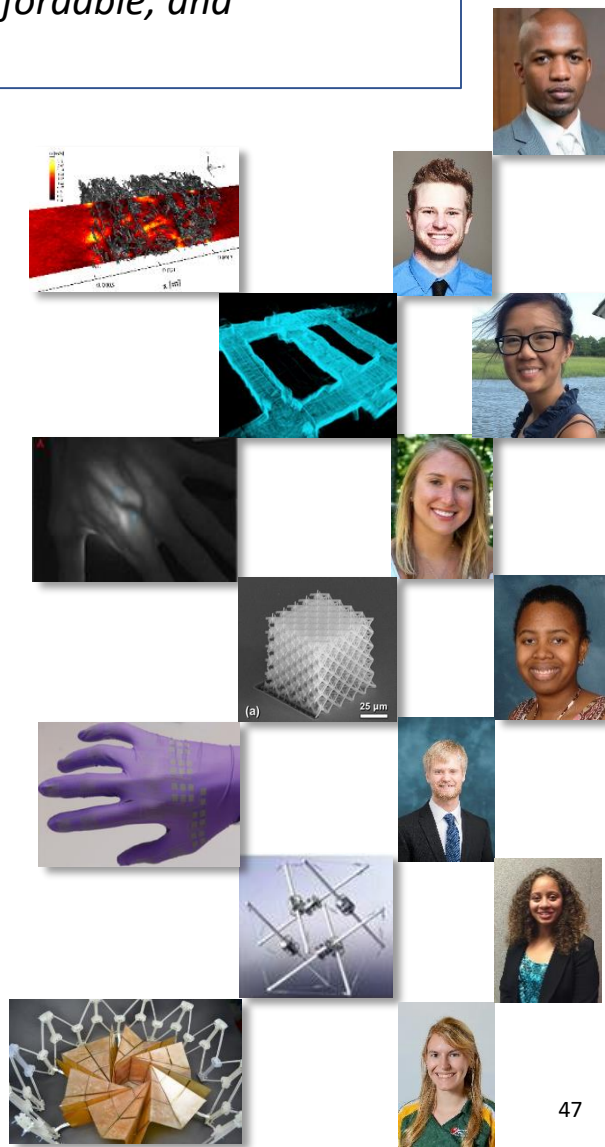
Early Stage Innovations

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

Space Technology Research Institutes

- 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



Additive Manufacture Training Program - Pilot

- **Problem/Need:** The limitation for increased university involvement in metal AM is access to metal AM machines or metal AM samples. Therefore, causing a very limited or lack of available skilled workforce.
- **Objective:** Develop an applied course for polymer and metal additive manufacture (AM). The course serves upper community college students, senior level undergraduate or first year graduate students. On-the-job training and placement within the aerospace AM industry is the goal.
  - Huntsville City Schools
  - Colhoun Community College (CCC)
  - University of Alabama in Huntsville (UAH)
- **Prerequisites:** Any technical major having completed of CAD and traditional manufacturing courses.
- **Course:**
  - **F**ull 14 week class for a max of 16 students.
- **Internship with AM Lab at MSFC:**
  - Top 1-2 students in each class from both CCC and UAH will receive a paid summer internship

Additive Manufacture Training Program - Pilot

- The Office of Education Minority University Research and Education Program (MUREP) is duplicating this program at several NASA centers.
- MUREP is partnering with STMD and providing $1M to support the implementation of this pilot program.
- MUREP has released a solicitation piloting this program. The goal is to select 3-4 awards pending adequate proposals of merit.

Activity Title: MUREP Innovation in Space Technology Curriculum

- *Timeline: FY19*
- *Goal: The goal of the MISTC is to contribute to the preparation, training, and development of the future NASA workforce. This will be accomplished by utilizing NASA's unique contributions in collaboration with two-year/community college Minority Serving Institutions (MSIs) and other academic institutions to develop innovations in curriculum and experiential learning opportunities. These innovations will be aligned with the priorities of NASA's Space Technology Mission Directorate (STMD), which is responsible for developing the crosscutting, pioneering, new technologies and capabilities needed by the agency to achieve its current and future missions.*