Next-Generation Suborbital Researchers Conference

Stephen Jurczyk
Associate Administrator
Space Technology Mission Directorate

June 2, 2016
Space Technology...
.... an Investment for the Future

- Enables a **new 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**.
- **Engages the brightest minds** from academia and industry, including small businesses, in solving NASA’s tough technological challenges.
- Invests in the economy by **creating markets and spurring innovation** for traditional and emerging aerospace business.

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

**STMD engages and supports:**
NASA Capabilities
Academia
Small Businesses
The Broader Aerospace Enterprise

Cumulative University Partnerships in Early Stage

Over 700 STMD projects w/ Academic Partnerships
Guiding Principles of the Space Technology Programs

- **Adhere to a Stakeholder Based Investment Strategy**: NASA Strategic Plan; NASA Space Tech Roadmaps / NRC Report; NASA Mission Directorate / Commercial advocacy

- **Invest in a Comprehensive Portfolio**: Covers low to high TRL; Grants & Fellowships; SBIR & prize competitions; prototype developments & technology demonstrations

- **Advance Transformative and Crosscutting Technologies**: Enabling or broadly applicable technologies with direct infusion into future missions

- **Develop Partnerships to Leverage Innovation and Resources**: Partnerships with Mission Directorates and OGAs to leverage limited funding and establish customer advocacy; Public – Private Partnerships to provide NASA resources and support to U.S. commercial aerospace interests

- **Select Using Merit Based Competition**: Research, innovation and technology maturation, open to academia, industry, NASA centers and OGAs

- **Execute with Lean Structured Projects**: Clear start and end dates, defined budgets and schedules, established milestones, lean development, and project level authority and accountability.

- **Infuse Rapidly or Terminate**: Operate with a sense of urgency; Rapid cadence of tech maturation; informed risk tolerance to implement / infuse quickly or terminate

- **Place NASA at technology’s forefront – refresh Agency’s capabilities**: Results in new inventions, creates a pipeline of NASA and national innovators, and refreshes the agencies technical capabilities
Space Technology Pipeline

Early Stage
- NASA Innovative Advanced Concepts
- Space Tech Research Grants
- Center Innovation Fund

Mid TRL
- Game Changing Development

High TRL
- Technology Demonstration Missions

Commercial Partnerships
- SBIR / STTR
- Flight Opportunities
- Centennial Challenges
- Regional Economic Development

Low TRL
- Small Spacecraft Technologies
STMD created CPP to focus our investments in the commercial sector to address NASA needs and to stimulate space commercialization.

- **SBIR/STTR**: Advance and infuse/commercialize new technologies developed by Small Businesses.
- **Flight Opportunities**: Develop suborbital and small launch vehicle market in addition to maturing technologies for future missions.
- **Centennial Challenges**: NASA’s prize authority to conduct prize-based challenges of high public interest to advance technologies.
- **Regional Economic Development**: Focused collaborations between NASA and multiple commercial entities within strategic geographic regions of interest.
Flight Opportunities facilitates technology development of innovative space technologies to:

- Reduce risk
- Reduce cost
- Improve performance
- Advance capabilities
Multiple paths are available for developing and testing technologies

- **SpaceTech-REDDI Umbrella NRA**
  - Appendices issued for specific requirements:
    - **External Call for Payloads Appendix**
      - U.S.-based researchers receive funding to purchase proposed flight service directly from commercial providers
    - **Tipping Point Technologies Appendix**
      - Embraces public-private partnerships between NASA and US industry to expand capabilities in space

- **NASA Internal Calls for Payloads**
  - U.S. government researchers access testing via contracted commercial suborbital flight providers

- **Announcement of Collaborative Opportunity**
  - “Sister solicitation” to Tipping Point Appendix
    - Provide opportunities for industry-led effort
Currently Participating Organizations

Flight Services for REDDI & NASA Payloads

- UP Aerospace
- Virgin
- WORLD VIEW
- Masten
- NSC
- zero g

ACO Public Private Partnerships

- Generation Orbit
- Vector Space
- Dynetics
- UP Aerospace

NOTE: Only showing flights purchased or conducted to date. Researchers selected under REDDI are in the process of purchasing flight service from additional commercial providers.
# Gecko Grippers

*A novel approach to grappling non-cooperative objects in microgravity*

<table>
<thead>
<tr>
<th>Year</th>
<th>Achievement</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>Parabolic flight test</td>
<td>Demonstrated grappling ability</td>
</tr>
<tr>
<td>2015</td>
<td>Parabolic flight test</td>
<td>Demonstrated mobility and free-floating grappling</td>
</tr>
<tr>
<td>2016</td>
<td>Deployment to ISS</td>
<td>Longer duration testing in microgravity</td>
</tr>
</tbody>
</table>

Testing helped researchers adjust design and demonstrate functionality in a realistic operational environment.
Additive Manufacturing Facility (AMF)

*Enabling production of critical components in micro-gravity*

<table>
<thead>
<tr>
<th>Year</th>
<th>Achievement</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Parabolic flight test</td>
<td>Technology optimization for microgravity</td>
</tr>
<tr>
<td>2013</td>
<td>SBIR Phase 3</td>
<td>Develop printer for ISS</td>
</tr>
<tr>
<td>2013</td>
<td>Parabolic flight test</td>
<td>Demonstrated effectiveness</td>
</tr>
<tr>
<td>2014</td>
<td>Deployment to ISS</td>
<td>Zero-Gravity 3D experimental printer operated successfully</td>
</tr>
<tr>
<td>2016</td>
<td>Deployment to ISS</td>
<td>AMF deployed as a permanent manufacturing facility on ISS</td>
</tr>
</tbody>
</table>

*In-flight observations enabled hardware/software modifications and rapid optimization for operation in microgravity*
# Mars Landing Technology

*Enabling unprecedented precision for spacecraft landings*

<table>
<thead>
<tr>
<th>Year</th>
<th>Achievement</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Vertical-launch/landing testing</td>
<td>Demonstrated navigation based on terrain-feature recognition and descent-course changing capabilities</td>
</tr>
<tr>
<td>2016</td>
<td>Baseline for Mars 2020 rover mission</td>
<td>System will assist with precision landing of Mars 2020 rover</td>
</tr>
</tbody>
</table>

*Testing provided rapid, low-cost means to validate this technology and prove its ability to successfully direct entry, descent, and landing of spacecraft on any space target*
New Flight Provider Selected

• Flight Opportunities program periodically runs a competition to add flight providers to the IDIQ-2 contract for NASA Internal Payloads
• Proposals were received and evaluated and a selection has been made
Congratulations