This presentation provides an overview of the NASA mission and overviews of both the IPP and SBIR programs and how they relate to each other and to the NASA mission. Examples are provided concerning NASA technology needs and how the SBIR program has not only enabled technology development to meet those needs, but has also facilitated the infusion of that technology into the NASA mission.
NASA Explores For Answers That Power Our Future

Inspiration

- NASA powers inspiration that encourages future generations to explore, learn, and build a better future.

Innovation

- NASA powers innovation that creates new jobs, new markets, and new technologies.

Discovery

- NASA powers discovery that enables us to learn more about ourselves, our world, and how to manage and protect it.

Inspiration + Innovation + Discovery = Future
NASA’s Strategic Goals

• Fly the space shuttle as safely as possible until its retirement, not later than 2010.

• Complete the International Space Station in a manner consistent with our international partner commitments and the needs of human exploration.

• Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

• Bring a new Crew Exploration Vehicle into service as soon as possible after shuttle retirement.

• Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

• Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.
Global Exploration Strategy

- Human Civilization
- Scientific Knowledge
- Exploration Preparation
- Global Partnerships
- Economic Expansion
- Public Engagement
Global Exploration Strategy
NASA Organization

Space Operations Mission Directorate

Science Mission Directorate

Aeronautics Mission Directorate

Explorations Systems Mission Directorate
Sensors in Extreme Environments

- Multifunctional Intelligence
- High performance
- High weight
- Extreme Temperature Resistance
- Extreme Radiation Resistance
- Meteorite Impact & Dust Resistance
- Ultra-sensitive Signal capture
- Scientific Productivity
- Human “Amplifiers”
- IVHM
- Launch $• Aeronautics Applications
- Human Habitats
- Mission to Europa: 1-5 Mrads
- Lunar Surface: -233 °C to 123 °C
- Mars Surface: -87 °C to -5 °C
- Voyager: Signal From 9.3 x 10⁹ mi

- Highly electrostatic
- Ultrafine
- Human Habitats

- Lunar Surface:
  - -233 °C to 123 °C

- Mars Surface:
  - -87 °C to -5 °C
Innovative Partnerships Program

Matching Technology Needs with Technology Capabilities
IPP’s Dynamic Innovation Process

NASA Innovative Partnerships

Technology Capabilities

Emerging Firms

Universities

Research Institutions

Government Labs

Small Businesses

Industry NASA Centers

Translate

Facilitate

Communicate

Motivate

Locate

Cultivate

Negotiate

Educate
Innovative Partnerships Program Elements

**Technology Infusion**
- Small Business Innovation Research (SBIR)
- Small Business Technology Transfer Research (STTR)
- IPP Seed Fund

**Innovation Incubator**
- Centennial Challenges
- New Business Models
- Innovation Transfusion

**Partnership Development**
- Intellectual Property Management
- Technology Transfer
- New Innovative Partnerships
IPP Technology for Mission Directorates

Innovative Partnerships Program
- SBIR/STTR
- Centennial Challenges
- Seed Fund
- Partnerships

Technology Needs
- Communication

Technology Infusion
- Bridging the “Valley of Death”
- Narrow the gap and reduce risk
- Begin building bridges early

Mission Directorates
- Programs
- Projects

Executed at the Field Centers
Technology Demonstration is critical to Infusion

- As a rule of thumb, projects like technology to be TRL-6 by PDR
- Technology Demonstration in relevant environments is critical

TRL 9  Actual system “flight proven” through successful mission operations.
TRL 8  Actual system completed and “flight qualified” through test and demonstration (ground or space).
TRL 7  System prototype demonstration in a **relevant environment**.
TRL 6  System/subsystem model or prototype demonstration in a **relevant environment** (ground or space).
TRL 5  Component and/or breadboard validation in **relevant environment**.
TRL 4  Component and/or breadboard validation in laboratory environment.
TRL 3  Analytical and experimental critical function and/or characteristic proof-of-concept.
TRL 2  Technology concept and/or application formulated.
TRL 1  Basic principles observed and reported.
SBIR Technology Infusion Examples

Mars Exploration Rovers
- ASCII chip for memory modules and analog-to-digital converters.
- Heat switches to control radiator for electronics package.
- Lithium-ion batteries for battery packs.
- ARC-invented heatshield technology Phenolic Impregnated Carbon Ablator (PICA)
- SBIR awards to FMI advance manufacturing scalability of the technology
- PICA selected as an enabling technology for successful STARDUST mission
- STARDUST success leads to further application as heatshield on crewed reentry vehicles
- Mars Phoenix Lander
- Icy Soil Acquisition Device supplied by Honeybee Robotics, Inc.

Space Shuttle and ISS
- Sensor Control and Acquisition Telecommunications (SCAT)
- Wireless Instrumentation Systems
- Microgravity Instrumentation (And Structural Dynamics)
- SpaceDev (formerly Starsys) contributed to the design of the Microscopy Electrochemistry and Conductivity Analyzer (MECA)

Mars Phoenix Lander
- Lithium ion batteries supplied by Yardney Technical Products, Inc.
Leak Detection System

1997
NASA space shuttle hydrogen sensors demonstrated on STS 95 and 96

1998
NASA X-33 RLV program validated hydrogen safety system MSFC STTR with Case Western Reserve University

1999
NASA Hypersonic X–43 validated hydrogen safety sensors MSFC STTR with Case Western Reserve University

2000
International Space Station hydrogen sensing system included on the water processing O2 generator

2001
Helios aircraft collaborative effort with AeroVironment and DFRC

2003
Ford Model U—Standard Hydrogen, Inc. (spin-off company) provides comprehensive hydrogen monitoring system

- KSC SBIR for sensor technology to detect hydrogen leaks
- $1.6M STTR Phase 3 follow-on effort from GRC to further develop next-generation hydrogen and oxygen miniaturized leak detection systems
- $700K Space Act Agreement with Glennan Microsystems/Ohio State University for High Temperature Electronic Nose
- Received the R&D 100 Award in 2005

Aeronautics, Space Operations, and Exploration Systems Mission Directorates

NASA Glenn Research Center
Gary Hunter • 216–433–6459

Makel Engineering, Inc.
Darby Markel • 530–895–2770

www.nasa.gov
Technologies and Firms are Searchable

NASA Technology Source provides information on current and recently completed SBIR/STTR Phase I projects funded by NASA. The purpose of this site is to facilitate the transition of resulting technologies into further development, investment, and utilization for NASA mission programs and commercial applications.

Browse 1 - 4 of 4 matches

Proposal Info.

<table>
<thead>
<tr>
<th>X1.02-8340 (SBIR 05-2)</th>
<th>Automated Design and Analysis Tool for CLV/CEV Composite and Metallic Structural Components</th>
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Abstract

The innovation of the proposed effort is a unique automated process for the analysis, design, and sizing of CLV/CEV composite and metallic structures. This developed process will permit hundreds of conceptual and preliminary design trade studies to be performed in a matter of only a few days rather than several months. This shorter time is made possible by replacing or reducing currently required experienced analyst interaction (man in the loop) with pre-defined knowledge-based sizing templates for laminate strength and productivity optimization. Innovative virtual structural component definitions that float between automatic HyperSizer to FEA iteration cycles redefine aerospace surfaces areas while simultaneously including connecting bonded/bolted joints. The resulting capability will be an open architecture built within the HyperSizer<sup>®</sup>+<sup>®</sup> commercial software suite capable of interacting with other NASA or industry developed specialty discipline analysis codes and externally integrating HyperSizer with NASA larger design systems. This new capability will be unique in that no other commercial or non-commercial tool will have the same level of depth, breadth, accuracy, speed, verification & validation, and software robustness for performing weight prediction and reduction, structural integrity margins-of-safety reporting, and reliability prediction and improvement.

https://sbir.gsfc.nasa.gov/sbir/search/fundedTechSearch.jsp
Field Center Missions

**Ames Research Center:** Research of new technologies

**Dryden Flight Research Center:** Flight research

**Glenn Research Center:** Aeropropulsion and communications technologies

**Goddard Space Flight Center:** Earth, the solar system, and universe observations

**Jet Propulsion Laboratory:** Robotic exploration of the solar system

**Johnson Space Center:** Human space exploration

**Kennedy Space Center:** Prepare and launch missions around the Earth and beyond

**Langley Research Center:** Aviation and space research

**Marshall Space Flight Center:** Space transportation and propulsion technologies

**Stennis Space Center:** Rocket propulsion testing and remote sensing technology
# NASA SBIR/STTR Program

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<td><strong>Phase II</strong> $600K (matching for additional $150K) / 2 years</td>
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<td>Research Institute: 30% - 60%</td>
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<td></td>
<td>LBC: max. 30%</td>
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SBC - Small Business Concern  
LBC - Large Business Concern
## NASA SBIR/STTR Program

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<th>NASA</th>
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http://sbir.nasa.gov/
SBIR/STTR Program Schedule

2008 Program Solicitation
Opening Date: 07/07/2008
Closing Date: 09/04/2008
Selections: Nov. 2008

http://sbir.nasa.gov
Inherent Challenges of Space Systems

- Surviving Launch Conditions: high g-load, vibration, payload fairing, deployment
- Functioning in Extreme Environments: radiation, temperature, gravity, vacuum
- Limiting Power Availability
- High Degree of Autonomy and Reliability
- Long Range Communication and Navigation
Proposal Review & Selection Criteria

Proposal Review

- Factor 1: scientific/technical merit and feasibility (50%)
- Factor 2: experience, qualifications and facilities (25%)
- Factor 3: effectiveness of the proposed work plan (25%)
- Factor 4: commercial merit and feasibility (adjectival)

Proposal Ranking and Selection

- NASA Project/Mission Alignment
- Value, Priority and Infusion Potentials
- Champion/Advocate
Who’s Who in NASA Program

**Program Management:**
Program Executive - Source Selection Official (Headquarters)
Agency Program Management Office (Ames Research Center)
Field Center Program Offices

**Technical:**
Mission Directorate Representatives
Topic Managers/Subtopic Managers
Technical Reviewers

**Resource Management:**
Resource analysts

**Procurement:**
Contracting Officer (NSSC - NASA Shared Service Center)
Tech Monitor, Contracting Officer’s Technical Representative (COTR)
Nature of NASA SBIR Contracts

- SBIR contracts are fixed price contracts to be completed on a best effort basis.
- Contractors own resulting intellectual property (data, copyrights, patents, etc.).
- Government has royalty-free rights for government use of intellectual property.
- Government protects data from public dissemination for four years after contract ends.
- NASA is a potential customer.
Goal: infusion to NASA missions, programs and projects

- Identify potential project(s) for infusion early.
- Achieve TRL 6: systems/subsystem model or prototype demonstration in a relevant environment (ground or space).
- Work closely with technical monitor (COTR) and his/her colleagues.
- Be proactive and responsive to various opportunities.
Secrets of Success

- Familiar with Federal and NASA SBIR/STTR program.
- Learn NASA missions and enabling technology needs. Proposals should show an understanding of one or more relevant space science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.
- Have niche capabilities: unique competitive edge. Also, know state-of-the-art and competing technologies.
- Be strategic: treat Phase I, Phase II and NASA infusion as a package. Research should be conducted to demonstrate feasibility during Phase 1 and show a path towards a Phase 2 prototype demonstration.
- Build relationships: champions and networking.
Approaches

- Search and identify specific technical areas (subtopics) and lead center(s) of your interest.
- Request subject matter expert contact information from respective field center program POCs.
- E-mail/Call technical POCs and initiate dialogues.
- Learn technology needs and priorities.
- Visit and make presentations, if necessary.
Simple Math

- SBIR and STTR are not taxes. They are set asides.
- Extramural R&D:
  \[100\% = 2.5\% \text{ SBIR} + 0.3\% \text{ STTR} + 97.2\%\]
- External Contractors = Primes + Small Businesses
- Prime = Internal + Small Businesses
- Opportunities = SBIR + STTR + Agency Projects + Primes + Other Agencies
SBIR/STTR Center Points of Contact

**Ames Research Center (ARC)**
Dr. Rich Pisarski, 650-604-5582, Ryszard.L.Pisarski@nasa.gov
Kim Hines, 650-604-5582, Kimberly.K.Hines@nasa.gov

**Dryden Flight Research Center (DFRC)**
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**Glenn Research Center (GRC)**
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Jim Stegeman, 216-433-3389, James.D.Stegeman@nasa.gov

**Goddard Space Flight Center (GSFC)**
Dr. Jim Chern, 301-286-5836, Jim.Chern@nasa.gov

**Jet Propulsion Laboratory (JPL)**
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Dr. Carol Lewis, 818-354-3767, Carol.R.Lewis@jpl.nasa.gov
SBIR/STTR Center Points of Contact

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Kathy Packard, 281-244-5378, Kathryn.B-Packard@nasa.gov

**Kennedy Space Center (KSC)**
Joni Richards, 321-867-2225, Joni.M.Richards@nasa.gov

**Langley Research Center (LaRC)**
Bob Yang, 757-864-8020, Robert.L.Yang@nasa.gov
Kimberly Graupner, 757-864-8618, Kimberly.E.Graupner@nasa.gov

**Marshall Space Flight Center (MSFC)**
Lynn Garrison, 256-544-6719, Virginia.B.Garrison@nasa.gov

**Stennis Space Center (SSC)**
Ray Bryant, 228-688-3964, Ray.Bryant-1@nasa.gov
Questions?
Additional Information
IPP Seed Fund

- An annual process for selecting innovative partnerships to address technology barriers via cost-shared, joint-development projects.
- Enhances NASA’s ability to meet the priority technology gaps of all four of NASA’s Mission Directorates.
- The IPP Office at NASA HQ issues an annual Seed Fund call to all NASA Centers – they downselect and send to HQ for final selections.
- The Seed Fund operates through a collaboration of Center IPP Offices, NASA co-PI, and external co-PI.
- Proposals are evaluated against the following criteria:
  - Relevance/Value to NASA Mission Directorates.
  - Scientific/Technical merit and feasibility.
  - Leveraging of resources.
- In the last two years, an investment of $15.9 million by IPP facilitated the generation of 67 partnerships and was leveraged by a factor of four, providing a total of $62.2 million for the advancement of critical technologies and capabilities for the Agency.
Seed Fund TRL Advancement

FY06 Seed Fund Portfolio

FY07 Seed Fund Portfolio
Demonstration Highlights

Technology Demos

- **Cryostable Low-cost Mirror (Deep Space Missions)**
- **Inflatable Human Habitat (Human Lunar)**
- **Inflatable Decelerator (AFL MARS and COTS)**
- **Li-ion Battery for PLSS (Human EVA)**
- **Cryo-tracker Flight Qualification (Atlas/Centaur Launches)**
- **4D Flight Mgmt (NGATS)**
- **ISHM - Test Stand and J2X Engine (Aries 1 Upper Stage)**

Li-ion Battery for PLSS (Human EVA)
Antarctic Habitat Demonstrator

- NASA / NSF / ILC Dover Innovative Partnership Program (IPP)
- Test of expandable structures in Antarctic Analog to advance NASA knowledge base for lunar application
- Test of expandable structures to advance NSF knowledge and assess applicability to polar missions

System Requirements (NASA & NSF Combined) - Annotated
- Reconfigurable components
- Ejected by 4 people in 4 hours
- Can withstand 100 mph winds
- High Packing Efficiency
- Can deploy on uneven ground
- Withstand the Antarctic white
- Multiple cycle use
- Lighting/power/data acquisition
- Meet NSF building codes

Main Habitat (2 Segments)
- Insulated Structure
- Open 

Main Habitat
- 2 Man Head Rooms: 5
- Floor Area: 284 sq ft
- (40 ft x 7)

Packed System
- 1000 lb (2200 lbP)
- 10.1 Packing Efficiency

Airlock
- 5 man Head Doors: 6.5 ft
- Floor Area: 24 sq ft (9 ft x 4 ft)

Insulated Floor

Electrical / Computer / Heating System

Reconfigurability Studies

Connections between sections were simple in ECWG + demonstrated reconfigurability

Section Couplings (2)

The system adapted well to the uneven ground due to compliant interfaces and structures

Packed & deployed system dozens of times

Antarctic Habitat Demonstrator Study Goals

Large Expandable Structures:
- Packing efficiency & shipping/handling survival
- Deployment operability in a gravitational environment and in polar gear (representing space suits)
- Adaptability to uneven and rugged surfaces representing the lunar surface
- Reconfigurability

- Performance in a harsh environment
- Deployment with integrated electronics (power, lighting, sensors, etc.)
- Remote structural health monitoring over long periods of time
- Use of in-situ materials for shielding from radiation
- Lunar dust mitigation practices

Radiation Protection Studies

Researching ways to apply regolith to the walls of a structure for radiation shielding

Bags
- Fill bags attached to structure

Blankets
- Flexible PE blankets applied where required

Regolith Lifter
- Push regolith on deflated structure, inflate structure, capture regolith on walls
How Do Prizes Benefit NASA?

- Increased Participation by New Sources of Innovation
- Leveraging of Tax-Payers’ Dollars
- Innovative Technology Development to Meet NASA’s Needs
- Increased Awareness of Science and Technology
- Hands-on Training for Future Workforce
# Funded Centennial Challenge Competitions

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<th>Competition</th>
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<th>2009</th>
<th>2010</th>
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<td>$1M</td>
<td>250</td>
<td>350</td>
<td>400</td>
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<td>250</td>
<td>500</td>
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<tr>
<td>Personal Air Vehicle</td>
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<td>250</td>
<td>300</td>
<td>400</td>
<td>500</td>
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<td>300</td>
<td>400</td>
<td>500</td>
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<td>300</td>
<td>400</td>
<td>500</td>
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<tr>
<td>Lunar Lander</td>
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<td>250</td>
<td>750</td>
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**Total Competition**

- **Beam Power Challenge**
- **Tether Challenge**
- **Astronaut Glove Challenge**
- **MoonROx Challenge**
- **Lunar Lander Challenge**

Personal Air Vehicle Challenge

Regolith Excavation Challenge
And The Winner Is...

...Peter Homer
Facilitated Access to the Space environment for Technology development and training

Objectives:
- Advancing technology maturity to enhance technology infusion.
- Providing regular opportunities for access to unique environment.
- Demonstrating use of commercial services.
Innovation Transfusion

**Issue:**
There is significant potential for NASA to learn and benefit from innovative technologies, processes and practices occurring outside the Agency; some potential currently realized on ad hoc basis.

**Goal:**
Create strategic connections between innovative external organizations and NASA for increased Agency benefit from external creativity.

---

**Project Components**

- **Innovation Ambassadors**
  
  Technical training program for up to 1 year at an external organization

- **Innovation Scouts**
  
  Workshops with NASA to external organizations focusing on specific innovations

- **Agency Dissemination**
  
  Use existing mechanisms to communicate innovations
• Partnership with another agency to develop a new airborne spectrometer (MaRS)
• MaRS uses Offner and push broom design for improved performance metrics (radiometric precision, uniformity, simplicity, reliability)
• Partner provides $10M in funding to increase technology from TRL 3 to 7
• 24 month build
• Demonstrated in 2006

Airborne Compact Imager
• NASA selects advanced push broom, compact spectrometer (Moon Mineralology Mapper) for joint NASA/ISRO experiment
• Based on MaRS design
• 24 month build
• Launch in 2008
Outreach & Publications

http://www.techbriefs.com/
http://www.sti.nasa.gov/tto/
http://www.sti.nasa.gov/spinoff/searchrecord
http://ipp.nasa.gov/innovation/index.html

NASA @ Home & NASA City
http://www.nasa.gov/city

Visit us at ipp.nasa.gov
NASA Technologies Enhance Our Lives

Innovative technologies from NASA's space and aeronautics missions (above) transfer as benefits to many sectors of society (below).

Each benefit featured in Spinoff 2007 is listed with an icon that corresponds to the mission from which the technology originated.

**Health and Medicine**
- Improves CPR
- Detects cardiovascular disease
- Assists patients with cognitive disorders
- Evaluates nerve function
- Fights acne
- Broadens cellular analysis
- Enhances diagnostic imaging

**Transportation**
- Eases air traffic management
- Advances rotorcraft design
- Improves flight safety
- Boosts helicopter performance
- Protects general aviation aircraft

**Public Safety**
- Detects potential threats
- Sharpens views in critical situations
- Cleans air and water for indoor environments

**Consumer, Home, and Recreation**
- Restores artwork
- Enhances education and recreation
- Reduces fat while improving flavor
- Transforms paint into insulation
- Protects machines and the environment
Environmental and Agricultural Resources
- Maps, monitor, and manage Earth's resources
- Provides environmental data
- Saves energy and prolong motor life
- Prevents corrosion in steel and concrete structures

Computer Technology
- Simplifies analysis and design
- Translates 2-D graphics to 3-D surfaces
- Improves health and performance monitoring
- Enables smarter content management
- Validates system design

Industrial Productivity
- Strengthens structures
- Boosts data transmission
- Enhances precision fabrication
- Broadens sensing horizons
- Resists extreme heat and stress
- Develops ultra-hard steel
- Saves time and energy
- Streamlines production
- Controls noise and vibration
- Advances thermal management
What Can IPP Provide?

- **Funding or Leveraged Resources**
  - NASA SBIR/STTR funds several hundred small businesses
  - IPP Seed Fund seeks partnerships to leverage resources with the private sector and other Federal labs
  - Centennial Challenges offers millions in purses

- **Technology and Software**
  - Access through licensing or other partnerships

- **Facilities**
  - Access to NASA’s facilities through partnerships

- **Expertise**
  - Access to NASA’s technical expertise through partnerships

- **Facilitation to enable partnerships**
- **Advocacy as a change agent to try new things**
Interested in partnering with NASA?

Contact the relevant IPP Center Chief(s):

<table>
<thead>
<tr>
<th>Center</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARC</td>
<td>Lisa Lockyer</td>
<td><a href="mailto:Lisa.L.Lockyer@nasa.gov">Lisa.L.Lockyer@nasa.gov</a></td>
<td>(650) 604-0149</td>
</tr>
<tr>
<td>DFRC</td>
<td>Gregory Poteat</td>
<td><a href="mailto:greg.poteat@dfrc.nasa.gov">greg.poteat@dfrc.nasa.gov</a></td>
<td>(661) 276-3872</td>
</tr>
<tr>
<td>GRC</td>
<td>Kathy Needham</td>
<td><a href="mailto:Kathleen.K.Needham@nasa.gov">Kathleen.K.Needham@nasa.gov</a></td>
<td>(216) 433-2802</td>
</tr>
<tr>
<td>GSFC</td>
<td>Nona Cheeks</td>
<td><a href="mailto:Nona.K.Cheeks@nasa.gov">Nona.K.Cheeks@nasa.gov</a></td>
<td>(301) 286-8504</td>
</tr>
<tr>
<td>JPL</td>
<td>Ken Wolfenbarger</td>
<td><a href="mailto:james.k.wolfenbarger@nasa.gov">james.k.wolfenbarger@nasa.gov</a></td>
<td>(818) 354-3821</td>
</tr>
<tr>
<td>JSC</td>
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