innovative: Mining for funding and research expertise through SBIR and STTR programs

The Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) programs are designed to stimulate technological innovation in the private sector to meet federal research and development needs. The three-phase approach enables small businesses to develop a technology in response to a specific set of NASA mission-driven needs.

- In Phase I, researchers establish the technical feasibility and merit of a proposed innovation.
- Proposals awarded contracts may proceed to Phase II, in which the bulk of the R&D efforts occur.
- In Phase III, the result of Phase II is infused into NASA programs, other government organizations, and/or the commercial marketplace.

At Goddard, FY07 brought with it many SBIR/STTR research contracts, several of which have successfully entered Phase III and are expected to directly benefit a NASA mission or need.

For more information about the program details and phases, visit: http://sbir.gsfc.nasa.gov

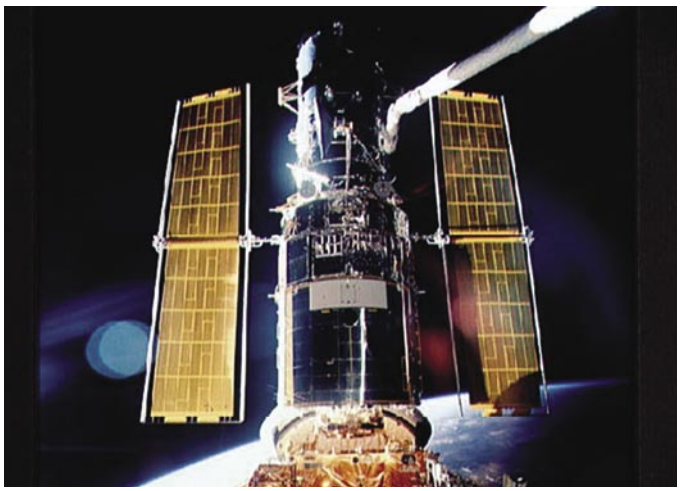
More than 30 companies received SBIR/STTR funding in FY07, totaling $3.5M.

AOS goes from Phase I to Phase III to benefit the Hubble Space Telescope

Hubble Space Telescope

As FY07 came to a close, NASA was beginning its second Phase III SBIR contract with Advanced Optical Systems, Inc. (AOS) of Huntsville, AL. The company's latest contract is designed to directly benefit the Hubble Space Telescope (HST) through the conceptualization and build of the "Hybrid Guidance Sensor III," a system to aid satellite rendezvous and docking. The hybrid sensor combines AOS's Ultor sensing technology (which was developed as part of an SBIR contract with the U.S. Navy), and Marshall Space Flight Center's Advanced Video Guidance Sensor (AVGS). Ultor uses a camera and natural illumination (e.g., sun, stars, etc.), while AVGS illuminates with a laser and reflections off of targets. Combining the two technologies provides redundancy and therefore robustness and reliability to aid the critical docking process.

Now in Phase III, NASA and AOS are in the process of testing the new system using facilities at Goddard and Marshall Space Flight Center. Testing is expected to be completed in early 2008, and researchers expect the technology to benefit not only the HST but other NASA missions requiring rendezvous and docking, such as ORION. And beyond NASA, applications exist within the Department of Defense (DoD), Navy, Army, and Air Force. Outside government and military applications, the technology may also be useful in helping to dock ships in ports, maintaining precise distances between ships for resupply operations, and other uses.



Hubble Space Telescope

SBIR contract with Bauer Associates yields improved nanoscale optical measurement techniques

Another SBIR Phase III agreement—this time with Bauer Associates, Inc. of Wellesley, MA—stands to benefit many NASA missions. The organization conceived of and proved the theory behind a new concept for optically measuring large mirror surfaces. During Phase II of the SBIR contract, researchers developed a working prototype instrument that utilizes a non-interferometric, optical technique for measuring absolute aspheric shape over the full surface of large mirrors to the nanometer level, without the need for known reference surfaces, simplifying R&D efforts. Moving into Phase III, Bauer worked with the Smithsonian Astrophysical Observatory to use the prototype to measure the surface of NASA's High-Resolution X-Ray Explorer (HIREX) Pathfinder mirror. And multiple Phase II follow-on contracts are underway to further develop the capabilities of this technology.

Meanwhile, commercialization talks are ongoing with an established manufacturer of large optics to develop and integrate the instrument into the company's fabrication and metrology facilities. Through IPP funding, this agreement has addressed a NASA need while helping a small business develop a new product that has commercial as well as NASA potential, providing benefits to NASA, the company, and the U.S. economy.

innovative: Combining resources to make great things possible through the IPP Partnership Seed Fund

The IPP at NASA Headquarters established the Partnership Seed Fund to address barriers and initiate cost-shared, joint-development partnerships, providing "bridge funding" to enable larger partnerships and development efforts. Each year, Goddard's IPP Office coordinates and advises the proposal efforts for projects including partnerships with other government agencies, small and large businesses, universities, and other NASA Centers. In the sections that follow, we discuss the progress that was made in FY07 on Seed Funded projects, and introduce the new proposals that were selected for funding.

2006 IPP Seed Fund recipients make great progress

Recipients of 2006 Seed Funding spanned a wide variety of research goals, from optics to exploration planning. The IPP Office managed the submission process for Goddard, developing an innovative process for reviewing many proposals and then selecting and aiding the development of the proposals submitted to NASA Headquarters. The Goddard recipients that received funding in 2006 have been hard at work on the jointly funded research that stands at the helm of benefiting many important NASA missions. These recipients made significant progress in FY07, as discussed in the stories that follow.

Advancing and lowering the cost of NASA's next-gen X-ray and IR telescopes

A Seed Fund partnership among Goddard, Lake Shore Cryotronics, and Lockheed Martin (LM) is helping researchers advance the technology readiness level (TRL) of Goddard's Continuous Adiabatic Demagnetization Refrigerator (CADR) through complementary design changes in control electronics and cryogenic components. These advancements will benefit future missions by enhancing the temperature stability of high-resolution X-ray and infrared (IR) telescopes that make observations with detectors cooled to ultra-low temperatures. Progress to date includes control voltage calculations and improved stability of the system.

NASA Goddard researcher Peter Shirron is collaborating with Lake Shore Cryotronics and Lockheed Martin to advance his innovative adiabatic demagnetization refrigerator (CADR) technology.

Benefits to NASA

NASA will benefit significantly from this partnership, which is contributing directly to NASA's need to demonstrate a system that meets all cooling requirements for upcoming missions. The partnership work will:

- Enable Goddard to provide detectors and instruments for a wide range of future X-ray, submillimeter and IR missions
- Provide significant cost and schedule savings by reducing the cost and duration of flight electronics development
- Offer significant benefits to high-profile missions such as Constellation-X and to a Goddard X-ray instrument on the Japanese New X-ray Telescope (NeXT) mission

Lowering the cost and risk of the Hubble and James Webb Space Telescopes

The James Webb Space Telescope (pictured) may benefit from Seed Fund work with Teledyne.

Another IPP Seed Fund partnership with Teledyne Technologies is enabling the development and testing of new concepts for very large astronomical focal planes. The project aims to provide the extreme performance required for future NASA missions that call for large-format focal planes to cover the field of view, as well as precision guiding to support high spatial resolution to achieve very high signal-to-noise ratios for transient phenomena such as planet transits. To date, researchers have demonstrated simultaneous imaging and guiding of Teledyne's sensor chip assembly and are working with the company to develop a new sensor chip assembly for testing that will be suitable for use in space astrophysics.

Benefits to NASA

The work will:

- Provide NASA with a new architecture for future large observatories in space
- Lower cost and risk while improving performance, significantly benefiting future missions that require large-format focal planes, in particular HST and the James Webb Space Telescope (JWST)
- Possibly benefit future NASA missions requiring extreme spatial resolution with the largest feasible fields of view, including the Joint Dark Energy Mission (JDEM) and the Microlensing Planet Finder (MPF)
- Provide the credibility and technology readiness level (TRL) necessary to ensure low-risk implementation in these and other future missions

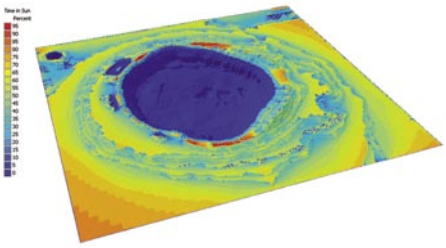
Developing new remote sensing

With support from the IPP Seed Fund, ITT Space Systems is working collaboratively with Goddard and Marshall Space Flight Centers to advance the TRL of a multi-core glass mirror architecture, helping to meet the needs of next-generation large space telescopes. Goddard researchers are conducting acoustic, vibration, and ambient-temperature figure testing of ITT Space Systems' multi-core mirror architecture, and Marshall will carry out cold figure testing with facilities developed for the JWST program. To date, researchers have completed the design of a 2.8 kg mirror, which has passed preliminary acoustic testing at Goddard. A second mirror is currently being fabricated. Subsequent integrated structural modeling will enable a physical understanding of mirror performance.

Benefits to NASA

A primary objective of the work is to enable ITT to provide mirrors for missions, such as the Single Aperture Far-Infrared (SAFIR) Observatory, more rapidly and at a much lower cost. NASA stands to benefit greatly through:

- Availability of more cost-effective remote sensing technologies that will help researchers better see, detect, and measure the Earth, Sun, solar system, and universe
- A higher level of technology readiness that will likely impact NASA, as well as other federal agencies (e.g., Department of Homeland Security, Defense Advanced Research Projects Agency) and commercial entities



ILIADS

2006 IPP Seed Fund recipients make great progress *(continued)*

Integrating software to improve lunar images, data, and overall missions

An IPP Seed Fund partnership between Goddard and United Space Alliance (USA) was formed this year to integrate Goddard's Integrated Lunar Information Architecture for Decision Support (ILIADS) lunar Geospatial Information System (GIS) software tools with USA's Questus™, a crew-centric management and planning applications suite specifically developed for space mission operations. Research aims to help lunar exploration engineers, scientists, mission operations personnel, and exploration crews sift through and extract meaningful information from environmental and situational data from multiple sources, in order to make the most effective decisions to drive exploration. To this end, researchers are constructing a comprehensive planning and decision support capability that can be used for near-term Lunar Precursor and Robotic Program (LPRP) exploration mission formulation studies, and to conduct real-time and safe crew-centric lunar sorties in the long term. To date, researchers have demonstrated the capabilities of the integrated software, have begun defining and implementing interface control documents, and are developing a model.

(Editor's Note: A separate project with USA has also received Seed Funding for 2008. *See the story on page 11 for details.)*

Benefits to NASA

The ILIADS–Questus integration will:

- Provide access to lunar environment and mission information that can be easily retrieved, visualized, and correlated
- Benefit the Lunar Reconnaissance Orbiter (LRO), enabling NASA to capture and utilize lunar data/images with much greater resolution than ever before
- Serve as a potential revenue stream for NASA as commercial opportunities for lunar exploration arise

> "I don't think this partnership could have happened without the support of Goddard's Innovative Partnerships Program Office and the Agency's new Seed Fund. I am so pleased to see NASA putting real resources toward initiating partnerships. There will be very real benefits to specific NASA objectives in terms of both cost and capabilities."
>
> *— Julia Loftis, Goddard Innovator*