



## NASA Goddard Space Flight Center

### Goddard: Bringing the 'Vision' to Reality

In 2004 President George W. Bush presented the nation with a new Vision for Space Exploration. During this same time frame, the Mars rover Spirit was beginning its journey across the Red Planet. Ultimately, Spirit and its companion rover, Opportunity, found evidence that water had once existed on the surface of Mars, raising another question -- Did some form of life once exist there?

Answering this fundamental question is among several questions that future NASA missions will attempt to answer. The Vision provides the country with a "building block" strategy of human and robotic missions, beginning with returning the Space Shuttle safely to flight in mid-2005, completing the International Space Station, returning humans to the moon by 2020 and eventually exploring Mars and beyond.

### Embracing The Future

NASA's Goddard Space Flight Center has a prominent role in implementing the Vision for Exploration.

Goddard manages the operational Space and Ground Network that supports the Human Spaceflight Program, as well as Earth orbiting missions, international, commercial, classified and unclassified national missions. Goddard supported the Return to Flight effort with essential space communications networks and Extra Vehicular Activity (EVA) tools.

In addition, Goddard's Hubble team collaborated closely with Johnson Space Center and Langley Research Center to design, test and build sophisticated new EVA tools and sensors for on-orbit Shuttle tile repair and inspection. JSC selected the HST EVA team based on their outstanding



track record for developing unique astronaut tools used to upgrade Hubble during four successful servicing missions.

Through its work with HST, Goddard has developed a truly unique competency in developing systems that intersect human and robotic capabilities. These pathfinding servicing and robotic technologies will be vital to exploration.

In 2004, NASA selected Goddard to manage the Agency's Robotic Lunar Exploration Program (RLEP). The RLEP will consist of activities that enable sustained human and robotic exploration of Mars, as well as more distant destinations in the solar system. The RLEP will consist of a combination of orbital and surface missions that support NASA's exploration program's evolving requirements.

Goddard is now developing in-house the very first mission under the RLEP called the Lunar Reconnaissance Orbiter (LRO), scheduled to launch in 2008. LRO will carry a suite of six instruments and Goddard has responsibility for one such instrument called the Lunar Orbiter Laser Altimeter, or LOLA. LOLA will fire a laser 28 times per second to the surface of the Moon, providing measurements of the surface features.

The Center will manufacture sensor systems for in-space and surface applications, and instruments for planetary program. Goddard also will build, manage and operate space probes and orbiting platforms that will fulfill NASA's mission to explore the solar system and beyond and search for life elsewhere in the Universe. To date, Goddard has built more planetary instruments than any other organization.

Goddard's suborbital, special projects, and technology demonstration mission experience, via its sounding rocket and scientific balloon program, provides NASA with a unique and affordable capability to demonstrate world-class, high value technology and flight systems essential to implement the Vision.

Goddard also has a vigorous Earth science research program that employs satellites and sensors to meet national needs for global climate change, supports operational weather organizations, and applies cutting edge technologies, modeling capabilities and data management systems crucial to protecting our home planet.

### **A Legacy of Scientific Research and Understanding**

Goddard is truly a unique national asset. Among its competencies is science leadership, which includes the management, theoretical analysis,

experimental research and use of scientific data. Goddard scientists are recognized worldwide as leaders in the science community, maintaining their competency via competitive peer reviewed research.

Science at Goddard is managed through the Sciences and Exploration Directorate, which has three Divisions – Earth-Sun, Solar System, and the Universe. Future science missions managed by Goddard will enable researchers to further their study of the land, sea, ice and air, understand the secrets of the solar system so that humans may one day visit other planets, and continue to advance our understanding of how galaxies, stars and planets form and evolve.

### **Earth-Sun Exploration Division**

Scientists here carry out a broad program of scientific research, both in theory and by experiments, that studies the Earth, the Sun, and the coupled Earth-Sun system. Some of the areas they explore are: solar and space physics and its possible effects on the Earth's climate; the effects of clouds, precipitation, aerosols on Earth's weather and climate; and furthering our understanding of Earth's global water cycle, land surface hydrology, carbon cycle, and marine and terrestrial ecosystems.

### **Exploration of the Universe Division**

Scientific study here furthers the exploration of the Universe, searches for life, and seeks answers to age-old questions such as:

- How do galaxies, stars, and planetary systems form and evolve?
- Which planets might harbor life?
- What powered the Big Bang?
- What happens to space, time and matter at the edge of a black hole?

To accomplish this mission, scientists conduct a broad program of research in the realm of astronomy, astrophysics, and fundamental physics.

### **Solar System Exploration Division**

Scientists here explore the solar system and study the formation and evolution of planetary systems. Research in this area is focused on answering questions such as:

- How do planets form and evolve?
- What is the current and future state of the Earth, and what processes are changing it?
- Where are other habitable environments in the solar system?
- What do we need to know to send explorers safely to the Moon and Mars, and what should

they and their robotic partners do when they get there?

- How and why does the Earth differ from other terrestrial planets in our solar system and other solar systems?

### **Managing NASA Missions**

Goddard's program and project management experience is exceptional, with more than 275 successfully completed science missions since the Center opened in 1959. Personnel here are experts in implementing diverse portfolios of complex, space-based, orbital and suborbital scientific programs and projects across their full life cycle. For decades, the Center's scientists and engineers have worked in concert with science principal investigators, engineering organizations, mission assurance, external partners, and agency managers to achieve a high level of mission success.

Goddard's workforce of more than 1,000 engineers represents unparalleled experience in engineering competence and end-to-end mission systems engineering and integration. Missions such as the Wilkinson Microwave Anisotropy Probe, Tropical Rainfall Measurement Mission, and now Lunar Reconnaissance Orbiter and Solar Dynamic Observatory, demonstrate Goddard's high level of systems engineering and multi-disciplinary expertise. Goddard is a world-class engineering center with a full suite of engineering disciplines and technologies for implementing diverse, highly complex orbital and suborbital systems.

Goddard has long been recognized as a leader in developing new sensors and instruments. The Center is also a leader in building, managing, and operating large optical and distributed observing systems. In the future, Goddard will have a leadership role in creating the innovative technologies and large aperture telescopes that will explore the Universe and search for life on other planets.

From NASA's inception, Goddard has led the way in building and managing space communications and navigation systems. From today's Space and Ground Network successfully supporting the Return to Flight effort, to the future Mars Laser Communications Demonstration, Goddard's experience and expertise supports a broad range of missions. Goddard's navigation competency enables it to support missions in low-Earth, mid-Earth and high-Earth orbits, geosynchronous locations, libration points, and deep space, as well as precision formation flying.

### **The Goddard Campus and Its Workforce**

Goddard is named after the father of modern rocketry - Robert H. Goddard. The current Greenbelt campus of Goddard encompasses approximately two square miles, or 1,280 acres. Currently, about 8,200 civil servants and contractors work at the Greenbelt facility in positions as scientists, engineers, technicians, professional, and administrative assistants. Including employees working off-site at Wallops Flight Facility, the Goddard Institute for Space Sciences, the Independent Verification & Validation Facility, and the White Sands Complex, the employment number climbs to about 9,700.

Each Goddard-managed off-site facility has a distinct function. A brief description of each facility is outlined below.

#### **Wallops Flight Facility**

NASA Goddard's Wallops Flight Facility was established in 1945 by the National Advisory Committee for Aeronautics as a center for aeronautic research. Located on the Virginia Eastern Shore, research conducted here involves the development and deployment of low-cost, highly capable suborbital and orbital research, which is accomplished around the world using sounding rockets, scientific balloons, expendable launch vehicles, unmanned aerial vehicles and student experiment carriers. The Wallops launch range conducts work that helps improve the efficiency, and reduce the cost of, conducting rocket launches.

To further the Vision for Space Exploration, Wallops is using balloons for planetary research and sounding rockets to advance spacecraft technology.

#### **White Sands Complex**

NASA's White Sands Complex (WSC) is located near Las Cruces, N.M. Operating here are two functionally identical satellite ground terminals: the White Sands Ground Terminal Upgrade, and the second TDRSS Ground Terminal.

These two terminals ensure uninterrupted communications between various ground stations, NASA's orbiting fleet of Tracking and Data Relay satellites, customer spacecraft (satellites), and the computer systems that support such spacecraft. The WSC also serves as an interface for distributing satellite data to control centers and scientists who then use the daily influx of data to expand our ever growing knowledge of the Earth and the universe.

## **Goddard Institute for Space Studies**

The Goddard Institute for Space Studies (GISS) is located at Columbia University in New York City. Research at the GISS emphasizes a broad study of global change, an interdisciplinary research initiative addressing natural and man-made changes in our environment that occur on various time scales from decades to millennia and which affect the habitability of our planet.

Research here combines the analysis of comprehensive global datasets with global models of atmospheric, land surface, and oceanic processes. The study of past events on Earth, as well as the study of other planets, to aid in our prediction of the future evolution of Earth is also examined.

## **Independent Verification and Validation Facility**

Located in Fairmont, in the heart of West Virginia's emerging technology sector, the NASA Independent Verification and Validation (IV&V) Facility was established in 1993 as part of an agency-wide strategy to provide the highest achievable level of safety and cost-effectiveness for mission critical software.

The IV&V Facility was founded under the NASA Office of Safety and Mission Assurance as a result of recommendations made by the National Research Council and the Report of the Presidential Commission on the Space Shuttle Challenger accident.

The IV&V Facility continues to experience growth in personnel, projects, capabilities, and accomplishments. The IV&V Facility's efforts have contributed to NASA's improved safety record since the Facility's inception.

## **Inspiring the Next Generation of Explorers**

Each NASA Center supports their local community and region with formal and informal education and outreach activities. In the formal arena, Goddard conducts the 'Teachers on Loan' program, which consist of school teachers, on loan to NASA from local elementary, middle and high schools, who help develop engaging science curriculums for teachers to use in their classrooms.

Goddard also manages the NASA Aerospace Education Services Program, or AESP, which serves America's education community by enhancing awareness and understanding of scientific and technological advances from our missions. AESP specialists are experienced professional educators who provide assistance and support to other educators in updating science, mathematics,

geography, and technology curricula, and in using new evolving instructional technology and teaching strategies in the classroom.

Informal outreach efforts involve supporting various community events with hands-on activities and publications that inform the general public of who we are and what we're doing. The Center hosts a bi-annual Community Day event. This popular 'open house' offers the local community a glimpse at some of our facilities, projects, and programs.

Reaching out to the community effectively promotes Goddard's mission, and we continuously search for unique ways to inspire the next generation of explorers.

## **Bringing the Benefits of Space to You**

Technology developed by Goddard scientists and engineers not only directly supports Earth and space science missions, but also helps make our world smarter, healthier, and safer.

Every day, in an astounding variety of ways, American lives are affected positively by the Nation's investment in NASA research. Fields such as agriculture, communications, computer technology, environment and resources management, health and medicine, manufacturing, transportation, and climate modeling have all benefited greatly from NASA-derived technologies.

For a more detailed look into how all Americans have been positively impacted by NASA technology, visit:

**<http://www.sti.nasa.gov/tto/>**

To learn more about Goddard missions, programs and news, visit:

**<http://www.nasa.gov/centers/goddard/home/index.html>**

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