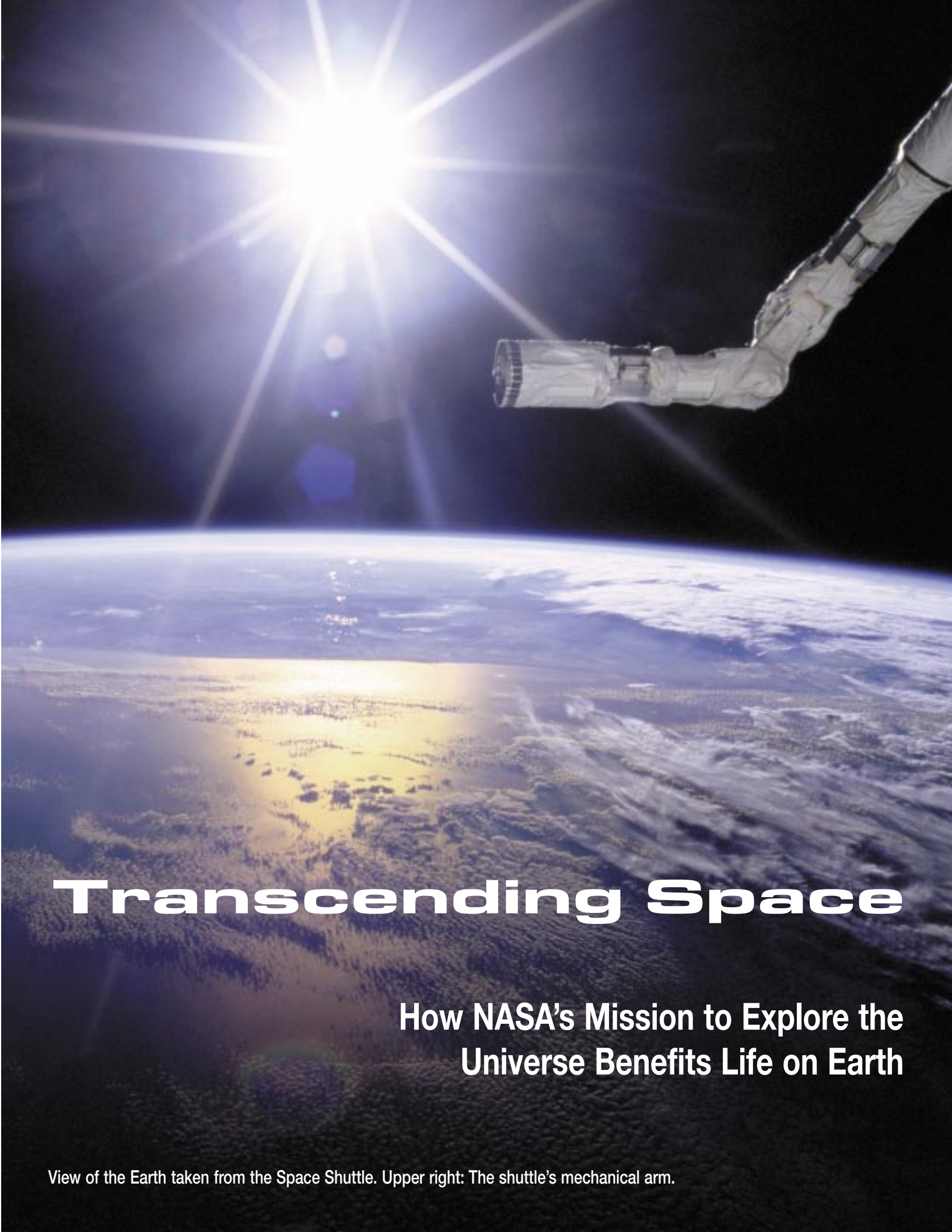


Transcending Space

How NASA's Mission to Explore the Universe Benefits Life on Earth

View of the Earth taken from the Space Shuttle. Upper right: The shuttle's mechanical arm.

The story of the National Aeronautics and Space Administration (NASA) begins in 1958. Originally formed in response to the U.S.S.R.'s launch of the Satellite Sputnik, NASA's immediate goal was to develop and pursue human space travel. Projects Mercury, Gemini, and Apollo all built upon each other resulting in the Apollo 11 mission to the moon and successful lunar landing in 1969. Since then, NASA has been responsible for extraordinary achievements in science and technology. In the 1970's, the Skylab and Apollo Soyuz projects laid the groundwork for the Space Shuttle missions in the 1980's. Today, the Space Shuttle program is heavily involved in constructing the International Space Station, NASA's most ambitious effort to date.

When we think of NASA, our first thoughts are of dramatic lift offs from Cape Canaveral and the indelible images of mission control from the Johnson Space Center in Houston. But in addition to these high profile centers, there are eleven other NASA facilities across the nation, each specializing in a different area of research and development. These centers are overseen by NASA headquarters in Washington, DC. All the centers are involved in harvesting and interpreting scientific data with the potential to assist in everything from developing new compounds to better understanding climate. What follows is a guide to the NASA facilities that are helping us explore the universe and better understand ourselves.

NASA Headquarters – Washington, DC

NASA Headquarters exercises management over the space flight centers, research centers, and other installations that constitute NASA. Responsibilities of Headquarters cover the determination of programs and projects; establishment of management policies, procedures, and performance criteria; evaluation of progress; and the review and analysis of all phases of the aerospace program.

Ames Research Center – Moffett Field, California

Ames is NASA's lead center for Information Technology. Ames has worked successfully to upgrade the space shuttle cockpit by developing an improved user interface and display technology. Using high performance computers, scientists at Ames are using global climate modeling to better evaluate and predict the impact of natural and human activity on our planet. And development of an Advanced Planning and Scheduling System for the Mars 03 rover will organize, prioritize, manage and coordinate scientific tasks requested from multiple scientific teams. The system will greatly improve the efficiency and scheduling of research and experiments performed by the Rover.

In addition to these exciting projects related to IT applications, the center is involved in airspace operations research, including air traffic control and wind tunnel testing.

Dryden focuses on improving high performance aircraft.

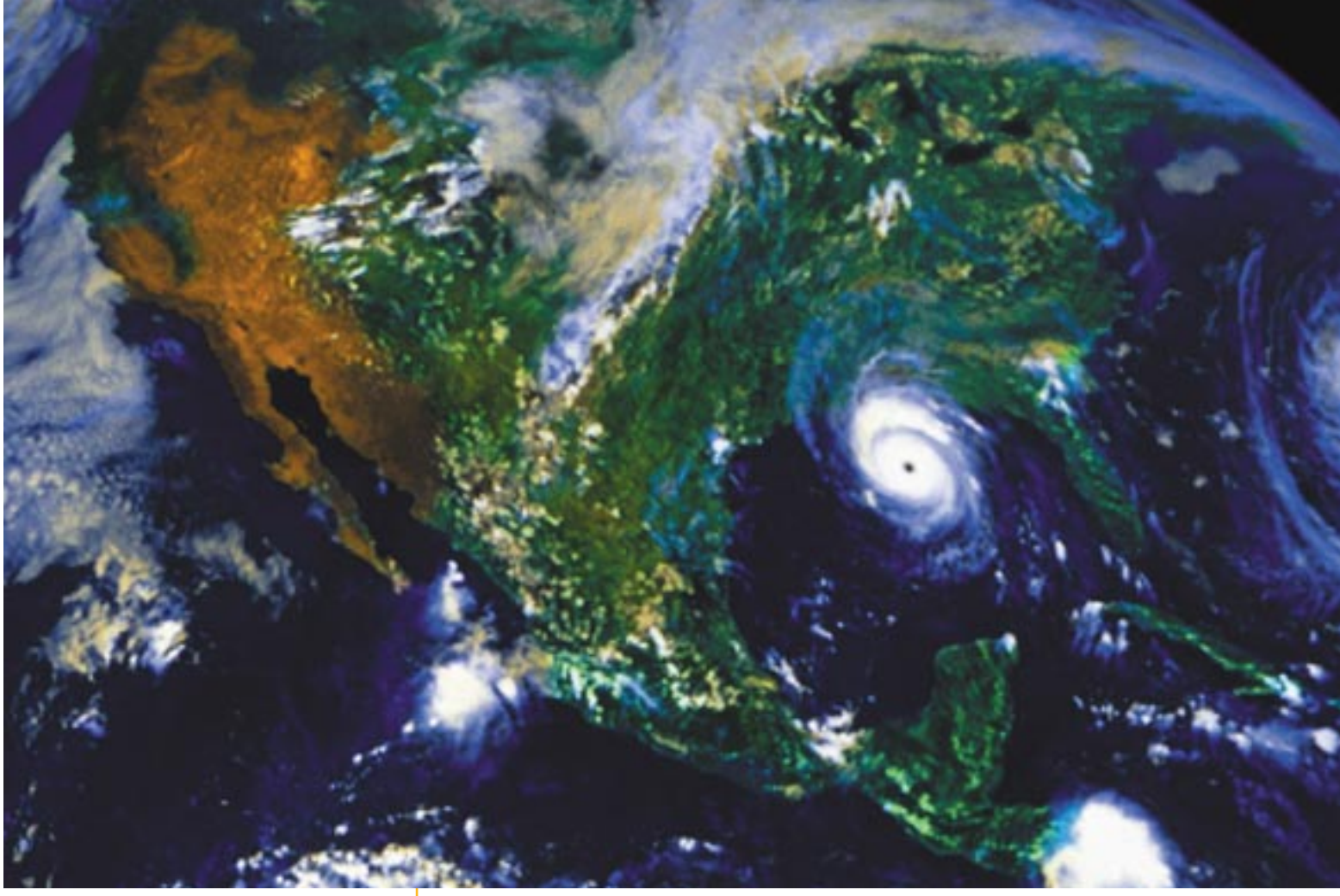
Dryden Flight Research Center – Edwards, California

NASA's primary installation for flight research focuses on improving military and civilian aircraft. Current research includes the testing of twisting or warping flexible wings for enhanced maneuverability of high-performance aircraft. Development of specialized flight techniques and research into the durability of thermal protection systems for spacecraft are other examples of research being conducted at Dryden. In addition, Dryden is working on the development of Helios aircraft for use in extraterrestrial planetary atmospheres. This research will eventually lead to the development of atmospheric satellites that can sustain themselves from within the earth's atmosphere rather than being put into orbit. These satellites will result in major advancements for the telecommunications industry and weather-tracking applications.

Currently in the planning stages at Dryden, hypersonic air-breathing aircraft have the potential to dramatically affect human air and space travel by increasing payload capacities and lowering costs for air and space vehicles. Hypersonic aircraft travel at speeds of Mach 7 and Mach 10. Currently the fastest manned aircraft top out at Mach 3.

Glenn Research Center – Cleveland, Ohio

Glenn is NASA's lead center for turbomachinery. Broad-based research at this center is focused on propulsion and communication technology produced for practical aeronautics and aerospace applications. Development of innovative propulsion systems for satellite positioning is just one example of how Glenn applies it's expertise to support NASA.



Knowledge of the Earth and its climate is greatly enhanced by NASA research and technology.

Supernova blasts such as this one are the kind of events in deep space that are the subject of space research at Goddard.

Goddard Space Flight Center – Greenbelt, Maryland

Research at Goddard is devoted to Space Science—studies of stars, galaxies, black holes, and dark matter—as well as Earth studies dealing with the ozone layer, ocean studies and greenhouse effect.

Goddard is working to build the next-generation telescope to succeed Hubble. Named for James E. Webb, a NASA pioneer, the James Webb Space Telescope will be able to look deeper into the universe, probe the formation of planets in disks around young stars, and study black holes in other galaxies.

Independent Verification & Validation Facility – Fairmont, West Virginia

NASA's Independent Verification and Validation Facility (IV&V) was created in direct response to the Space Shuttle Challenger accident. The facility provides comprehensive software testing and develops risk-management processes to ensure maximum safety and efficiency of mission-critical software. Run under the leadership of the Goddard Space Flight Center, the facility has a diverse mix of full-time employees and in-house specialists all dedicated to ensuring the highest levels of safety and cost effectiveness.

Johnson Space Center trains US and international space crews.

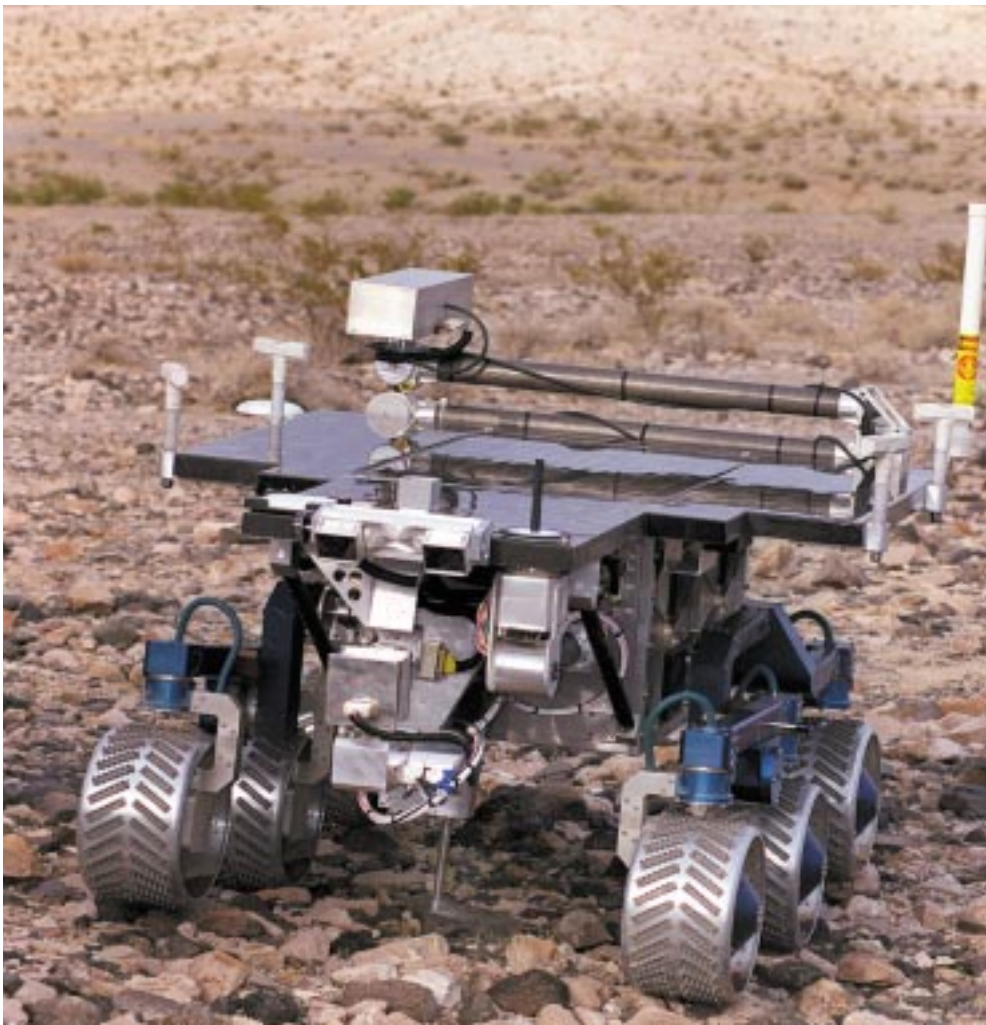
Jet Propulsion Laboratory – Pasadena, California

The Jet Propulsion Laboratory (JPL) is NASA's lead center for robotic exploration of the solar system. JPL is making advances in technology with new instruments and computer programs to make observations and record deep-space events on a much more detailed and distant scale than we have ever known. As the lead center for managing the deep space network, JPL equipment communicates with spacecraft and conducts research from equipment in California, Madrid, Spain, and Canberra, Australia. To record observations closer to home, JPL has a number of cameras and sensors on orbiting satellites to record data for earth science and atmospheric research applications.

Johnson Space Center – Houston Texas

In addition to being the home of the famed Mission Control facility, Johnson Space Center is the home of the Space Shuttle Program The center is responsible for the design and implementation of the International Space Station, and overseas for the research and development of hardware, software, as well as systems and processes related to the human exploration and development of space.

Project management for these human space endeavors includes managing the development, testing, production and delivery of all manned spacecraft. Related areas for which Johnson is responsible include life support, power systems, equipment, navigation, cooling systems, flight software, robotics, spacesuits and space walking equipment. Johnson is the main facility for the preparation and training of US Astronauts and International Space Station personnel from around the world.



NASA's Jet Propulsion Lab develops robotics, cameras and sensors to explore space.

Kennedy Space Center – Merritt Island, Florida

Located on the Merritt National Wildlife Refuge on Florida's Eastern shore, Kennedy Space Center is NASA's lead center for launch and cargo processing systems. Cape Canaveral, the eastern part of Merritt Island is managed and used by the Air Force. Kennedy manages launching and landing operations for the Space Shuttle program and serves as the final checkpoint for all equipment, spacecraft and personnel being launched into space related to the Shuttle program, the International Space Station and other NASA and commercial projects.

Complex 39 is at the heart of Kennedy, serving as an assembly building for the Space Shuttle. Through partnerships with aerospace contractors, Kennedy serves as home base with the majority of employees working for these contractors. Maintenance of such a large facility requires a complement of support services employees performing a wide variety of functions from grounds maintenance to drafting and design engineering.

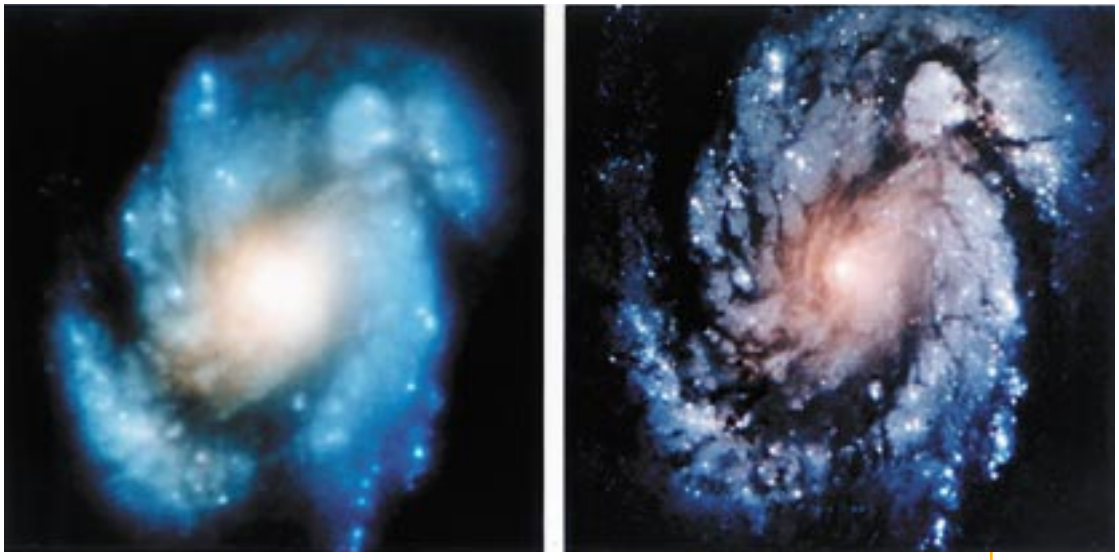
Merritt National Wildlife Refuge

Merritt Island, home to Kennedy Space center, is a National Wildlife Refuge covering 140,000 acres. Kennedy uses about 6,000 total acres for their operations and the land is managed by the Department of the Interior as a wildlife refuge and national seashore.

Merritt is home to more than 500 species of wildlife and has a number of unusual characteristics that make it an ideal location for a diverse population. It is located between subtropic and temperate climates zones, and supports seven different types of habitats for wildlife to flourish. These habitats include brackish marshes and estuaries, hardwood hammocks and coastal dunes. This diversity makes Merritt Island a rare sanctuary for both local and migrating wildlife.

A total of 15 endangered species are in residence at the refuge including bald eagles, manatees and sea turtles. Just south of Kennedy's perimeter is the northern end of the Banana River which acts as a sanctuary for grazing manatees. Each season, thousands of sea turtles come ashore to the island to lay their eggs. Located along the Atlantic flyway, Merritt is also a major refuge for migrating and wintering birds. Thousands of wading birds, songbirds and shorebirds flock to the area each year.

Alligators are a permanent fixture at Merritt and can sometimes get in the way. Prior to Shuttle landings Kennedy Center, employees must clear the landing area of debris which often includes shooing away alligators sunning themselves on the runway!



Hubble's view of deep space before and after lens repairs.

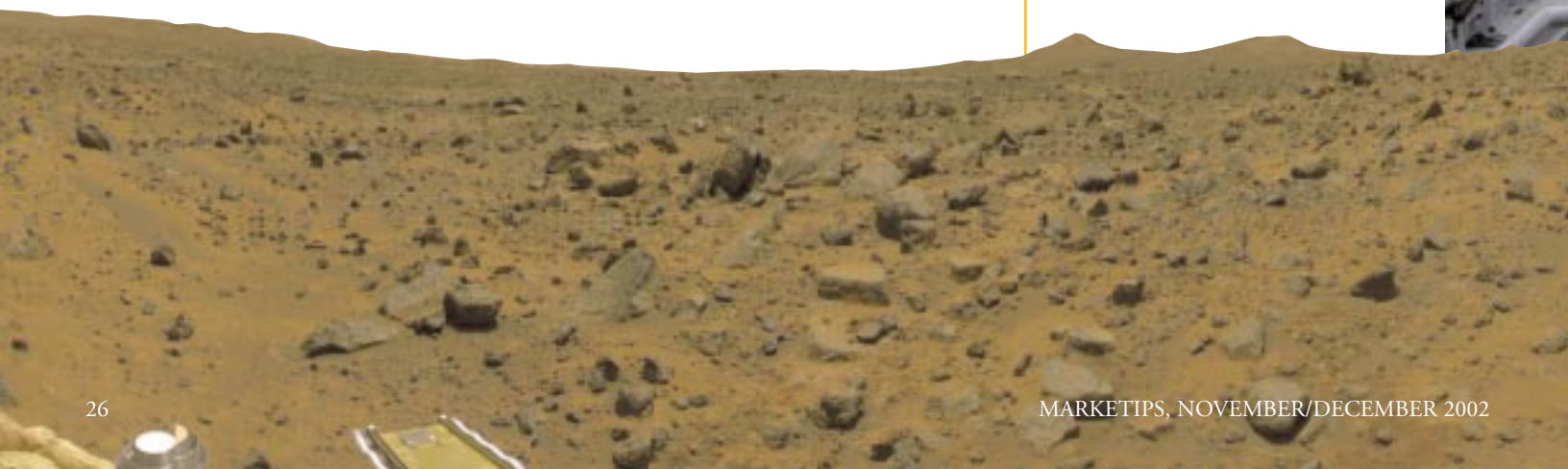
Langley Research Center – Hampton, Virginia

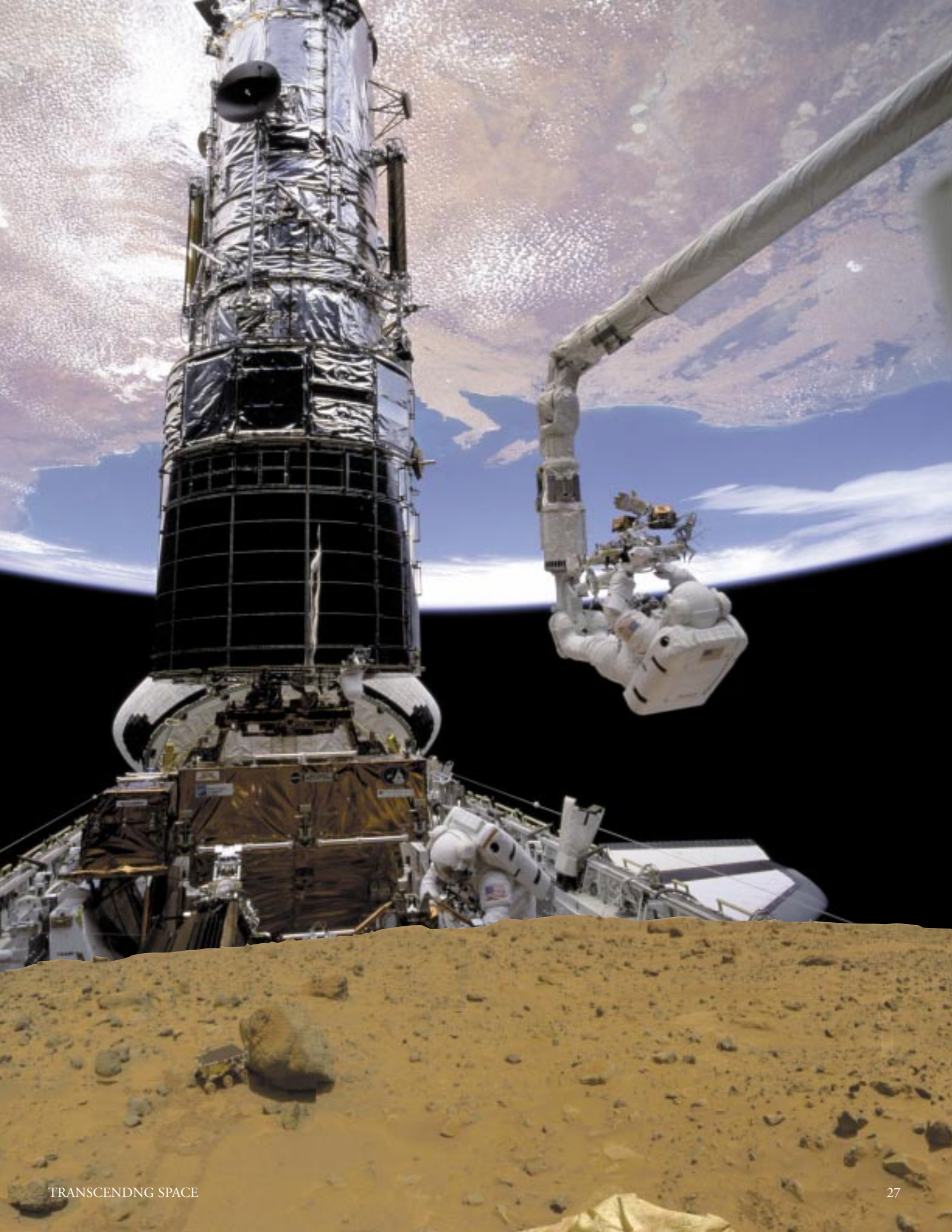
Research and development at Langley is focused on aeronautics research for the development of airframe systems and quieter aircraft. Atmospheric science as well as research and development of aircraft that work in extraterrestrial atmospheres is also done at Langley, which is also known for its wind tunnel and aerospace testing facilities.

Marshall Space Flight Center – Huntsville, Alabama

Marshall has a distinguished history of developing successful propulsion systems for many of NASA's most high-profile projects including the Saturn Rockets, which lifted man to the moon in 1969. As NASA's lead center for space propulsion, Marshall has led propulsion projects for Skylab, the Space Shuttle program, and the Hubble space telescope. More recently, Marshall developed and tested an Earth observatory for the International Space Station. Able to take pictures free of the glare that plagues Earth-bound observatories but controllable from the ground, it is giving us new information about our planet, its weather, and our environment.

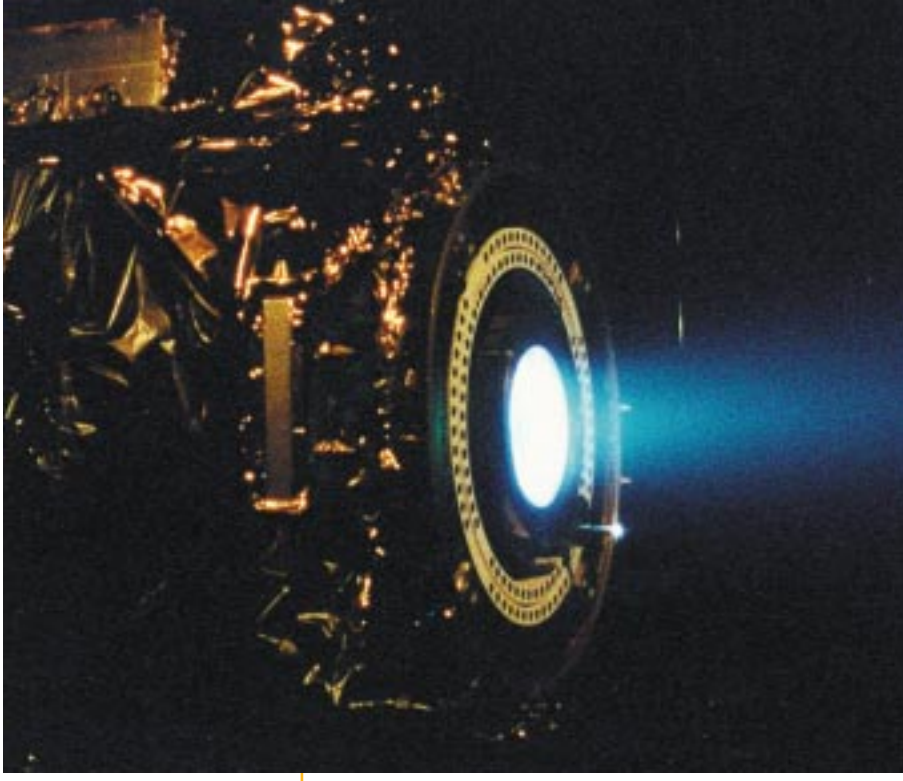
The Hubble telescope project was managed out of Marshall Space Flight Center. Servicing missions such as the one pictured at right are managed from Johnson Space center. Langley develops vehicles and technology that can survive in harsh extraterrestrial environments. Such as the Mars landscape pictured below.





Stennis Space Center – Southern Mississippi

As NASA's primary center for testing and certifying rocket propulsion systems, Stennis runs all NASA propulsion test programs and is responsible for the approval of all NASA propulsion systems, including the main engines used for the Space Shuttle program. All Shuttle engines must undergo and pass a series of test firings at Stennis Space Center prior to being installed.



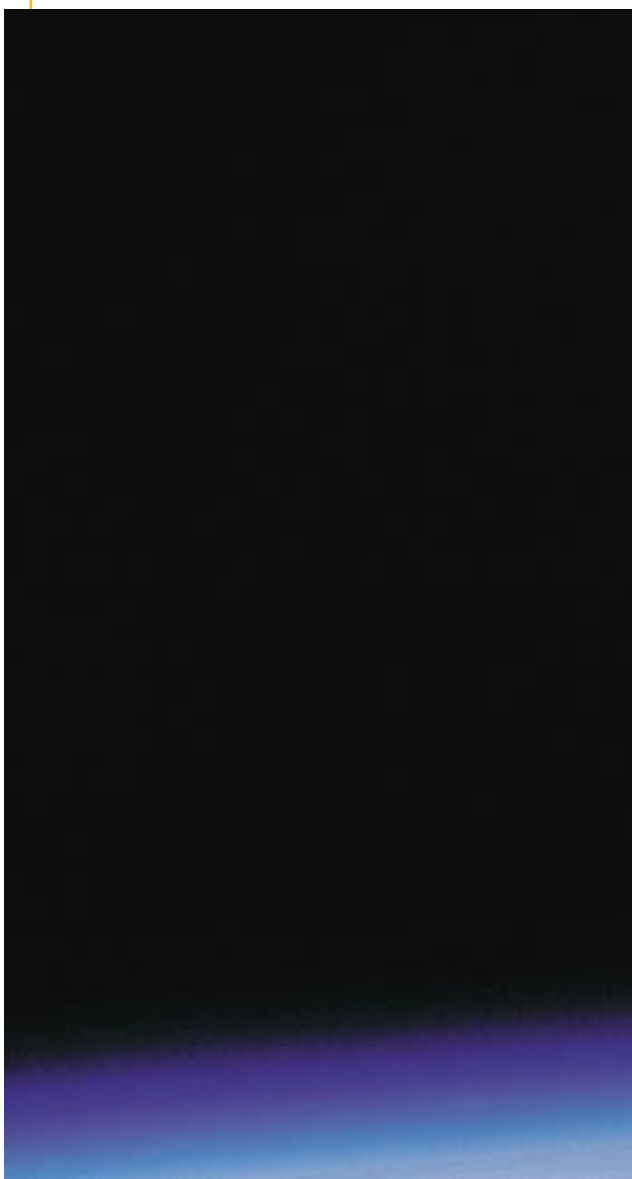
Wallops Flight Facility – Virginia

Wallops Flight Facility is one of the oldest launch sites in the world, and is now NASA's main facility for suborbital research programs supporting space-based research on the Earth and the environment. Wallops provides launching facilities and expertise to a wide variety of customers for educational, commercial and scientific advancement.

White Sands Test Facility – New Mexico

Responsible for all testing of potentially hazardous materials used in space flight, White Sands supports NASA in the Space Shuttle and International Space Station programs. White Sands tests oxygen systems, does explosive testing, and performs repairs on hardware for reuse in programs. In addition, White Sands evaluates and performs failure investigations and hazard assessments. The facility also provides backup and training facilities for the launch and landing of the Shuttle.

Source: National Aeronautics and Space Administration Website (NASA.gov)



In an effort to streamline operations, NASA Headquarters has designated each facility as a Center of Excellence in a particular area. Each Center of Excellence is recognized as NASA's leading authority in their designated area. Centers are not limited to activities exclusively related to this designation, but serve as the lead for projects related to each specific area.

Ames Research Center
Information Technology

Dryden Flight Research Center
Atmospheric Flight Operations

Glenn Research Center
Turbomachinery

Goddard Space Flight Center
Scientific Research

Independent Verification & Validation Facility
Sophisticated Software Systems

Wallops Flight Facility
Suborbital Research Programs

Jet Propulsion Laboratory
Deep Space Systems

Johnson Space Center
Human Operations in Space

White Sands Test Facility
Hazardous Materials, Components, and Rocket Propulsion Systems Testing

Kennedy Space Center
Launch and Cargo Processing Systems

Langley Research Center
Structures and Materials

Marshall Space Flight Center
Space Propulsion

Stennis Space Center
Propulsion Testing Systems

Benefits of Space

Because of this extraordinary network of scientists, engineers and specialists at NASA facilities around the country, space exploration has been responsible for major technological advances that impact humanity on a grand scale. With all of the resources of NASA's fourteen facilities, and all of the high level scientific research being preformed to explore the universe in the safest and most efficient way, technological development is abundant. One of the main goals for NASA is to interface with the business community and offer support to help successfully transfer these developments into practical commercial applications.

The medical benefits alone are astounding. Endoscopic surgery has been greatly enhanced by the development of a robotic arm that holds a camera in place during surgery. This eliminates the need for a member of the surgical staff to hold the camera and results in a steadier view and more precise camera angles for the surgeon.

MS patients are enjoying the benefits of NASA research through a cooling suit originally developed for astronauts. Lowering a patient's body temperature has been proven in many cases to dramatically improve symptoms of MS. Through the use of a personal cooling system developed from NASA technology, patients are able to capitalize on this benefit and live more comfortable and productive lives.

Pharmaceutical research performed in space is helping to develop new and more effective drugs. Crystals grown on Earth for pharmaceutical research possess flaws which can diminish their effectiveness. However, crystals grown in space develop without flaws, thus creating the potential for purer and more effective forms of drugs and pharmaceuticals. This is just one example of how medical research performed in space can result in huge benefits for the population of Earth.

Innovations needed for space travel, such as lightweight building materials and stronger polymers, have had a major impact on aviation technology, improving the durability and flexibility of aircraft and other means of transportation.

Telecommunications, navigation and information management have already seen huge advancements, and with continued space exploration these fields will advance at an even greater rate. Detailed topographical information has improved various technologies worldwide such as navigation systems and wireless technology. Pagers, cell phones and Palm Pilots are all a result of technology originally conceived by NASA and have greatly improved how we communicate and organize information.

A new navigation system developed by NASA is currently being tested at Chicago's O'Hare airport. The system is designed to ease flight delays by allowing for the landing of more planes in shorter time periods than is possible with traditional air-traffic control radar. The system feeds information directly to the pilot just prior to landing using satellite Global Position System technology. This allows the pilot to have up-to-the-second information about the airspace surrounding the plane. NASA hopes to improve takeoff and landing capacity on a single runway by five to ten percent with the use of this new technology.

Climatology, the study of the earth's climate and it's impact on humans, has also seen major advancements. Through the use of satellites and imaging from space, there is a much greater understanding of how the climate of our planet impacts our lives and how we, in turn, affect the climate. Combustible energy, one of modern technology's most critical resources, but raises serious environmental concerns. Space research will help us understand and find solutions for pollution, atmospheric changes and global warming.

Even NASA's waste products are proving to be beneficial. Surplus rocket fuel discarded by NASA is being utilized to disarm landmines. Rocket fuel must be used almost immediately upon being mixed, or it begins to solidify and is rendered useless. Solidified rocket fuel, however, is a crucial component in a flare used to disarm landmines. Using a method developed in the commercial sector, landmine explosive components are burned away using a flare which burns through the outer casing of the mine and, in turn, burns the explosive material inside. This technique eliminates the dangerous practice of manually disarming the mines or remotely detonating the mines, the resulting explosions of which can cause injuries or property damage. The flares have been successfully used in Kosovo and Jordan – protecting property and people from disabling or fatal wounds.

These examples represent just a fraction of the kinds of tangible benefits space exploration and research can yield. NASA continues to search for answers to some of our most profound questions, and in that pursuit helps us advance as a society, as a member of the global community and as a planet.

NASA Research For Your Office

NASA is making life better on a daily basis. Check out some of the more 'down to Earth' items you can purchase from GSA that were originally developed using NASA technology:

Cordless Tools
From drills to flashlights, GSA has the full complement of cordless tools available. Check it out on GSA *Advantage!*™ or through GSA Schedule 51 V – Hardware Superstore.

Rechargeable Batteries
Available on GSA *Advantage!*™
AAA-D and everything in-between. GSA can provide you with everyday rechargeable batteries or batteries for specialized equipment including cameras and laptops.

Cordless Keyboard and Mouse
Gain the freedom of a cordless keyboard and mouse.
Available through GSA's Information Technology Schedule 70 or online at **www.gsaadvantage.gov**

Smoke Detectors
Keep alert in case of fire. GSA carries a full line of smoke detectors.
Available on GSA *Advantage!*™

Scratch Resistant Lenses
Protect your eyes with our scratch resistant safety glasses and sunglasses.
Available online at **www.gsaadvantage.gov**

Wireless Technology
GSA offers a wide variety of pagers, cell phones, and other wireless products to fit your needs. Contact GSA's IT acquisition center at (703) 305-3038 or e mail us at **it.center@gsa.gov.**

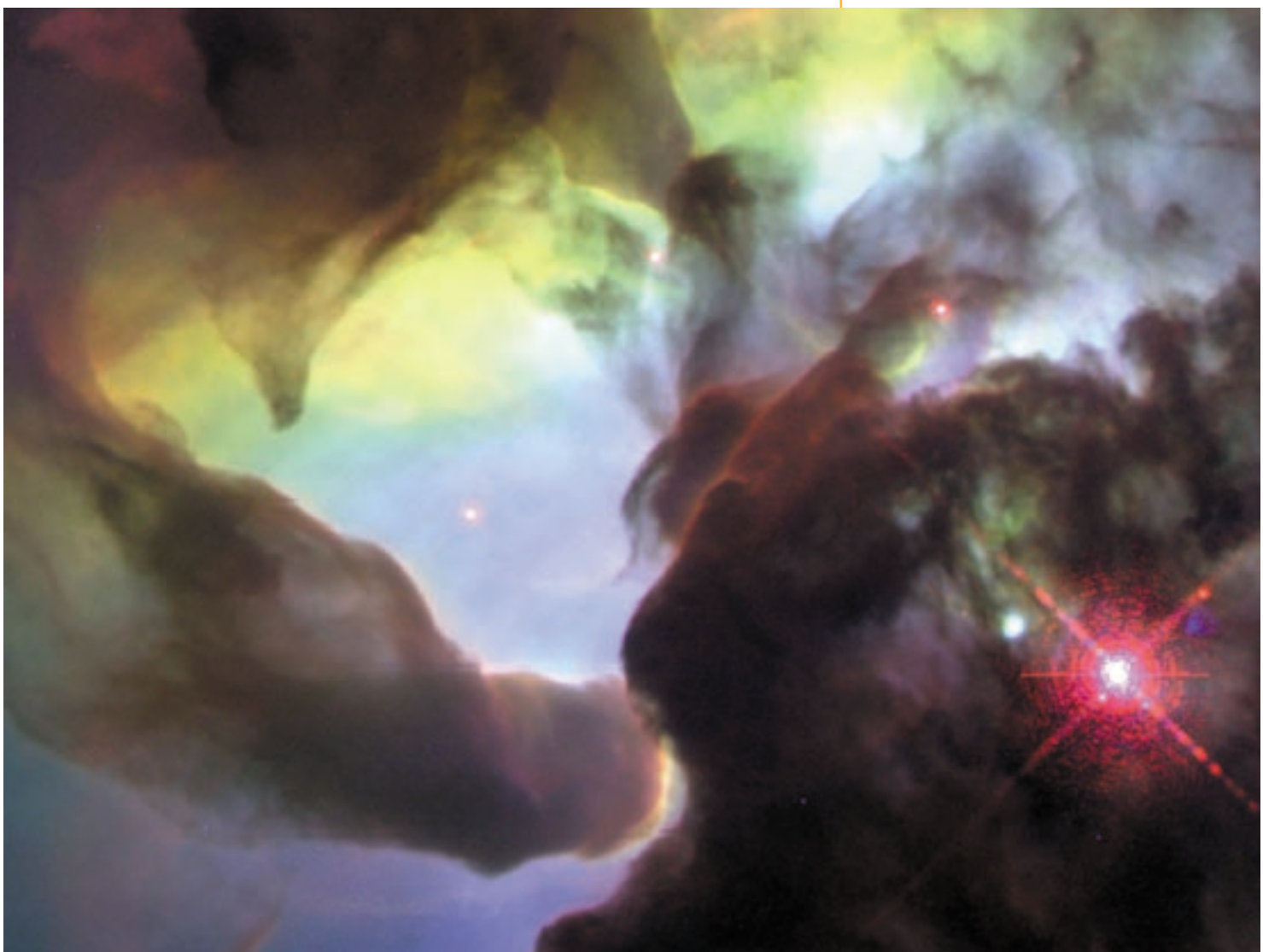
To find out more and purchase these and thousands of other items, visit us on-line at **www.gsaadvantage.gov** or at **fss.gsa.gov/elibrary** for Schedule program information.

GSA – Helping NASA Explore the Universe

On March 16, 1926, at a field in Auburn, Massachusetts, Dr. Robert Goddard, who pioneered modern rocketry, prepared to launch the first liquid-propellant rocket ever to fly. It was a skeletal device ten feet long, held upright in a crude metal frame that somewhat resembled the support pipes for a backyard swing. Goddard was accompanied by his wife and assistant, Esther Kisk Goddard, his machinist, Henry Sachs, and his former graduate student, Percy Roope. Holding a long pole with a lit blowtorch at the end of it, Sachs ignited the engine, and Goddard pulled a release cable anchoring the rocket. The rocket hesitated, and then as flames left its nozzle, it lifted off the ground, gaining speed until it reached an altitude of four times its height and then veered off to the left, finally crashing two hundred twenty feet away in a muddy cabbage field. Esther Goddard, who was operating the movie camera to document the event, complained bitterly afterward that the movie camera ran out of film just before the rocket lifted off, so there would be no visual record of the actual flight.

Today, when NASA conducts research and sends rockets into space, it relies on a far larger network of people. It also relies on better equipment for documentation—and for countless other needs. GSA is proud to be a part of that network, and proud to supply NASA with photographic equipment and hundreds of other different items, as well as a variety of services, to support the space program.

The Lagoon Nebula

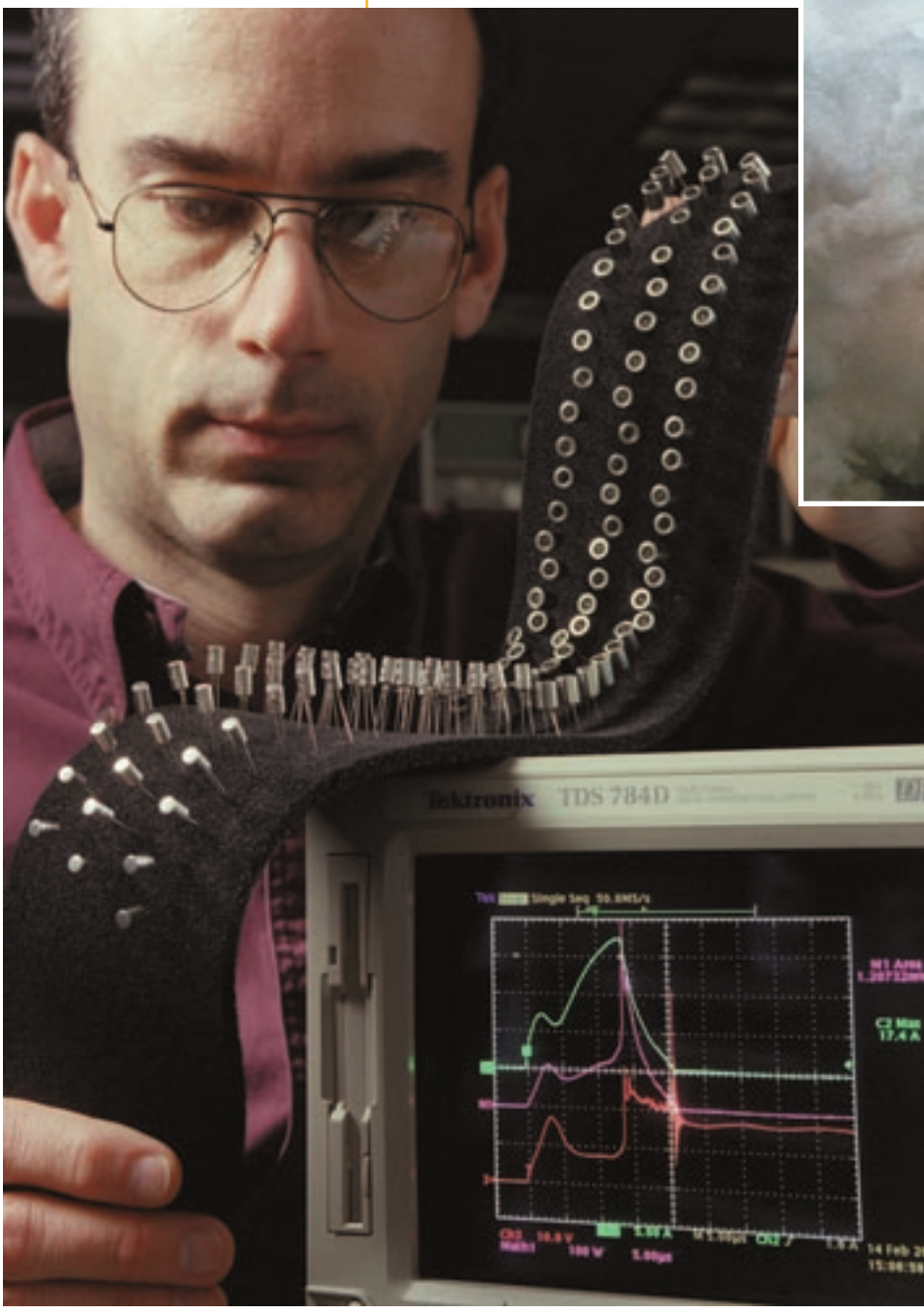


GSA provides NASA with products ranging from adhesives to wrenches. Products purchased recently by NASA from GSA include tool kits, duct tape, furniture, flashlights, shipping boxes, rope, filing cabinets, copier paper, paintbrushes, toner cartridges, paper towels, metal foil, cleaning cloths, fibrous cord, drill sets, face shields, space heaters, antifreeze, surge protectors, first aid kits, paint thinner, and fans. Scientific apparatus includes photographic and imaging equipment, ultraviolet spectrometers, projectors, chemical fume hoods, thermal analysis equipment, water purification systems, and optical equipment. GSA has supplied NASA labs with glove boxes, which are totally enclosed boxes that can be filled with an inert gas such as argon or nitrogen and used to manipulate air sensitive specimens—such as moon rocks. It has supplied NASA 3-dimensional viewing equipment for inspecting the shuttle with high-grade laboratory chemicals. And in keeping with the best research, there have been reams of publication materials. NASA is now saving over two million dollars annually by using GSA Schedule 76, Publication Media.

"I feel we are going to enter a new era, it is just a matter of imagination how far we can go with rockets," said Goddard, and added, "I think it is fair to say you haven't seen anything yet." Those words have never been more true than now, and they become clearly apparent when considering the kind of research that GSA is supporting at NASA.

Reusable Launch Vehicles—The Next Generation

NASA's space launch initiative (SLI) is developing technologies for the next generation of reusable launch vehicles. Finding lighter and stronger materials will be a must for building launch vehicles that are safer and less expensive. Still in the applied research stage, these vehicles will eventually replace the Space Shuttle. Recently, the Marshall Space Flight Center in Huntsville purchased a high-resolution infrared video camera from GSA that will serve as part of a quality control system to inspect new composite aerospace materials for defects. When a specific material is heated, the temperature patterns on the surface can be observed with the camera. Irregular material will interfere with the heat flow and show up as a different pattern. Irregularities might be caused by a higher fiber content, a smaller or larger porosity, a different way in which the material is put together, or from contamination in the manufacturing process. Sam Russell, a researcher at Marshall explained that any of these irregularities could make the material unsuitable or less reliable for its intended use.



Upgrading the Shuttle, Keeping It Flightworthy

Randy Keen works in an electronics laboratory at the Marshall Space Flight Center that supports a variety of work, including free flying expendable rocket experiments. But most of the work he does revolves around the orbiter propulsion system and mainly the Solid Rocket Booster program of the Space Shuttle itself. The shuttle is now just 21 years old, and numerous upgrades are a given as technology advances and systems are redesigned while older systems are refurbished.

The two solid fuel boosters power the shuttle for the first two minutes of flight. After their fuel is spent they are no longer needed, and so are jettisoned to save weight. But because they can be refurbished and reused, their fall to the ocean is slowed with parachutes to help avoid damage. A few weeks ago, a colleague brought Randy an Altitude Switch Assembly to test. Housed in the nose of the booster, this switch is part of a system that deploys the nose cap, allowing release of a small, pilot chute on each of the solid fuel boosters. This chute pulls out a drogue chute, which stabilizes the booster during reentry, straightening and aligning it properly. At five to six thousand feet, a second switch deploys the main chute. When the two boosters reach the water, they float nose up in the water. Divers plug the bottom ends, sealing the opening and forcing out the water. Two recovery ships drag them in, and a crane on the deck hoists them out of the water.

Because testing a component exposes it to stress, NASA is looking for more efficient testing procedures that would more closely simulate flight requirements. In order to help design a new testing protocol, the switch was set up on a lab bench with a power supply unit and an oscilloscope, supplied by GSA, that measured change in electrical voltage over a period of time.

Each of the two boosters on the shuttle carries two "black boxes" that are called an Integrated Electronics Assembly (IEA). The black boxes are 4 feet by 18 inches square, with one in the forward end and a second one in the back end. These boxes send a variety of data back to the orbiter (where the astronauts and research equipment are housed), running a variety of electronic checks on booster function and recording temperatures and pressures of various components and systems. This includes the turbine speed control for the hydraulic actuator system that points the rocket nozzle on the Solid Rocket Booster, which steers the vehicle during the initial part of the flight.

The black box in the back (aft) end tends to get damaged when the booster hits the water after it has been jettisoned from the shuttle. So NASA is looking for ways to move it to a safer location in the watertight area in the front end. But this will require new types of electrical connections, including those used to trigger the explosive bolts that release the booster from the main rocket. So Randy has also been using the oscilloscope for testing and evaluating these new types of ordnance devices.

"We always look for things on GSA contracts," said Randy. It saves us a lot of time and trouble. Before we would have to spec equipment and then evaluate proposals from several vendors. With GSA, that's done away with. It cuts a whole lot of the red tape."

New Ways of Exploring Life

Dr. Pamela Conrad, with the Jet Propulsion Laboratory in Pasadena, uses ultra-fast gas chromatographs from GSA in her research on how to look for evidence of life on other planets.

The gas chromatograph works by pulling air into an absorbent substance. When this substance is heated, it releases volatile substances that were in the air. These volatile substances are passed through a narrow capillary column. Substances with a lighter molecular weight will pass through more quickly, and ones with a heavier molecular weight will pass through more slowly. The chromatograph takes note of this information, which can then be interpreted by a researcher who can determine the specific type of substance.

"Our group is interested in developing methods for detecting life and its chemical evidence. This means we first have to be able to identify and measure those chemical clues on Earth," said Dr. Conrad. "This equipment is valuable to us because we can use it to find a fast, non-destructive way of identifying different kinds of

The Reflection Nebula in Orion

life, and for distinguishing it from non-living things—it's somewhat akin to finding a footprint in the sand that can be matched to a specific person."

As living organisms metabolize nutrients that they have taken in, they give off waste materials in the form of hydrocarbons. Finding these hydrocarbons is potential indication of life, and identifying them can help determine the kind of life. Sometimes the difference between a biosynthesized compound and a mineral can also be determined by the fluctuations in gas levels given off by the organism. Although Dr. Conrad's group is currently studying microorganisms and materials here on Earth, it is possible that the techniques and data they are now acquiring may one day be applied to recognizing and studying life on other worlds.

Travel in a Small City: Supplying Vehicles

GSA has been supplying vehicles to the Kennedy Space Center, NASA since the 1960s. These include vans, sedans, and buses, as well as light, medium and heavy trucks. The Kennedy Space Center alone has 1,800 vehicles from GSA that are leased to NASA and its major contractors.

NASA is also partnering with GSA in its alternative fuel program, with 400 compressed natural gas vehicles and a compressed natural gas fuel site at the Kennedy Space Center. NASA is also providing two ethanol fueling stations for flex-fuel vehicles leased from GSA.

Supporting Future Scientists

When an agency no longer needs property, this property is declared "excess," and becomes available to other agencies. (The National Science Foundation has used the program extensively to provide universities and colleges doing research with computers and other equipment from NASA.) If no other federal agency wants this property, it then becomes available to state agencies as surplus property. These agencies can then distribute it to eligible recipients, including schools, fire departments, local government agencies and public works departments. NASA also participates in the "Computers for Learning" program, which is under the auspices of GSA's Office of Governmentwide Policy. The program was created under Executive Order 12999, which was issued in April 1996. The program transfers to schools educationally useful surplus equipment, including computers. A web site where interested schools can register for the program, and where agencies with available equipment can locate them, can be found at http://www.computers.fed.gov/school/user.asp

"And make fair weather..."

More than likely you've seen Armstrong Hall on television. Near the Columbia University campus in New York City, the ground floor is home for Tom's Diner, where Jerry Seinfeld held court with Elaine, Kramer, and George. But most of the upper floors, which are occupied by NASA's Goddard Institute for Space Studies, are dedicated to the more serious study of climatology. But not long ago, the building was not in compliance with the New York City building and fire codes—and it needed serious renovations. GSA worked arduously for several years to find new real estate for the Institute that would be suitable for the ongoing research it conducted. But there was a problem. Many of the researchers who worked there were also affiliated with Columbia and needed to be near the campus. So GSA and Columbia conducted a series of negotiations that resulted in Armstrong Hall being refurbished, brought it up to code specifications and installed faster communications lines that could handle increased computer networking requirements.

Among its diversity of projects, The Goddard Institute is using global climate models to study climates from periods as long ago as 600 million years. This includes a number of warmer eras, which may prove important in studying the increasing global warming on Earth. Dr. James E. Hansen, director of the Goddard Institute said, "Because environmental issues are a serious concern today, we're glad that we can find environmentally friendly products from GSA." Products include items ranging from recycled paper to remanufactured toner cartridges.

Electronics in a Harsh Environment

At NASA's John H. Glenn Research Center in Cleveland, researchers are using a high-powered microscope from GSA to study silicon carbide (SiC) crystals grown in the lab. Electronics made from SiC will be able to withstand temperature ranges as high as 600 degrees centigrade (1,112 degrees Fahrenheit). This is considered a "harsh environment," far higher than current silicon electronics components can tolerate.

In time, the uses for SiC will be dramatic. It will be possible to reduce or eliminate the thermal radiators on spacecraft used for cooling electronics systems, thus saving significant payload weight. This will be important both on probes to the Sun and also to Venus, which has an atmosphere of 450 degrees Centigrade. And because SiC components can better withstand radiation than comparable silicon components, it will be possible to save weight on radiation shielding.

SiC electronics would also have major weight-saving implications for both military and industrial aircraft; high-temperature sensors and central electronics in cars that would lead to greater fuel efficiency; communications and radar; and vastly greater efficiency and reliability for power distribution by public utilities.

But the technologies for SiC crystal growth and device fabrication are not yet developed enough to be reliably used in scientific or industrial technologies. So researchers, such as Phil Neudeck at Glenn, are using the microscope to study qualities in SiC crystals they are growing that may eventually have critical implications in their practical usefulness.

Cool Runnings

In order to convey liquid oxygen from a cryogenic tank to a booster tank, it needs to be pumped by electric motors. The shafts of the motor and the pump have to be precisely aligned when running so the pump seals don't fail. Since the pumps undergo enormous changes because the lox is so cold (it boils at minus 183 degrees C!), they have to be deliberately misaligned at normal temperatures to compensate for the misalignment that will occur when the lox is being pumped. To do this, the Kennedy Space Center uses a laser alignment system from GSA.

Security

NASA has contracted with GSA for security staff and personnel. GSA has also supplied NASA with flat panel LED flat panel display screens that are being used in UH-1 Huey helicopters patrolling Cape Canaveral as part of forward-looking infrared (FLIR) systems that can view intruders at night in total darkness. The screens function like the cathode-ray tube screens they replace. But they are lighter by about ten pounds, more reliable, don't burn out as fast and save space. With all the same type of electrical connections as the old-style screens, they can be installed easily.

...And Tomorrow

Donald "Deke" Slayton, one of the original seven Mercury astronauts, was grounded for an irregular heartbeat. Undaunted, Slayton chose to stay with NASA in support roles, when he was named chief of the Astronaut Office and later when he became director of flight crew operations. When the Apollo 13 crew was in jeopardy, it was often Slayton's calm and level voice that helped talk them through the problems they faced in averting disaster. At GSA, we believe that we also have a support mission, not only for NASA but for federal agencies in locations throughout the world. The problems we help solve can be large or small. Often, only a few people ever know the role that GSA has played in ensuring the integrity of a supply line that must always be prepared. And we always will be. Deke Slayton, by the way, finally did get the chance to fly in space when he was part of the Apollo-Soyez space mission in July 1975 when he stayed in orbit for nine days. And GSA was there for NASA then, too. Robert Goddard said, "It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow." GSA is ready for that tomorrow.

GSA Schedule

Tomorrow. Bring it on.

Question: What will tomorrow bring?

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