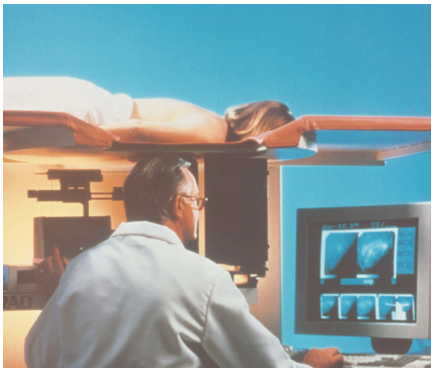
Goddard Space Flight Center

Named after rocket research pioneer Dr. Robert H. Goddard, NASA Goddard Space Flight Center was established in 1959. Goddard employs hundreds of premier scientists and engineers who are devoted to research in Earth science, space science, and technology. The Technology Commercialization Office (TCO) at Goddard was established to encourage broader utilization of Goddard-developed technologies in the American industrial and academic communities.

The automotive industry uses NASTRAN® to design front suspension systems and steering linkages.

One of Goddard's most noteworthy examples is the NASTRAN® (NASA Structural Analysis) software application, written to help design more efficient space vehicles such as the Space Shuttle. NASTRAN was released to the public in 1971 by NASA's Office of Technology Utilization. The commercial use of NASTRAN has helped to analyze the behavior of elastic structures of any size, shape, or purpose. For example, the automotive industry uses the program to design front suspension systems and steering linkages. It is also used in designing railroad tracks and cars, bridges, power plants, skyscrapers, and aircraft. The program alone was estimated to have returned $701 million in cost savings from 1971 to 1984. NASTRAN was inducted into the U.S. Space Foundation's Space Technology Hall of Fame in 1988, one of the first technologies to receive this prestigious honor.

Since the beginning of the technology transfer program at Goddard, several technologies have made significant contributions to the medical industry. The Implantable Cardioverter Defibrillator (ICD) was conceived in the mid-to-late 1960s, and tested at Sinai Hospital, of Baltimore, Maryland, in 1969. This heart assist system was derived from NASA's space circuitry technology. In 1985, after a number of years of pre-clinical testing, the device entered clinical trials and received U.S. Food and Drug Administration approval. The ICD is a fully implantable device, not much larger in size than the implantable pacemaker. The success of this therapy became regarded as the "gold standard" in the treatment of malignant arrhythmias.



Another spinoff application enabled by Goddard is the charge coupled device (CCD). This technology has made great strides in the area of non-invasive breast cancer detection. The stereotactic breast biopsy system incorporated the charge coupled technology as the key component of a digital camera that scans the breast structure with X-rays. The device images suspicious breast tissue more clearly and efficiently, saves women time and money, reduces pain and radiation exposure, and eliminates the scarring of more invasive techniques. With more than 500,000 women undergoing breast biopsies each year, the system has dramatically reduced annual health care costs. The system that first made possible this new technique is the LORAD Stereo Guide™ Breast Biopsy System, which incorporates Scientific

Imaging Technologies, Inc.'s CCD as part of its digital camera system. The technology breakthrough that spawned the LORAD system originated at Goddard, where scientists developed the Space Telescope Imaging Spectrograph for the Hubble in 1997. Goddard is supported by the **Small Business Innovation Research (SBIR)** program in its commercialization efforts. This program, established by Congress in 1982, provides increased opportunities for small businesses to participate in R&D. Legislation enacted in 2000 extended and strengthened the SBIR program and increased its emphasis on pursuing commercial applications of SBIR project results.

The LORAD Stereo Guide™ Breast Biopsy System incorporates Goddard's charge coupled device technology as part of a digital camera system that "sees" a breast structure with X-ray vision.

The **Small Business Technology Transfer (STTR)** program awards contracts to small business concerns for cooperative R&D with a non-profit research institution, such as a university. Modeled after the SBIR program with the same basic requirements and phased funding structure, the STTR program is a separately funded activity.

Since its inception, the SBIR program at Goddard has made great strides in bringing small businesses and NASA innovation together. For example, Foster-Miller, Inc., a company that developed a high performance, low cost substrate for printed circuits under an SBIR contract, collaborated with NASA to develop better, more cost effective satellite- and land-based applications. The commercial product that resulted from the agreement led to the start of a spinoff company called Superex Polymer, Inc. The resulting product, called liquid crystal polymers, proved to be exceptionally strong and ideal for food and beverage packaging, high performance tubing, barrier layers for cryogenics, and high temperature electrical insulation.

Through a series of SBIR contracts with NASA, a company called Creare, Inc., has become a leader in advanced cryogenic systems. This collaboration at Goddard has resulted in the development of a Miniature Cryogenic Turboalternator. This low temperature cooler for NASA was used in the Next Generation Space Telescope, Constellation-X. Long-term commercial applications include cryocoolers for low and high temperature superconducting medical and electronics instruments. This technology was also integrated with the Near Infrared Camera and Multi-Object Spectrometer instrument on the Hubble Space Telescope in 2001. Creare is currently developing components and systems for specialized cryogenic applications.

Liquid crystal polymers proved to be exceptionally strong and ideal for food and beverage packaging. Their properties can prevent oxygen from deteriorating the taste of precooked and packaged food.

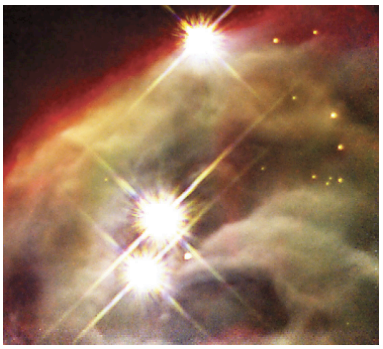
Goddard's fundamental mission is to expand our current knowledge of the Earth and its environment, the solar system, and the universe through observations from space. Goddard manages and implements flight programs and projects, including the Hubble Space Telescope and Next Generation Space Telescope, Geostationary and Polar Operational Satellites, "Living With a Star" and Solar Terrestrial Probes, the Earth Observing System, Explorers and Earth Explorers, Structure and Evolution of the Universe missions, and a portion of the New Millennium Program. Goddard also oversees the development and operation of the Tracking and Data Relay Satellites, and Space and Ground Networks.

The Center also manages about two dozen Sun-Earth Connection and Structure and Evolution of the Universe missions currently in operation, including the Advanced Composition Explorer and the Microwave Anisotrophy Probe. Goddard is currently building the Swift mission to determine the nature of gamma ray bursts, considered the largest explosions in space since the Big Bang. Additionally, it is building next-generation X-ray and gamma-ray detectors for future NASA missions.

Goddard plans, organizes, and evaluates a broad program of scientific research in the Earth sciences, ranging from basic research to flight experiment development, mission operations, and data analysis. The

Center conducts missions that obtain highly accurate and frequent measurements of the Earth, as well as advanced computer networks that transmit data and the resulting information to a wide variety of global users. Scientific investigations include studying the internal structure, dynamics, and material variations of the Earth, as well as research to better understand the effects of climate change on ecosystems and the effects of land surface vegetation change on the climate.Goddard is an important resource for observing, understanding, and modeling the global oceans and related research that focuses on the links between all aspects of the water cycle, as well as global weather and climate. Scientists develop and apply microwave and multispectral optical remote sensing to measure and define the abundance of water, ice, and snow on land surfaces; oceanic salinity; precipitation; the exchange of water between soil, biosphere, and atmosphere; and oceanic biological productivity.

In the next 10 years, Goddard will provide leadership in the systematic measurement and NASA/National Oceanic and Atmospheric Administration transition missions to understand how the Earth is changing and the primary causes for such change.



Peering into our stellar backyard, the Near Infrared Camera and Multi-Object Spectrometer peeled back the outer layers of the Cone Nebula to see the underlying dusty “bedrock” in this stellar “pillar of creation.”

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