NASA Facts

National Aeronautics and
Space Administration

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Huntsville, Alabama 35812

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NASA's Propulsion Research Laboratory

At Marshall Space Flight Center

A new, world-class laboratory for research into future space transportation technologies opened in July 2004 at NASA's Marshall Space Flight Center in Huntsville, Ala. The state-of-the-art Propulsion Research Laboratory centralizes cutting-edge research that one day could improve access to orbit, open the space frontier for ambitious exploration, and strengthen commercial development and human settlement of space.

The laboratory and its principal occupant, the Marshall Center's Propulsion Research Center, provide a national resource for advanced space propulsion research. The lab is the epicenter of the effort to move the U.S. space program beyond the confines of conventional chemical propulsion into an era of greatly improved access to space and rapid transit throughout the solar system.

The Propulsion Research Laboratory accommodates researchers from across the United States. Scientists and engineers from NASA, the Department of Defense, the Department of Energy and other government agencies, universities, and industry pool their skills and expertise to perform landmark proof-of-principle demonstrations in a secure and safely isolated -- but accessible -- location within the Marshall Center.

Unlike other propulsion facilities designed to support a single or limited number of technologies, the new NASA lab is multifunctional, promoting synergism among different research efforts and allowing the sharing of expensive equipment. It provides invaluable educational opportunities to students and young researchers and houses a wellspring of innovation to benefit not only NASA, but ultimately the commercial sector as well.

The facility has 66,000 square feet of useable laboratory space and features a high degree of experimental capability. Its flexibility also allows it to address a broad range of propulsion technologies and concepts, such as plasma/electromagnetic, thermodynamic and propellantless propulsion. An important area of emphasis is the development and utilization of advanced energy sources for space transportation.

Research Labs
Technologies under investigation in the Propulsion Research Laboratory are on the cutting edge of modern propulsion science and engineering.

One of the labs is dedicated to **simulated fission propulsion**. Researchers are examining the potential for using fission heat to energize propellant for spacecraft journeying into deep space. Heat from fission reactions may be simulated using resistive heating -- that is, heat generation by electrical current flow through a wire, as in a hair dryer or electric space heater -- and converted back to electricity to power an electric thruster. Fission heat can also be used to heat a gas propellant that subsequently expands through a nozzle, creating high thrust.

A technology area that applies to a broad range of electromagnetic concepts involves high power plasmas, or electrically charged gases. Activities in the **plasma propulsion labs** focus on investigation of efficient plasma energization, containment and directed thrust. Fusion energy also may be obtained from high-powered plasmas, greatly improving propulsion performance for ambitious exploration of our solar system. Other important, related research areas include propulsion controls, pulsed electromagnetic fields, plasma interactions and high-performance switching technology.

The **advanced chemical propulsion lab** focuses on dramatic improvements in chemical propellants. Activities include advanced research and evaluation of new, energetic propellants and fuels. Researchers also are investigating chemical combustion physics and seeking improvements in current operating chemical systems.

Another lab is dedicated to **antimatter propulsion**. The collision and mutual annihilation of matter and antimatter is the most energetic reaction known in physics. The Marshall Center and its industry and education partners are engaged in unique research to develop technologies for storage and use of antimatter for space propulsion. Minute amounts of antimatter are being used in the lab for this research.

The **solar propulsion laboratory** is capable of exposing large, inflatable concentrators, or solar collectors, to direct sunlight -- 78,000 watts of power -- for propulsion experiments. In Earth orbit, solar energy is available at an intensity of approximately 130 watts per square foot. By comparison, solar energy on the planet's surface -- routinely limited by clear weather and nightfall -- is only available at 93 watts per square foot, making solar energy collected in space a cheaper and more beneficial energy source for propulsion. The solar energy can heat a propellant, provide power for electric thrusters or transfer photonic momentum directly to the solar sail spacecraft.

Propellant volume and mass usually take up a significant portion of every spacecraft, reducing size and the amount of useable payload. Lab researchers investigating **propellantless propulsion** are exploring technologies involving systems that do not carry their own propellant, such as electrodynamic and momentum exchange tethers and solar sails.

Other labs support additional research. Researchers studying **advanced experimental diagnostics** are working to improve such innovations as advanced, non-intrusive, laser-based measurement and high-speed cameras capable of taking 100 million frames per second.

Flexible Facility
A unique feature of the Propulsion Research Laboratory is its flexibility. If a technology doesn't prove to be as advantageous as expected, the lab areas are easily converted to investigate a different propulsion technology. It's also possible to simply and safely modify mechanical and electrical power hardware without interrupting research in other areas. Most lab rooms can handle portable shielding for potentially hazardous experiments.

All laboratory space, engineering resources and technical support are located on one floor of the complex. A centralized workshop, diagnostics lab, electronics shop, visitors' gallery and research lab spaces of various sizes are included. Broad corridors -- about 12 feet wide -- and large doors permit easy movement of large experiment hardware and portable equipment from room to room.

More about NASA's Marshall Center
NASA is the nation's premier agency for the development of Space Transportation systems, including future-generation launch vehicles and in-space systems. Such systems require revolutionary advances in critical aerospace technologies -- from thermal expansion, electromagnetic and propellantless propulsion systems to ones involving nuclear energy sources, such as fission, fusion or antimatter.

The Marshall Space Flight Center is a key leader in all these efforts, aimed at enabling dramatic improvements in the safety, cost and reliability of future space transportation systems. For more information about NASA space transportation systems, visit:

http://www.spacetransportation.com

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