

PRESS KIT/JUNE 2015

# Low-Density Supersonic Decelerator (LDSD)



# Media Contacts

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Cover: An artist's concept of the Low-Density Supersonic Decelerator being tested from the U.S. Navy's Pacific Missile Range Facility in Kaua'i, Hawai'i.

For more information  
[http://www.nasa.gov/mission\\_pages/tm/ldsd](http://www.nasa.gov/mission_pages/tm/ldsd)

# Media Services Information

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## **NASA Television Transmission**

NASA Television's channels NTV-1 (formerly the Public Channel) and NTV-3 (formerly the Media Channel) are now in high definition. NTV-2 (formerly the Education Channel) is a standard digital feed. NTV-1 provides real-time coverage of NASA missions, events and special programming. NTV-2 provides real-time coverage of NASA missions, education content and special programming in standard definition. NTV-3 provides mission coverage, news conferences and relevant video and audio materials to local, national and international newsgathering organizations.

News networks, their reporters, and other broadcast media organizations must tune their satellite receivers to the NTV-3 to ensure reception of clean feeds for all mission coverage, news conferences, and other agency distributed news and information. NASA TV is available in continental North America, Alaska and Hawai'i on AMC-18C. A Digital Video Broadcast (DVB) compliant Integrated Receiver Decoder (IRD) is needed for reception.

For digital downlink information for each NASA TV channel, schedule information for LDSD activities and access to NASA TV's public channel on the Web, visit: <http://www.nasa.gov/ntv>.

## **News Conferences**

On Monday, June 1, reporters who have previously received access clearance from the U.S. Navy are invited to the Pacific Missile Range Facility (PMRF) in Kaua'i, Hawai'i to attend a news conference about the test. After the televised briefing at 8 a.m. Hawai'i Standard Time (11 a.m. PDT/2 p.m. EDT), reporters in attendance will be offered a behind-the-scenes tour of

the facility and LDSD operations. Reporters who cannot attend may dial in remotely.

## **Flight Test Viewing**

Journalists are invited to PMRF to watch the liftoff and flight of the balloon carrying LDSD on launch-attempt days. After the balloon launch, reporters will be able to watch events as they unfold from monitors in the LDSD media center located in the PMRF hangar.

NASA's LDSD carries several onboard cameras. It is expected that video of selected portions of the test, including the rocket-powered ascent, will be downlinked and streamed live to several NASA websites, including:

<http://www.nasa.gov/nasatv>

and

<http://www.ustream.tv/nasajpl2>

## **Internet Information**

For more information about NASA's LDSD, visit the mission page at:

[http://www.nasa.gov/mission\\_pages/tdm/ldsd](http://www.nasa.gov/mission_pages/tdm/ldsd)

The LDSD program is part of the agency's Space Technology Mission Directorate, which is innovating, developing, testing and flying hardware for use in NASA's future missions. For more information about NASA's investment in space technology, visit: <http://www.nasa.gov/spacetech>

Mission news and updates will also be posted on Twitter via @NASA\_Technology, @NASA and @NASAJPL with the hashtag #LDSD.

# Quick Facts

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*Test vehicle weight, with fuel:* 6,808 pounds (3,088 kilograms)

*Test vehicle dimensions:* 15 feet, 5 inches (4.7 meters) diameter, prior to inflation of the 20 foot- (6 meter-) diameter decelerator known as a Supersonic Inflatable Aerodynamic Decelerator, or SIAD.

*Parachute dimensions:* 100 feet (30.5 meters) diameter – the largest parachute ever deployed

*Launch balloon, at vehicle separation:* 460 feet (140 meters) wide and 396 feet (120 meters) tall — would fit snugly inside a football stadium like the Rose Bowl.

*Test vehicle maximum speed:* Mach 4

*Launch period:* June 2–12, 2015

*Duration of flight test from balloon launch to vehicle splashdown:* approximately 3 to 6 hours

## Key Points

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- To safely land heavier spacecraft on Mars, larger-parachutes and other kinds of drag devices that can be deployed at supersonic speeds are needed.
- High in Earth's stratosphere, NASA's Low-Density Supersonic Decelerator mission will test new, full-scale parachutes and drag devices at supersonic speeds to refine them for future use at Mars. Testing will be conducted through 2016.
- These new drag devices are among the first steps on the technology path to landing humans and habitats safely on Mars.
- Current Mars landing techniques date back to NASA's Viking mission, which put two landers on Mars in 1976. That mission's parachute design has been in use ever since — and was used again in 2012 to deliver the Curiosity rover to Mars. To conduct advanced exploration missions in the future, however, NASA must advance the technology to a new level of sophistication since Viking-style parachutes' capabilities are limited.
- The main goal of this second Low-Density Supersonic Decelerator flight is to test our Supersonic Ringsail parachute. We want to see if the chute can successfully deploy and decelerate the test vehicle while it is in supersonic flight. A third test flight is scheduled for the summer of 2016.

# Why LDSD?

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As NASA plans ambitious new robotic missions to Mars, laying the groundwork for even more complex human science expeditions to come, the spacecraft needed to land safely on the Red Planet's surface necessarily become increasingly massive, hauling larger payloads to accommodate extended stays on the Martian surface. Current technology for decelerating from the high speed of atmospheric entry to the final stages of landing on Mars dates back to NASA's Viking Program, which put two landers on Mars in 1976. The basic Viking parachute design has been used ever since — and was successfully used again in 2012 to deliver the Curiosity rover to Mars.

NASA seeks to use atmospheric drag as a solution, saving rocket engines and fuel for final maneuvers and landing procedures. The heavier planetary landers of tomorrow, however, will require much larger drag devices than any now in use to slow them down — and those next-generation drag devices will need to be deployed at higher supersonic speeds to safely land vehicle, crew and cargo. NASA's Low-Density Supersonic Decelerator (LDSD) Technology Demonstration Mission, led by NASA's Jet Propulsion Laboratory in Pasadena, California, is conducting full-scale, stratospheric tests of these breakthrough technologies high above Earth to prove their value for future missions to Mars.

Three devices are in development. The first two are Supersonic Inflatable Aerodynamic Decelerators, or SIADs — very large, durable, balloon-like pressure vessels that inflate around the entry vehicle and slow it from Mach 3.5 or greater to Mach 2 or lower. These decelerators are being developed in 20-foot- (6-meter-) diameter SIAD-R and 26-foot- (8-meter-) diameter SIAD-E configurations. Also in development is a 100-foot- (30.5-meter-) diameter parachute, called the Supersonic Ringsail parachute, which will further slow the entry vehicle from Mach 2 to subsonic speeds. All three devices will be the largest of their kind ever flown at speeds several times greater than the speed of sound.

Together, these new drag devices can increase payload delivery to the surface of Mars from our current capability of 3,300 pounds (1.5 metric tons) to between 4,400 and 6,600 pounds (2 to 3 metric tons), depending on which inflatable decelerator is used in combination with the parachute. They will increase available landing altitudes by 1 to 2 miles (2 to 3 kilometers), increasing the accessible surface area we can explore. They also will improve landing accuracy from a margin of 6 miles (10 kilometers) to just 2 miles (3 kilometers). All these factors will increase the capabilities and robustness of robotic and human explorers on Mars.

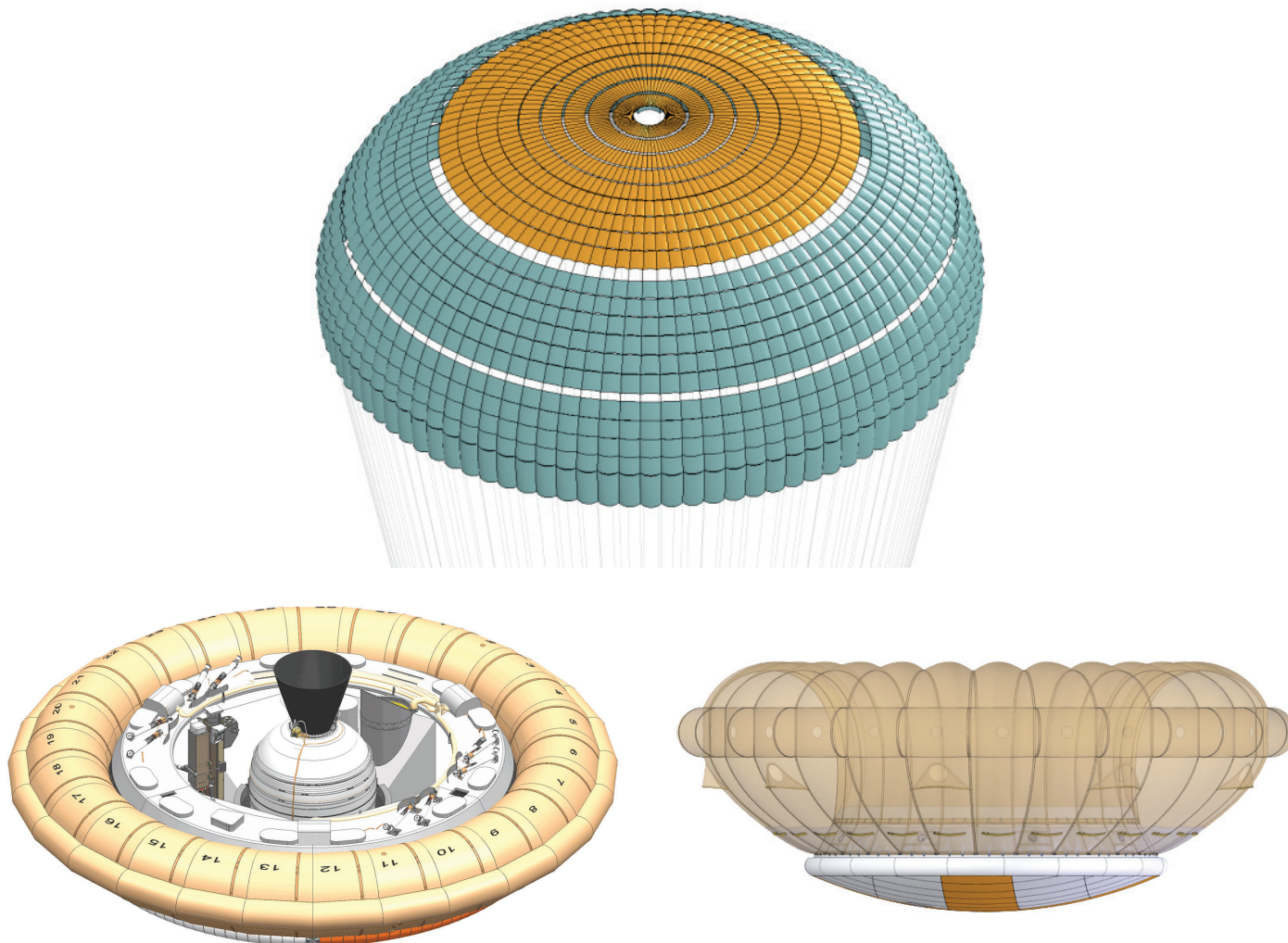


To thoroughly test the system, the LDSD team will fly the drag devices several times — at full scale and at supersonic speeds — high in Earth’s stratosphere, simulating entry into the atmosphere of Mars. The investigators have conducted design verification tests of parachutes and supersonic inflatable aerodynamic decelerators through the spring of 2015. The first flight of the test vehicle and braking systems took place on June 28, 2014, from the Pacific Missile Range Facility (PMRF) on Kaua’i, Hawai’i.

Two more supersonic flight tests will be conducted from PMRF in the summers of 2015 and 2016.

Once tested, the devices will enable missions that maximize the capability of current launch vehicles, and would be used in Mars missions.

The LDSD project is sponsored by NASA’s Space Technology Mission Directorate and is managed by the Jet Propulsion Laboratory.



*Illustrations of the three new drag devices being developed by the LDSD project: 100-foot (30-meter) Supersonic Ringsail (SSRS) Parachute (at top), 20-foot (6-meter) SIAD-R (bottom left), 26 foot (8-meter) SIAD-E (bottom right).*

# LDSD Flight Test Overview

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NASA will perform a supersonic flight dynamics test as part of the Low-Density Supersonic Decelerator (LDSD) project at the U.S. Navy's Pacific Missile Range Facility (PMRF) on Kaua'i, Hawai'i. During the test, the LDSD project will assess two devices for landing heavy payloads on Mars: the SIAD and a supersonic parachute.

NASA has 11 potential dates for launch of the high-altitude balloon carrying the LDSD experiment: June 2–12. The NASA LDSD test over the Pacific Ocean will simulate descent speeds a spacecraft would be exposed to when flying through the Martian atmosphere.

During this year's test, a large saucer-shaped vehicle carrying an inflatable Kevlar inner-tube-shaped decelerator and parachute system will be carried to an altitude of 120,000 feet (37 kilometers) by a giant balloon.

After release from the balloon, rockets will lift the vehicle to 180,000 feet (55 kilometers) and reach supersonic speeds. Traveling at three times the speed of sound, the saucer's decelerator will inflate, slowing the vehicle, and then a parachute will deploy at 2.35 times the speed of sound to carry it to the ocean's surface.

## Flight Test Vehicle

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*These illustrations show front (at left), side (at center) and back (at right) views of the LDSD flight test vehicle as it will appear prior to launch, hanging from its launch tower.*

The saucer-shaped vehicle being launched is designated LDSD Supersonic Flight Dynamics Test Vehicle Number 2. It is 15 feet, 5 inches (4.7 meters) diameter and weighs almost 7,000 pounds (3,200 kilograms) when fully fueled.

The test vehicle includes a balloon-like pressure vessel, called a Supersonic Inflatable Aerodynamic Decelerator, or SIAD. When inflated, the vehicle's diameter grows to

20 feet (6 meters). The decelerator is inflated with pressurized hot gas. Sized for future robotic missions, this version of the SIAD is called SIAD-R.

A second SIAD that is in development, but has not flown aboard the test vehicle, is called SIAD-E. The SIAD-E is inflated by ram air pressure and is 26 feet (8 meters) in diameter when deployed.

The SIAD-R is attached to the outer rim of the capsule-like atmospheric entry vehicle. It employs gas generators to inflate when the test vehicle is flying at Mach 3, and to decelerate the vehicle to Mach 2.35, where it becomes safe to deploy the supersonic parachute. The SIAD-R was successfully tested during last year's flight test and has been certified for future Mars operations.

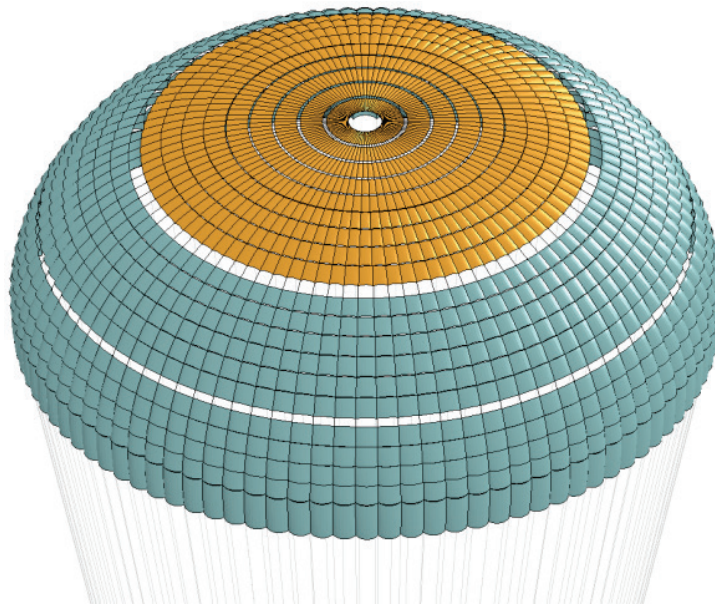
The second braking technology to be tested during this summer's flight test is the Supersonic Ringsail parachute. The full-scale LDSR parachute is the largest supersonic parachute ever tested for use at Mars.

During the June 2014 test, a previous design called the Supersonic Disksail parachute deployed but did not inflate as expected. In the harsh environment found at high altitude and high Mach numbers, the chute shredded during inflation. However, the mission received this data a year ahead of schedule, and with it gained significant insight into the fundamental physics of parachute inflation. Since last year's test, the LDSR team has been re-writing the book on highspeed parachute operations.

The parachute's configuration was changed from the previous Supersonic Disksail to Supersonic Ringsail in order to increase the crown of the chute's strength during the initial milliseconds of supersonic inflation. The parachute's geometry and construction were improved for use in the extreme supersonic environment.

To improve the parachute's geometry, the team redesigned the canopy to redistribute loading, and added to the number of gaps in the crown to reduce the severity of the supersonic inflation environment. To improve construction, they added to the amount of high-strength Kevlar in critical areas to support higher loads and significantly improved manufacturing techniques to make the parachute more robust and tolerant of damage.

This new parachute is about 100 feet (30.5 meters) in diameter – more than twice the area of the most recent Viking-based parachute used to land Curiosity. The parachute weighs about 230 pounds (105 kilograms) and can generate over 120,000 pounds-force (530,000 newtons) of drag. This is an enormous aerodynamic load, making the parachute an extremely efficient decelerator.



*The Supersonic Ringsail parachute is the key braking technology being tested during this summer's experimental flight test of the Low-Density Supersonic Decelerator project.*



# Timeline of Events

At the beginning of the flight test, the saucer-shaped LDSD vehicle hangs from a tower in preparation for launch. The launch tower holds the test vehicle 50 feet above the ground, and then releases it when the balloon rises overhead. The height prevents the test vehicle from impacting the ground as it swings away from the tower on the rising balloon.

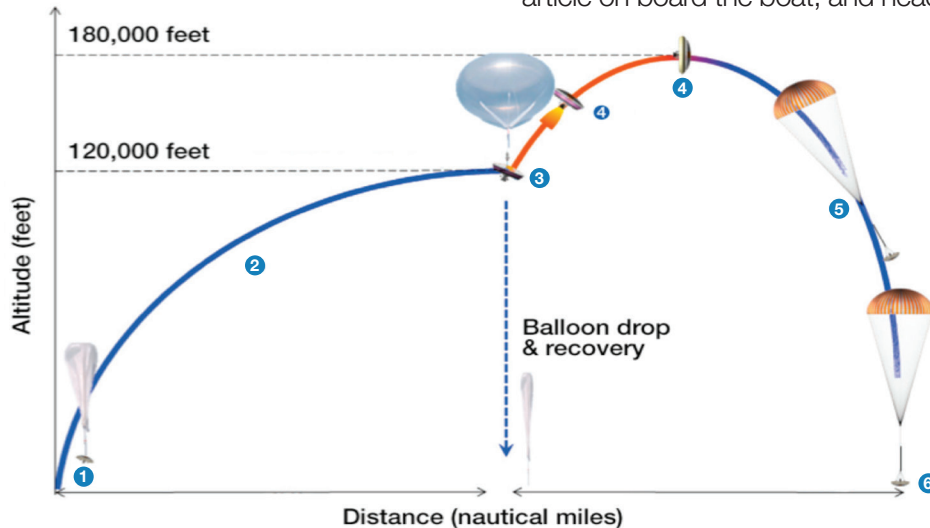
At T-minus 0, the vehicle and balloon are released from the tower and the balloon slowly carries the vehicle to an altitude of 120,000 feet (36,000 meters), where the vehicle is released from the balloon. The ascent to drop altitude is expected to take less than two and a half hours.

Low-resolution images from the saucer are expected to be downlinked live during the test. They are expected to show the vehicle dropping away from its high-altitude balloon and then rocketing up to the edge of the stratosphere.

After being released from the balloon, the vehicle's rocket lights and quickly takes the craft to an altitude of 180,000 feet (55 kilometers) — the top of the stratosphere — where the supersonic test begins. Small solid-fuel rocket motors spin the test vehicle for stability ahead of the main motor ignition.

Upon reaching its maximum altitude, the test vehicle is traveling at approximately Mach 4. The test vehicle will deploy the Supersonic Inflatable Aerodynamic Decelerator (SIAD) at Mach 3. The SIAD decelerates the vehicle to approximately Mach 2.4. The test vehicle will then deploy a mammoth parachute (the Supersonic Ringsail Parachute), which carries it safely to a controlled water impact about 40 minutes after being dropped from the balloon.

Following the flight test, both the balloon envelope and test vehicle will be recovered. The duration of the recovery phase will be driven by how quickly boats are able to locate the items to be recovered, address any safety hazards and assess the article, pick up the article on board the boat, and head back to port.



	Event	Time
1	Launch (balloon released)	0
2	Float and drop of test vehicle	no earlier than 2 hrs 20 mins
3	Rocket fire duration	66 sec post drop
4	Inflatable device (SIAD) deploys	108 sec post drop
5	Parachute deploys	124 sec post drop
6	Vehicle splashdown	42 mins post drop

# Technology Demonstration Missions

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## **Mission Statement**

NASA's Technology Demonstration Missions Program bridges the gap between early proof-of-concept tests and the final infusion of cost-effective, revolutionary new technologies into successful NASA, government and commercial space missions.

## **Technology Demonstration Missions: In Depth**

Bridging the gap. That's the mission of NASA's Technology Demonstration Missions, or TDM: to bridge the gap between need and means, between advanced technologies and flight-qualified systems, between early proof-of-concept tests and the final infusion of cost-effective, revolutionary new technologies into successful NASA, government and commercial space missions.

The TDM program focuses on crosscutting technologies with strong customer interest that meet the needs of NASA and industry by enabling new missions or greatly enhancing existing ones. Chosen technologies will be thoroughly ground-tested and flight-tested — reducing risks to future flight missions, gaining operational heritage and continuing NASA's long history as a technological leader. These newly proven technologies will enable future NASA missions to pursue bolder goals; make human missions safer and more rewarding; and enable new expansion of space industry in the government and commercial sectors.

The Technology Demonstration Missions Program Office at NASA's Marshall Space Flight Center in Huntsville, Alabama, is overseeing a portfolio of technology demonstration flight projects led by NASA centers and industry partners across the country. The program is part of NASA's Space Technology Mission Directorate in Washington.

More information  
[http://www.nasa.gov/mission\\_pages/tdm/main/index.html](http://www.nasa.gov/mission_pages/tdm/main/index.html)

# Program/Project Management

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NASA's Space Technology Mission Directorate in Washington funds the LDSD mission, a cooperative effort led by NASA's Jet Propulsion Laboratory in Pasadena, California. JPL is home to the LDSD project manager, Mark Adler, and its principal investigator, Ian Clark. NASA's Marshall Space Flight Center, in Huntsville, Alabama, manages LDSD within the Technology Demonstration Mission Program Office. NASA's Wallops Flight Facility in Virginia is coordinating support with the Pacific Missile Range Facility in Kaua'i, Hawa'i, and providing the balloon systems for the LDSD test.

## **About NASA's Space Technology Mission Directorate**

The nation's investments in space technology enable NASA to make a difference in the world around us. The Space Technology Mission Directorate (STMD) is responsible for developing the crosscutting, pioneering, new technologies and capabilities needed by the agency to achieve its current and future missions.

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. STMD employs a merit-based competition model with a portfolio approach, spanning a range of discipline areas and technology readiness levels. By investing in bold, broadly applicable, disruptive technology that industry cannot tackle today, STMD seeks to mature the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

Research and technology development takes place within NASA Centers, in academia and industry, and leverages partnerships with other government agencies and international partners. STMD engages and inspires thousands of technologists and innovators creating a community of our best and brightest working on the nation's toughest challenges.

More information  
<http://www.nasa.gov/directorates/spacetech/home/index.html>

