



# “Challenges and future opportunities in our nation’s space program”

The Real Time & Embedded Computing Conference  
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# ABSTRACT

For the first time in decades, there is a significant amount of change in our nation's space program. Along with change, there are opportunities, and NASA has begun a set of planning to be prepared for the future, emphasizing innovation and technology development, increased emphasis on collaboration, commercially-provided access to space, and the need for reinvention.

This discussion will briefly give an overview of NASA, showcase some of the diverse activities that are part of our nation's space program, identify some of the new changes envisioned to NASA's mission, and how our space program can continue to inspire the future during challenging times.

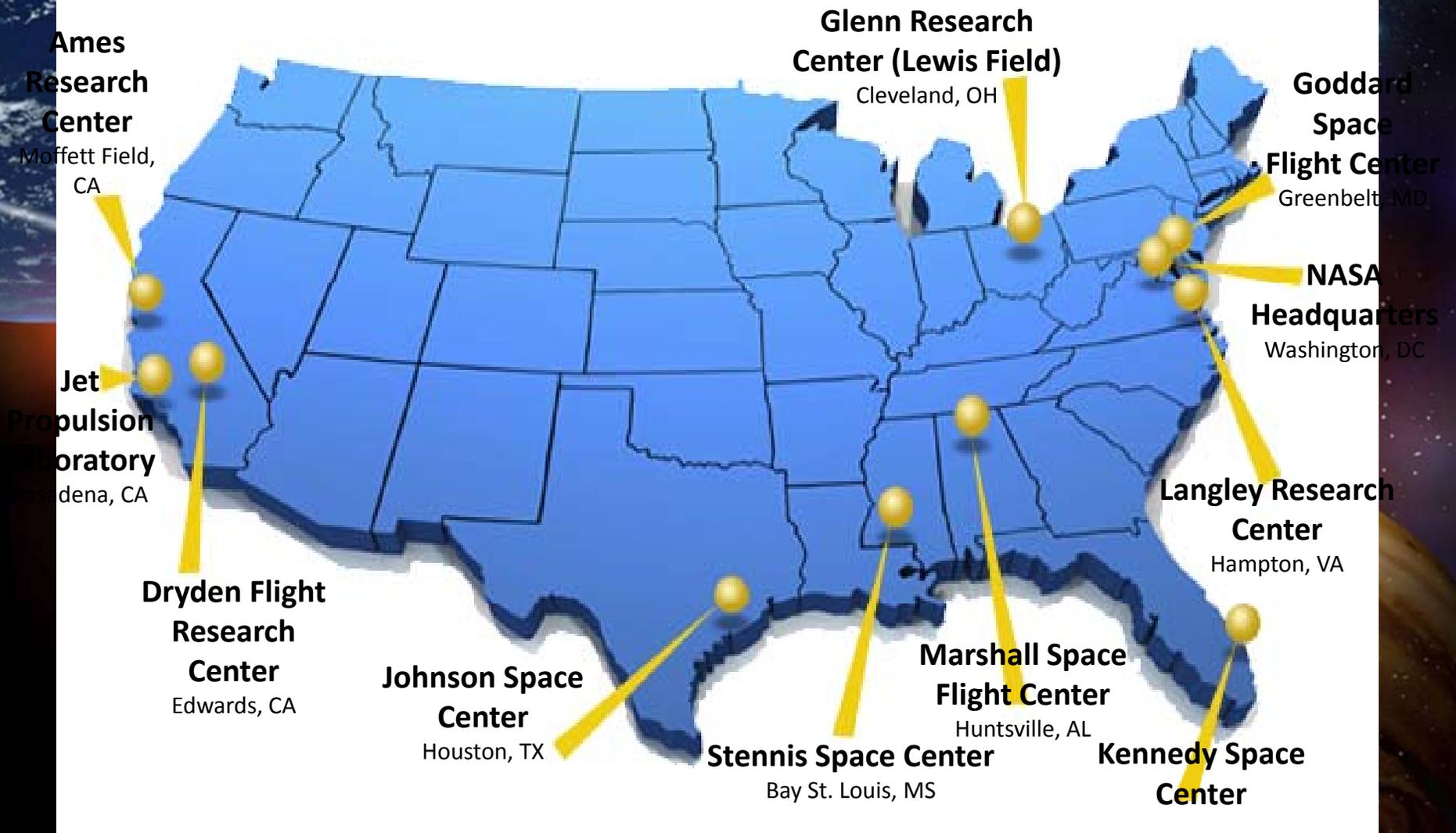


# NASA Overview

Since its inception in 1958, NASA has accomplished many great scientific and technological feats in air and space. NASA technology also has been adapted for many nonaerospace uses by the private sector. NASA remains a leading force in scientific research and in stimulating public interest in aerospace exploration, as well as science and technology in general. Perhaps more importantly, our exploration of space has taught us to view Earth, ourselves, and the universe in a new way. While the tremendous technical and scientific accomplishments of NASA demonstrate vividly that humans can achieve previously inconceivable feats, we also are humbled by the realization that Earth is just a tiny "blue marble" in the vastness of space.



# NASA Field Center Locations





# PHOTO GALLERY

## Sunrise at Pad 39A

The sun begins to rise in the east overlooking Launch Pad 39A at NASA's Kennedy Space Center in Florida, with newly arrived space shuttle Discovery.

Discovery arrived at the launch pad on Feb. 1, 2011 for its next launch opportunity to the International Space Station on the STS-133 mission, currently scheduled to lift off on





# PHOTO GALLERY



Artist's rendering of the Glory spacecraft. Credit: NASA/GSFC/Ryan

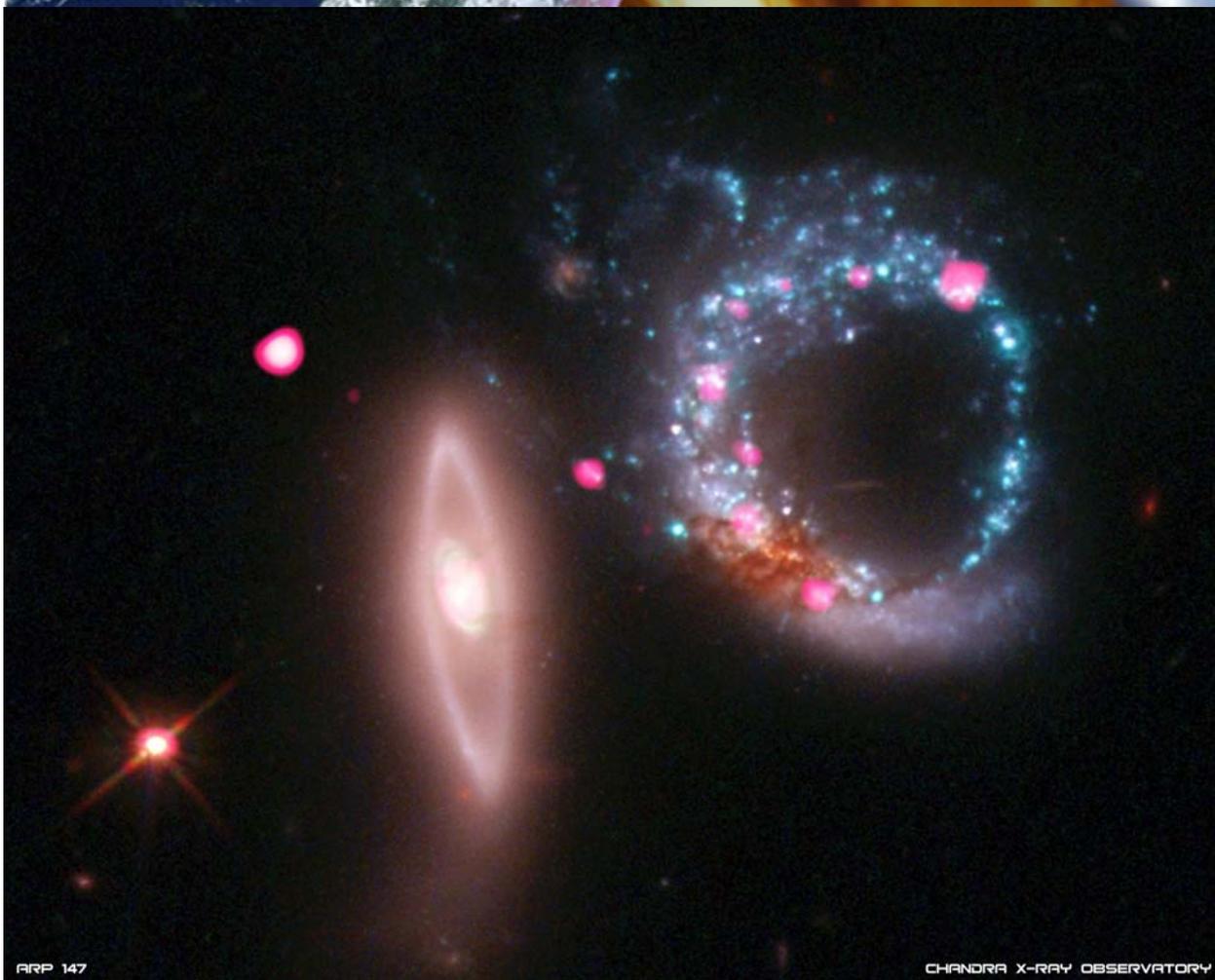
## Glory's Launch Aboard Taurus Nears

The launch of NASA's Glory spacecraft aboard an Orbital Sciences Taurus XL rocket is scheduled for Wednesday, Feb. 23. Liftoff will be from Space Launch Complex 576-E at Vandenberg Air Force Base in California. Liftoff is targeted for 2:09:43 a.m. PST .

Data from the Glory mission will allow scientists to better understand how the sun and tiny atmospheric particles called aerosols affect Earth's climate. Both aerosols and solar energy influence the planet's energy budget -- the amount of energy entering and exiting Earth's atmosphere. An accurate measurement of these impacts is important in order to anticipate future changes to our climate and how they may affect human life.



# PHOTO GALLERY

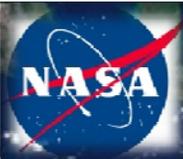


ARP 147

CHANDRA X-RAY OBSERVATORY

**Giant Ring of Black Holes**  
Just in time for Valentine's Day comes a new image of a ring -- not of jewels -- but of black holes. This composite image of Arp 147, a pair of interacting galaxies located about 430 million light years from Earth, shows X-rays from the NASA's Chandra X-ray Observatory (pink) and optical data from the Hubble Space Telescope (red, green, blue) produced by the Space Telescope Science Institute, or STScI.

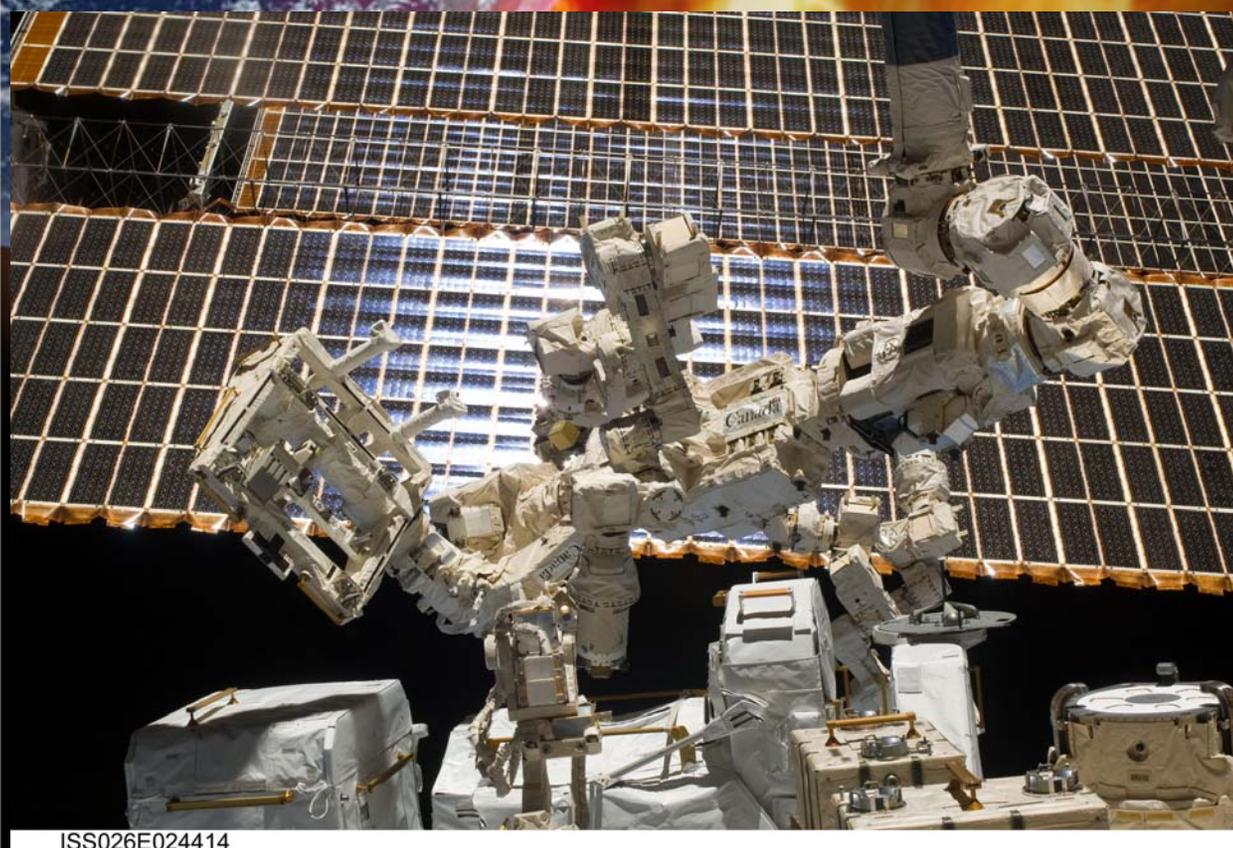
*Image Credit: X-ray: NASA/CXC/MIT/S .Rappaport et al.,  
Optical: NASA/STScI*



# PHOTO GALLERY

## Dextre Gets to Work

Dextre, the Canadian Space Agency's robotic "handyman", is featured in this image photographed by an Expedition 26 crew member aboard the International Space Station on Feb. 3, 2011. Dextre completed its first real job since the robot passed its final exam in December 2010, unpacking two critical pieces of equipment delivered by the unpiloted Japanese Kounotori2 H-II Transfer Vehicle (HTV2) spacecraft - the space equivalent of a moving van.



ISS026E024414

*Image Credit: NASA*



# PHOTO GALLERY



## **An Explosion of Infrared Color**

This oddly colorful nebula is the supernova remnant IC 443 as seen by NASA's Wide-field Infrared Survey Explorer, or WISE. Also known as the Jellyfish Nebula, IC 443 is particularly interesting because it provides a look into how stellar explosions interact with their environment.

IC 443 is the remains of a star that went supernova between 5,000 and 10,000 years ago, captured here as an image from NASA's Wide-field Infrared Survey Explorer, or WISE.

*Image Credit: NASA/JPL-Caltech/UCLA*



# PHOTO GALLERY



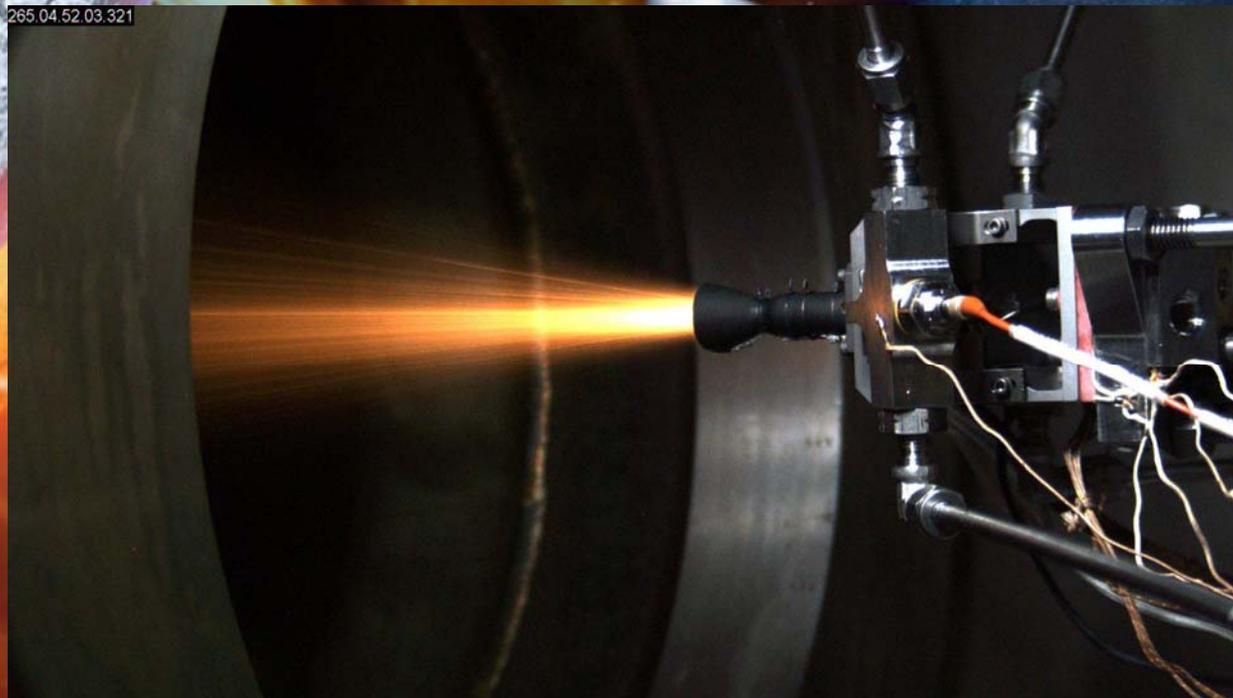
## Astronaut Glove

Students from Ferebee-Hope Elementary School in Washington, D.C., take turns trying on a glove from a space suit on Tuesday, Feb. 8, 2011. Ferebee-Hope Elementary School, in collaboration with Reading is Fundamental, hosted this event in honor of Black History Month, and to highlight the importance of reading. NASA Associate Administrator for Education and STS-129 astronaut Leland Melvin read to first and third grade students at the school from the book *The Moon Over Star* during the event.

Image Credit: NASA/Carla Cioffi



# PHOTO GALLERY

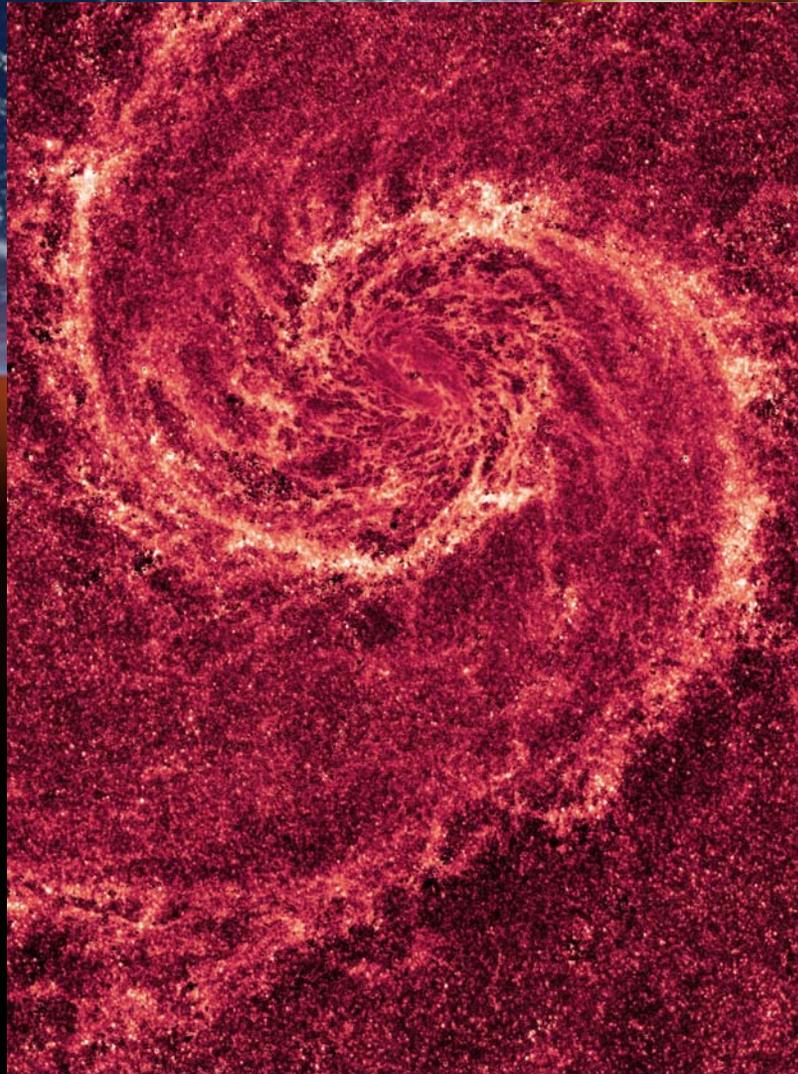


## The Next Generation

In October 2010, NASA's Marshall Space Flight Center and White Sands Test Facility worked with Pratt & Whitney Rocketdyne to successfully complete a series of thruster tests that will allow maneuvering and landing the next generation of robotic lunar landers that could be used to explore the moon's surface and other airless celestial bodies. The test results will help the project to move forward with robotic lander designs using advanced



# PHOTO GALLERY



## Seeing Red

This image by the Hubble Space Telescope shows a dramatic view of the spiral galaxy M51, dubbed the Whirlpool Galaxy. Seen in near-infrared light, most of the starlight has been removed, revealing the Whirlpool's skeletal dust structure. This new image is the sharpest view of the dense dust in M51.

The narrow lanes of dust revealed by Hubble reflect the galaxy's moniker, the Whirlpool Galaxy, as if they were swirling toward the galaxy's core.

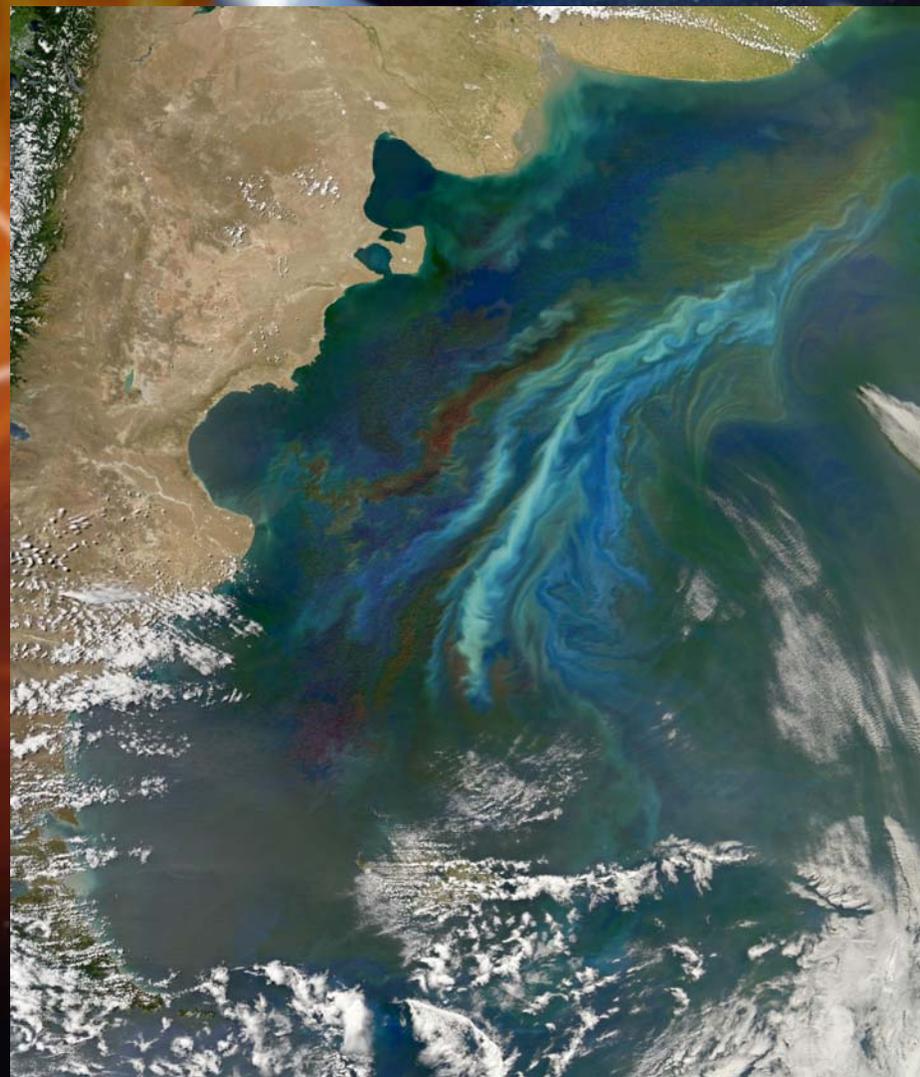
*Image Credit: NASA, ESA, M. Regan and B. Whitmore (STScI), R. Chandar (University of Toledo), S. Beckwith (STScI), and the Hubble Heritage Team (STScI/AURA)*



# PHOTO GALLERY

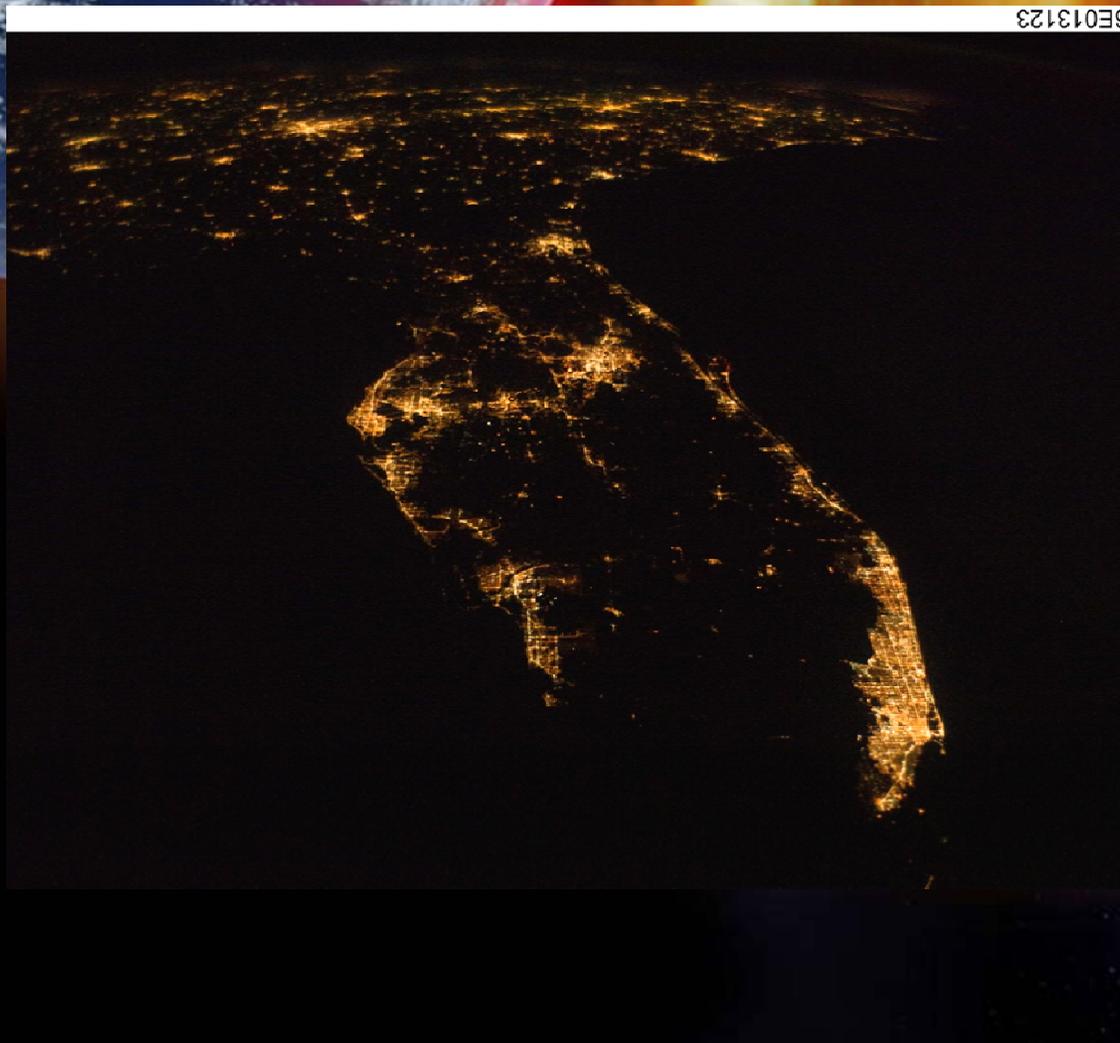
## **Stirring Up a Bloom Off Patagonia**

Off the coast of Argentina, two strong ocean currents recently stirred up a colorful brew of floating nutrients and microscopic plant life just in time for the Southern Hemisphere's summer solstice. The Moderate Resolution Imaging Spectroradiometer on NASA's Aqua satellite captured this image of a massive phytoplankton bloom off of the Atlantic coast of Patagonia on Dec. 21, 2010. Scientists used seven separate spectral bands to highlight the differences in the plankton communities across this swath of ocean.





# PHOTO GALLERY



## City Lights Redux

A southerly looking night view of the upper two-thirds of the Florida peninsula was recorded by the Expedition 26 crew aboard the International Space Station on Dec. 28, 2010. Cape Canaveral and the Kennedy Space Center are very well lit on the Atlantic Ocean side of the peninsula to the left in this image. The Tampa-St. Petersburg area is seen on the Gulf of Mexico or right side of the frame. At bottom or in the north areas of the picture are portions of the state's panhandle as well as cities and communities in southern Georgia.

*Image Credit: NASA*



# PHOTO GALLERY

## A Break in Training

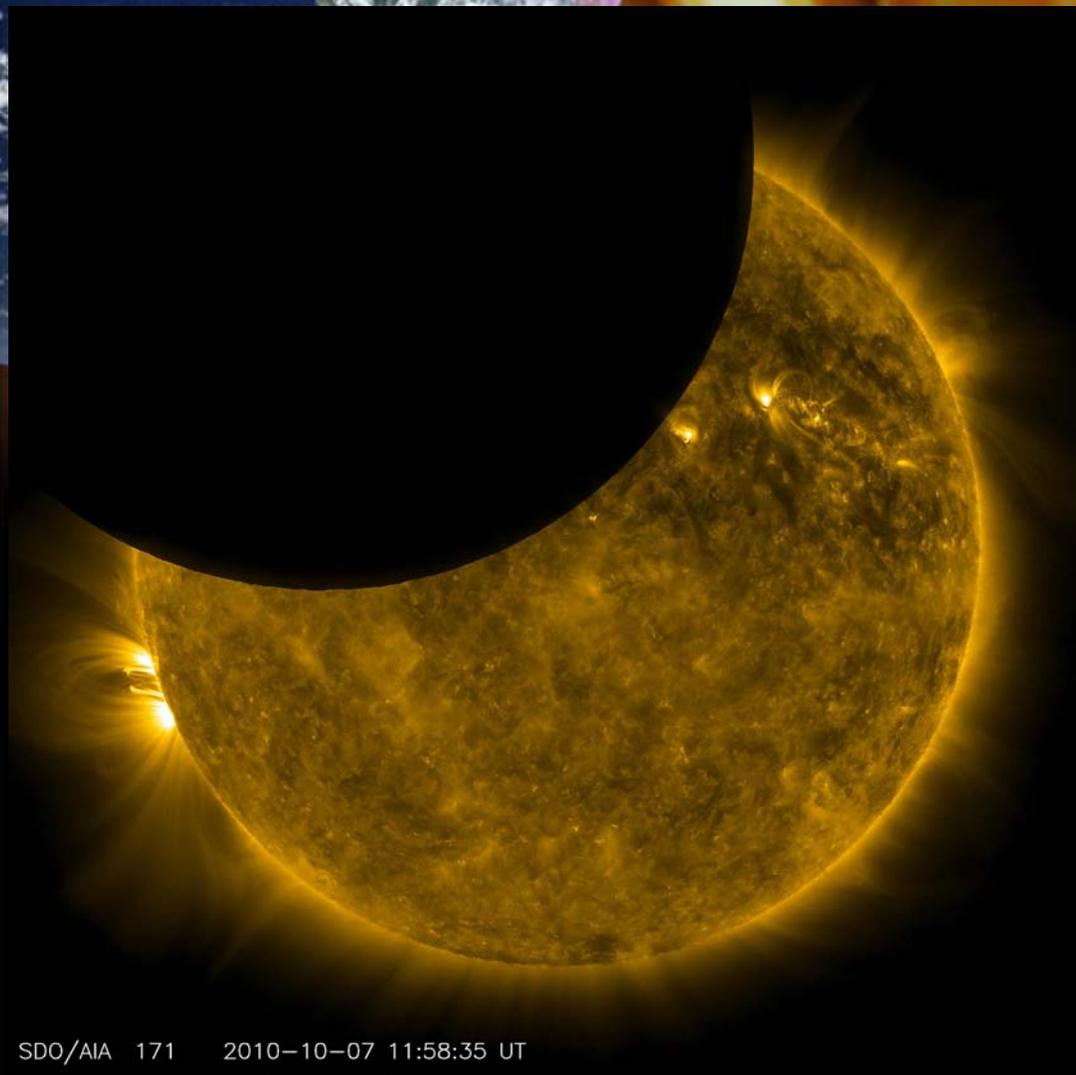
At Kennedy Space Center, the STS-133 crew takes a break from a simulated launch countdown to ham it up on the 195-foot level of Launch Pad 39A. From left are, Pilot Eric Boe, Mission Specialist Michael Barratt, Commander Steve Lindsey, and Mission Specialists Tim Kopra, Nicole Stott, and Alvin Drew.

Discovery and its STS-133 crew will deliver the Permanent Multipurpose Module, packed with supplies and critical spare parts, as well as the European Service Module, the dexterous robotic arm, the external tank, and the external tank helper, to the





# PHOTO GALLERY



## Sun and Moon

On Oct. 7, 2010, NASA's Solar Dynamics Observatory, or SDO, observed its first lunar transit when the new moon passed directly between the spacecraft (in its geosynchronous orbit) and the sun. With SDO watching the sun in a wavelength of extreme ultraviolet light, the dark moon created a partial eclipse of the sun.

SDO launched last February aboard an Atlas V rocket from Space Launch Complex 41 at CCAFS

*Image Credit: NASA*



# PHOTO GALLERY

## A New Era

SpaceX's Falcon 9 rocket and Dragon spacecraft lift off from Launch Complex-40 at Cape Canaveral Air Force Station, Fla., at 10:43 a.m. EST, Wednesday, Dec. 8, 2010. In orbit, the Dragon capsule went through several maneuvers before it re-entered the atmosphere and splashed down in the Pacific Ocean about 500 miles west of the coast of Mexico. This is first demonstration flight for NASA's Commercial Orbital Transportation Services (COTS) program, which will provide cargo flights to the International Space Station in the future.

*Image Credit: NASA/Tony Gray and Kevin Conell*





# FY2012 Budget Highlights

Source: <http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/nasa.pdf>

## Funding Highlights:

- Provides \$18.7 billion, the same amount the agency received in 2010. Funding focuses on areas that will improve the Nation's space capabilities, strengthen our competitive edge, and prepare the next generation of leaders in the field. The Budget also proposes to streamline operations and boost efficiencies at facilities.

- Maintains the Nation's commitment to humanity's foothold in space—the International Space Station—bringing nations together in a common pursuit of knowledge and excellence.

- Supports the development of a heavy-lift rocket and crew capsule to launch beyond Earth's orbit, including a mission to an uncharted planet on the furthest journey in human history.



# FY2012 Budget Highlights

Source: <http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/nasa.pdf>

## Funding Highlights:

- Embraces partnership with the commercial space industry and the thousands of new jobs that it can create by contracting with American companies to provide astronaut transportation to the Space Station—thus reducing the risk of relying exclusively on foreign crew transport capabilities.
- Supports groundbreaking innovations by continuing a program of robotic solar system exploration and new astronomical observatories, including a probe that will fly through the Sun's atmosphere and a new competitively-selected planetary science



# FY2012 Budget Highlights

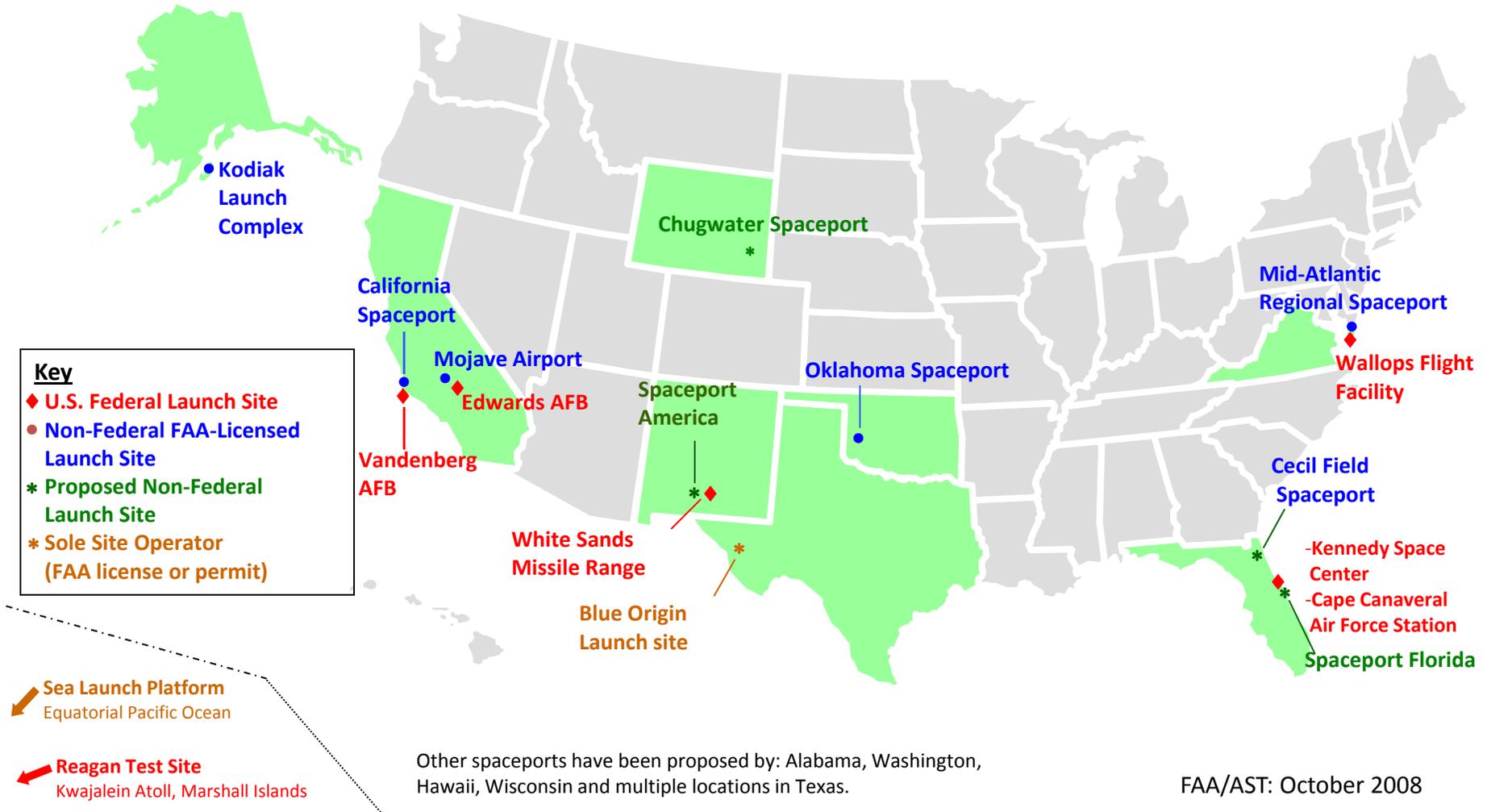
Source: <http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/nasa.pdf>

## Funding Highlights:

- Supports a robust and diverse fleet of Earth observation spacecraft to strengthen U.S. leadership in the field, better understand climate change, improve future weather predictions, and provide vital environmental data to Federal, State, and local policymakers.
- Sharpens the focus of the aeronautics research program by emphasizing enhancing aviation safety and airspace efficiency, and reducing the environmental impact of aviation.
- Launches a pilot program to provide NASA Centers and surrounding communities with clean energy through the innovative use of NASA



# Commercial and Government Active and Proposed Launch Sites



● Kodiak Launch Complex

● California Spaceport

● Mojave Airport

◆ Edwards AFB

◆ Vandenberg AFB

\* Chugwater Spaceport

\* Spaceport America

● Oklahoma Spaceport

◆ White Sands Missile Range

◆ Blue Origin Launch site

● Mid-Atlantic Regional Spaceport

◆ Wallops Flight Facility

● Cecil Field Spaceport

◆ Kennedy Space Center

◆ Cape Canaveral Air Force Station

\* Spaceport Florida



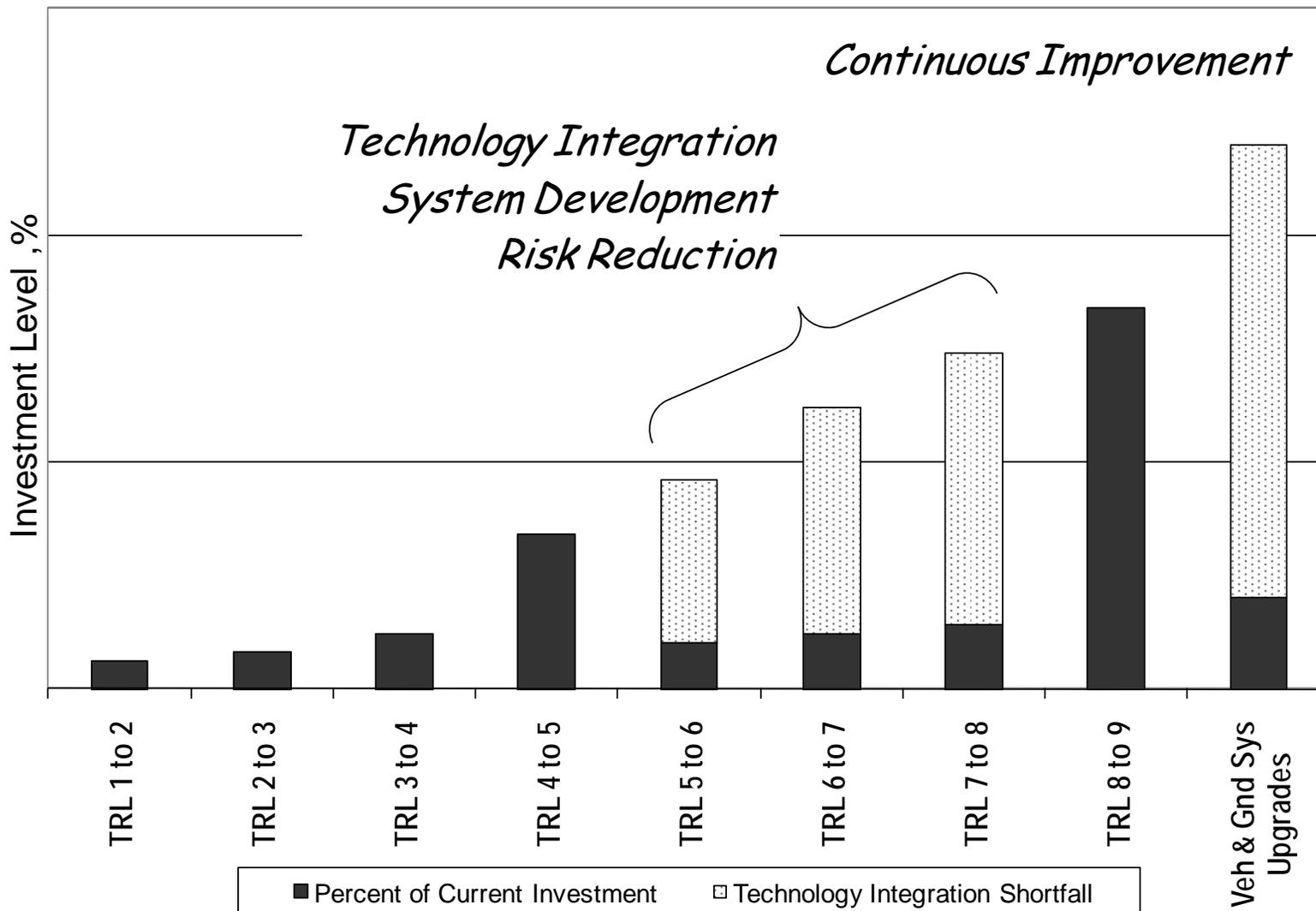
# WHY CHANGE?

**What are the challenges and cost drivers in our current Ground and Mission operations?**

- Dated, Vehicle-unique infrastructure
- Labor intensive operations
- Proliferation of duplicative systems
- Lack of sufficient insight into system configuration/  
system performance margins
- Low mission availability due to weather restrictions  
and significant maintenance/ refurbishment  
required between missions
- Conservative risk and safety postures



# Need for Additional “Higher TRL” Investment

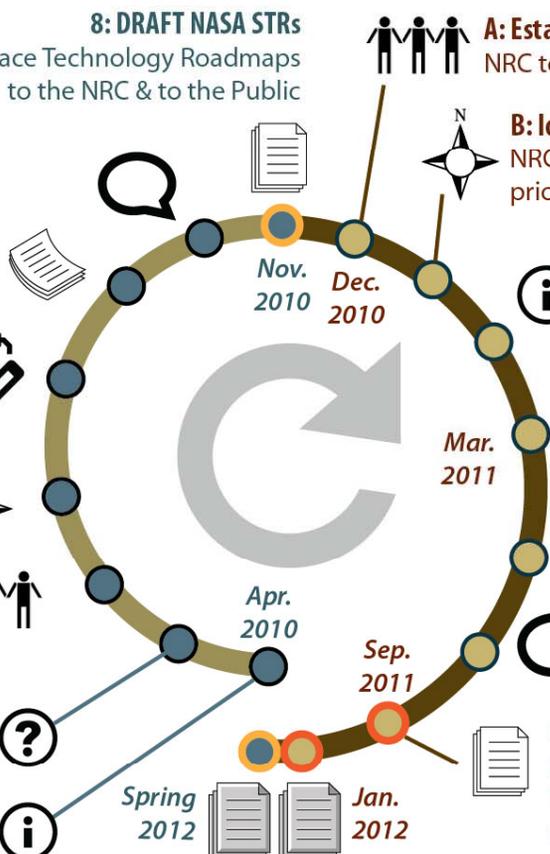




# Space Technology Roadmaps Process

## NASA Process

- 1: START & Input from MDs & Center**  
Identified MD Goals, Missions, Architectures & Timelines; MD Technology Roadmaps & Prioritizations; Center Technology Focus Areas
- 2: Identify Technology Areas**  
Identified Technology Areas (TAs)
- 3: Establish TA Teams**  
OCT established NASA internal 6-member subject expert teams for each TA, with one or two chairs
- 4: Common Approach for TA Teams**  
Guidelines, assumptions, deliverables
- 5: Form Starting Point for TA Roadmaps**  
Assessed past roadmaps; MD & Center inputs
- 6: Roadmapping Process**  
Preliminary roadmaps for TA areas
- 7: Internal Reviews**  
Each TA Roadmap reviewed by OCT & extended teams of subject experts



## NRC Process

- A: Establish NRC Teams**  
NRC to appoint steering committee and 6 panels
- B: Identify Common Assessment Approach**  
NRC to establish a set of criteria to enable prioritization within and among all TAs
- C: Initial Community Feedback**  
NRC to solicit external input from industry & academia
- D: Additional Community Feedback**  
NRC to conduct public workshops
- E: Deliberations by NRC Panels**  
NRC panels meet individually to prioritize technologies and suggest improvements to roadmaps
- F: Documentation by NRC Panels**  
NRC Panels to provide written summary to Steering Committee
- G: NRC Interim Findings**  
NRC to release a brief interim report that addresses high-level issues associated with the roadmaps, such as the advisability of modifying the number or technical focus of the draft NASA roadmaps
- H: FINAL NRC REPORT**  
With decisional information, including: summary of findings and recommendations for each of the roadmaps; integrated outputs from the workshops and panels; identify key common threads and issues; priorities, by group (e.g., high, medium, low), of the highest priority technologies from the TAs

## NASA Space Technology Roadmaps Process



# SUMMARY

Obviously, our country's space program has been a source of pride and inspiration, but now we need to adapt to ensure that the nation gets the very best investment from NASA

Public input and advocacy is needed for:

- Identifying and Prioritizing Technology Investments
- Helping to Determine Long-range mission and goals
- Developing the proper balance between private and public enterprise for improving access to space
- Attracting explorers, innovators and a new group of leaders to invest their careers in the space program

Learn how you can help !!



# FOR MORE INFORMATION

General information about NASA

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

NASA 2011 Strategic Plan

<http://www.nasa.gov/pdf/NASA2011StrategicPlan.pdf>

NASA FY2012 Budget info:

<http://www.nasa.gov/news/budget/index.html>

National Research Council Website

(currently under contract to NASA for collecting public input and vetting draft technology roadmap developed by NASA)

<http://www.nationalacademies.org/NASARoadmaps>