

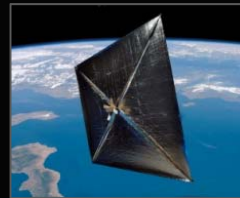
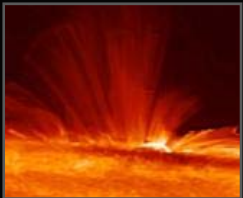


Marshall Space Flight Center

Tennessee Valley Corridor Leadership Council
November 6, 2014



marshall



HUMAN EXPLORATION

NASA's Path to Mars



EARTH RELIANT

MISSION: 6 TO 12 MONTHS
RETURN TO EARTH: HOURS

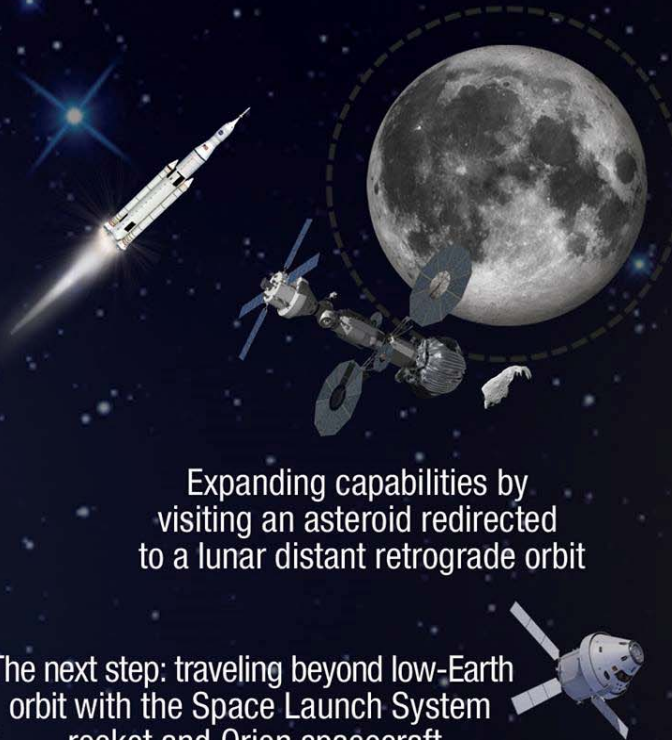


Mastering fundamentals
aboard the International
Space Station

U.S. companies
provide access to
low-Earth orbit

PROVING GROUND

MISSION: 1 TO 12 MONTHS
RETURN TO EARTH: DAYS

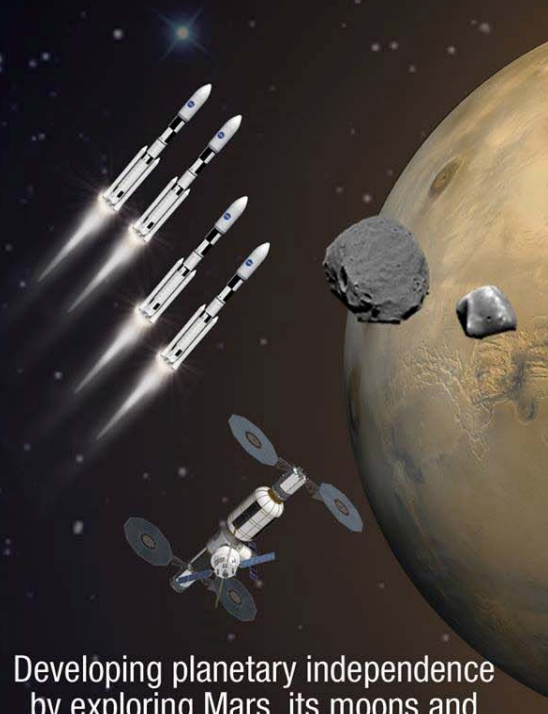


Expanding capabilities by
visiting an asteroid redirected
to a lunar distant retrograde orbit

The next step: traveling beyond low-Earth
orbit with the Space Launch System
rocket and Orion spacecraft

MARS READY

MISSION: 2 TO 3 YEARS
RETURN TO EARTH: MONTHS



Developing planetary independence
by exploring Mars, its moons and
other deep space destinations

NASA Advanced Manufacturing Technology Portfolio

Develop advanced manufacturing technologies that enable the development of more capable and lower-cost spacecraft and launch vehicles

Collaborate with the National Manufacturing Initiative and partnering with other government agencies (DOD, DOE, DOC/NIST, NSF), Industry, and Academia



ADDITIVE



COMPOSITES



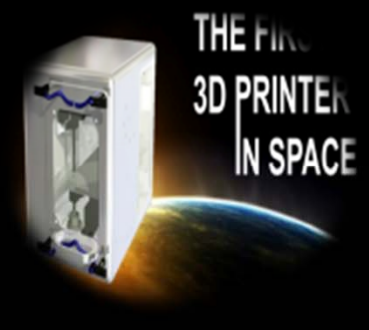
DIGITAL



METALS



IN-SPACE

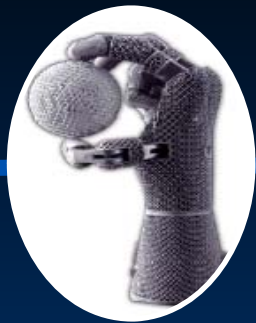


Advanced Manufacturing is Critical to all NASA Mission Areas.

Building the National Network for Manufacturing Innovation (NNMI)

Advanced Manufacturing Partnership 2.0: “*Accelerating U.S. Advanced Manufacturing*” - Manufacturing drives knowledge production and innovation in the United States by supporting two-thirds of private sector research and development and by employing the vast majority of U.S. scientists, engineers, and technicians to invent and produce new products.

NNMI - The Start of a Network...



**Additive
Manufacturing**



**Power
Electronics**



**Digital
Manufacturing**



**Lightweight
Metals**



**Advanced
Composites**



**Integrated
Photonics**

Current SLS Status



Launch Vehicle Stage Adapter: Contract awarded in February 2014.

MPCV-to-Stage Adapter: First flight hardware in Florida for Exploration Flight Test-1 in Dec 2014.



Avionics: Avionics "first light"; currently testing most powerful flight system computer processor ever.

Core Stage: Vertical Assembly Center and initial confidence barrels, domes completed.



Boosters: Forward Skirt test completed; proceeding toward Quality Motor-1.

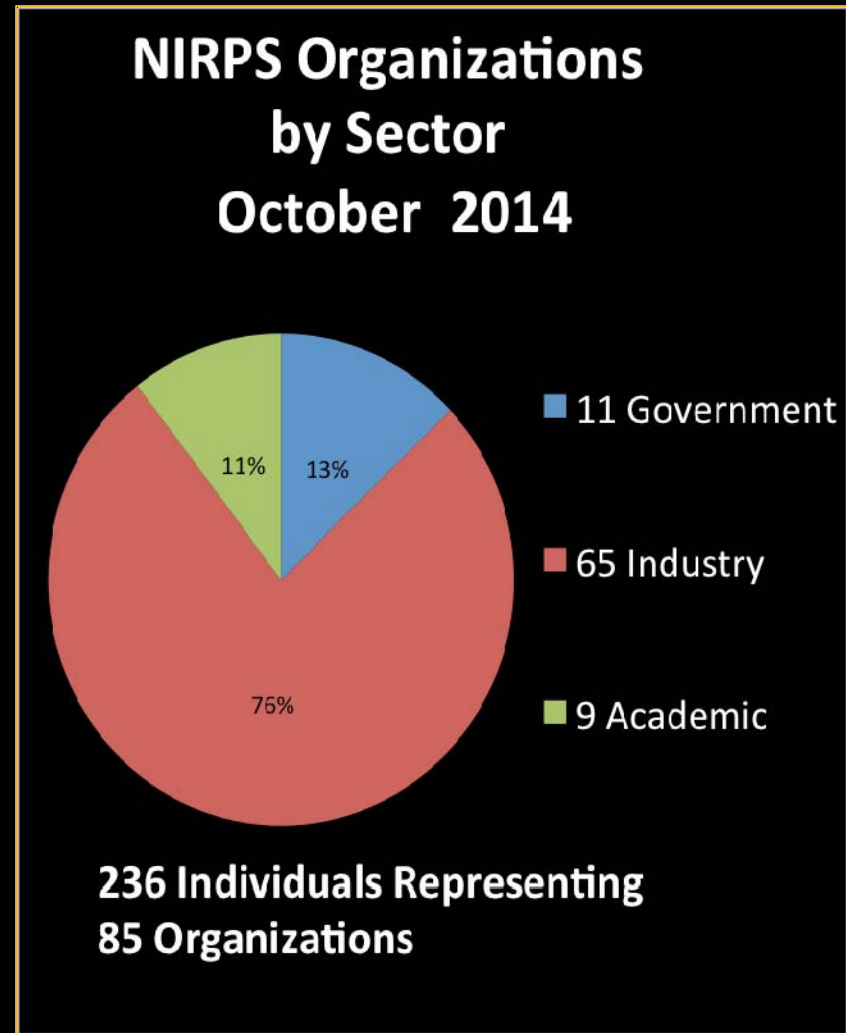
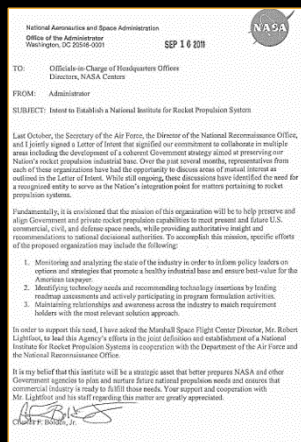
Engines: Preparing for RS-25 testing at Stennis Space Center; renovations underway to B-2 stand.



National Institute for Rocket Propulsion Systems (NIRPS)

- The National Institute for Rocket Propulsion Systems (NIRPS) is an office at NASA's MSFC that serves to maintain and advance U.S. leadership in all aspects of rocket propulsion for defense, civil, and commercial uses.
- NIRPS supports the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee (JANNAF).
- Formulated in 2011 as directed by the NASA Administrator.

NIRPS

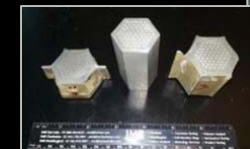
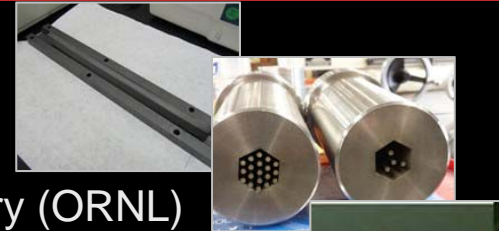


Nuclear Thermal Propulsion (NTP)

Current Focus on three areas:

1. Fuel element design and fabrication

- Graphite composite development at Oak Ridge National Laboratory (ORNL)
- CERMET development at Marshall Space Flight Center
- All fabrication facilities licensed to work with depleted uranium (DU)



2. Prototypic Fuel Element Materials Testing at Marshall

- Test facilities capable of testing at high temperature, in flowing hydrogen environment
- Designed to screen materials and examine thermal hydraulic performance
- Licensed to work with DU
- Small samples tested in the Compact Fuel Element Environmental Test (CFEET) System
- Full scale elements tested in the Nuclear Thermal Rocket Element Environmental Simulator (NTREES)



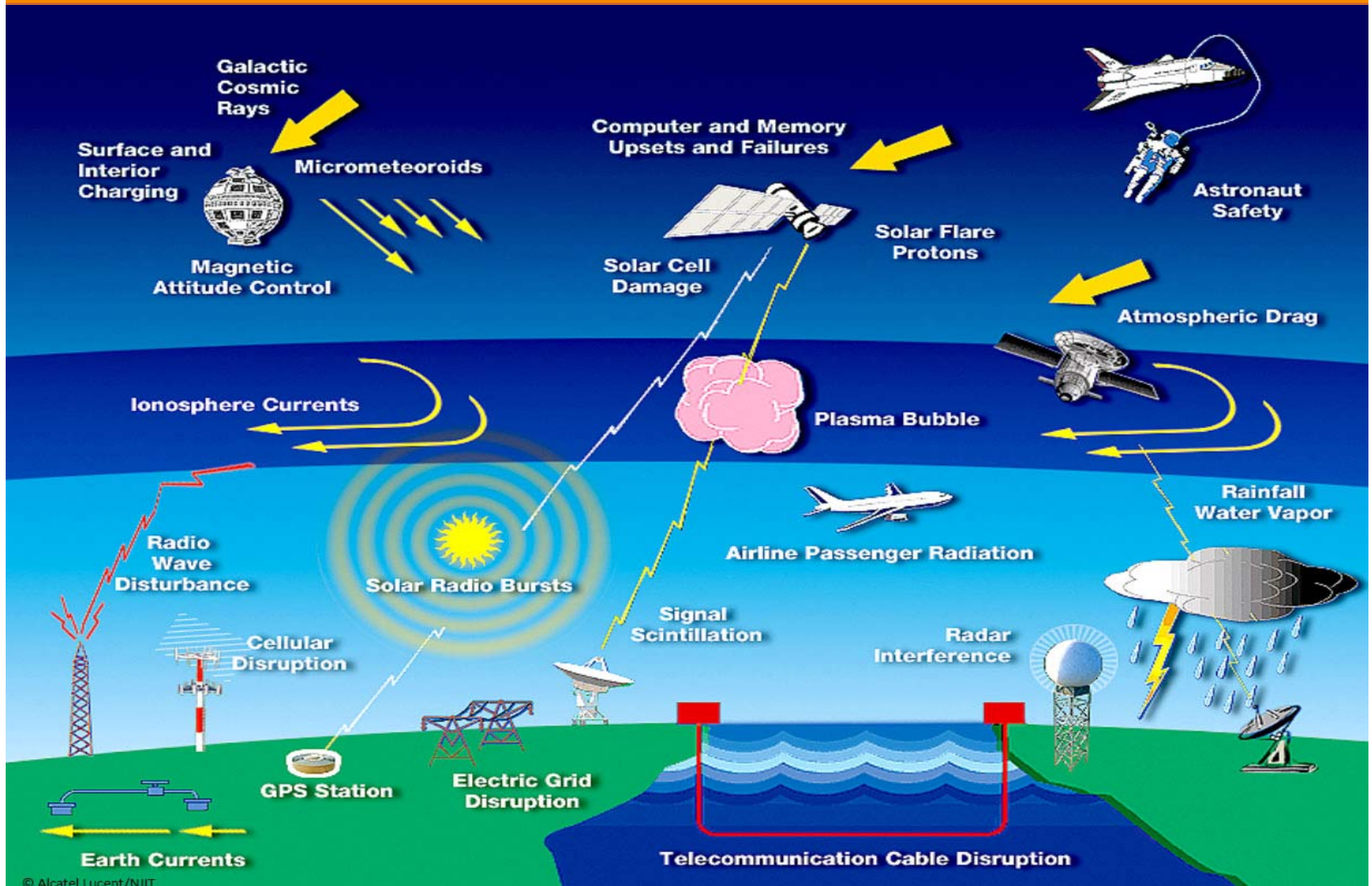
3. Determine affordable development and qualification strategies for human-rated NTP systems

Current Goals for the Future

- Continue developing key technologies related to NTP
- Build confidence in affordability and viability of NTP



Space Weather: Research to Applications at Marshall

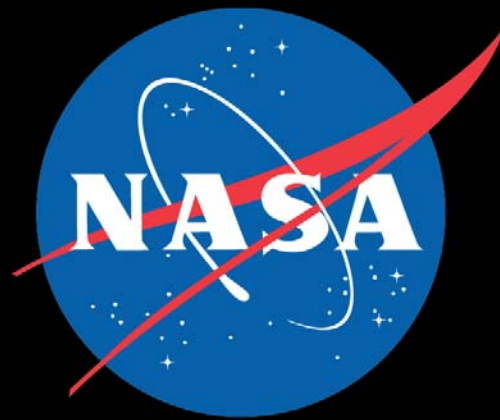


Marshall's Commitment to Commercial Partnerships

- NASA technologies, capabilities, and assets available to support growing commercial space industry
- More than 300 ongoing collaborative agreements
- Partnerships Office created as entry point and advocate



***Marshall is ready for future challenges –
adapting and building mutually beneficial partnerships
to develop new and innovative technologies.***



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