National Aeronautics and
Space Administration

Space Technology Mission Directorate – Enabling Technologies For Mars Exploration

Presented by:
Dr. Prasun Desai, Acting Director
Strategic Integration and Analysis
Space Technology Mission Directorate

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Challenges for Deep Space Exploration

Communication

Environment Control & Life Supporting Systems

Power Generation & Storage

Logistics

Navigation

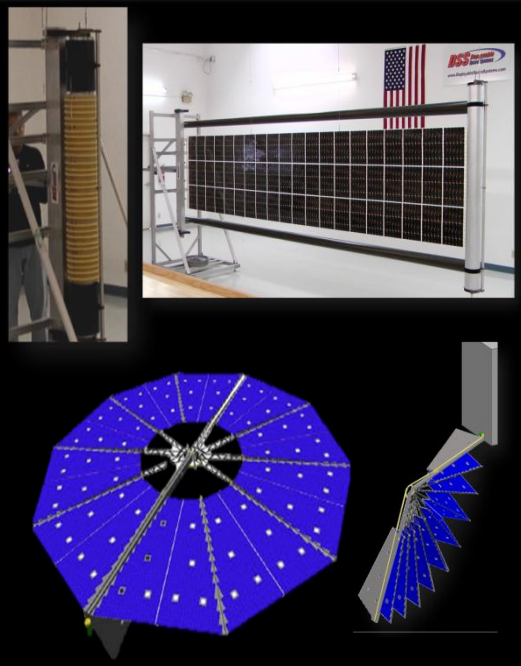
Manufacturing In Space & For Space

Entry, Descent & Landing

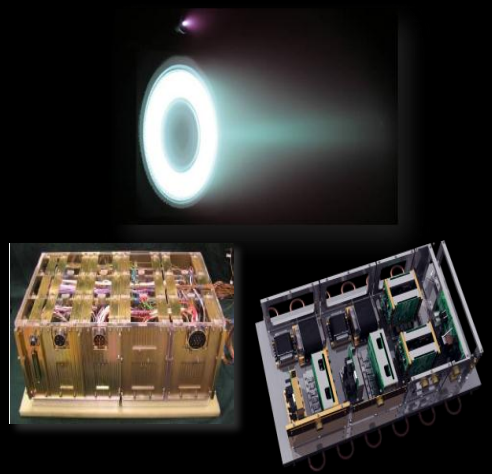
Radiation Mitigation

Propulsion

High-Powered Solar Electric Propulsion



Solar Arrays

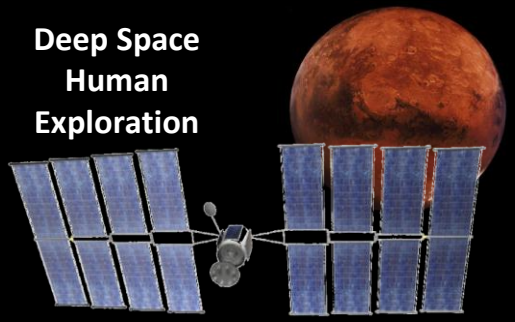


Thruster and Power Processing Unit

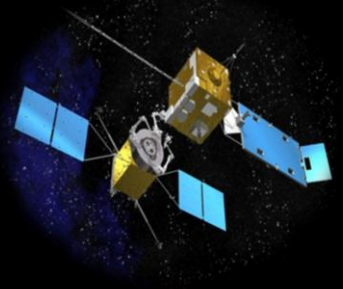
Propellant Feed System and Storage Tanks

High-powered SEP Enables Multiple Applications

Deep Space Human Exploration

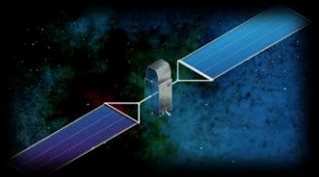


Satellite Servicing



Payload Delivery

Commercial Space Applications



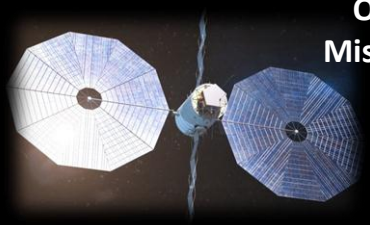
Solar Electric Propulsion

ISS Utilization

Orbital Debris Removal

Space Science Missions

OGA Missions



MARS CHALLENGES

Surface Power

Life Support

Human Ops Support and Robotics

Mars Resource Utilization and Ascent from Surface

Space Radiation

Entry, Descent, and Landing (EDL)

Communications and Navigation

Transit (Cargo and Humans)


MARS CHALLENGES
TECHNOLOGY SOLUTIONS
NASA
Surface Power
Fission/solar power
Fuel cells/batteries
Life Support
Next-Gen highly reliable and closed-loop life support.
Advanced EVA suits
Human Ops Support and Robotics
Telerobotics
Robotics—task removal from astronauts
Autonomous systems
Mars Resource Utilization and Ascent from Surface
Utilization of in-situ resources
Generation of human consumables
Creation of propellant
Space Radiation
Radiation protection
Radiation modeling, characterization, and measurement
Entry, Descent, and Landing
ECL Systems for Human Class Missions
Hypersonic entry systems
Supersonic descent systems
Communications and Navigation
Optical communication
Advanced guidance systems
Transit (Cargo and Humans)
Solar electric propulsion
Lightweight structures and materials
Cryogenic propellant storage and transfer

MARS CHALLENGES

STMD INVESTMENTS

Surface Power

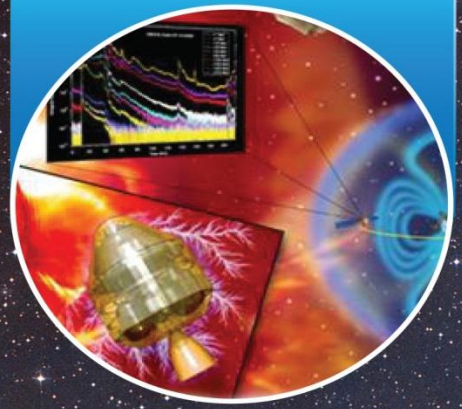
- Advanced batteries
- Regenerative fuel cells
- Fission nuclear systems
- Solar arrays

Life Support

- CO_2 to O_2 recovery
- Water processing
- Air regulators

Space Radiation

- Advanced radiation protection
- Radiation modeling and forecasting
- Dosimeters



Entry, Descent, and Landing

- Hypersonic Inflatable Aerodynamic Decelerator/High-Energy Atmospheric Reentry Test
- Adaptive Deployable Entry Systems Project
- Low-Density Supersonic Decelerator
- MSL Entry, Descent, and Landing Instrument
- Heat Shield for Extreme Entry Environment Technology
- Supersonic Retro Propulsion
- Hypersonic Entry, Descent, and Landing

MARS CHALLENGES

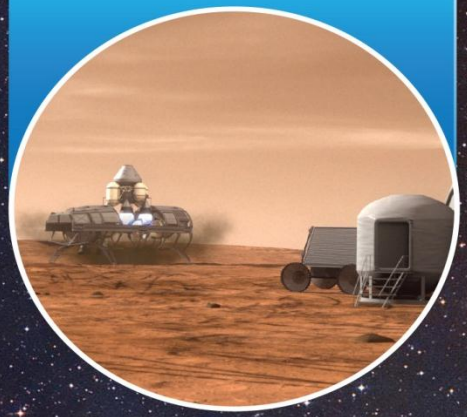
STMD INVESTMENTS

Transit (Cargo and Humans)

- Composite Cryotank
- Cryogenic Propellant Storage and Transfer
- Lightweight Materials and Structures
- Solar Electric Propulsion

Mars Resource Utilization and Ascent from Surface

- O_2 from Mars atmosphere
- RESOLVE instruments
- Propellant production



Communications and Navigation

- Deep Space Atomic Clock
- Laser Communication Relay Demonstration
- Deep Space Optical Communications

Human Ops Support and Robotics

- Automated system ops
- Robotic, human safe, maintenance and ops
- Avionics/multicore processor