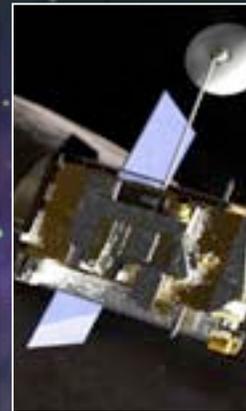




Advanced Capabilities Update



Carl Walz

NASA Exploration Systems Mission Directorate

December 3, 2008

ACD Update

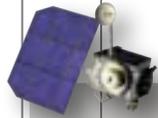


- Overview
- ISS Research
- Human Research Program
- Lunar Precursor Robotic Program
- Exploration Technology Development Program

Exploration Roadmap



05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



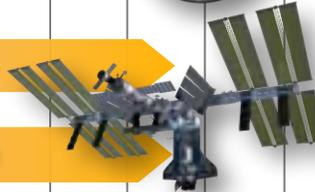
Exploration and Science Lunar Robotics Missions



Lunar Outpost Buildup

Research and Technology Development on ISS

Commercial Orbital Transportation Services for ISS



Space Shuttle Operations



Space Shuttle Program Transition and Retirement

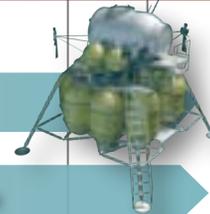
Ares I and Orion Development



Operations Capability Development
(EVA Systems, Ground Operations, Mission Operations)

Orion and Ares I Production and Operation

Altair Lunar Lander Development

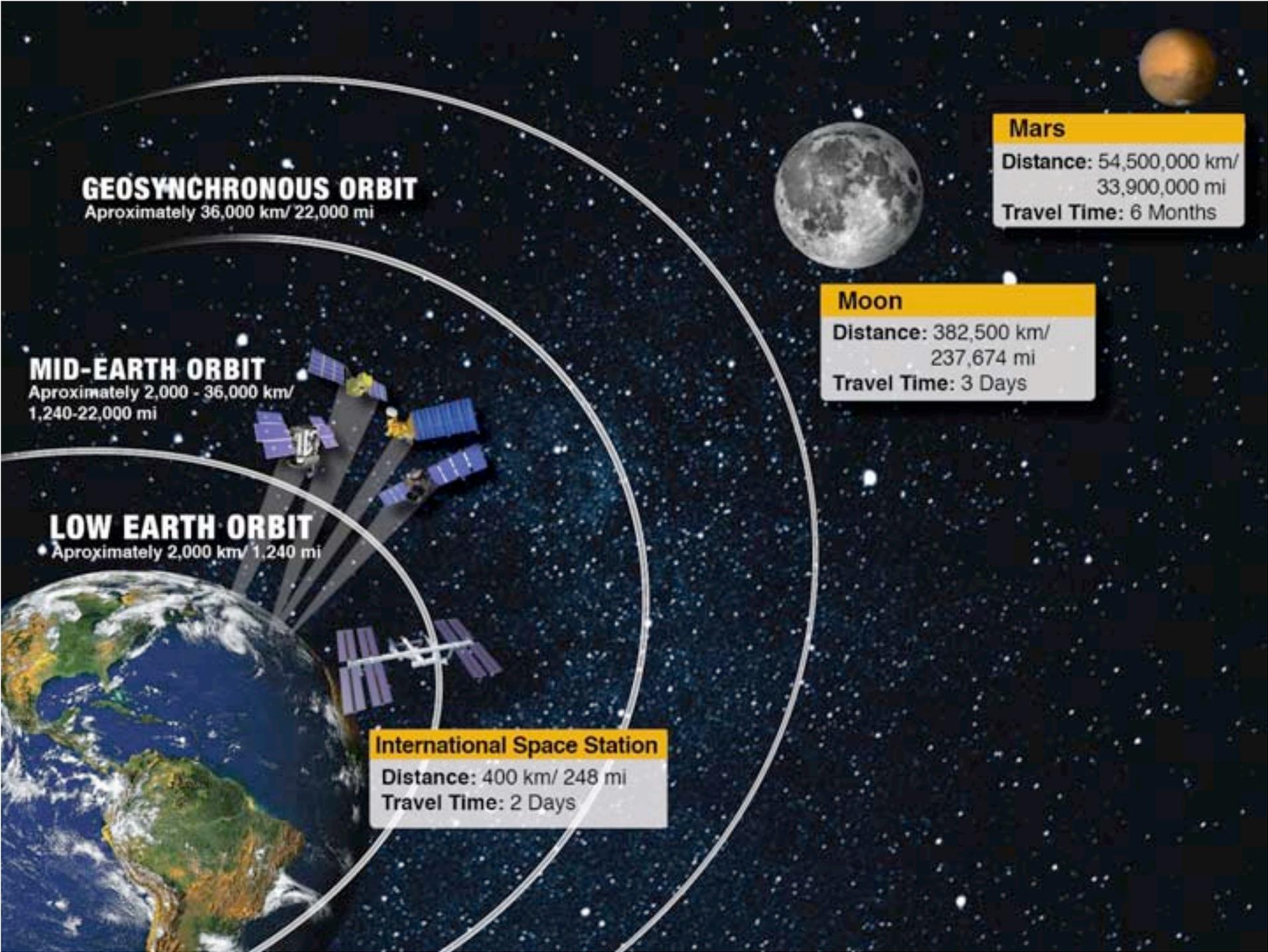


Ares V and Earth Departure Stage

Surface Systems Development



Advanced Capabilities Update



GEOSYNCHRONOUS ORBIT

Aproximately 36,000 km/ 22,000 mi

MID-EARTH ORBIT

Aproximately 2,000 - 36,000 km/
1,240-22,000 mi

LOW EARTH ORBIT

Aproximately 2,000 km/ 1,240 mi

International Space Station

Distance: 400 km/ 248 mi
Travel Time: 2 Days

Mars

Distance: 54,500,000 km/
33,900,000 mi
Travel Time: 6 Months

Moon

Distance: 382,500 km/
237,674 mi
Travel Time: 3 Days



ISS Research

Research and Technology Development on the ISS



Lab-on-a-Chip Application Development - Portable Test System



Vehicle Cabin Air Monitor (VCAM)



Combustion Integrated Rack (CIR)



SHERA Experiment in MSG



Fluids

Integrated Rack (FIR)



Human Research Program

Human Research Program Overview



- Goals

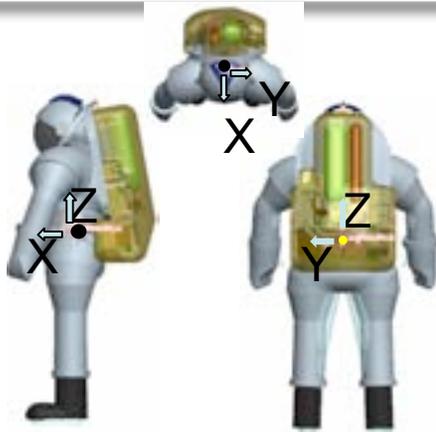
- Reduce spaceflight risks to humans and focus on the highest risks to crew health and performance during exploration missions
- Enable development of human spaceflight medical and human factors standards
- Develop and validate technologies that serve to reduce medical risks associated with human spaceflight

- Program Elements

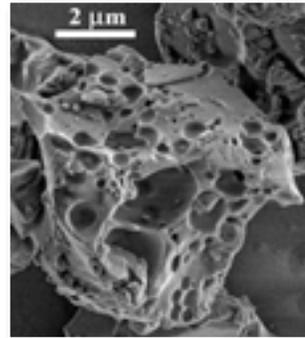
- Program Science Management/NSBRI
- ISS Medical Project
- Space Radiation
- Human Health Countermeasures
- Exploration Medical Capability
- Space Human Factors & Habitability
- Behavioral Health & Performance



Human Research for Exploration



EVA physiology testing for improved new suit design



toxicity testing



improve understanding of astronaut fitness level in flight



countermeasure for risk of renal stone formation



Nutritional Status Assessment investigation on health and nutrition

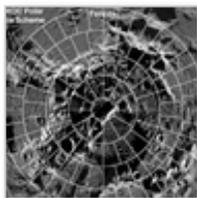


Human vibration testing system

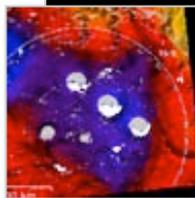


LPRP

Lunar Reconnaissance Orbiter



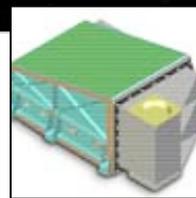
LROC
Lunar
Reconnaissance
Orbiter Camera



LEND
Lunar
Exploration
Neutron
Detector



DLRE
Diviner Lunar
Radiometer
Experiment



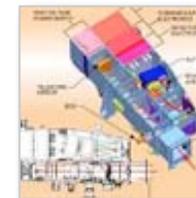
CRaTER
Cosmic Ray
Telescope for
the Effects of
Radiation



MINI-RF
Synthetic
Aperture
Radar

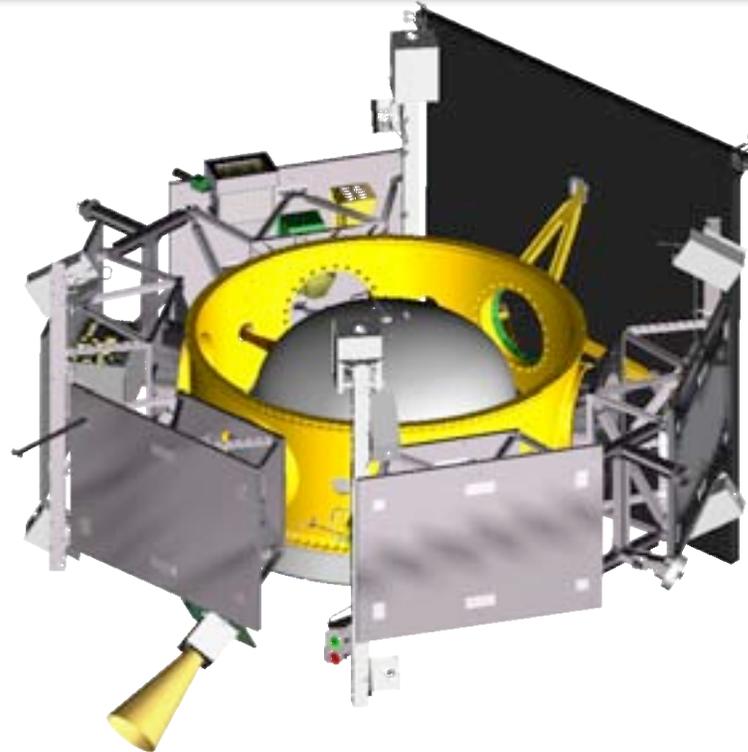


LOLA
Lunar Orbiter
Laser
Altimeter



LAMP
Lyman Alpha
Mapping
Project

Lunar CRater Observation & Sensing Satellite



Mid-Infrared Camera

- Curtain, Crater Temperature
- Curtain Morphology
- Water Ice



Visible Camera

- Impact Context
- Curtain Morphology



Near Infrared Camera

- Water Ice / Curtain Morphology
- NIR Context



Visible Spectrometer

- Flash Spectroscopy
- Water Vapor
- Organics



Near Infrared Spectrometers

- Curtain Water Ice & Vapor
- Hydrated minerals

LRO/LCROSS Mission Profile



LRO/LCROSS Mission Profile

video

Lunar Precursor Robotics Program



LRO:

- Environmental testing is progressing well.
 - Thermal Vacuum testing going well
 - All other environmental tests, including EMI/EMC are complete.
- Launch rescheduled for April 24 to accommodate a ULA request due to Atlas V technical and manifest issues.



LCROSS:

- Spacecraft completed Systems Acceptance Review (SAR). Final closeouts are being completed.



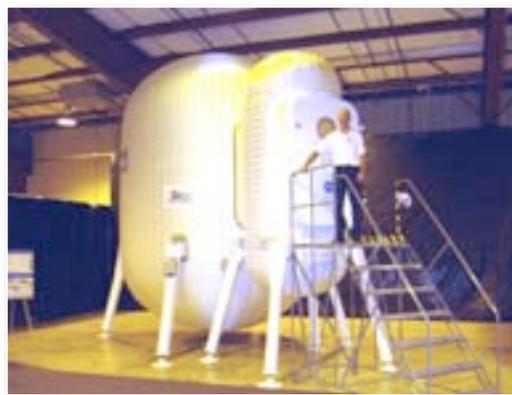


Exploration Technology Development Program

ETDP Objectives



- Reduce human and robotic exploration mission risk by developing advanced technologies and capabilities.
- Mature critical near-term technologies to support development of the Orion Crew Exploration Vehicle and Ares I launch vehicle
- Develop long-lead technologies to support a sustainable lunar outpost.
- Conduct research and test technologies for exploration on the International Space Station.



ETDP Content: Technology Projects

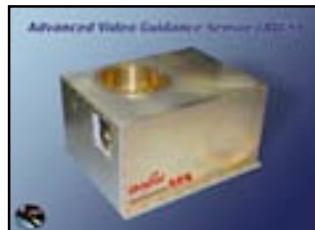


- Advanced Fission Based Power Systems
Energy Storage
- Energy Storage
- High Performance & Rad Hard
Electronics
- Supportability
- Dust Mitigation
- EVA
- Thermal Control
- Exploration Life Support
- Fire Prevention, Detection, &
Suppression
- Advanced Environmental Monitoring &
Control
- ISS Research
- Intelligent Software Design
- Automation for Operations
- Integrated Systems Health
Management
- TPS
- AR&D Sensors
- Autonomous Landing and Hazard
Avoidance Technology
- Propulsion and Cryogenic Fluid
Management Dust Mitigation
- Structures/Mechanisms/ Materials
- Human Robotic Systems
- ISRU
- Advanced Composite Materials

Technology Development for Orion



Ablative TPS



AR&D Sensors



Structures & Materials

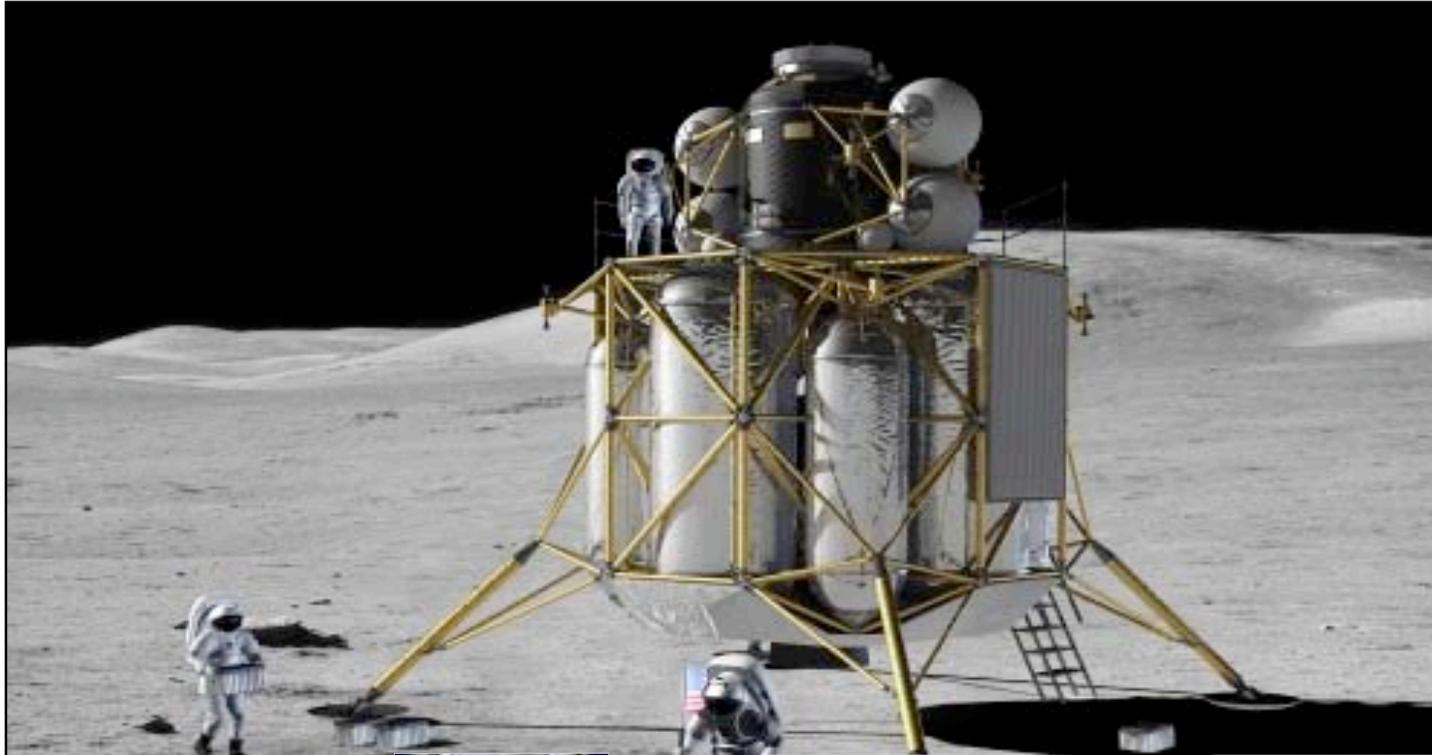


Thermal Control



Exploration Life Support

Technology Development for Altair Lunar Lander



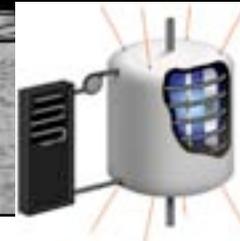
Propulsion & Cryogenics



Propulsion & Cryogenics

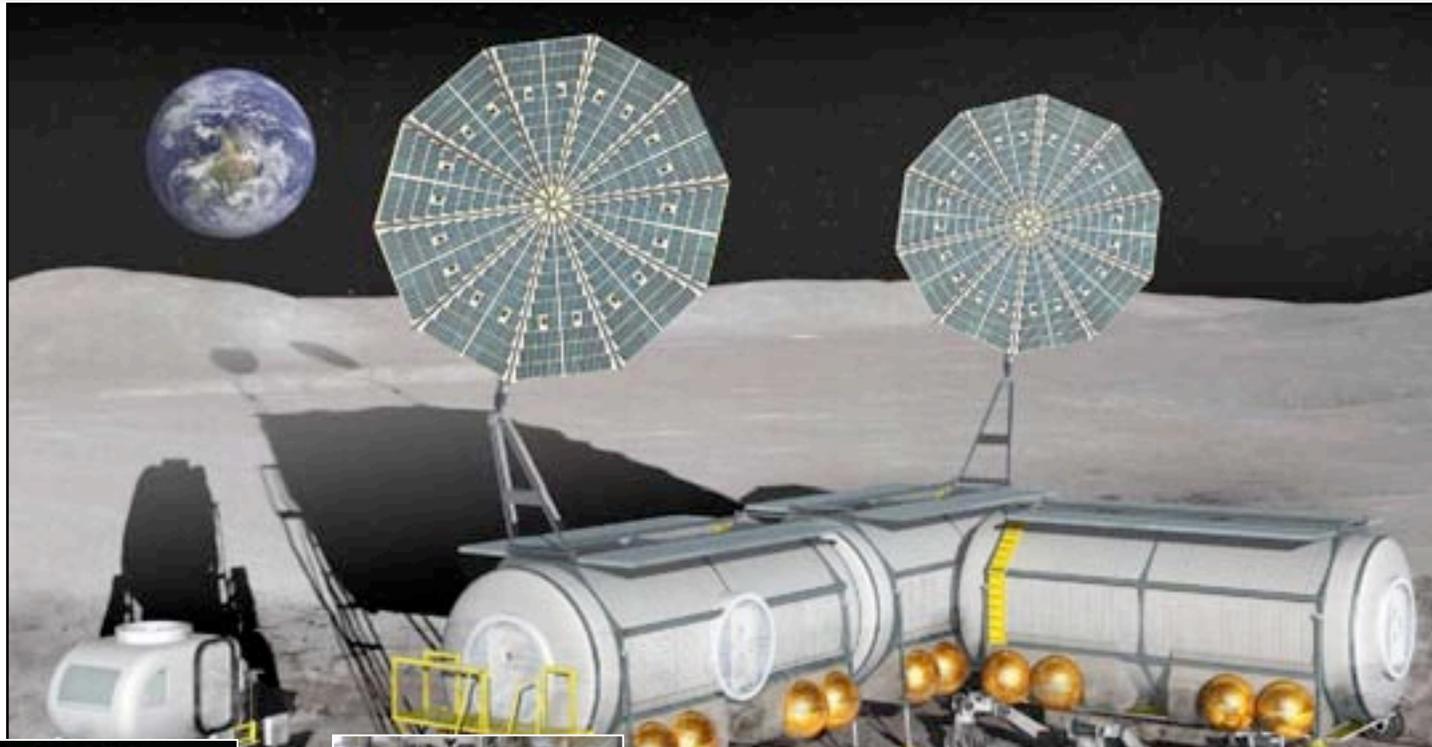


Autonomous Precision Landing



Propulsion & Cryogenics

Technology Development for the Lunar Outpost



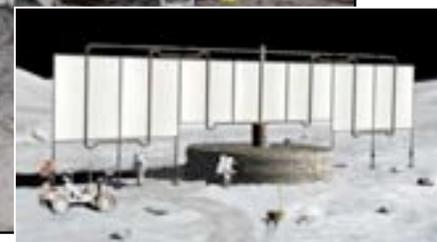
Structures & Materials



Life Support



Energy Storage



Power

Technology Recent Accomplishments



- Moses Lake Washington test of Lunar Surface System concepts
- Rollout of the Small Pressurized Rover mock up
- Formulating new project in Advanced Composites for Ares V/Altair
- Small Pressurized Rover/Unpressurized Rover Field Test at the Black Point Lava Flow (October 20-31)
- ISRU Technology demonstrations, on Mauna Kea in Hawaii (Nov 1-12)

