

National Aeronautics and Space Administration



Exploration Systems Mission Directorate: New Opportunities in the President's FY2011 Budget

Dr. Laurie Leshin
Deputy Associate Administrator, ESMD

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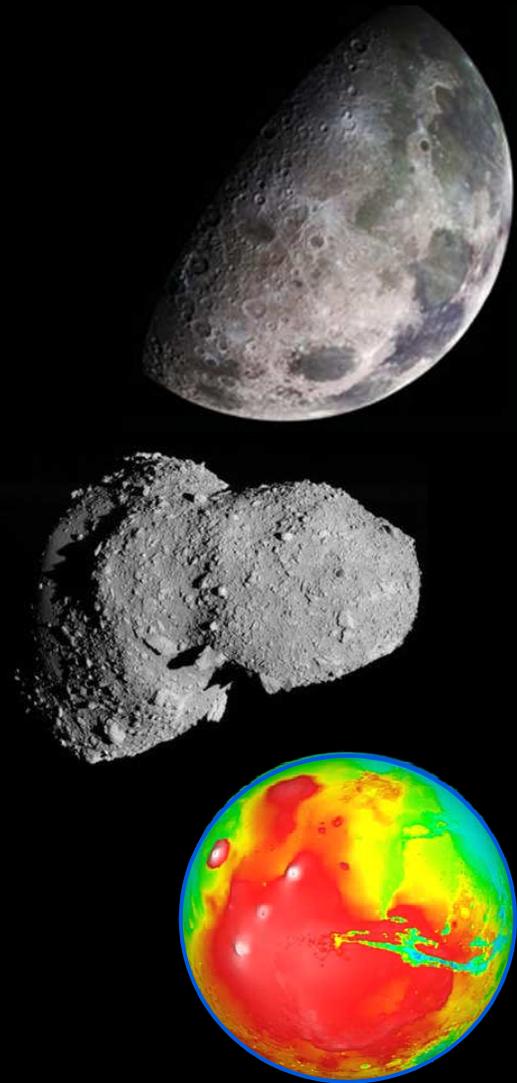


Exploration Systems
Mission Directorate
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ESMD: Blazing a Trail Into the Solar System



- NASA's human spaceflight program seeks to extend human presence throughout the solar system
- The President's FY2011 Budget Request takes a new approach to this goal, focusing on capabilities that will allow us to reach multiple destinations, including the Moon, Asteroids, Lagrange points, and Mars and its moons
- The investments seek to create the new knowledge and capabilities required for humans to venture beyond low Earth orbit to stay
- Approach expands alternatives available for human exploration, currently limited by lack of strategic investment in technology development over past decades



FY 2011 President's Budget Overview



The President's budget will invest an additional \$6 billion in NASA over the next five years - an overall \$100 billion commitment to the agency

- ESMD's proposed budget is \$4.3 B for FY11, an increase of \$0.5 B over FY10
- President's Budget challenges NASA to embark on a new human space exploration program that invests near-term in obtaining key knowledge about future destinations and demonstrating critical enabling technologies for human spaceflight and exploration, including:
 - Research and development of heavy-lift and propulsion capabilities
 - Transformative technology development and flagship technology demonstrations to reduce cost and expand capabilities of future human exploration activities
 - Exploration precursor robotic missions to multiple destinations in the solar system to cost-effectively scout human exploration targets and identify hazards and resources for visitation and habitation
 - Expanded efforts to develop U.S. commercial human spaceflight capabilities, making space travel more accessible and affordable
 - Increased investment in Human Research to prepare for long journeys beyond Earth
- Budget submission cancels the Constellation Program

Strategy to Enable Future Human Missions Beyond LEO



**Enabling
Human
Exploration**

Needed Capabilities

Precursor Knowledge



Study Teams for Exploration



- Total of Ten Internal Study Teams Stood Up
 - 6 pre-formulating new programs : *Flagship Technology Demonstration, Enabling Technology Development and Demonstration, Heavy Lift and Propulsion Technology, Exploration Robotic Precursors, Commercial Crew , Human Research*
 - 1 assessing transition of Constellation
 - 3 Agency cross cutting teams : *Integration, International, Participatory Exploration*
- What the Teams are Doing
 - Providing inputs for very near-term products needed to support required reporting to OMB, Congress and others
 - Developing options for overall program strategy, identifying needs and goals, exploring alternate implementations, establishing high level milestones and a budget profiles
 - Focusing on planning at the program level, generally not specific, final missions
 - Helping tee up decisions for NASA Leadership

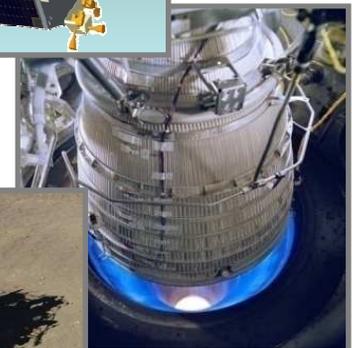
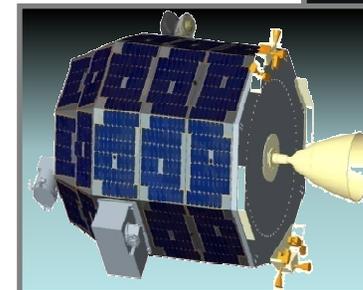
Commercial Crew and Cargo Services



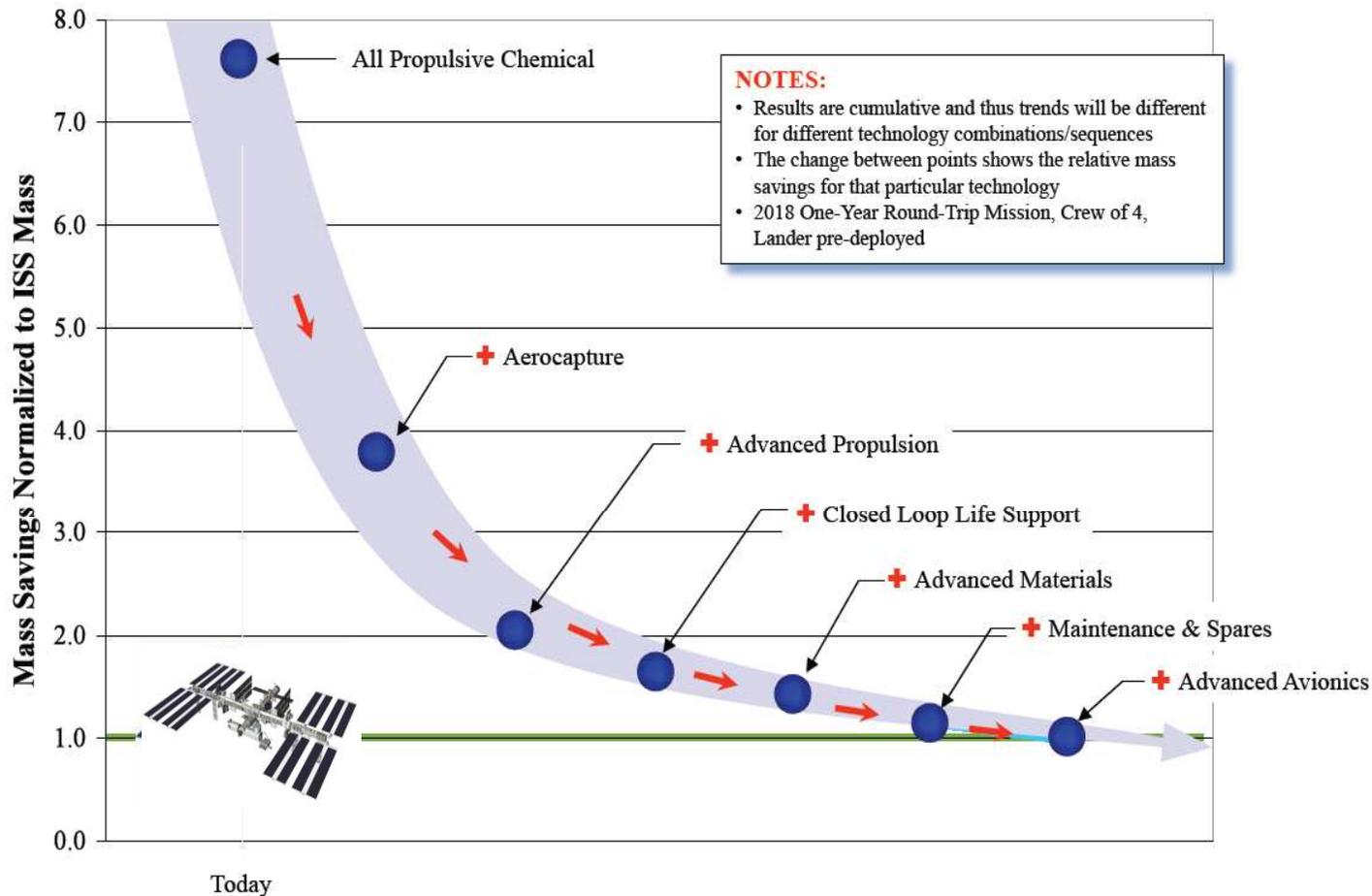
New Exploration Research & Development Activities



- Exploration Technology and Demonstrations
 - \$7.8 billion over five years
 - *Develop and demonstrate technologies to reduce costs and expand capabilities for future exploration*
- Heavy-Lift and Propulsion Technology
 - \$3.1 billion over five years
 - *Research and development of new cost-effective propulsion systems, engines, LV materials, etc.*
- Exploration Precursor Robotic Missions
 - \$3.0 billion over five years
 - *Scout exploration targets, identify hazards and resources for human visitation and habitation*



Flagship Technology Demonstrations - Benefits

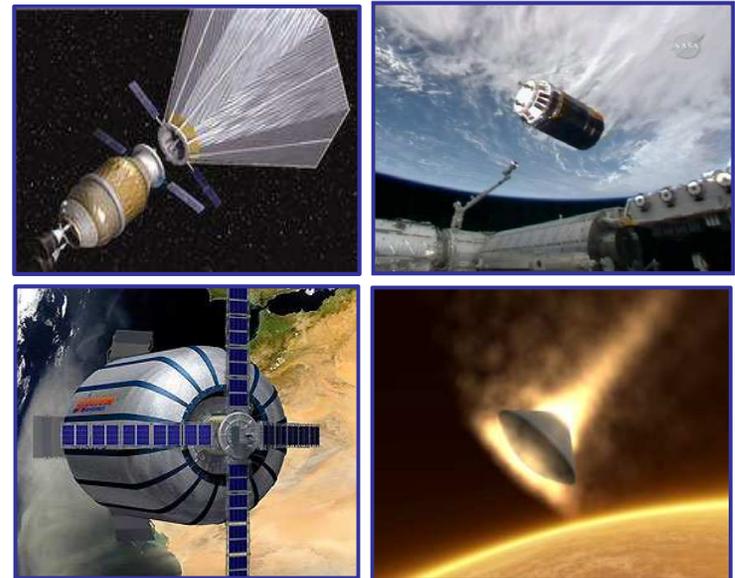


- Without technology investments, the mass required for a human Mars mission is approximately eight times the mass of the International Space Station
- Technology investments of the type proposed in the FY 2011 budget are required to put such a mission within reach

Flagship Technology Demonstrations - Approach



- Evaluation underway of highest leverage demonstrations; Mars destination is a driving case for high leverage demonstration and technology
- First three primary technology targets for single or combined missions to include:
 - In-orbit propellant transfer and storage
 - Lightweight/inflatable modules
 - Automated/autonomous rendezvous and docking
- Fourth flight program such as
 - Aerocapture/entry, descent and landing
 - Advanced life support
 - Advanced in-space propulsion (ion/plasma, etc)
- Initiate four technology demonstrations in FY2011
- Follow-on demonstrations informed by emerging technologies
- Identify potential partnerships with industry, other agencies, and international partners and leverage ISS for technology demonstrations, as appropriate



Enabling Technology Development & Demonstration



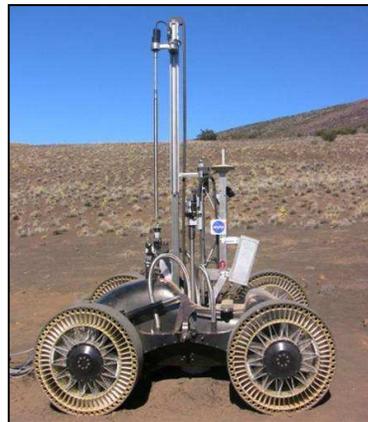
Key Question: How do we use human-robotic partnerships to increase productivity, reduce costs, and mitigate risks?



Key Question: Can we land autonomously, precisely, and safely on an extra-terrestrial surface in uncertain environments ?



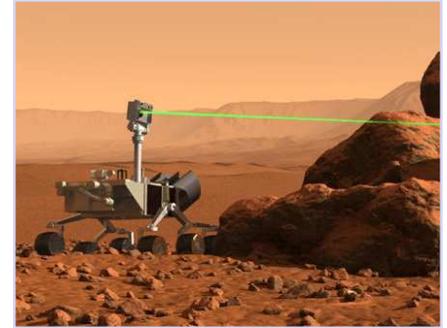
Key Question: Can we locate and access in situ resources?



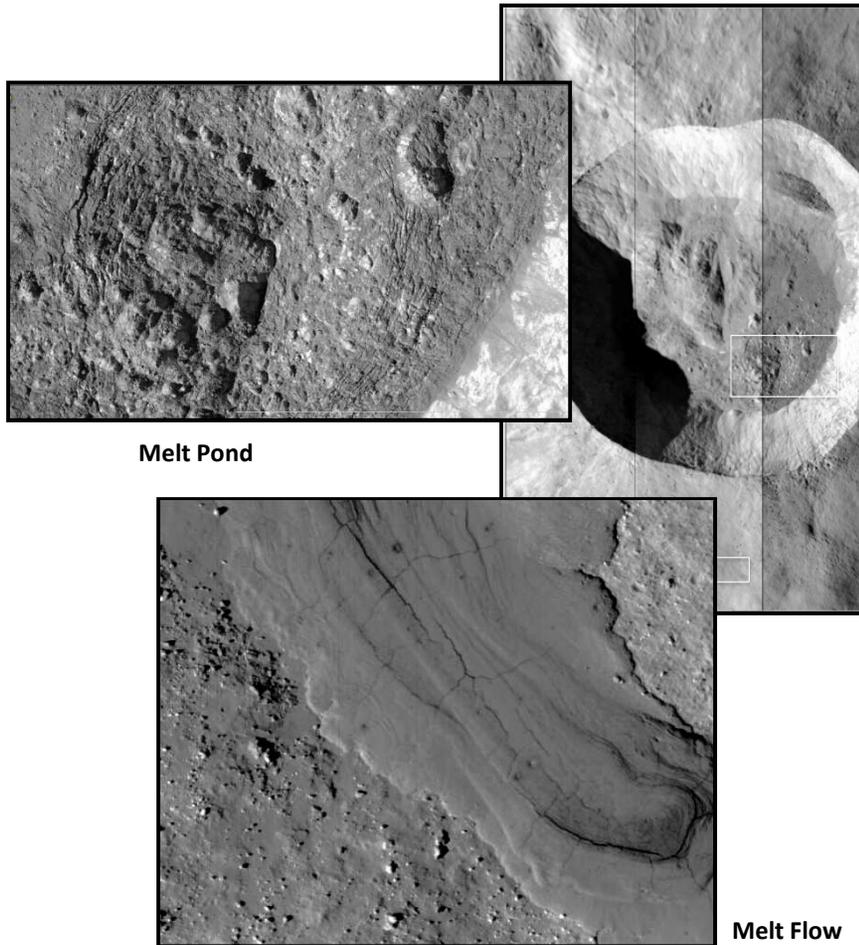
Exploration Precursor Robotic Missions - Approach



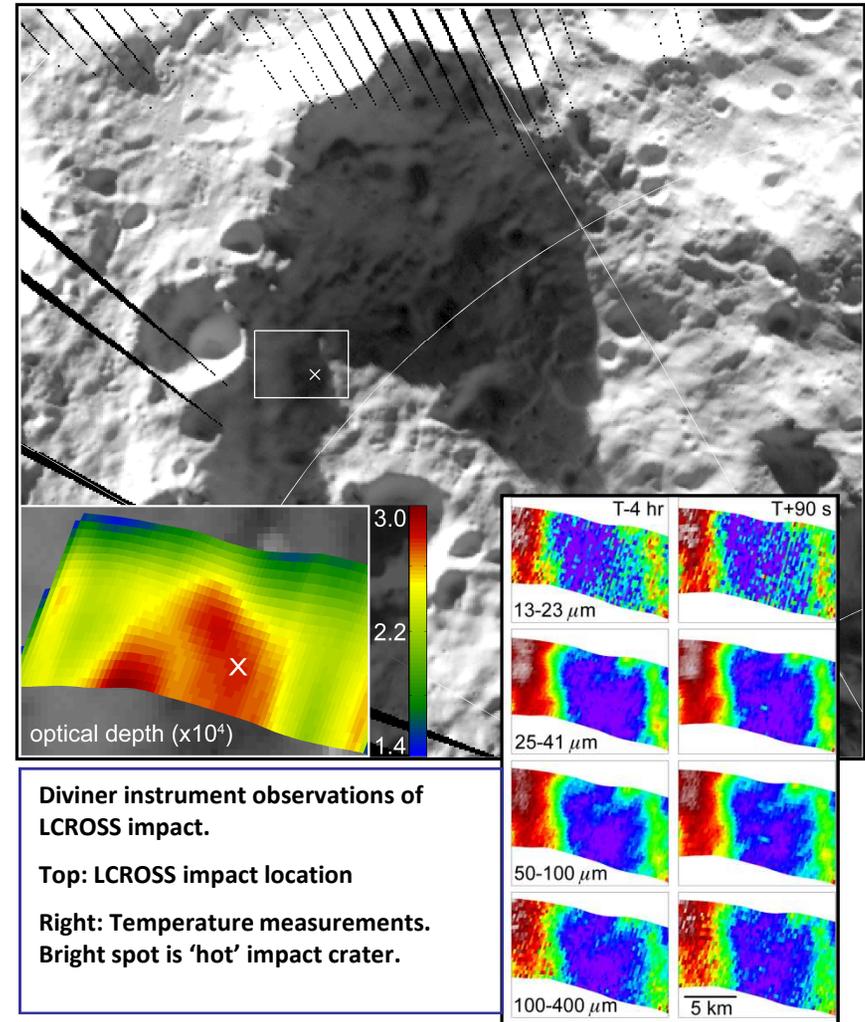
- Maintain steady tempo of exploration missions and investigations to address priority needs in preparation for human exploration
- Initiate at least two missions in FY 2011
- Candidate missions include:
 - Lunar missions, following up on LRO/LCROSS results, landers demonstrating tele-operation capable of transmitting near real-time video to Earth, investigations for validating availability of resources for extraction
 - Reconnaissance of and/or landing on near-earth asteroids or on the moons of Mars (Phobos and Deimos)
 - Landing in situ resource utilization capability to process lunar or asteroid materials into fuel and/or other exploration enabling materials
 - Mars precursor measurements and demos
- Emphasize partnerships -- inter-Directorate, international, interagency, etc. – MOOs on SMD , Int'l, Commercial missions
- Provide venue for flight validation and infusion of developed technology and for Participatory Exploration opportunities



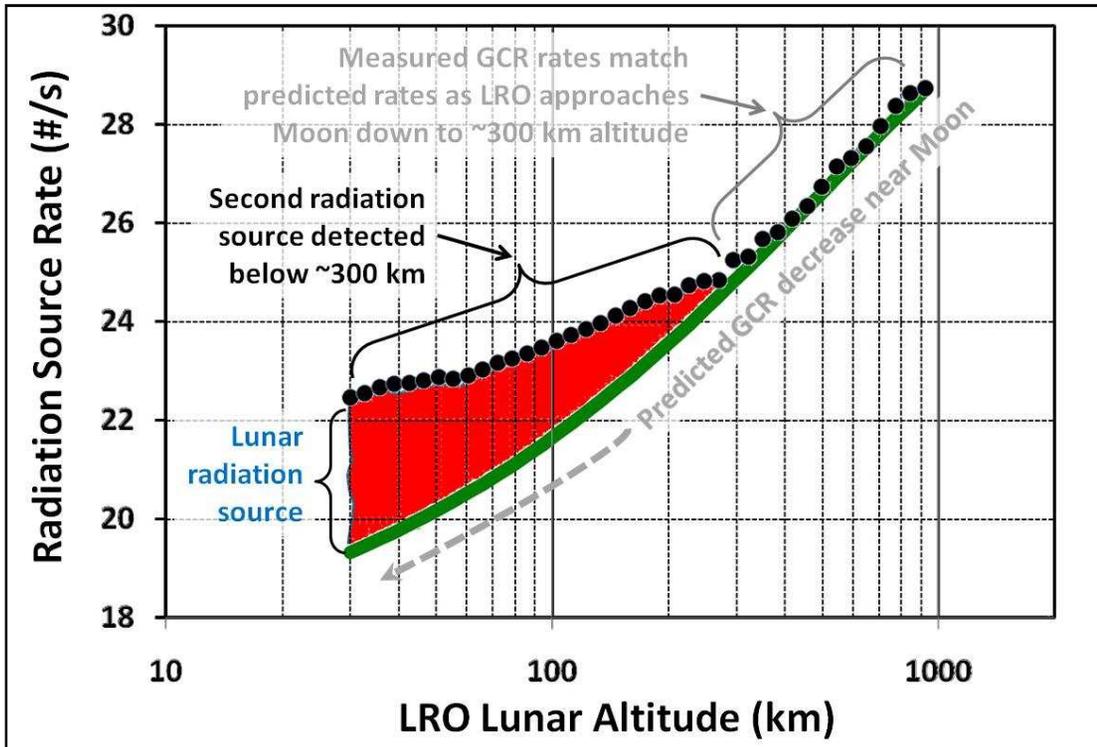
LRO and LCROSS: Pioneering Robotic Precursors



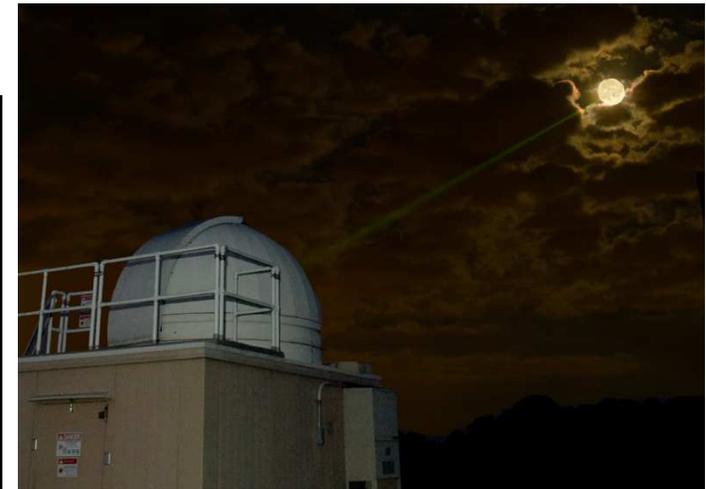
An especially interesting impact melt feature of the crater Giordano Bruno . Like lava, impact melt flows like a stream until the source of the melted rock is gone, or when it cools and freezes into solid rock.



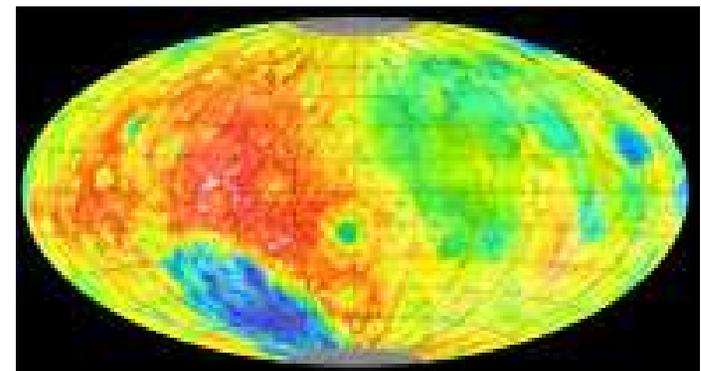
LRO Highlights



Enhanced radiation near the Moon detected by CRaTER Instrument



A bright green laser pulse travels from the Next Generation Satellite Laser Ranging Station to the moon.



Draft topographical map of the Moon from data collected by LRO's LOLA.

Summary and Future Plans



- The President's FY11 Budget for ESMD proposes an exciting, vigorous set of new programs that will bring much-needed new capabilities to fruition, and provide critical precursor knowledge that will ultimately enable a sustainable plan for sending humans into the solar system to stay
- Key investments in new and innovative capabilities will:
 - Expand our exploration opportunities,
 - Reduce mission costs,
 - Contribute NASA innovation to broader national needs
- Stay tuned for more details of these new Programs over the coming months, and watch for opportunities to submit your ideas to NASA through RFIs and proposal competitions – we need your creativity!
- For more information on the new budget, check out:

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

