SMD Research Program
-- Science AOs and Grants --

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Research is a part of everything we do, and it is a part of every budget line.

Research and Data Analysis (R&DA)
- Research and Analysis (R&A)
- Supporting Research and Technology (SR&T)
- Suborbital Investigations (Aircraft, Balloon, Sounding Rocket)
- Data Analysis (DA) (includes General Observers - GO)

Missions
- Development (including PI-led mission development and PI-led instrument development)
- Operations (including science operations and data processing)
- Science Teams (including Participating Scientists and Interdisciplinary Scientists)
Principles for the Research Program

• Scientific merit through peer review
  – Use scientific merit, as determined through community and peer review, as the primary criterion for science program planning and resource commitment.

• Timely availability of data
  – Ensure vigorous and timely interpretation of mission data, requiring that data acquired be made publicly available as soon as possible after scientific validation.

• Community participation
  – Ensure the active participation of the research community outside NASA, which is critical to success.

• Maintain NASA capabilities
  – Maintain essential technical capabilities at the NASA Centers.
Solicitations - AOs

• Announcements of Opportunity
  – Used to solicit science investigations requiring the development of flight hardware up to and including a complete mission from formulation through operation and data analysis
  – Used when NASA is requesting science investigations rather than instruments meeting specific technical specifications
    • Otherwise use Request for Proposals (RFP)
  – PI-led mission AOs (investigations involving complete missions)
    • Explorer, Discovery, ESSP, Mars Scout, New Frontiers
  – Instruments for Strategic Missions (investigations involving instruments and science team members)
    • Lunar Reconnaissance Orbiter Instruments
    • Mars Science Laboratory Instruments
    • Radiation Belt Storm Probes Instruments
PI-led Mission Launches

New Front | Discovery | Scout | ESSP | Explorer


SAMPEX | Pathfinder

FAST | NEAR

SAMPEX

1992 | 1996

TRACE | WIRE

SWAS | FUSE

Lunar Pro | Stardust

1997 | 1998 | 1999

IMAGE | WMAP | GRACE | GALEX

2000 | 2001 | 2002 | 2003

CONTOUR | CHIPS

2004 | 2005 | 2006

Swift | THEMIS | AIM | CALIPSO

CloudSat | OCO | IBEX | WISE

2007 | 2008 | 2009

New Horiz | Phoenix | Dawn | Kepler | Aquarius

2010 | 2011 | 2012+

Scout TBD | ESSP TBD | MIDEX TBD

Juno | Disc TBD
PI-led Mission AOs

• Discovery
  – Budget includes development, operations, and competed data analysis program (Discovery DAP)
  – Budget approx $270M per year (through FY08) growing to $310M per year (in FY11)
  – 2006 AO closed April 5, cost cap $425M (FY06)

• Explorer
  – Budget includes development and prime mission operations
  – Budget approx $210M per year (FY05-FY06), $150M per year (FY07-FY09), rebounding to $190M per year (in FY11)
  – Next AO (MIDEX) no earlier than FY2008
PI-Led Mission AOs

• ESSP
  – Budget includes development and operations
  – Budget approx $120M per year (through FY09) growing to $200M per year (in FY11)
  – Next AO no earlier than FY2008

• Mars Scout
  – Budget a component of overall Mars Exploration budget
  – AO released on May 1, proposals due on August 1, cost cap $475M (FY06)

• New Frontiers
  – Budget includes development and operations
  – Budget approx $155M per year (through FY08) growing to $250M per year (in FY10)
  – Next AO no earlier than FY2008
Solicitations - NRAs

• NASA Research Announcements
• Research Opportunities in Space and Earth Sciences
  – SMD’s Omnibus NRA
  – Used to solicit virtually all non-flight opportunities
  – ROSES-06 has 64 program elements (so far)
• Solicit R&DA plus science teams
  – R&A (e.g. Solar and Heliospheric Physics)
  – SR&T (e.g. Advanced Component Technology)
  – Suborbital (e.g. Atmospheric Composition TC4)
  – DA (e.g. Cassini Data Analysis)
  – GO (e.g. GALEX Guest Investigator)
  – Science Teams (e.g. MRO Participating Scientists)
  – Multi-mission science integration (e.g. Earth System Science Research using Data Products from EOS Satellites)
  – Earth science applications (e.g. Decision Support)
ROSES Funding Available

Number of ROSES Elements

$M for New Awards

Total: ~$150M
(41 program elements)
• Research is part of everything we do, and it is a part of every budget line
  – Budget is distributed as a component of every program and every project
  – Different divisions bookkeep their research budgets in different ways
    • E.g. Science teams can be embedded in individual flight projects or funded from a research project – some are R&A, some are not
    • E.g. Data analysis can be embedded in individual flight projects or funded from a research project – some are R&A, some are not

• Research is a “program line” in the NASA budget
  – R&A is only one “project” in the “program”
  – Mission operations
  – Data analysis
  – Suborbital projects
  – Data archives
  – Etc.
Research Budget

The following budget chart aggregates the competed SMD research budget excluding flight hardware development

• Traditional R&A
  – R&A project (each Division has one)
  – R&A embedded in flight programs (e.g. Mars, Living With a Star, Beyond Einstein)
  – Technology distributed

• Data analysis (other than traditional R&A)
  – General Observer/Guest Investigator programs
  – Archival data analysis programs
  – Mission or program specific data analysis programs
  – Data archive, virtual observatory, etc.

• Science Teams (other than traditional R&A)
  – PI teams for missions and instruments selected through AO
  – Additional team members selected through competition
    • Participating scientists, interdisciplinary scientists, science working group members, etc.
Research from Flagship Missions

• Development and operation of “Flagship Missions”
  – Flagship missions enable NASA to meet science objectives
  – Significant community funding is associated with large missions
    • Hubble Space Telescope: Development of instruments provided over $1.2B to 10 instrument teams; Observing enabled 6510 GO grants over 15 years providing $283M to 4138 investigators, 1323 postdocs, 1852 grad students.
    • Earth Observing System missions provided $1.6B in funding over 14 years to 781 investigators, 112 postdocs, 159 grad students for algorithm development, IDS investigations, cal/val investigations.
    • Spitzer Space Telescope: Science operations provided $100M to 318 investigators over 6 years for science team and general observers.
    • Cassini: Science operations provided $200M over 9 years to 125 investigators, 120 postdocs and grad students for science development and data analysis.
  – All funding is peer reviewed and selected through AOs, NRAs, Calls for Proposals (observing), or unsolicited but peer reviewed proposals.
## SMD Research Budget

<table>
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<th>FY05</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08-11 (average per year)</th>
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<td><strong>Other R&amp;DA (w/ science teams)</strong></td>
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**Notes**
- Totals are approximate and illustrative only
- Only “Standard” R&A was reduced by 15%
- Does not include development (missions, instruments)
- Out year (FY07-FY11) “Other R&DA” budgets are incomplete due to (a) missions that have not yet been extended, (b) unselected missions
Science Enabled by Exploration

• The NASA human space exploration program will create science opportunities
  – Near-term: Robotic lunar exploration
  – Next decade: Human sorties to the Moon
  – Long-term: Extended human lunar missions, human missions to Mars and other destinations

• SMD will fund science enabled by the Exploration program using established principles
  – Execute the most compelling and highest priority science
  – Take advantage of all appropriate opportunities
  – Prioritized in the context of the existing science program
    • since the funds come from the same pool
  – Set priorities jointly with the science community
    • through strategic planning and peer review
  – Use open competition and peer review
SMD has asked the NRC Space Studies Board to undertake a study on lunar science priorities

- Study serves as statement of community interest in lunar science
- Provides a comprehensive, well-validated, and prioritized set of scientific research objectives for the Moon
- Anticipates science value in the context of the rest of the SMD science portfolio
- Interim release by August 2006 to support ongoing activities
- Final report by May 2007

Study will provide long range science objectives to frame decisions on lunar enabled opportunities

- In the context of established science priorities
“Suitcase Science”

• First opportunities enabled by human lunar exploration will be small, autonomous experiments deployed by astronauts during first lunar sorties
  – Resource constrained
  – Analogous to ALSEP – Apollo Lunar Surface Experiment Package
  – AKA “Suitcase science”

• SMD is planning to solicit concept studies this year for suitcase science investigations
  – Science priorities set by decadal surveys & NASA roadmaps
  – Concept study would identify resource requirements -- potentially provide input to exploration architecture
  – Concept study would identify technology or other R&D required
“Suitcase Science”

• SMD is planning to solicit concept studies this year for suitcase science investigations
  – Evaluation criteria would include
    • Compelling nature of science in context of national science priorities
    • Justification of need for human deployment and lunar surface location
    • Reasonableness of estimated resource requirements
    • Relevance to NASA
  – Select 5-10 investigations for 1 year

• Solicitation will be issued as a ROSES program element
  – Draft solicitation ready to go
  – Reasons to go:
    • Potential impact on lunar architecture
    • Engage science community in thinking about high priority science on the Moon
  – Reasons to delay:
    • SSB study pending
Backup
Near Term AO Schedule

• 2005
  – Radiation Belt Storm Probes (instruments)

• 2006
  – Discovery (missions)
  – Mars Scout (missions)

• 2007 or later
  – Explorer (MIDEX missions)
  – ESSP (missions)
  – New Frontiers
  – Other opportunities
Research & Data Analysis

• R&DA includes basic and applied supporting research and technology in space and Earth sciences, including
  – theory, modeling, and analysis of data;
  – aircraft, stratospheric balloon, and suborbital rocket investigations;
  – development of experiment techniques suitable for future missions;
  – development of concepts for future missions;
  – development of advanced technologies relevant to missions;
  – development of techniques for and the lab analysis of both extraterrestrial and terrestrial samples that support missions;
  – determination of atomic and composition parameters needed to analyze space data as well as samples from the Earth or space;
  – Earth surface observations and field campaigns that support missions;
  – development of integrated Earth system models;
  – development of systems for applying Earth science research data to societal needs; and
  – development of applied information systems applicable to SMD objectives and data.