



SMD Research Program

-- Science AOs and Grants --

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Planning Conference
Science Subcommittees, NASA Advisory Council
May 3-4, 2006



Research Program

- 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.

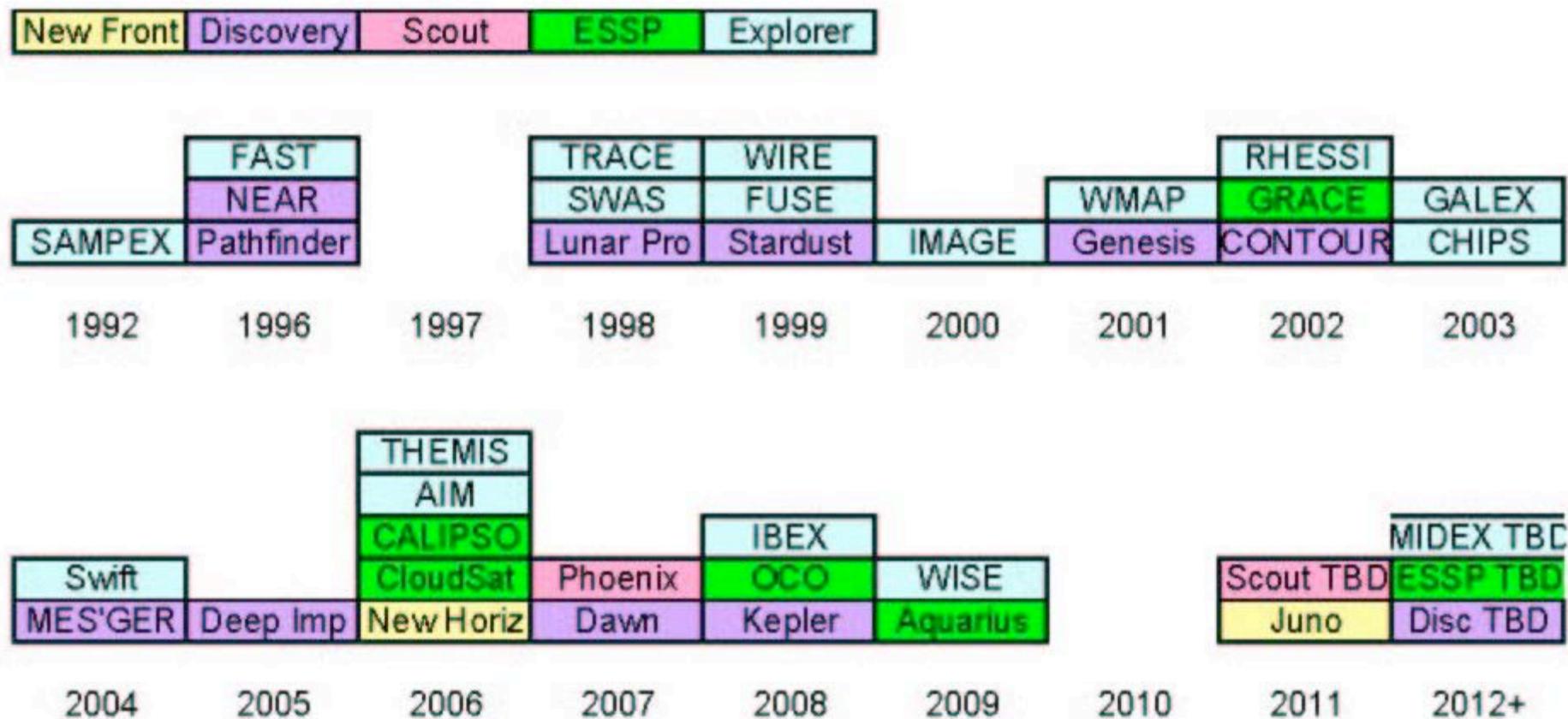


Solicitations - AOs

- 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





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

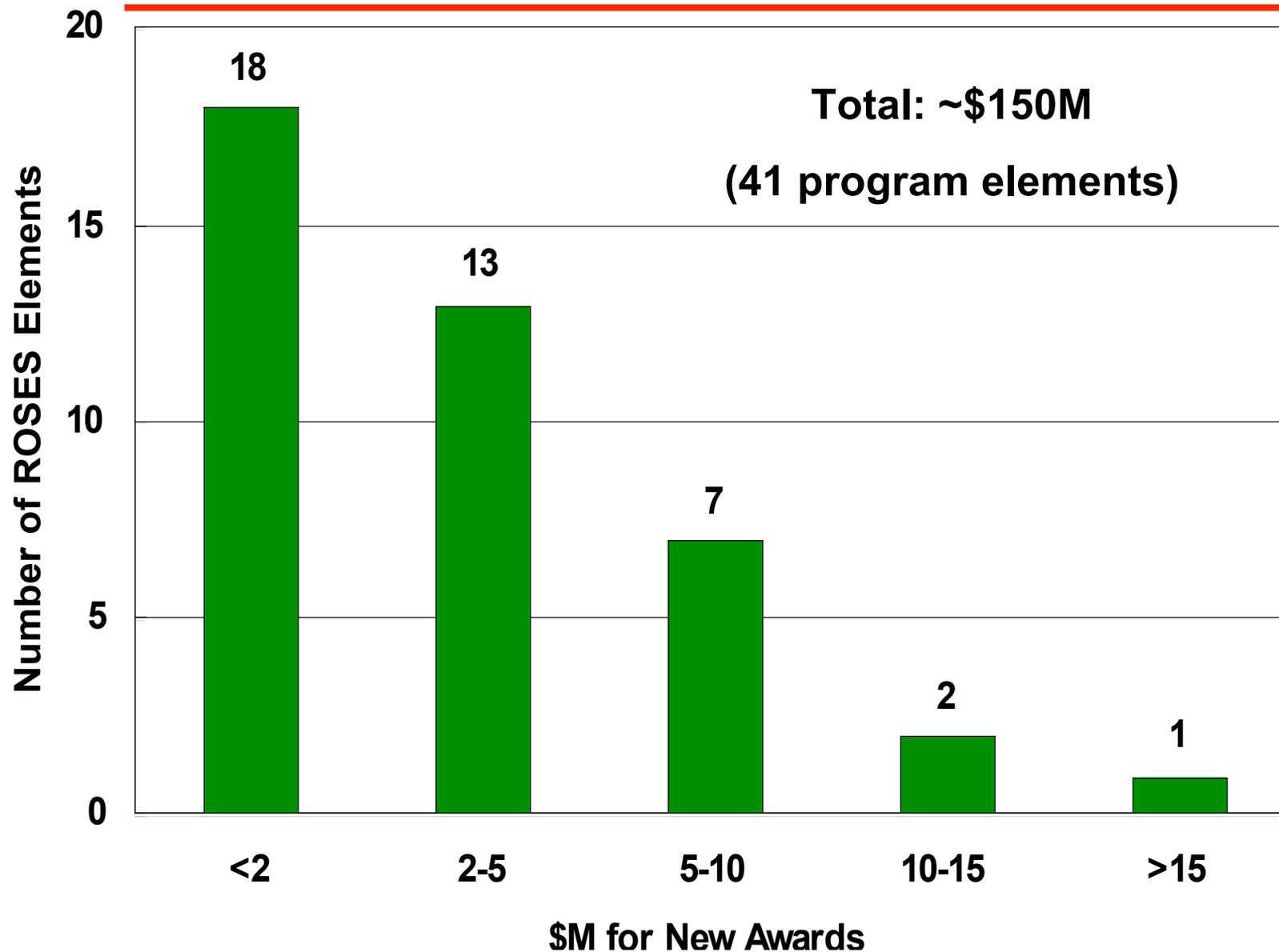


Solicitations - NRAs

- 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





Research Budget

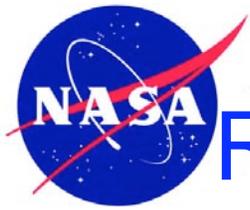
- Research is part of everything we do, and it is a part of every budget line
 - Budget is distributed as a component of every program and every project
 - Different divisions bookkeep their research budgets in different ways
 - E.g. Science teams can be embedded in individual flight projects or funded 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

<u>"Standard" R&A</u>	<u>FY05</u>	<u>FY06</u>	<u>FY07</u>	<u>FY08-11</u> (average per year)
Astrophysics	60	60	50	50
Heliophysics	30	30	30	30
Planet Sci (w/ astrobiology)	150	130	100	110
Earth Science	200	170	160	180
<u>Other R&DA (w/ science teams)</u>				
Astrophysics	170	170	150	120
Heliophysics	80	90	120	100
Planetary Sci (w/ Mars)	130	140	150	130
Earth Science	270	270	290	310
SMD Total	1090	1060	1050	1050

- 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



Space Studies Board Lunar Study

- 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.



ROSES Due Dates

