

From: Fran Bagenal, University of Colorado
 To: Proto-Planetary Science Subcommittee
 Re: Thoughts on the FY07 NASA budget for Planetary Science

Since I have spent a fair amount of the past few weeks studying the NASA Science Mission Directorate budget in preparation for the Congressional Science Committee hearing on March 2nd* I thought I would share with other members of the proto-PSS some numbers and some thoughts. At the hearing I was representing the Heliophysics (ex-Sun-Earth-Connections) community. But my other foot is in Planetary Science (ex-Solar System Exploration Division – yes, this is an inconvenient time to change names) and, as chair of the Outer Planets Assessment Group,** I am particularly concerned about exploration of the outer solar system.

*<http://www.house.gov/science/hearings/full06/March%202/index.htm>

**<http://www.lpi.usra.edu/opag/>

FY07 BUDGET – The Numbers

The big topic of the past few weeks is the FY07 budget - in particular, the substantial reductions from the FY2006 projections. Note that this chart from the NASA presentation of the budget includes cuts to FY2005.

President's FY 2007 Budget Request (Dollars in Millions)

<u>Solar System Exploration</u>	<u>FY2005</u>	<u>FY2006</u>	<u>FY2007</u>	<u>FY2008</u>	<u>FY2009</u>	<u>FY2010</u>	<u>FY2011</u>
FY 2007 PRES BUD	1,720.5	1,582.3	1,610.2	1,598.6	1,840.4	1,899.6	1,846.7
Changes from FY 2006 Request	-137.6	-318.2	-737.5	-1,233.3	-1,158.6	-1,166.6	

Details of the FY07 budget for Planetary Science Division (ex-Solar System Exploration) is as follows (except DSN has been moved to Heliophysics). For those not intimately familiar with NASA’s Planetary Science Division, let me explain some of the terms:

Discovery – a mission line of PI-led, competitively-bid missions at a total mission cost of about \$350-400M – examples are NEAR, Messenger, Stardust, Deep Impact. Dawn is currently under review after cancellation announced on March 2nd. M3 is a lunar mission. There is currently an Announcement of Opportunity (AO) and teams will be submitting proposals for mission concepts in April. The original aim was to have an AO every 2-3 years with launches on the order of every 18 months.

New Frontiers – a mission line of PI-led, competitively-bid missions at a total mission cost of about \$700M. The first is the New Horizons mission to Pluto that was launched on January 19th. The second is Juno, a Jupiter polar orbiter, which is currently planned for 2010/11. The next AO is scheduled for 2008. The scope of NF missions are limited to a list of targets consistent with the NRC Decadal Survey.

At the October 2005 OPAG meeting Andy Dantzler, Director of the Planetary Science

Division, announced that there would be on the order of \$10M available for studies of future flagship missions – successors to Cassini. The top priority of the Decadal Survey is a Europa orbiter. Recent Cassini-Huygens observations also make Titan an attractive target. There is also a push for sending probes into the atmospheres of the giant planets. Unfortunately, support for such studies were delayed indefinitely in the FY 2007 budget.

The columns are for

	2006	2007	2008	2009	2010	2011
FY 07 President's Budget Request	1,582.3	1,610.2	1,598.6	1,840.4	1,899.6	1,846.7
Discovery	145.9	161.9	196.7	294.7	345.2	299.8
Dawn	63.6	56.1	5.7	6.0	7.0	9.3
M3	14.6	7.4	3.3	3.1	1.7	
Messenger, Stardust, Genesis, ASPERA-3	25.0	13.4	15.9	13.9	13.3	18.0
Discovery Research	10.8	13.1	15.7	15.9	18.0	18.4
Future Missions (AO released 1/06)	10.6	47.8	123.8	215.3	260.7	211.2
Corporate / Other	21.3	24.1	32.3	40.5	44.5	42.9
New Frontiers	148.1	154.9	160.6	255.6	256.1	238.1
New Horizons	83.3	18.6	10.2	5.8	6.1	6.6
Juno	52.3	117.2	127.9	217.8	148.8	147.6
Future / Corp. (Next AO NET FY 08)	12.5	19.1	22.5	32.0	101.2	83.9
Technology	56.7	72.6	63.4	65.7	67.0	67.2
In-Space Propulsion	30.0	30.8	23.5	23.7	23.8	23.8
Radioisotope Power Systems	23.5	37.8	36.3	38.2	39.4	39.6
Corporate	3.2	4.0	3.6	3.8	3.8	3.8
Deep Space Mission Systems	254.6	246.9	256.9	265.2	270.5	270.8
Solar System Research	326.6	273.6	290.1	311.7	312.5	301.9
Research & Analysis, PDS, Curation	145.8	111.7	112.7	131.5	132.3	133.2
Cassini, Rosetta, MUSES-C	88.5	95.0	97.5	96.4	96.8	85.3
06 Earmarks / EPO / SMD Admin / Corporate	92.3	66.9	79.9	83.8	83.4	83.4
Mars Exploration	650.4	700.2	630.9	647.4	648.4	668.9
Phoenix	125.6	90.5	28.6	1.0		
MSL 2009	253.4	347.9	285.6	231.0	50.4	41.2
Operating Missions / R&A	121.0	110.0	98.8	83.6	70.1	51.0
JPL Building Support	39.7	46.0	26.2	13.9	13.0	13.3
Future/Tech./Corp. (Scout AO Spring 06)	110.7	105.8	191.7	317.9	514.9	563.4

A set of powerpoint slides presented by Mary Cleave (and used by others in presentations) shows the following changes to Planetary Science

What's Changed

- Lunar Robotic Exploration program transferred to Exploration Systems
- Deleted MTO, 2 Mars Testbed missions (Safe on Mars), 2 Scout Missions, Optical Communications and other associated Mars technologies
- Mars Sample Return (MSR) and future Mars technologies deferred
- Dawn mission delayed due to technical and cost problems - since CANCELLED
- Selected Moon Mineralogy Mapper (M3) as Discovery mission of opportunity (pending confirmation)
- Discovery 2006 AO released in January 2006, selection is expected by FY07

- In-Space Propulsion (ISP) - terminated or significantly reduced propulsion efforts (i.e., NEXT and Solar Sails); withdrawal from ST9/New Millennium flight demo
- Radioisotope Power System (RPS) - terminated the Stirling Qualification Unit, reduced the scope of the Stirling engineering unit, delayed system level demonstration of advanced power conversion technologies
- Astrobiology research reduced 50%; approximately 15% reductions to all other SSE R&A

What's Stayed the Same

- Mars Program: Phoenix '07, MSL '09, Scout '11, and operating missions (MRO, Odyssey, MGS, MER, Mars Express)
- New Horizons launched successfully on 1/19/06
- Stardust successfully returned sample of the comet and interstellar dust particles back to Earth on 1/15/2006
- MESSENGER and Aspera-3 continue to operate well

At the very end of Mary Cleave's presentation there are some details on what has been cut. You can see the biggest hits are to Mars, R&A, Discovery and Technology development.

	FY06	FY07	FY08	FY09	FY10	FY11
SOLAR SYSTEM EXPLORATION						
FY 2006 President's Budget	1,900.5	2,347.7	2,831.9	2,999.0	3,066.2	
Mars Exploration	-98.4					
Robotic Lunar (transfer to Exploration)	-134.6	-276.2	-371.4	-416.3	-427.1	
FY2006 President's Budget as Amended	1,667.5	2,071.5	2,460.4	2,582.6	2,639.1	
Mars Exploration	25.7	-243.3	-602.5	-584.6	-611.8	
Discovery	-22.8	-57.3	-104.8	-25.0	10.9	
New Frontiers	-10.4	-2.8	-2.1	-3.9	-2.9	
Solar System Technology (In-Space Propulsion, Advanced RTG)	-39.0	-56.6	-64.6	-63.4	-63.4	
Deep Space Mission Systems (DSMS)	-2.8	-4.7	-3.8	-2.5	-2.9	
Solar System Research	-35.9	-96.5	-84.2	-63.1	-69.4	
FY 2007 President's Budget	1,582.3	1,610.1	1,598.5	1,840.3	1,899.5	1,846.7

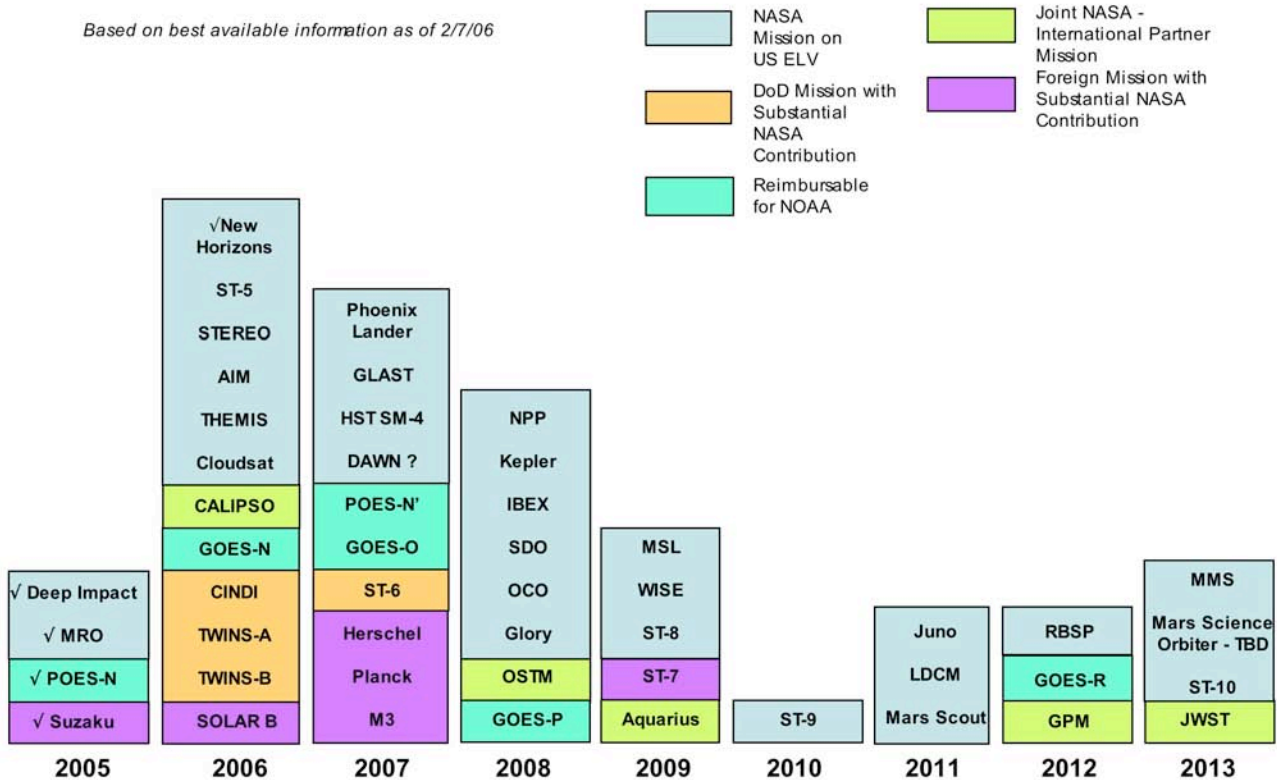
SCIENCE MISSION LAUNCHES

Looking at SMD overall, the precipitous drop in launches from 2006 to 2010 (when the only mission ST-9 is a small technology-demonstration mission). You will see a strong trend from many smaller missions (small or medium Heliophysics/Astrophysics Explorers – SMEX, MIDEX, Discovery) to very few larger missions (Juno JWST, MMS). As discussed extensively in the congressional testimonies, this has a very serious impact on training of young scientists and engineers who cut their teeth on these small missions.



NASA Science Mission Launches (CY05-CY13)

Based on best available information as of 2/7/06



MY CONCLUSIONS

(1) **Immediate concerns** - All the FY07 material presented in past couple of weeks seems to avoid going back to FY05 (present budget) and FY06. I have made a little spreadsheet that shows the issues of immediate concern - cuts to FY05 and FY06. Note that the net result is a 8.73% drop from FY05-FY06 – this is rarely mentioned by NASA administration. After that we have to admit the growth is not so bad, overall.

Planetary Science FY07 budget – includes DSN

FYEAR	2005	2006	2007	2008	2009	2010	2011	AVERAGE
FY07	1720.5	1582.3	1610.2	1598.6	1840.4	1899.6	1846.7	
%growth		-8.73	1.73	-0.73	13.14	3.12	-2.86	0.94
3% growth		1772.1	1629.8	1658.5	1646.6	1895.6	1956.6	

(2) **R&A** - I think the message has gotten across to Griffin and Cleave that the scientific community regards R&A as sacred and their logic of cutting R&A because of a decline in *future* missions is not logical (e.g. all 4 of us at the Congressional Committee on Science hearing on Mar 2nd argued strongly in support of R&A, even at the expense of flagship missions). I expect that much of the R&A cuts will be restored - where from is the question. I presume this will be a major topic at the proto-PSS meeting in May. The cancellation of

DAWN has freed up some \$\$ but I suspect that is already spent - somehow. The planetary science community – particularly the astrobiologists – are up in arms over these cuts.

(3) **Mission cost growth** - While there has been a public furor over cuts to science and considerable debate about whether science is/should be cut to pay for Return To Flight (or other human flight programs), the issue that we scientists really have to grapple with is the initial under-costing and subsequent over-runs on most missions in the pipeline. We can point to the worst offenders or point to institutions or policies that we blame for cost growths but the bottom line is that until we - yes, we the scientists, the ones who have the greatest stake in getting missions to return data - get mission costs under control we are heading for disaster. Personally, I think it will be difficult to argue for any planetary flagship missions under these conditions. I am worried that should we start something (e.g. Europa mission) it would end up eating all of the solar system budget for the next couple of decades. This is not to point the finger at Europa or JPL necessarily - as far as I can tell *all* large missions are having serious cost-growth problems. HOW do we gain control? I have no idea.

(4) **Science / NASA** - Griffin made a big deal about SMD getting an increasingly large fraction of NASA's budget (he said 24% in 1992 and 32% in 2007). These percentages are extremely fuzzy since NASA has gone through huge accounting changes in that time. Contributing factors are Full-Cost Accounting, including launch costs (that have doubled in 5 years), etc. So, I do not buy his argument that such large growth in the fraction of NASA going to SMD means that its growth should be slowed (to 1%). But the reality is that spending 1/3 of a NASA budget of \$15.5B on science really is pretty good. Yes, we should point out the successes of SMD and argue that it should grow at the same rate as NASA as a whole. And Planetary Science should get its share. But I feel on thin ice asking for additional funds - new money - when a second glance at the NASA budget shows reveals current rhino in the room to be the fact that we have lost control of mission cost growth.



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