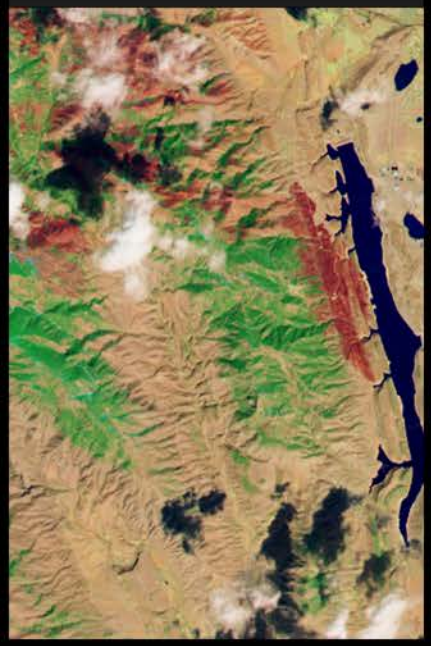
National Aeronautics and Space Administration



EARTH SCIENCE

HELIOPHYSICS

PLANETARY SCIENCE

ASTROPHYSICS

NASA SCIENCE BUDGET

FY2014 Budget Request Overview
Astrophysics Subcommittee
April 2013

www.nasa.gov

FY 2014 NASA Budget Request

	FY 2012 Actual	FY 2013 Annualized CR	FY2014	Notional FY2015	FY2016	FY2017	FY2018
NASA FY 2014	**$17,770.0**	**$17,893.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**
Science	**$5,073.7**	**$5,115.9**	**$5,017.8**	**$5,017.8**	**$5,017.8**	**$5,017.8**	**$5,017.8**
Earth Science	$1,760.5	-	$1,846.1	$1,854.6	$1,848.9	$1,836.9	$1,838.1
Planetary Science	$1,501.4	-	$1,217.5	$1,214.8	$1,225.3	$1,254.5	$1,253.0
Astrophysics	$648.4	-	$642.3	$670.0	$686.8	$692.7	$727.1
James Webb Space Telescope	$518.6	-	$658.2	$645.4	$620.0	$569.4	$534.9
Heliophysics	$644.8	-	$653.7	$633.1	$636.8	$664.3	$664.6
Aeronautics Research	**$569.4**	**$572.9**	**$565.7**	**$565.7**	**$565.7**	**$565.7**	**$565.7**
Space Technology	**$573.7**	**$578.5**	**$742.6**	**$742.6**	**$742.6**	**$742.6**	**$742.6**
Exploration	**$3,707.3**	**$3,790.1**	**$3,915.5**	**$3,952.0**	**$3,970.7**	**$3,799.0**	**$3,589.3**
Exploration Systems Development	$3,001.6	-	$2,730.0	$2,789.8	$2,801.5	$2,818.3	$2,819.5
Commercial Spaceflight	$406.0	-	$821.4	$821.4	$821.4	$590.0	$371.0
Exploration Research and Development	$299.7	-	$364.2	$340.8	$347.8	$390.7	$398.7
Space Operations	**$4,184.0**	**$4,247.8**	**$3,882.9**	**$4,014.9**	**$3,996.2**	**$4,167.9**	**$4,377.6**
Space Shuttle	$596.2	-	$0.0	$0.0	$0.0	$0.0	$0.0
International Space Station	$2,789.9	-	$3,049.1	$3,169.8	$3,182.4	$3,389.6	$3,598.3
Space and Flight Support (SFS)	$797.9	-	$833.8	$845.1	$813.8	$778.3	$779.3
Education	**$136.1**	**$136.9**	**$94.2**	**$94.2**	**$94.2**	**$94.2**	**$94.2**
Cross Agency Support	**$2,993.9**	**$3,012.2**	**$2,850.3**	**$2,850.3**	**$2,850.3**	**$2,850.3**	**$2,850.3**
Center Management and Operations	$2,204.1	-	$2,089.7	$2,089.7	$2,089.7	$2,089.7	$2,089.7
Agency Management and Operations	$789.8	-	$760.6	$760.6	$760.6	$760.6	$760.6
Construction & Envrmtl Compl Restoration	**$494.5**	**$401.9**	**$609.4**	**$440.9**	**$440.9**	**$440.9**	**$440.9**
Inspector General	**$38.3**	**$38.2**	**$37.0**	**$37.0**	**$37.0**	**$37.0**	**$37.0**
NASA FY 2014	**$17,770.0**	**$17,893.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**

Notes:
-- FY 2012 is consistent with submitted operating plans however, for comparability purposes, values for Space Technology reflect the funding for Space Technology related activities executed in Exploration, Space Operations, and Cross Agency Support.
-- FY 2012 Estimates include rescission of prior year unobligated balances, pursuant to section 528(f) of P.L. 112-55, Division B, Commerce, Justice, Science, and Related Agencies Appropriations Act, 2012
-- The FY 2013 appropriation for NASA was not enacted at the time that the FY 2014 Request was prepared; therefore, NASA is operating under a Continuing Resolution (CR) (P.L. 112-175). Amounts in the "FY 2013 annualized CR" column reflect the annualized level provided by the CR. Rescission of remaining unobligated balances of American Recovery and Reinvestment Act funds in the Office of Inspector General account pursuant to section 1306 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (P.L. 111-203)
-- Funds associated with out-year estimates for programmatic construction remain in programmatic accounts.

Agency-level Considerations

- **Sequestration.** The President believes we should replace sequestration with balanced deficit reduction.
- **Out-year Funding Assumptions.** In this time of national fiscal austerity, NASA has accepted the challenge to manage to a flat out-year top-line budget. Funding lines beyond FY 2014 should be considered notional. In general, NASA accounts are held at their FY 2014 request level with adjustments.
- **Campaign to Promote Efficient and Effective Spending.** This budget continues NASA's efforts to improve operational efficiency and maintains reduced spending for service contracting, travel, supplies and materials, printing and reproduction, and IT services.
- **Aligning the NASA Workforce.**
  - ✓ Aligns human capital with the priority requirements of the Agency
  - ✓ Reduces the rate of re-hiring in FY2014 consistent with budget limitations
- **Presentation in full-cost**, where all project costs are allocated to the project, including labor funding for the Agency's civil service workforce.
- **Comparisons to FY 2013**. Due to the timing of budget development, FY 2013 comparisons are to the full-year CR level in effect in the February time period.

FY 2014 SMD Program/Budget Strategy

- Provide the most productive Earth & space science program for the available resources
  - Guided by national priorities
  - Informed by NRC Decadal Surveys recommendations
  - Incorporating new ideas and partnerships
  - Increase cross-directorate collaboration on strategic projects (Mars 2020, NEOs)
- Responsibly manage the national investment in robotic space missions, with adherence to NPD 7120
  - Confirm new missions only after sufficient technology maturation and budgets at an appropriate confidence level
  - Take aggressive steps with missions that do not stay within budget
  - Aggressively manage JWST to the cost and schedule baseline
- Increase efforts to detect and study NEOs in support of future agency initiatives
- Begin Mars 2020 mission to build on Curiosity's discoveries
- Plan for land imaging capability beyond LDCM, Climate Sensors (previously on JPSS-2), and DSCOVR Earth observing instruments
- Implement the Administration's proposed STEM initiative

Recent Cost and Schedule Performance

All spacecraft launching from August 2011 - August 2014

	Original Baseline			Revised Baseline			Actual/Current		Change From Latest Baseline	
	Estab.	LRD	Dev $	Estab.	LRD	Dev $	LRD	Dev $	LRD	Dev Cost
Juno	2008	Aug-11	742				8/5/11	710	--	-4%
GRAIL	2008	Sep-11	427				9/10/11	398	--	-7%
Suomi NPP	2006	Apr-08	593	2011	Feb-12	815	10/25/11	768	- 4 mos	-6%
MSL	2007	Sep-07	1069	2010	Nov-11	1720	11/26/11	1769	--	3%
NuSTAR *	2009	Feb-12	110				6/13/12	116	+4 mos	5%
RBSP	2009	May-12	534				8/30/12	(a) 531	+ 3 mos	(a) -1%
LDCM	2010	Jun-13	583				2/11/13	(a) 577	- 4 mos	(a) -1%
IRIS *	2010	Jun-13	141				Jun-13	140	--	--
LADEE	2011	Nov-13	168				Nov-13	176	--	5%
MAVEN	2011	Nov-13	567				Nov-13	(a) 551	--	(a) -3%
GPM	2010	Jul-13	555	2012	Jun-14	519	Jun-14	509	--	-2%

* IRIS and NuSTAR are too small (<$250M LCC) to be subject to MPAR reporting, but are included here for completeness.

(a) In the upcoming Operating Plans for FY12 and FY13 funds, NASA expects to report even better performance (greater underruns) on RBSP, LDCM and MAVEN.

Science Budget Request Summary

	FY2012	* FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
Science Total	**5073.7**	**5115.9**	**5017.8**	**5017.8**	**5017.8**	**5017.8**	**5017.8**
Earth Science	**1760.5**		**1846.1**	**1854.6**	**1848.9**	**1836.9**	**1838.1**
Earth Science Research	441.1		443.3	483.1	483.4	485.1	476.5
Earth Systematic Missions	879.9		787.5	811.2	861.9	839.1	833.3
Earth System Science Pathfinder	183.3		353.6	293.1	232.2	237.4	250.0
Earth Science Multi-Mission Operations	168.6		171.7	174.3	177.9	179.0	182.0
Earth Science Technology	51.2		55.1	56.2	55.1	56.1	56.1
Applied Sciences	36.4		35.0	36.7	38.4	40.1	40.1
Planetary Science	**1501.4**		**1217.5**	**1214.8**	**1225.3**	**1254.5**	**1253.0**
Planetary Science Research	174.1		220.6	233.3	229.1	230.4	232.2
Lunar Quest Program	139.9		17.7				
Discovery	172.6		257.9	268.2	242.3	187.5	215.0
New Frontiers	143.7		257.5	297.2	266.5	151.0	126.2
Mars Exploration	587.0		234.0	227.7	318.4	504.7	513.2
Outer Planets	122.1		79.0	45.6	24.4	26.4	26.4
Technology	161.9		150.9	142.8	144.7	154.4	140.0
Astrophysics	**648.4**		**642.3**	**670.0**	**686.8**	**692.7**	**727.1**
Astrophysics Research	165.5		147.6	170.6	192.3	207.2	218.5
Cosmic Origins	239.9		228.0	216.5	193.1	196.7	194.1
Physics of the Cosmos	108.3		110.4	107.5	100.0	82.8	86.4
Exoplanet Exploration	50.8		55.4	59.4	57.7	60.7	90.7
Astrophysics Explorer	83.9		100.9	116.0	143.8	145.3	137.4
James Webb Space Telescope	**518.6**		**658.2**	**645.4**	**620.0**	**569.4**	**534.9**
Heliophysics	**644.8**		**653.7**	**633.1**	**636.8**	**664.3**	**664.6**
Heliophysics Research	166.7		195.7	163.0	167.5	172.1	174.1
Living with a Star	196.3		216.2	277.7	332.6	353.9	374.4
Solar Terrestrial Probes	216.0		146.6	68.7	48.9	50.1	27.9
Heliophysics Explorer Program	65.8		95.2	123.7	87.9	88.2	88.2

FY 2015-FY 2018 estimates are notional

* FY2013 reflects pre-appropriation "annualized CR" rate; pending Operating Plan will be less than $4.8B after rescissions and sequestration

Science FY12-14 Budget Changes

	FY2012	FY2013	FY2014	Comments
Science Total	**5073.7**	**5115.9**	**5017.8**	
Earth Science	**1760.5**		**1846.1**	
Earth Science Research	441.1		443.3	
Earth Systematic Missions	879.9		787.5	LDCM launch, and rampdown of SMAP
Earth System Science Pathfinder	183.3		353.6	Venture Class and OCO-3
Earth Science Multi-Mission Operations	168.6		171.7	
Earth Science Technology	51.2		55.1	
Applied Sciences	36.4		35.0	
Planetary Science	**1501.4**		**1217.5**	
Planetary Science Research	174.1		220.6	NEOO; Rosetta arrives at target
Lunar Quest Program	139.9		17.7	ends after LADEE and LRO, per prior plan
Discovery	172.6		257.9	InSight ramping up; GRAIL ended
New Frontiers	143.7		257.5	OSIRIS-REx ramping up
Mars Exploration	587.0		234.0	includes 2020 rover
Outer Planets	122.1		79.0	no funding for Outer Planet Flagship
Technology	161.9		150.9	phasing out In-Space Propulsion
Astrophysics	**648.4**		**642.3**	
Astrophysics Research	165.5		147.6	STEM transferred out of NASA
Cosmic Origins	239.9		228.0	Herschel rampdown
Physics of the Cosmos	108.3		110.4	
Exoplanet Exploration	50.8		55.4	
Astrophysics Explorer	83.9		100.9	supports Spring 2013 selections
James Webb Space Telescope	**518.6**		**658.2**	FY2014 is peak funding year
Heliophysics	**644.8**		**653.7**	
Heliophysics Research	166.7		195.7	Civil Service workforce
Living with a Star	196.3		216.2	Solar Probe and Solar Orbiter Collaboration
Solar Terrestrial Probes	216.0		146.6	MMS ramping down
Heliophysics Explorer Program	65.8		95.2	supports Spring 2013 selections

Astrophysics Budget Features

What's changed

- A new Explorer mission (TESS) and a new Explorer Mission of Opportunity (NICER) downselected for development leading to flight
- New Euclid project created in PCOS program to fund hardware procurement and US science team
- Spitzer, Planck, Chandra, Fermi, XMM, Kepler, Swift, and Suzaku extended per the recommendation of the 2012 Senior Review
- Efficiencies in Fermi mission operations implemented in FY14, resulting in a significant reduction of operating costs, and the Fermi GO program canceled for one year (FY14)
- 30% reduction to COR/PCOS program office budget (commensurate with reduced scope and content)
- Rebalancing of SR&T in all programs to implement Decadal Survey recommendations

What's the same

- Hubble, SOFIA, NuSTAR, Astro-H, ST-7, Balloons, R&A, Archives
- Budget for large decadal survey mission begins to grow in FY17

Astrophysics Earth Science
Heliophysics Planetary Science

Total Missions / Spacecraft
95 / 120

2013-Mar-17

Formulation 16 / 24

JPL 5 / 6
InSight 3/8/2016
GRACE FO (1/2) 8/2017
OCO-3 Late 2017
Euclid 3/2020
SWOT 10/2020

GSFC 9
DSCOVR 11/15/2014
MOMA-MS 2016
Free Flyer-1 NET 7/2016
OSIRIS-Rex 9/4/2016
JPSS-1 12/2016
Solar Orbiter Collaboration 1/2017
Solar Probe + 7/30/2018
Astro EX-1 TBD
Helio EX-1 TBD

LaRC 2 / 9
CYGNSS (1/8) 10/2016
TEMPO 2017

Implementation 20 / 25

LaRC 1
SAGE-3/ISS 8/2014

ARC 1
LADEE 8/12/2013

JPL 4
OCO-2 7/1/2014
SMAP 10/31/2014
ST-7 NET CY2015
Jason-3 3/1/2015

GSFC 12/18
LDCM 2/11/2013
IRIS: 6/26/2013 (protect 5/18)
TCTE: NET Sep 2013
MAVEN: 11/18/2013
GPM: 2/14/2014
MMS (1/4): 10/15/2014
Astro-H: NET CY2015
SET-1: 9/2015
GOES-R Series (1/4): 10/2015
ICESat-2: 7/22/2016
MetOp-C: 10/1/2017
JWST: 10/31/2018AQq

DFRC 1 / 0
SOFIA (1/0) 10/4/2013 FOC

MSFC 1
Strofio 8/16/2015

Joint Agency Satellite Division (JASD)
NOAA Reimbursables

Primary Ops 12 / 13

MSFC 1
New Horizons

JPL 6
NuSTAR
Herschel
Rosetta
Dawn
Juno
MSL Curiosity

GSFC 5 / 6
Fermi
SDO
Suomi NPP~
Van Allen Probes (1/2)
Aquarius

Extended Ops 47 / 58

ARC 1
Kepler

JPL 15/17
Spitzer
Planck
CloudSat
ACRIMSAT
GRACE (1/2)
Jason-1
OSTM/Jason-2~
QuikSCAT
Voyager (1/2)
Mars Express
Mars Odyssey
MER Opportunity
Cassini
MRO
Deep Impact

MSFC 3
Chandra
Hinode
MESSE-NGER

GSFC 27/36
HST
Suzaku
EO-1
XMM
Swift
Aqua
SORCE
IBEX
Terra
TRMM
Landsat 7~
ARTEMIS (1/2)
THEMIS (1/3)
STEREO (1/2)
GEOTAIL
Cluster-2 (1/4)
TWINS-A & B (1/2)

LaRC 1
CALIPSO
ACE
CINDI
AIM
RHESSI
SOHO
TIMED
WIND
LRO
LAGEOS (1/2)

Div	Form	Imp	Pri Ops	Ext Ops	Total
Astro	2	4	3	8	**17**
Earth	5	6	2	15	**28**
Helio	3	3	2	15	**23**
Planet	3	3	5	9	**20**
JASD	3	4	NA	NA	**7**
Total	**16**	**20**	**12**	**47**	**95**

Italics = NASA instruments on commercial, DOD, or international spacecraft
X / Y = # of missions / # of spacecraft
~ Operated by another agency
IRIS LRD updated from 4/28/2013 to 6/26/2013.

12 font: LCC > $1B
10 font: $250M < LCC < $1B
8 font: LCC < $250M
} for projects in formulation & implementation

Back-up Charts

Planetary Budget Features: What's Changed

- Enhanced NEO survey and characterization in support of agency initiatives and to protect the Earth
- Mars 2020 mission, based on Curiosity architecture, under definition
- Provides for MOMA instrument on ESA's 2018 ExoMars rover
- Provides the Electra communications package for ESA's 2016 ExoMars orbiter
- Selected InSight (Discovery-12 mission) for flight; accelerates the next AO by ~6 months
- Selected US investigations on the ESA's JUICE flagship mission
- Funding to support production and management of Pu-238 in partnership with DOE

Planetary Budget Features: What's the Same

- Continuation of missions in development (LADEE , MAVEN) and formulation (OSIRIS-REx)
- Continuation of operating science missions, but with reduced budget for extended missions per Senior Review
  - Prime Ops: Curiosity, Dawn, Juno, New Horizons
  - Extended Ops: MESSENGER, LRO, MRO, Odyssey, Opportunity, Cassini
  - ESA partnered missions: Venus Express, Mars Express, Rosetta
- Completion of Radioisotope Power Systems (RPS) Advanced Stirling Radioisotope Generator (ASRG) ready for flight later this decade
- Support of Planetary missions with navigation, data archiving, and sample curation
- Continuation of supporting research and technology selections and awards

Earth Science Budget Features

- Expands Venture-Class competitive flight program
- Advances development of SAGE III/ISS, GRACE-FO, SWOT, CYGNSS, OCO-3, Tempo, and ICESat-2 for launch before 2021
- Completes integration of DSCOVR Earth observing instruments (EPIC and NISTAR) and initiates ground data system development in preparation for 2014 launch
- Initiates new Land Imaging project for development of a national sustained Land Imaging Satellite System (with USGS)
- Initiates development of a program for continuous monitoring of solar radiation, global ozone profiles, and Earth radiation balance starting in the JPSS-2 time frame
- Pre-formulation studies will continue for PACE, L-band SAR, and other Decadal survey-recommended and climate architecture missions
- Funds Carbon Monitoring System at $10M/year

Heliophysics Budget Features

What's changed:

- A new Explorer mission (ICON, ASTRE, or OHMIC) and a new Explorer Mission of Opportunity (GOLD, CPI, or IMSA) downselected for development leading to flight
- New CubeSat project: a low-cost option for enabling scientific discovery related to Astrophysics, Heliophysics, Earth and Planetary sciences, addressing space technology and exploration systems development needs

What's the same:

- No change to LRD and Life Cycle cost commitments for missions: BARREL, MMS, IRIS, SOC, and SPP
- Continuation of missions in operations
  - Prime Ops: SDO, Van Allen Probes
  - Extended Ops: Geotail, Artemis, STEREO, THEMIS, AIM, Hinode, Cluster, ACE, RHESSI, SOHO, TIMED, Voyager, TWINS, CINDI, IBEX, and WIND