Astrophysics Division Update

Presented to the Astrophysics Subcommittee of the NAC

Dr. Jon Morse

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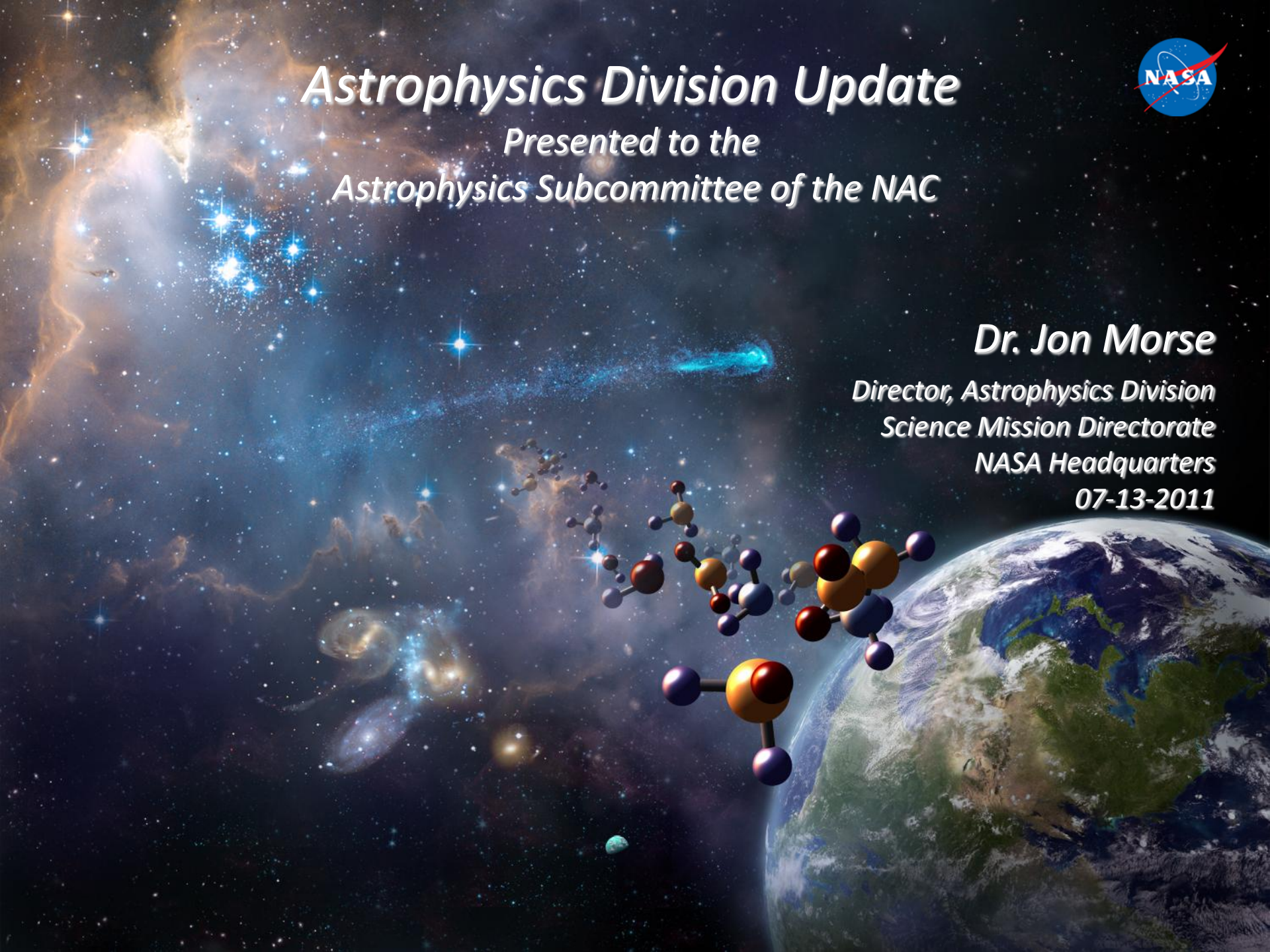
NASA Headquarters

07-13-2011



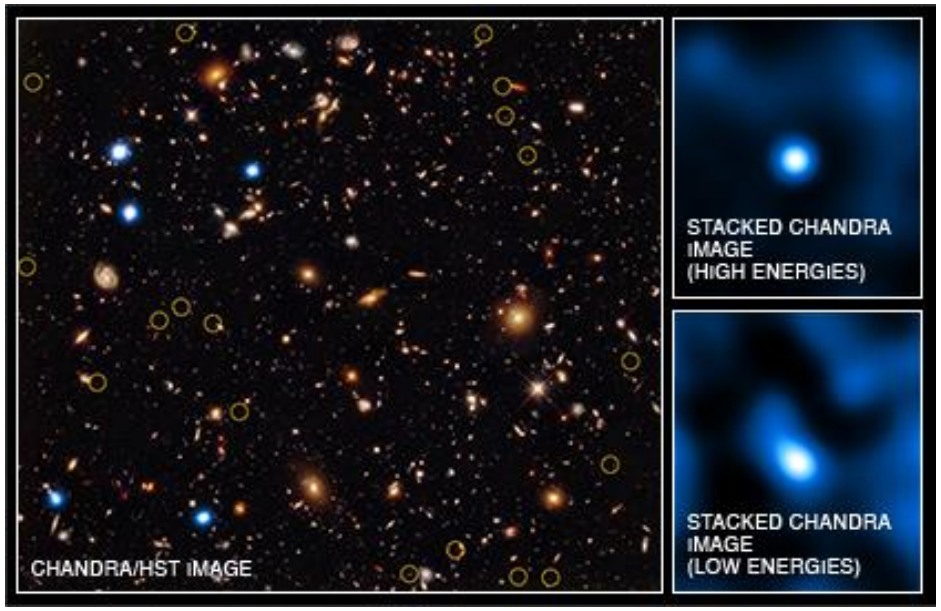
Outline

- Recent Press Releases and Science Highlights
- Programmatic update on missions
- Reviews of R&A and Archives
- *New Worlds, New Horizons* Decadal Survey Response

APS agenda summary:

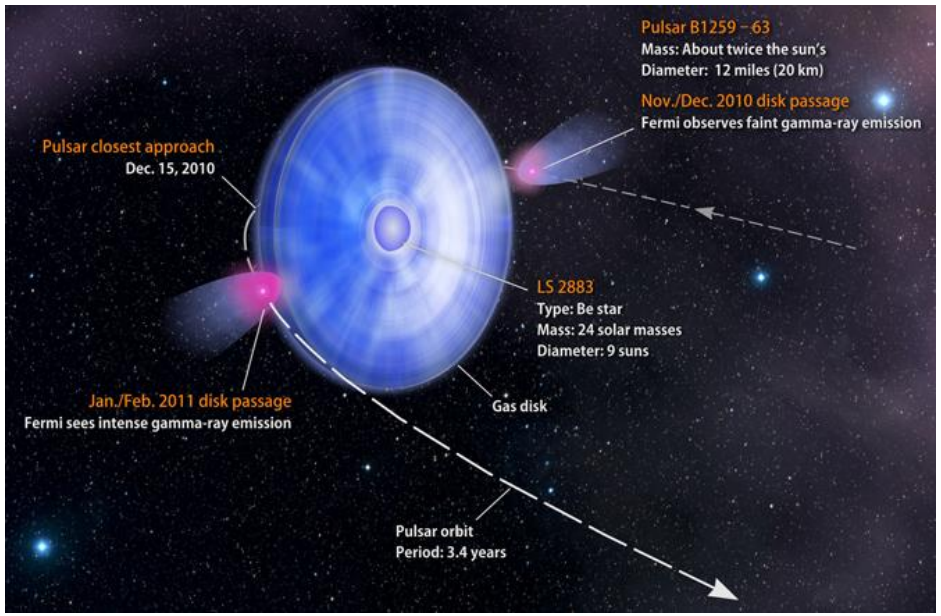
- Ethics briefing
- Astrophysics Division update
- R&A status and Senior Review
- WFIRST interim report
- JWST update
- ESA L1 astrophysics missions update
- Soon-to-be-decommissioned operating missions summaries
- PAG updates
- GPRA assessment
- Q&A with SMD AA

APD in the News



Chandra's press conference on Supermassive Black holes in the Early Universe.

Followed by the first ever (and successful!) Webchat with the panelists.



Fermi's observation of a radio pulsar in a high-mass X-ray binary system and the mystery of the large Gamma-ray emission as the pulsar emerges from behind the star.

Releases (1 of 2)

Apr 28 – **Swift / Hubble** - Probe Asteroid Collision Debris.
May 4 – **GP-B NSU** - Gravity Probe B Confirms Two Einstein Space-Time Theories.
May 4 – **WISE** - NGC 1491.
May 4 – **Hubble** - Image of the Meathook Galaxy.
May 9 – **Herschel** - Raging Storms Sweep Away Galactic Gas.
May 11 – **Chandra** - Crab in Action & the Case of the Dog that did not Bark.
May 11 – **Fermi** - 'Superflares' in the Crab Nebula.
May 12 – **Hubble** - Galaxy NGC 4214: A Star-Formation Laboratory.
May 18 – **R & A** - Free-Floating Planets May Be More Common Than Stars.
May 19 – **GALEX** - Dark Energy and Gravity - Ying and Yang of the Universe.
May 20 – **Fermi** - Radio Telescopes Capture Best-Ever Snapshot of Black Hole Jets.
May 23 – **Hubble** - The Star that Changed the Universe.
– **Kepler** - Kepler-10c and New Method to Validate Planets.
– **Spitzer** - Kepler-10 Stellar Family Portrait.
– **Kepler** - How to Learn a Star's True Age & Astounding Haul of Multiple Planet Systems.
--Hubble Views Star that Changed the Universe
May 24: -- **Chandra**: Nearby Supernova Factory Ramps Up
May 25: -- NASA's **WISE** Mission Offers a Taste of Galaxies to Come
-- **Swift**: Cosmic Explosion is New Candidate for Most Distant Object in the Universe
-- NASA'S **Hubble** Finds Rare "Blue Straggler" Stars in Milkyway's Hub
-- **Spitzer/Galex**: The Spitzer Photo Atlas of Galactic "Train Wrecks"
May 26: -- **Spitzer** Sees Crystal 'Rain' in Outer Clouds of Infant Star

Releases (2 of 2)

June 2011:

June 7: **Shaw Foundation**: Announcement of the Shaw Laureates 2011 - Astronomy prize goes to E. Costa & G. Fishman

June 8: **Chandra**: New Supernova Remnant Lights Up

June 10: **Swift and Chandra**: Nearby Galaxy Boasts Two Monster Black Holes, Both Active

June 15: **Chandra** Finds Massive Black Holes Common in Early Universe

June 16: **James Webb Space Telescope** Completes First Round of Cryogenic Mirror Test

June 24: **SOFIA** Successfully Observes Challenging Pluto Occultation

June 28: **XMM:** Neutron star bites off more than it can chew

June 29: **Fermi:** Odd Couple' Binary Makes Dual Gamma-ray Flares

June 29: **Spitzer:** Making a Spectacle of Star Formation in Orion

June 30: **Integral** challenges physics beyond Einstein

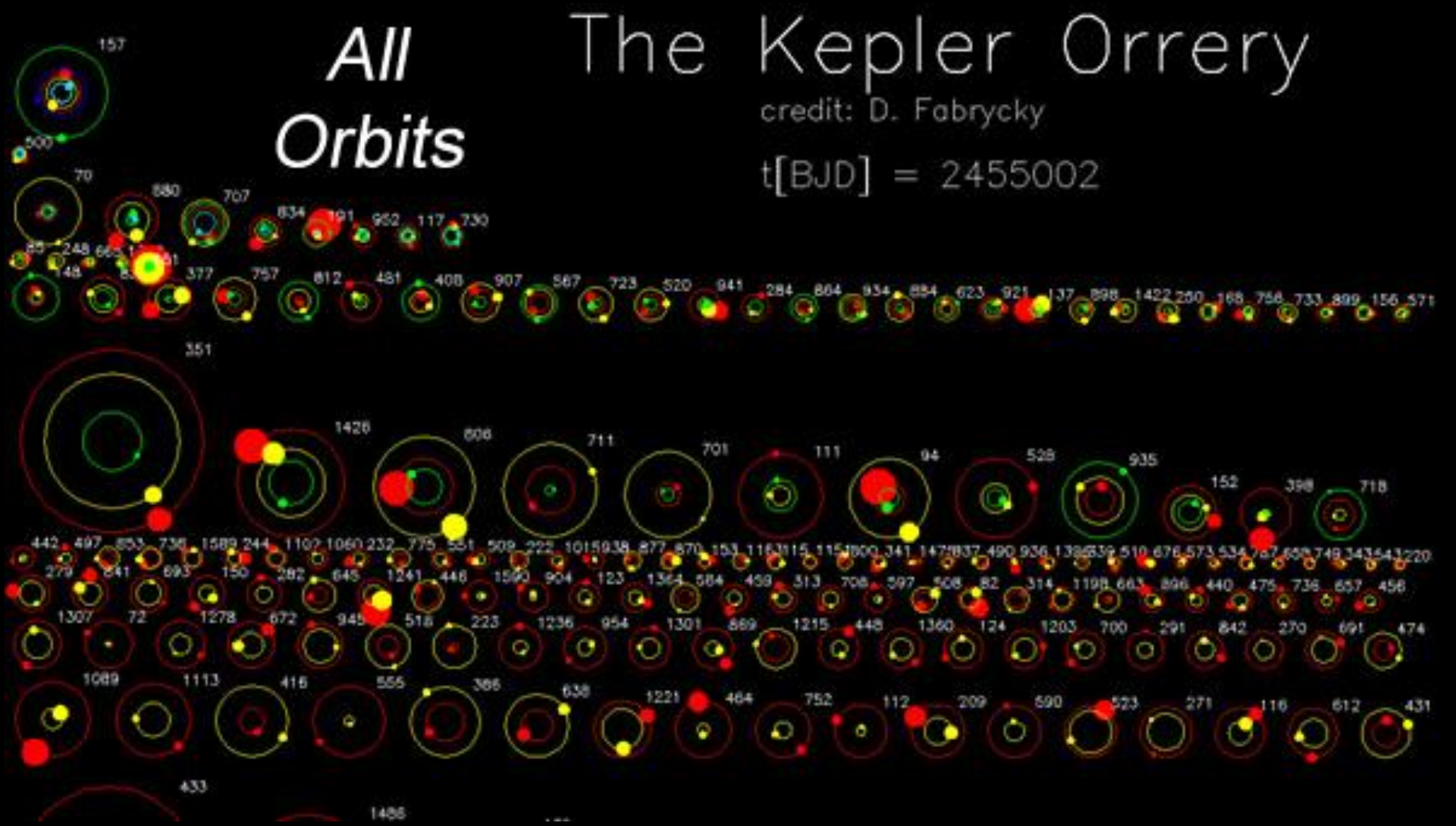
June 30: NASA Completes Mirror Polishing for **James Webb Space Telescope**

June 30: NASA's **Spitzer** Finds Distant Galaxies Grazed on Gas

July 2011

July 5: NASA's **Hubble** Makes One Millionth Science Observation

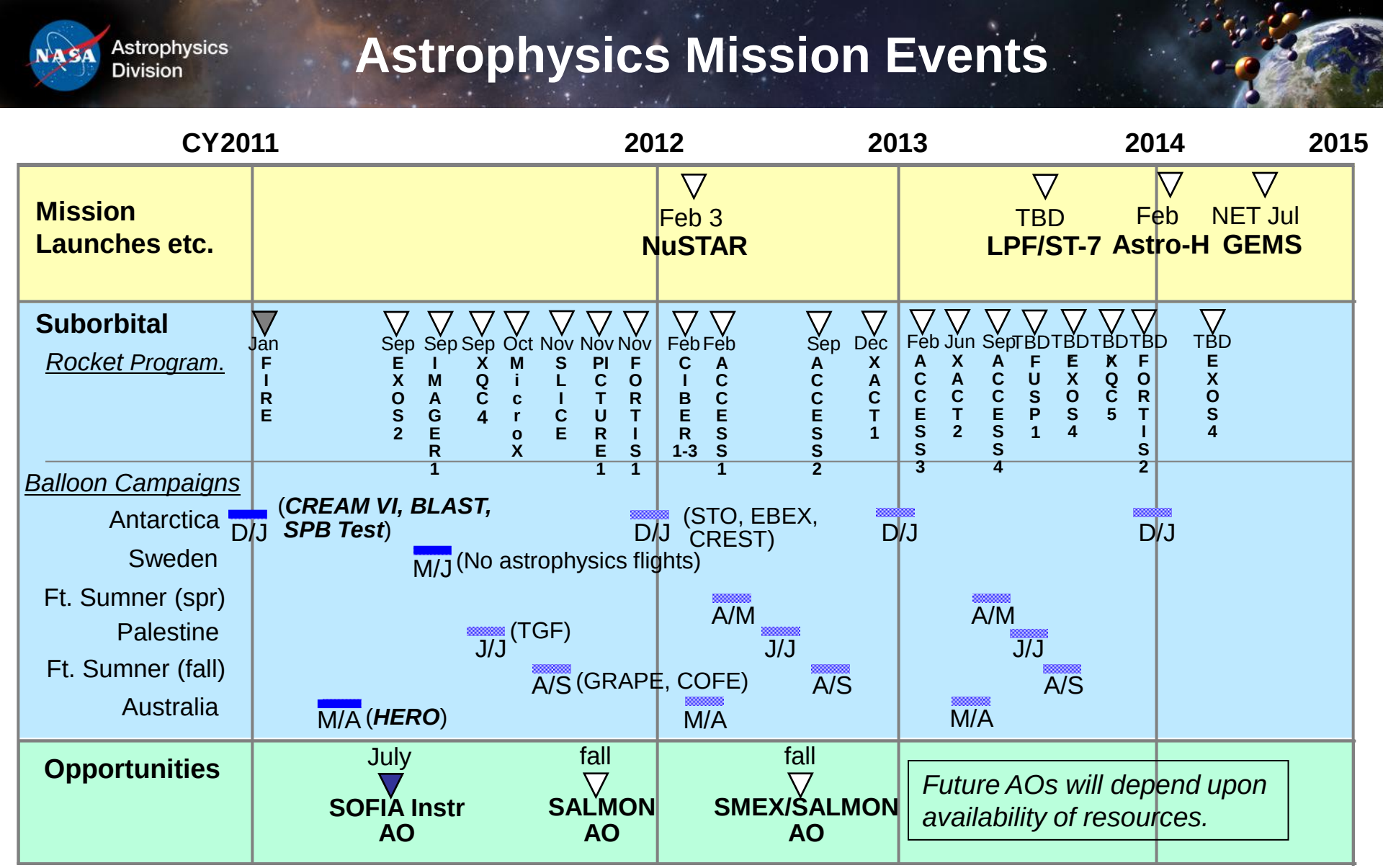
July 7**: Herschel** Helps Solve Mystery of Cosmic Dust Origins



Play Movie:

http://kepler.nasa.gov/multimedia/AnimationsandMore/animations/?ImageID=136

Astrophysics Mission Events



Last Updated: July 11, 2011

Astrophysics - Missions in Formulation & Implementation (1 of 2)

Project	Overall previous months				This Month					Comments
	-4	-3	-2	-1	O	T	C	S	P	
Physics of the Cosmos	G	G	G	G	G	G	G	G	G	
ST-7 (July 2013)	Y	G	G	G	G	G	G	G	G	Spacecraft sine wave testing successfully completed.
Explorer Program										
NuSTAR (Feb 3, 2012)	G	Y	G	Y	Y	Y	G	Y	G	Observatory I&T underway at OSC, with tight completion schedule planned for Nov 2011.
Astro-H (~Feb 2014)	Y	G	Y	Y	Y	Y	Y	Y	G	
GEMS (July 2014)	Y	Y	G	G	G	G	G	G	G	ETU#1 polarimeter vib test completed.

O: Overall, C: Cost, S: Schedule, T: Technical, P: Programmatic

On plan, adequate margin

Problems, working to resolve within planned margin

Problems, not enough margin to recover

Astrophysics - Missions in Formulation & Implementation (2 of 2)

Project	Overall previous months				This Month					Comments
	-4	-3	-2	-1	O	T	C	S	P	
Cosmic Origins										
SOFIA (ongoing)	G	G/Y	G	G	G	G	G	G	G	Completed the 10-flight Basic Science #1 flight series with FORCAST.
Exoplanet Exploration	G	G	G	G	G	G	G	G	G	
Balloons (ongoing)	G	G	G	G	G	G	Y	G	G	Completed 2011 Sweden campaign with both cosmic ray particle and Earth science missions.

O: Overall, C: Cost, S: Schedule, T: Technical, P: Programmatic

On plan, adequate margin

Problems, working to resolve within planned margin

Problems, not enough margin to recover

Astrophysics – Operating Missions Prime Phase

Astrophysics Division

Mission	Launch Date	End Date	-4	-3	-2	-1	0	C	S	T	P	PE Assessment
Planck	2009-05-14	2013-05-14	G	G	G	G	G	G	G	G	G	Catalog released Jan 12, 2011 - 4 days ahead of schedule
Herschel	2009-05-14	2012-05-14	G	G	G	G	G	G	G	G	G	ESA released 2nd and last GO call on June 9
Kepler	2009-03-07	2012-11-07	G	G	G	G	G	G	G	G	G	Team working towards SOC 8 development. Kepler featured as one of the astrophysics missions at NASA Day on the Hill tomorrow.
Fermi	2008-06-11	2013-08-18	G	G	G	G	G	G	G	G	G	Fermi User's Group meeting at GSFC on Thursday June 16
Hubble	1990-04-24	2014-05-31	G	G	G	G	G	G	G	G	G	

O:Overall

On plan, adequate Margin

Problems, working to resolve within planned Margin

Problems, not enough margin to recover

Astrophysics – Operating Missions Extended Phase

Astrophysics Division

Mission	Launch Date	End Date	-4	-3	-2	-1	0	C	S	T	P	PE Assessment
WISE	2009-12-14	2011-02-17	G					G	G	G	G	Science User's Group meeting June 20-21
Suzaku	2005-07-10	2011-09-30	G	G	G	G	G	G	G	G	G	
Swift	2004-11-20	2014-09-30	G	G	G	G	G	G	G	G	G	
Spitzer	2003-08-25	2012-12-31	G	G	G	G	G	G	G	G	G	
GALEX	2003-04-28	2011-09-30	G	G	G	G	G	G	G	G	G	End of Mission Plan in review
XMM-Newton	1999-12-10	2012-09-30	G	G	G	G	G	G	G	G	G	
Chandra	1999-07-23	2014-09-30	G	G	G	G	G	G	G	G	G	Recent SAFE mode, probably due to high radiation environment
RXTE	1995-12-30	2011-12-31	G	G	G	G	G	G	G	G	G	Developing 90 day notification letter for satellite turnoff

O:Overall

On plan, adequate Margin

Problems, working to resolve within planned Margin

Problems, not enough margin to recover

SOFIA

- Completed Short Science *#2* Flight Series (3 flights) with German Receiver for Astronomy at Terahertz *Frequencies (GREAT)*
- *Completed Basic Science #1 Flight Series (10 flights) with Faint Object InfraRed CAmera for the SOFIA Telescope (FORCAST)*
- Successfully viewed Pluto occultation event on June 23 using the High Speed Imaging Photometer for Occultation (HIPO)
- *Released Announcement of Opportunity (AO) for SOFIA Second-Generation Instruments on July 8*
- Installed GREAT in preparation for *Basic Science #2 Flight Series (6 flights during July 2011)*
- Obtained Agency approval for SOFIA to visit *the Washington area in late September for an E/PO event supporting the First Lady's "Joining Forces" initiative for military families*

- *All six U.S. educators in the inaugural class of Airborne Astronomy Ambassadors flew during Basic Science #1 (two educators shown at right with SOFIA Outreach Manager Dana Backman)*

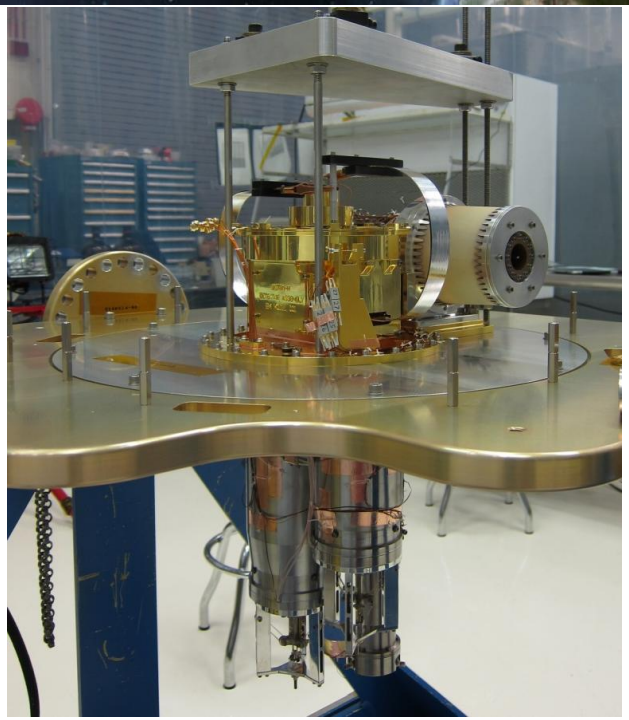
NuSTAR

NuSTAR Observatory in final Integration and testing at OSC, Virginia.

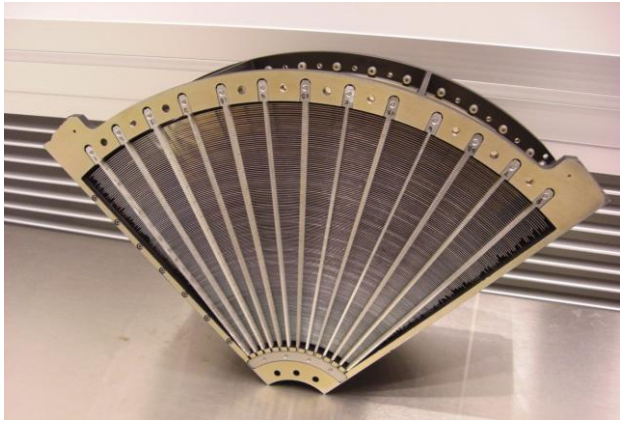
NuSTAR Observatory completion currently planned for November 2011 to support a February 3, 2012 launch from Kwajalein Island

Astro-H

- Project working to maintain cost and schedule.
  - New Instrument Manager and financial team brought on board in March. Costs coming under control. Schedule still in work.
- EM model Calorimeter Spectrometer Insert (CSI) has been completed. The CSI includes the detector and three Adiabatic Demagnetization Refrigerators (ADR's). It is the primary NASA deliverable to JAXA for the Astro-H mission.
  - Performance testing at cryogenic temperatures completed. Performance is nominal.
  - Cold vibration testing will be conducted in late July.
- Engineering Model (EM) Mirror Quadrant has been completed.
  - Vibration test on 5/30/11 led to identification of a design flaw in the radial support bars. (Bar thickness near outer attachment point too thin.)
  - Support bars being re-designed for flight model.
- Next Science Working Group Meeting will be held at SLAC 7/18-19.
- NASA hardware Critical Design Review (CDR) to be held 8/22-24 at GSFC.
- JAXA Mission CDR to be held in Japan NET 8/29-30 (TBR).



EM CSI prior to integration into test dewar.



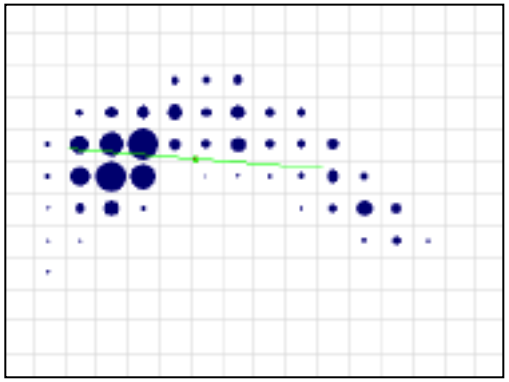
Astro-H EM Mirror Quadrant

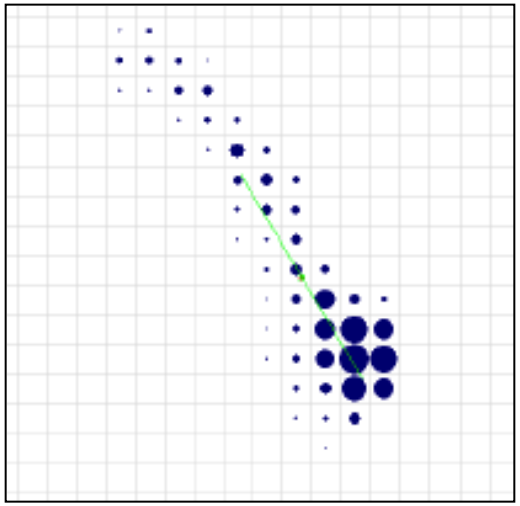
GEMS Accomplishments and Significant Events

GEMS

- The project continues holding for Engineering Peer Reviews (EPRs) to prepare for Preliminary Design Review (PDR) and Confirmation Review (CR) this Fall
- Successfully completed risk reduction vibration test of polarimeter engineering test unit, major accomplishment towards maturing technology of the polarimeter before PDR and CR.
- Team meeting scheduled for American Astronomical Society High Energy Astrophysics Division (HEAD) meeting September 7-10, 2011
- Dedicated X-ray Polarimetry science conference planned for Summer 2012
- GEMS highlighted at recent astrophysics conferences: Texas symposium (Germany, December 2010), International Space Science Institute particle acceleration workshop (Switzerland, April 2011)

Polarimeter Engineering Test Unit Performance Tests with Unpolarized 55Fe X-rays

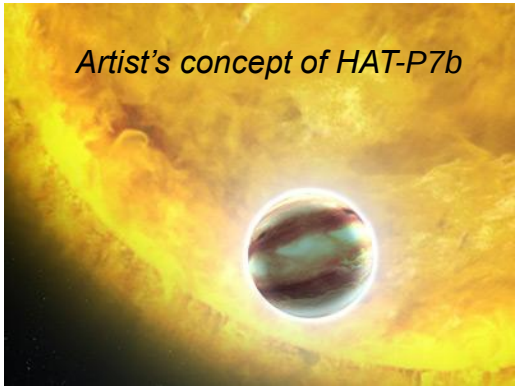




HST Update – April – July

- Recovery of Cepheid V1 in Andromeda, which enabled Edwin Hubble to find a preliminary distance in 1923
- Discovery of blue stragglers in the hub of the Milky Way
- Observation of a hit on Scheila by another (smaller) asteroid
- 21st anniversary photo release of interacting galaxies Arp 273

- Hubble Time Allocation Committee (TAC) made selections for Cycle 19 observations
- Hubble successfully transitioned from 24 x 7 staffing for mission operations at GSFC to 8 x 5 staffing (single shift)
- July 4 - Hubble collected its one millionth exposure, a spectrum of the exoplanet HAT-P7b



PCOS/COR PAR

Review Overview

- The Program Acceptance Review (PAR) for PCOS & COR Programs was held at GSFC on May 17-19, 2011
- The PAR APD Review was held on July 7, 2011
- A single Standing Review Board evaluated both Programs in a joint Site Review visit at GSFC
- Science objectives of both Programs aligned well with 2010 NASA Strategic Plan and shepherding investments for future strategic missions is needed
- The SRB recommends that the Program progress into Implementation phase
- Program Implementation Review (PIR) in 1 year vs 2 years since no major program/project in development during this review.

Path Forward

✓ Brief the 1-pager to NASA Associate Administrator - June 2.

✓ APD Review – July 7

- DPMC
- APMC

NB. Exoplanet Exploration Program already accepted in transition from Navigator. PIR to be held at an appropriate time in the future.

R&A Senior Review

- Report delivered to APS members
- See presentations by J. Gallagher and L. Sparke

2011 Archives Senior Review

Results of the Senior Review Evaluation

Projects	Evaluation
ADS	Excellent
HEASARC	Excellent
MAST	Excellent
IRSA	Very Good
NED	Very Good
NStED	Fair

General Findings

- Define better the roles and responsibilities between archive centers and the VAO; VO-centric activities should be included in the core budget of the archive centers. Improve communication and collaboration between the centers.
- Projects are very responsive to their communities in their short-term prioritization; however, the panel noted a lack of development of long-term planning across the ADCAR portfolio to develop a coherent vision on a 10 to 15 year horizon.
- Human interface *vs.* computer-to-computer access.

***Report available at**:* http://science.nasa.gov/astrophysics/astrophysics-data-centers/

WFIRST Science Definition Team

- Ad-interim June report released July 11 (TBC)
- Briefing to APD Director on June 29
- See J. Green/P. Schechter WFIRST presentation for detailed findings
- SDT will continue to meet over the summer and Fall to discuss pending DRM issues and get started on final report due in by end of 2012

- Planned WFIRST-related Events:
  - Microlensing science conference at JPL, Feb 2012
  - Science from IR surveys and GO program, Spring 2012

Future X-ray and GW missions

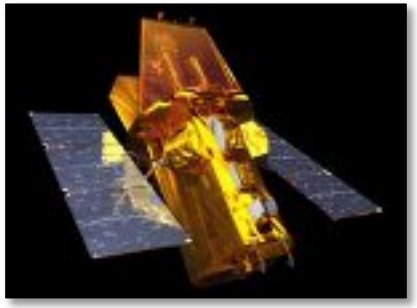
ESA L1 concepts:

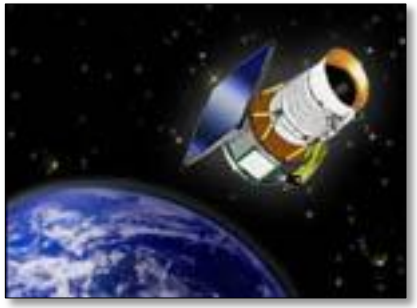
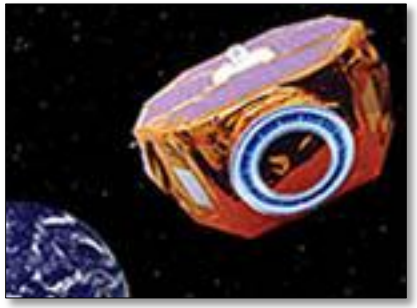
- Nick White and Tuck Stebbins will give a technical/scientific update today on IXO/ATHENA and LISA/NGO
- ESA planning downselection in Feb 2012 to 1 or 2 L1 mission candidates

- APD Programmatic aspects:
  - Late-summer NRA call for US-led medium-class X-ray, GW mission concepts from US teams (distinct from IXO/ATHENA; LISA/NGO)
    - Studies during first half of 2012 for input into planned NRC study
  - Fall 2011 SALMON AO to include calls for science team participation on international mission definition studies
  - Convene through NRC a review panel in Spring 2012 to re-evaluate NWNH future strategic missions in light of FY13 President's Budget Request and international developments

Astrophysics Division

Explorer Schedule



There are:

- 22 full EX missions (15 Astro/7 Helio),
- 20 Missions of Opportunity (11 Astro/ 9 Helio), and
- 8 USPI (all Helio)

Review Schedule:

- Step 1 Selections announced (target) .....Sept 2011
- Initiate Phase A Concept Studies (target) .....Oct 2011
- Phase A Concept Study Reports due (target) ....August 2012
- Down-selection for flight (target) .....February 2013

Astro2010 Decadal Survey Agency Response

- Astro2010/NWNH Science Objectives:
  - ✓ Astrophysics programmatic structure is well-aligned with the three scientific thrusts
- Astro2010/NWNH Small-Scale:
  - ✓ Augmented investments in core research and technology programs as recommended:
    - Astrophysics Theory Program
    - Definition of a future UV-optical space capability
    - Intermediate technology development
    - Laboratory Astrophysics
    - Suborbital Program
  - ✓ Initiated discussions with NSF on a joint program for Theory and Computation Networks (discussing with AAAC)
  - ✓ Maintaining discussions with JAXA and ESA on SPICA concept development
- Astro2010/NWNH Medium-Scale:
  - ✓ Augmented Exoplanet technology development support that feed into candidate architectures for a future direct-detection mission.
  - ✓ Initiated technology development support for cosmic inflation probe concepts.
- Astro2010/NWNH Large-Scale:
  - ✓ An Astrophysics Explorer Future Missions budget has been created to increase the flight rate to achieve the recommended four missions and four missions of opportunity selected by the end of the decade.
  - ✓ Support for mission concept planning and technology development relevant to the survey's Large space missions: WFIRST, LISA, IXO. NASA is also exploring potential collaborations on ESA's proposed Medium and Large Cosmic Vision missions.

Awards & Administrative Changes

Administrative Changes

- Colleen Wilson-Hodge completed her intermittent detail with the Division supporting the APD Research Program Review and returned to MSFC.
- Tina Swindell started her detail in May. She is from MSFC and is supporting APD and SMD for the Research Program.

June 2011 Issue
BLAST payload

Awards

- The Spitzer Space Telescope Project Team received the **2011 Rotary National Award for Space Achievement Stellar Award** on May 6 for "*Outstanding innovation, dedication, and technical excellence... enabling both engineering and scientific firsts from which the next generation of astrophysics missions will benefit.*"

Stellar Award

June 4, 2011 Issue
Kepler cover

BACKUP

2011 Archives Senior Review

The Astrophysics Archives Senior Review, held every three years, conducts an independent, comparative evaluation of the activities of NASA's Astrophysics Archives and their associated data centers, to assist NASA in maximizing the scientific productivity of the Astrophysics archival program.

NASA charters the Senior Review panel to:

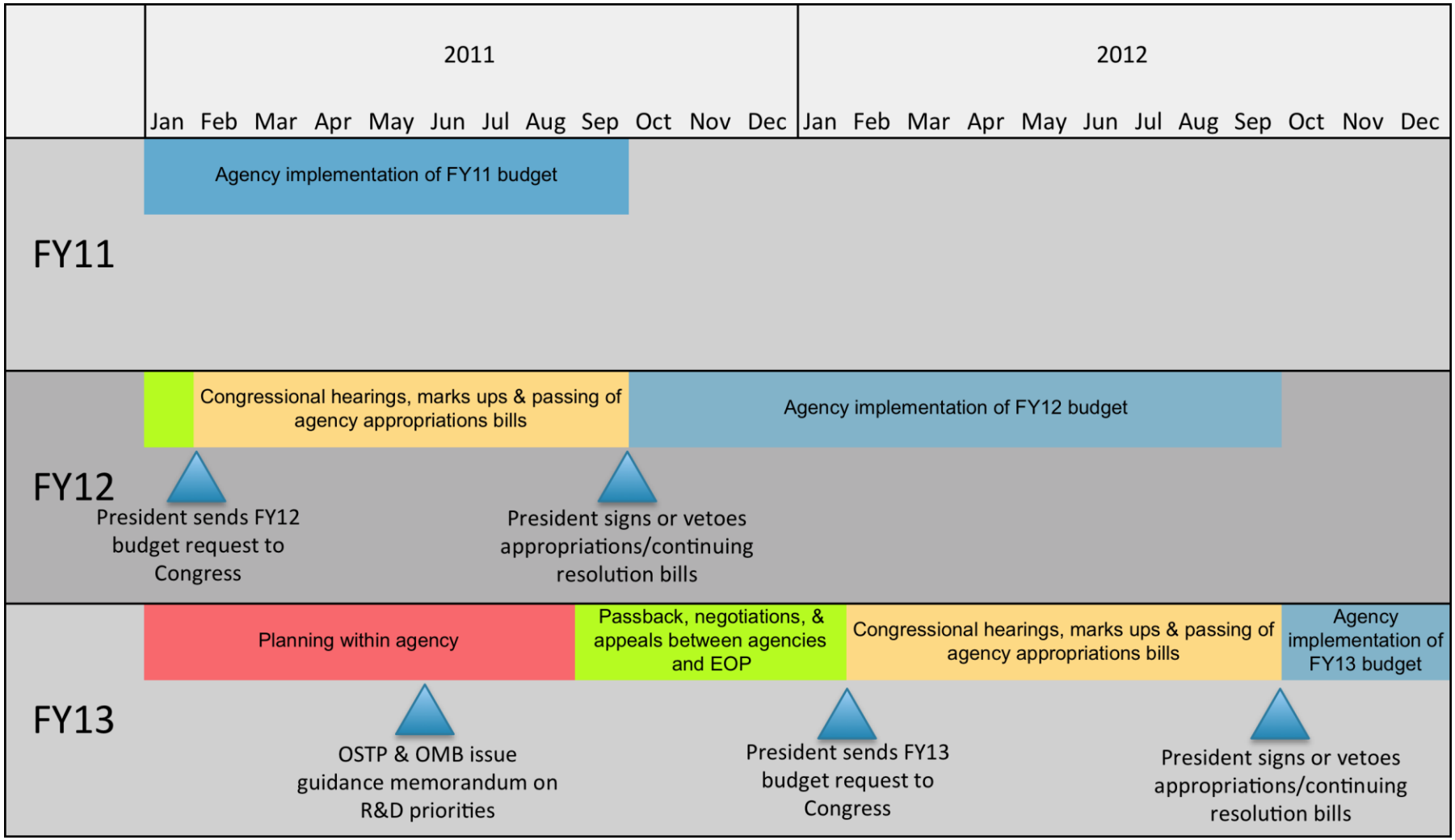
1. In the context of the science goals, objectives, and research focus areas described in the Science Mission Directorate's Science and Strategic Plans, rank the scientific merit on a "science per dollar" basis – based upon the expected returns from the various archives and their associated data centers reviewed during the three-year period from FY12 through FY14.
2. Assess the cost efficiency, technology development and dissemination, data collection, and archiving and distribution, as secondary evaluation criteria, after science merit/usefulness.
3. Based on (1) and (2), provide findings to assist with an implementation strategy for Astrophysics Division data curation and archiving for the period FY12 - FY14, including an appropriate mix of:
   - Continuation of projects as currently baselined, or with either enhancements or reductions to the current baseline;
   - Consolidation of projects and activities to enhance efficient management.
4. Make similar preliminary assessments for 2015 and 2016.

2011 Archives Senior Review

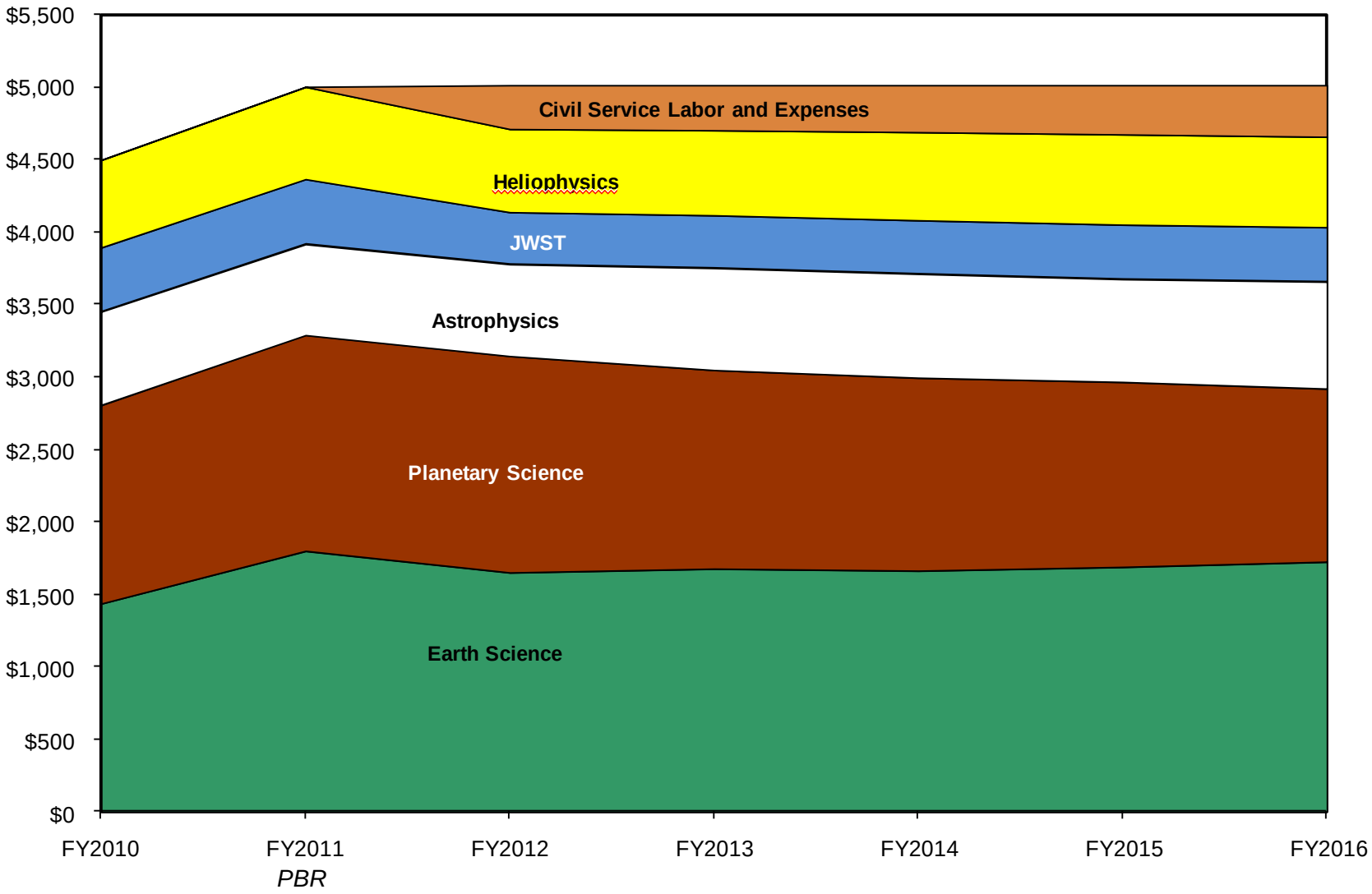
Assessment and Planned Activities FY12 - FY14

- ***ADS:*** The new ADS interface and functionality is a significant improvement to the old system, and should be able to meet the standards and expectations of the most web-savvy end-user for at least the next five years. Continue collaboration with CERN.
- ***HEASARC:*** HEASARC remains a crucial service to the high-energy astrophysics community, curating a large number of past and current missions, and with plans to act as data archive for future missions (NuSTAR, Astro-H, GEMS).
- ***MAST:*** MAST is a lean operation that delivers substantial scientific returns for a relatively small investment. MAST will continue to serve the Hubble Legacy Archive with high-level products, the GALEX final archive, and the Kepler data.
- ***IRSA:*** IRSA is experiencing considerable growth with the Spitzer Heritage Archive, WISE and Planck, and includes 20 all-sky IR surveys from 1 μm to 10 mm. Assess requirements for user support for each mission over the next 5 years.
- ***NED:*** NED plays an important role for the extragalactic community. NED will ingest data from the GALEX and WISE all-sky surveys, providing a multi-wavelength view of the extragalactic sky. NED will overhaul its Web interface.
- ***NStED:*** Discontinue the current NStED, as the cost ($1.2M/year) is not equal to the limited impact in exoplanet research and in ExEP. Re-vector effort towards bringing Kepler data analysis tools to the whole community.

The Budget Cycle



SMD Budget by Theme (RY $M)



Astrophysics Program Content

	FY 2010	2011 Pres Bud	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Astrophysics	**$647.3**	**$631.5**	**$637.7**	**$708.3**	**$721.0**	**$713.5**	**$741.9**
Astrophysics Research	*$149.1*	*$156.1*	*$161.6*	*$200.1*	*$211.8*	*$229.3*	*$238.6*
Astrophysics Research and Analysis	$59.6	$60.2	$64.3	$82.8	$83.9	$85.1	$88.0
Balloon Project	$28.2	$27.1	$29.3	$32.8	$33.6	$34.1	$35.3
ADCAR/ADP/Senior Review/Admin	$61.3	$68.7	$67.9	$84.5	$94.3	$110.1	$115.4
Cosmic Origins	*$225.3*	*$242.9*	*$219.7*	*$219.4*	*$209.9*	*$195.2*	*$184.5*
Hubble Space Telescope (HST)	$100.8	$102.7	$94.0	$93.4	$93.1	$88.8	$84.5
Stratospheric Observatory for Infrared Astronomy (SOFIA)	$73.6	$79.6	$71.4	$73.3	$77.2	$77.4	$75.0
Spitzer	$17.6	$22.6	$17.8	$9.8			
SR&T	$6.0	$7.0	$9.2	$17.3	$19.0	$19.0	$19.9
Herschel	$24.0	$24.5	$24.0	$20.8	$15.8	$5.8	
Future Missions/Management	$3.2	$6.5	$3.4	$4.7	$4.8	$4.1	$5.1
Physics of the Cosmos	*$116.0*	*$103.3*	*$100.3*	*$112.4*	*$111.9*	*$98.1*	*$96.8*
Fermi	$22.1	$22.7	$23.6	$23.1	$22.5	$15.4	$11.0
Planck	$9.5	$8.1	$7.2	$6.8	$4.6	$0.8	
Chandra/INTEGRAL/XMM	$77.3	$59.4	$55.5	$55.7	$55.5	$53.7	$53.6
SR&T	$4.3	$5.7	$11.4	$22.0	$24.5	$24.1	$27.2
Future and Management	$2.9	$7.4	$2.7	$4.9	$4.8	$4.1	$5.1
Exoplanet Exploration	*$43.4*	*$42.5*	*$48.2*	*$65.5*	*$63.6*	*$62.1*	*$69.8*
Kepler	$15.4	$16.9	$17.6	$12.3	$0.1		
Keck/LBTI	$4.8	$4.1	$5.6	$6.4	$5.6	$4.8	$3.5
SR&T	$12.7	$12.7	$17.9	$38.7	$50.4	$50.2	$50.4
Future Missions/Management	$10.5	$8.8	$7.2	$8.1	$7.6	$7.1	$15.9
Astrophysics Explorer	*$113.5*	*$86.7*	*$107.8*	*$110.9*	*$123.7*	*$128.7*	*$152.0*
Nuclear Spectroscopic Telescope Array (NuStar)	$56.2	$32.1	$11.4	$4.0	$1.1		
Astro-H	$15.8	$12.5	$9.8	$5.0	$1.9	$0.5	$0.6
Gravity and Extreme Magnetism	$3.1	$21.0	$69.4	$41.0	$20.8	$1.4	
Operating Explorers	$38.4	$21.2	$8.1	$4.0	$3.8		
Astro Explorers Future Missions			$9.2	$56.9	$96.1	$126.8	$151.4

• Amounts in $M; JWST is managed separately as its own Theme
•FY 2010-2011 amounts include Civil Service Labor and Expenses (CSLE)
•FY 2013-2016 estimates are notional
• FY 2012-2016 amounts do not include CSLE

NASA FY2012 Budget Request

Budget Authority ($M)	FY 2010 Actual	FY 2011 CR	FY 2011 Auth Act	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**4,497.6**	**4,469.0**	**5,005.6**	**5,016.8**	**5,016.8**	**5,016.8**	**5,016.8**	**5,016.8**
Earth Science	1,439.3		1,801.8	1,653.0	1,679.2	1,665.3	1,691.4	1,727.3
Planetary Science	1,364.4		1,485.7	1,488.9	1,365.7	1,326.4	1,271.0	1,188.9
Astrophysics	1,085.9		1,076.3	637.7	708.3	721.0	713.5	741.9
James Webb Space Telescope				354.6	359.3	365.3	371.6	371.6
Heliophysics	608.0		641.9	577.9	591.0	612.4	627.2	628.6
SCMD Civil Service Labor and Expense				304.7	313.2	326.5	342.2	358.6

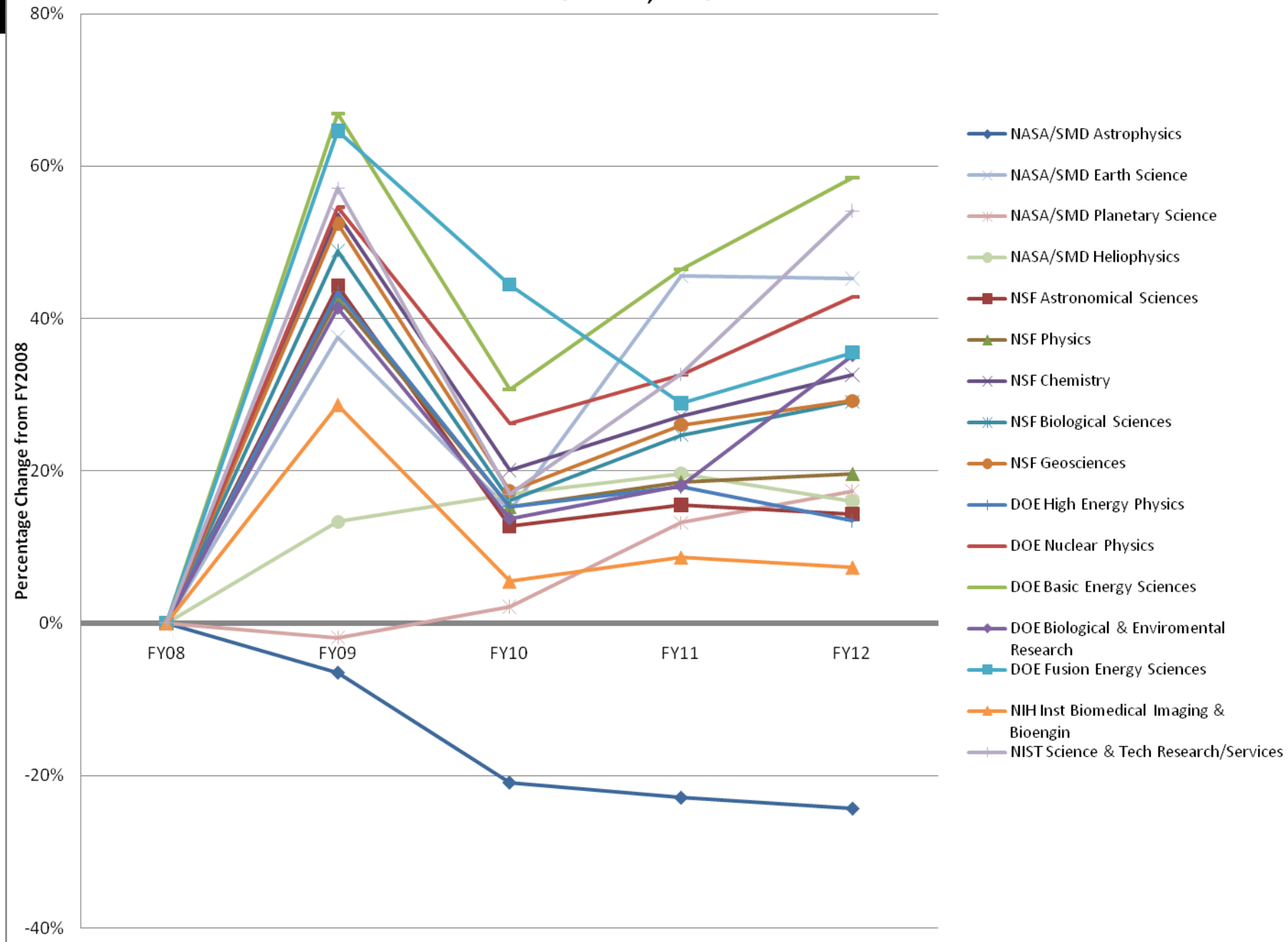
NASA Science Budget Changes

Budget Authority ($M)	FY 2010 Actual	FY 2011 CR	FY 2011 Auth Act	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY12-15 Total
FY 2011 President's Budget	**4,493.3**	**4,469.0**	**5,005.6**	**5,248.6**	**5,509.6**	**5,709.8**	**5,814.0**		
Content	4.3			-231.8	-492.8	-693.0	-797.2		-2214.8
Earth Science	18.6			-147.1	-267.8	-398.1	-424.0		-1237.0
Planetary Science	23.1			-6.5	-161.9	-235.4	-305.2		-709.0
Astrophysics	-16.4			-76.0	-100.6	-171.5	-303.8		-651.9
James Webb Space Telescope	-1.6			-5.4	39.8	115.7	255.8		405.9
Heliophysics	-19.4			3.2	-2.3	-3.8	-20.0		-22.8
Funding for Science CSLE				0.0	0.0	0.0	0.0		
Earth Science				-144.3	-142.4	-153.3	-166.7		
Planetary Science				-51.7	-63.5	-68.4	-73.2		
Astrophysics				-45.1	-49.8	-54.5	-66.3		
James Webb Space Telescope				-19.1	-15.7	-9.7	-3.4		
Heliophysics				-44.4	-41.8	-40.6	-32.5		
Science Civil Service Labor and Expenses				304.7	313.2	326.5	342.2		
Transfers (non-add, excluded above)									
JWST, from Astrophysics to new Theme				379.2	335.2	259.3	119.2		
Future Explorers, GEMS, Astro-H from Helio to Astro				28.6	44.8	47.6	71.2		
FY 2012 President's Budget Request	**4,497.6**		**5,005.6**	**5,016.8**	**5,016.8**	**5,016.8**	**5,016.8**	**5,016.8**	

Programmatic Content changes:

- *Earth Science DESDynI and CLARREO Tier-1 missions significantly delayed; GMI-2 development for GPM LIO cancelled; non-flight program expansions curtailed*
- *Planetary funding can no longer support all 5 development programs; Decadal Survey will provide priorities to guide decision-making on which programs will be cancelled, delayed, descoped, or implemented as planned*
- *Astrophysics able to fund the highest decadal priorities, but only technology development for large missions beyond JWST*
- *JWST budget growth to $375M/year (including Labor); schedule under review*
- *Heliophysics: launch vehicle cost increases may require descope of Solar Orbiter Collaboration*

Federal Funding for Physical and Related Sciences FY2008, FY2009 (with ARRA), FY2010, FY2011 PBR, FY2012 PBR



SPICA Overview (July 2011)

Telescope:

- *SPace Infrared telescope for Cosmology and Astrophysics (SPICA)*
- *3.2 m Infrared Space Telescope*
- *Operating at < 6K (sky-limited)*
- *Wavelength range: 5-210(700) μm*
- *Orbit at L2; total mass ~4000 kg*
- *Launch year: 2018+ proposed*
- *Mission duration: 3 yrs (5 yrs goal)*

Proposed Instrument Suite:

- MCS (mid-IR camera/spectrometer: 5-38 μm - *Japan*)
  - Wide-field camera: 5'x5' fov, 0.15"/0.30" pixels, R~5-10
  - Low (R~50-100), Med (R~680-1550), High (R~30,000) Spectroscopy
- SCI (mid-IR coronagraph; 5-27μm, contrast $<10^{-4}$ - *Japan*)
- SAFARI (far-IR imaging spectrometer [FTS]: 35-210 μm, R~20-2000 - *ESA*)
- "Proposed US Instrument" (far-IR spectrometer; ~40-700 μm, R~700 - *NASA*)
- FPC (near-IR Focal Plane Cameras for science & guiding; 1-5 μm - *Korea*)

Focal Plane Instrument (FPI) Science & Technical Review is currently ongoing (July-Oct '11)

Three US scientists participating; goal is to finalize instrument suite before SDR in Feb. 2011