Frontiers in Astrophysics and the Federal Budget Landscape

Dr. Jon Morse
Rensselaer Polytechnic Institute

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Big Picture Questions

"How does the Universe work?" (Physics of the Cosmos) [Physics of the Universe]

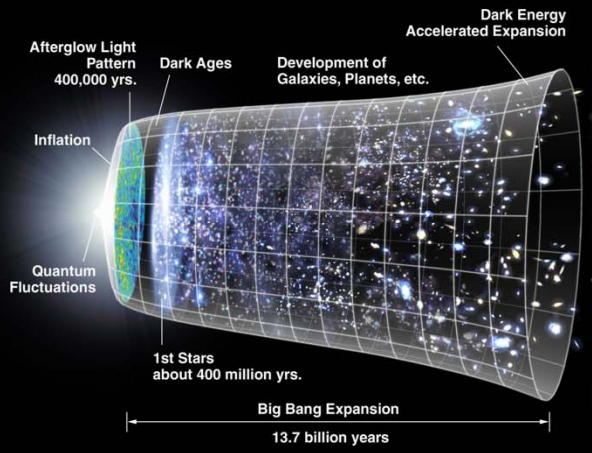
- To discover what drove the Big Bang and the nature and interactions between space, time, energy and matter at a fundamental level.

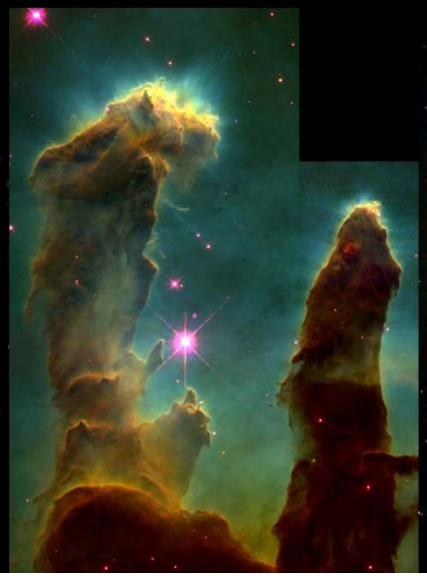
"How did we get here?" (Cosmic Origins) [Cosmic Dawn]

- To discover how the Universe expanded and evolved from an extremely hot and dense state into the galaxies of stars, gas, dust and planets that we observe today.

"Are we alone?" (Exoplanet Exploration) [New Worlds]

- To search for Earth-like planets orbiting other stars and to discover evidence of life on those planets.

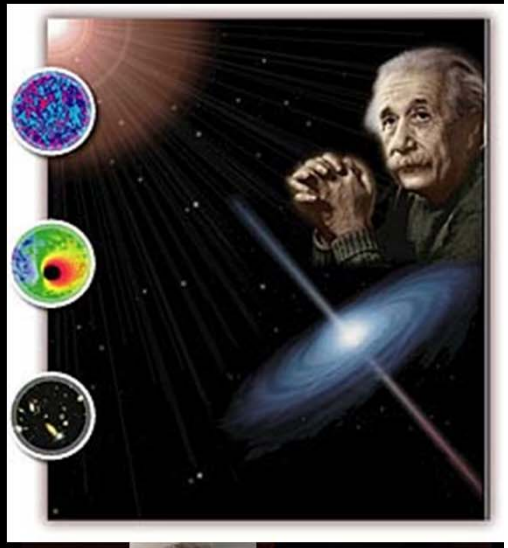




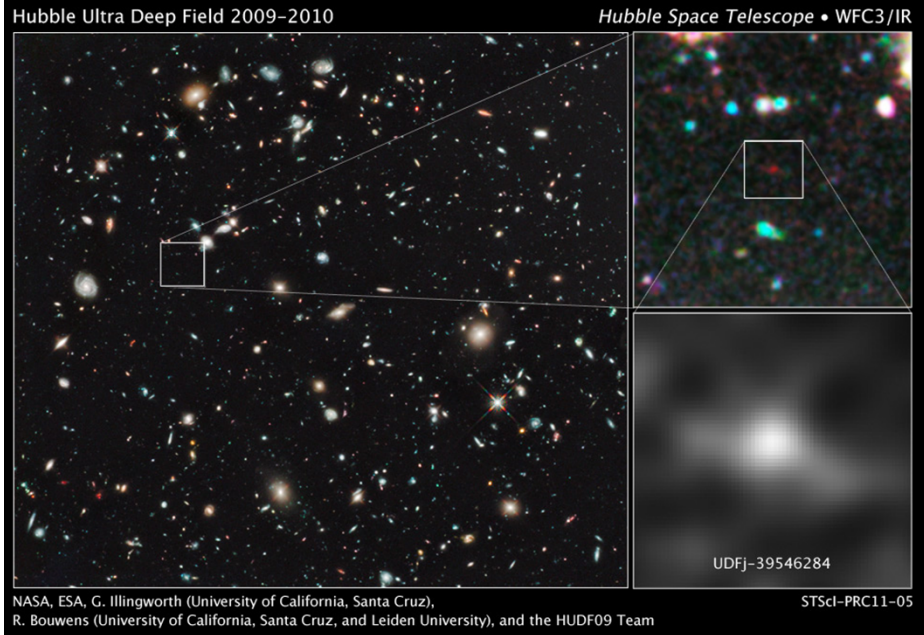
Meeting National Needs

Astrophysics supports…

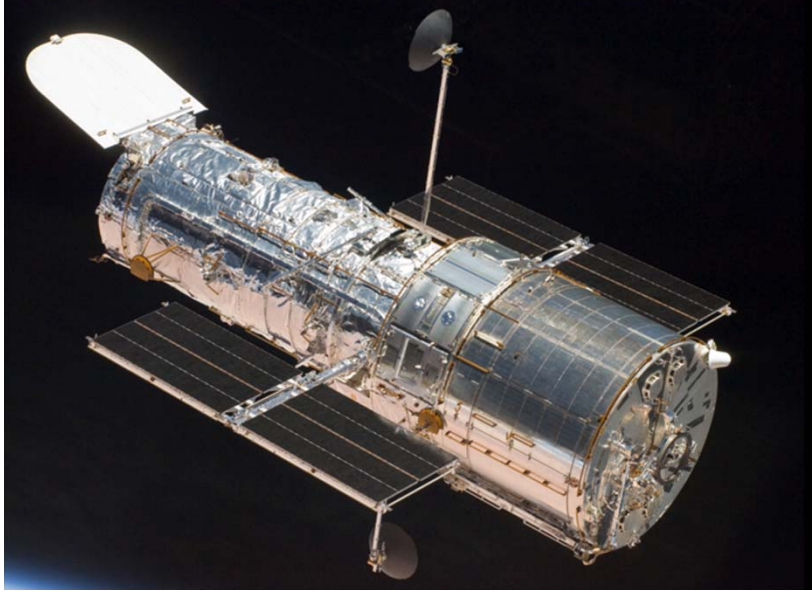
- **Basic R&D on the fundamental laws of nature** that ultimately drive innovation and long-term economic growth.
  - *The cosmos is a frontier for defining the new physics of the 21st century.*
- **International science and technology cooperation** across a broad suite of science disciplines.
- **Highly synergistic cutting-edge technology** with applications in national security, commercial space imaging, medical imaging and data processing, cancer treatment, materials research, etc.
- **Nobel Prize-winning research** that enriches society and fills the next generation with excitement, wonder and hope.
  - *Astronomy and the search for life in the universe permeate modern society, setting the context for life as we know it and appealing to basic questions of our origins and uniqueness.*

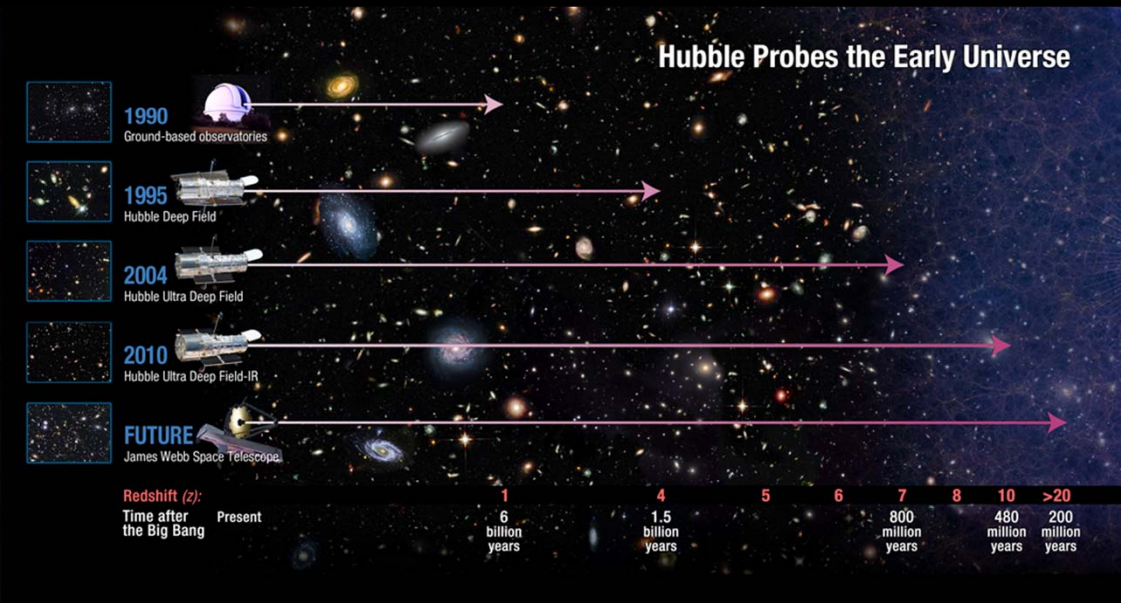


Hubble Finds Most Distant Galaxy Candidate Ever Seen in Universe

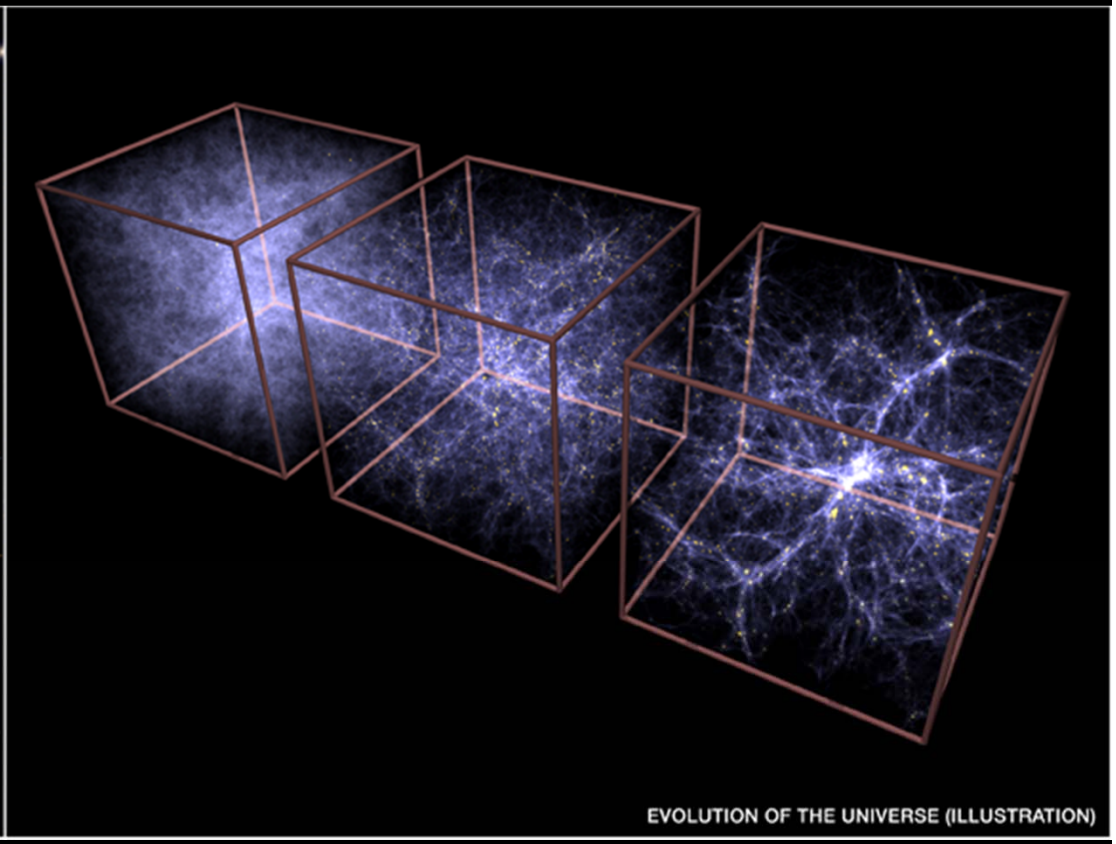


The farthest and one of the very earliest galaxies ever seen in the universe appears as a faint red blob in this ultra-deep–field exposure taken with NASA's Hubble Space Telescope. This is the deepest infrared image taken of the universe. Based on the object's color, astronomers believe it is 13.2 billion light-years away. The proto-galaxy is only visible at the farthest infrared wavelengths observable by Hubble. Observations of earlier times, when the first stars and galaxies were forming, will require Hubble's successor, the James Webb Space Telescope (JWST).



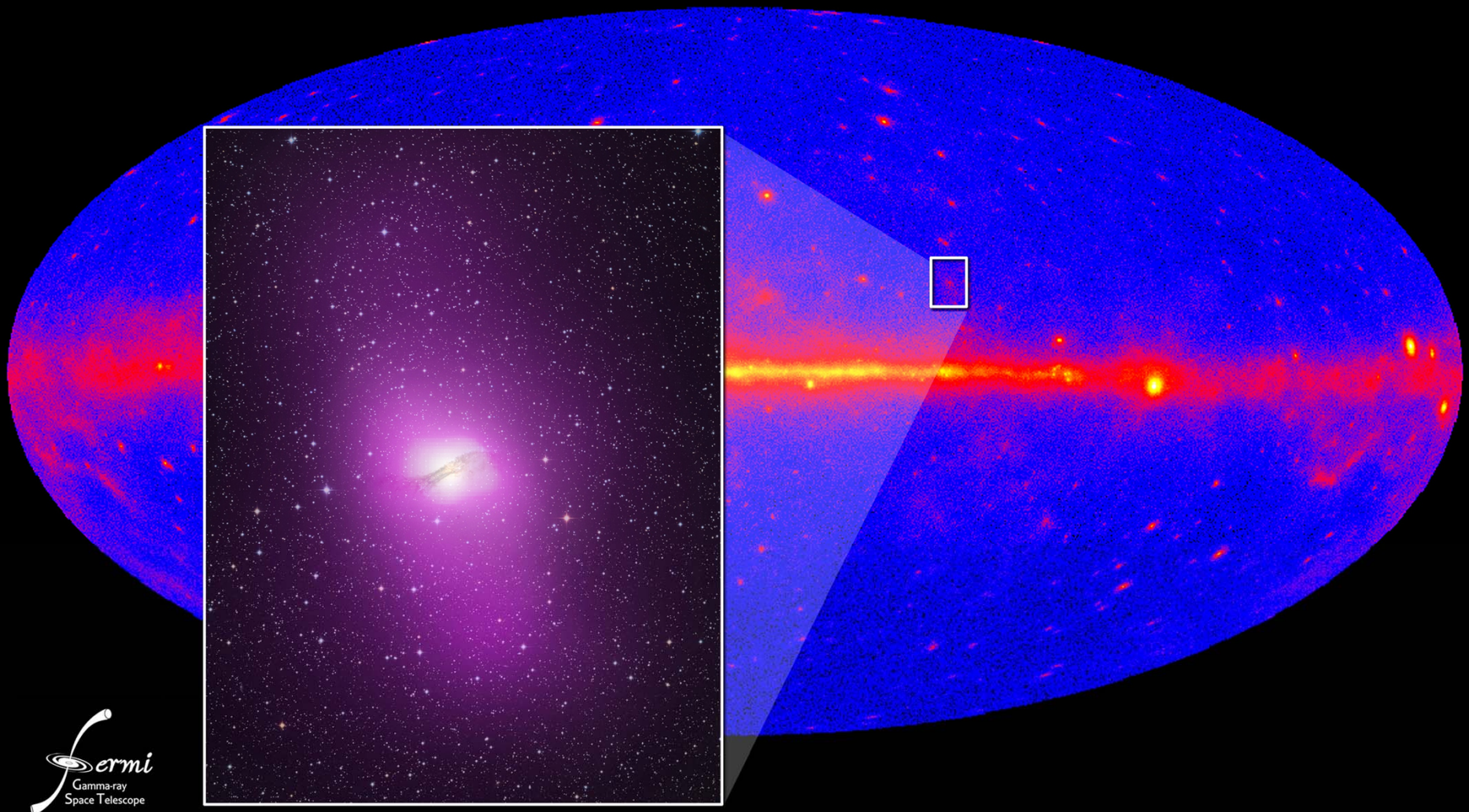


Chandra X-ray Observatory: Growth of Large-scale Structure and Dark Energy



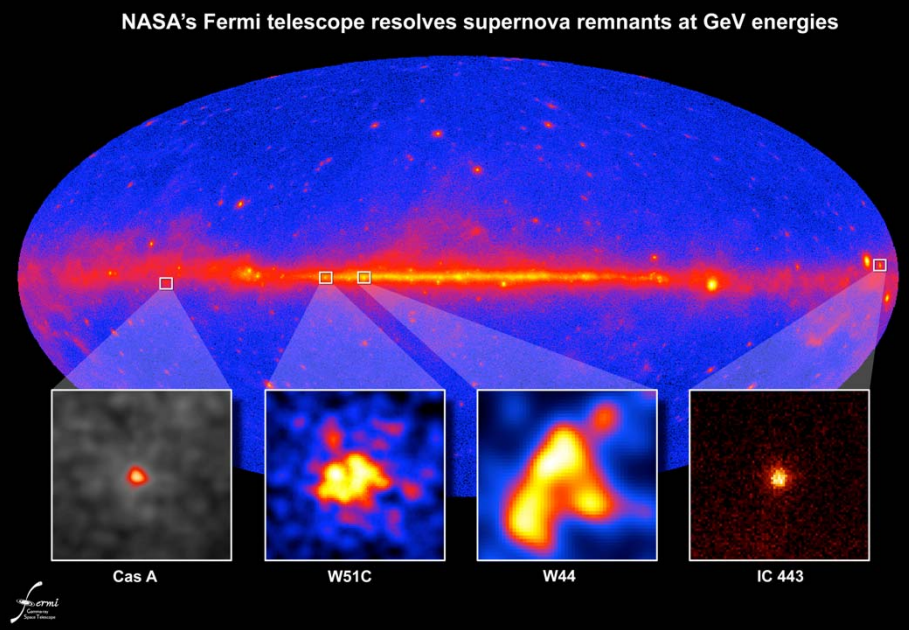
Credit: X-ray (NASA/CXC/SAO/A.Vikhlinin et al.); Optical (SDSS); Illustration (MPE/V.Springel)

NASA's Fermi telescope resolves radio galaxy Centaurus A



Fermi
Gamma-ray
Space Telescope

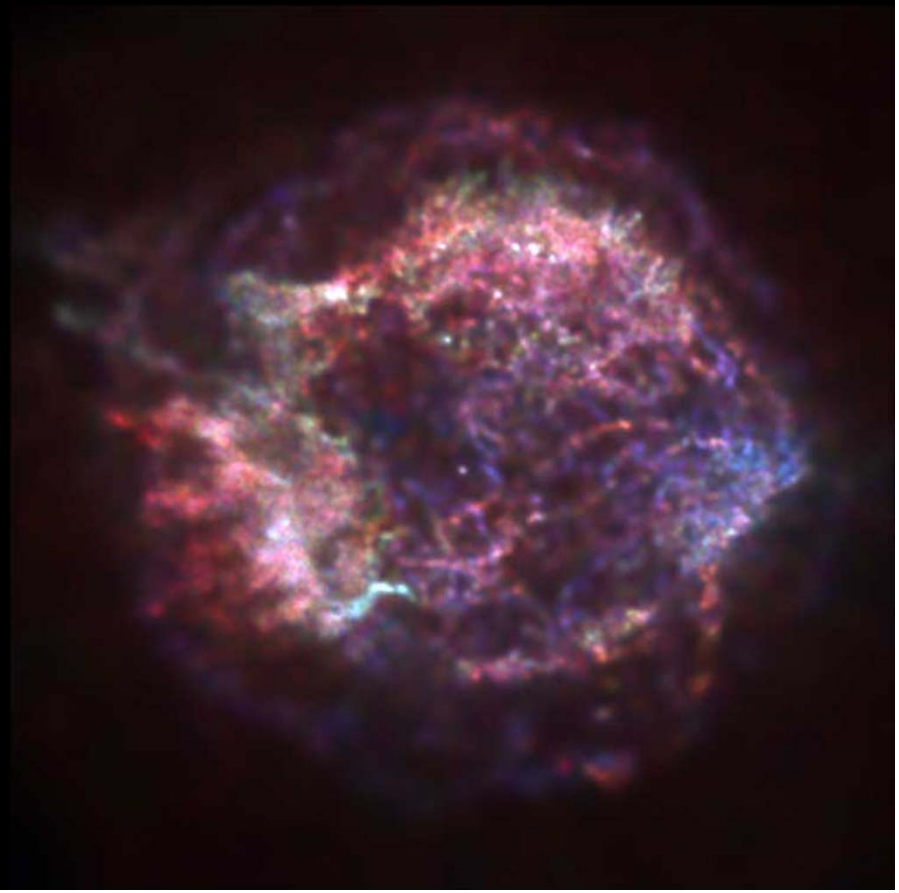
High Energy Views of Supernova Remnants And the Origin of the Elements



Fermi's Large Area Telescope resolved GeV gamma rays from four supernova remnants.

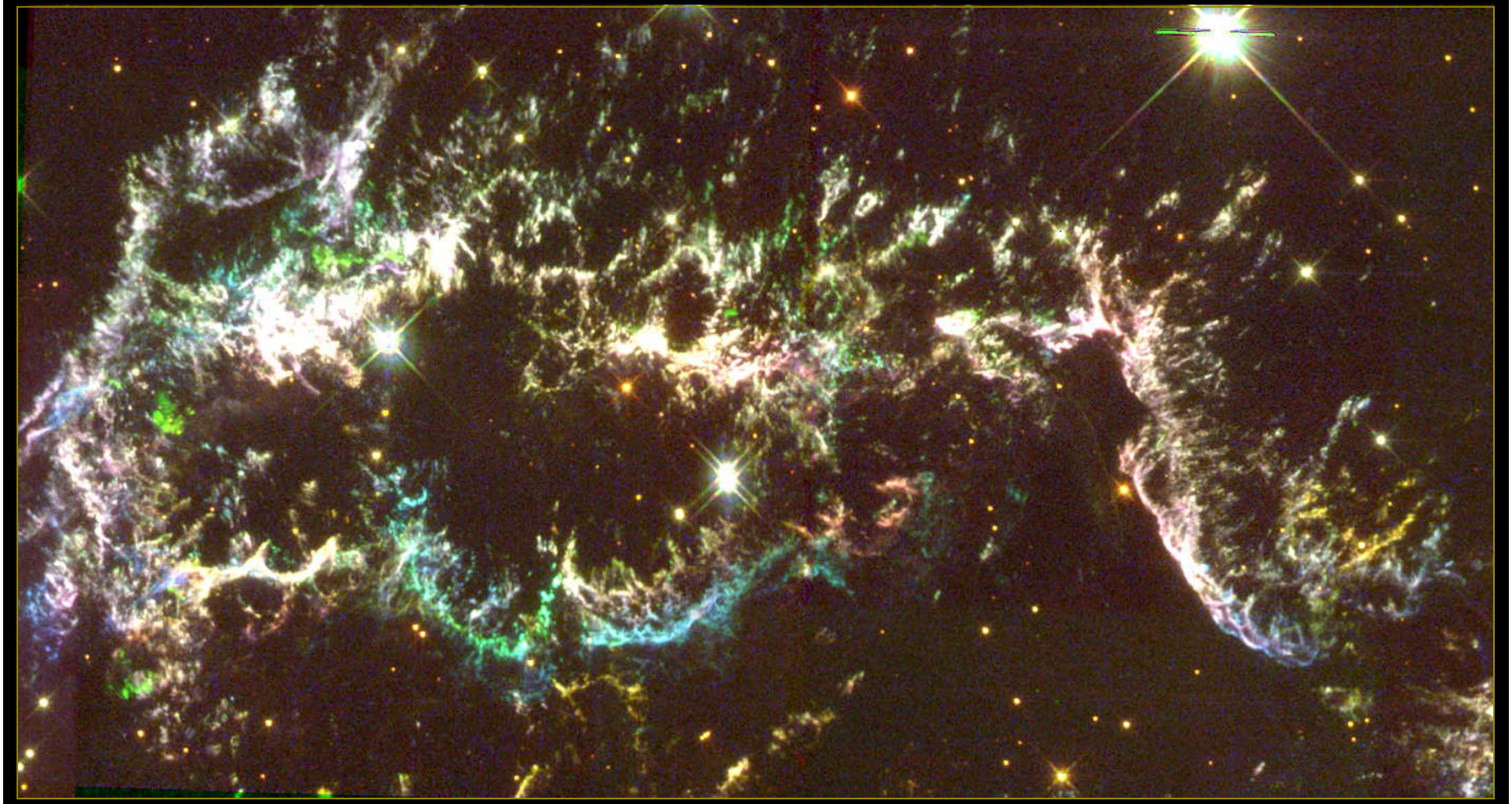
Credit: NASA/DOE/Fermi LAT Collaboration

Chandra 2-Msec X-ray image of Cas A
Hwang et al. (2004)



Emergence of Time Domain Astrophysics
from Space – Imaging & Spectroscopy

Cas A - North Ring



2000.0

F450W F675W F850LP
[O III] [S II]+[OII] [S III]

See Morse, Fesen, et al. 2004, ApJ, 614, 727

Emergence of Time Domain Astrophysics
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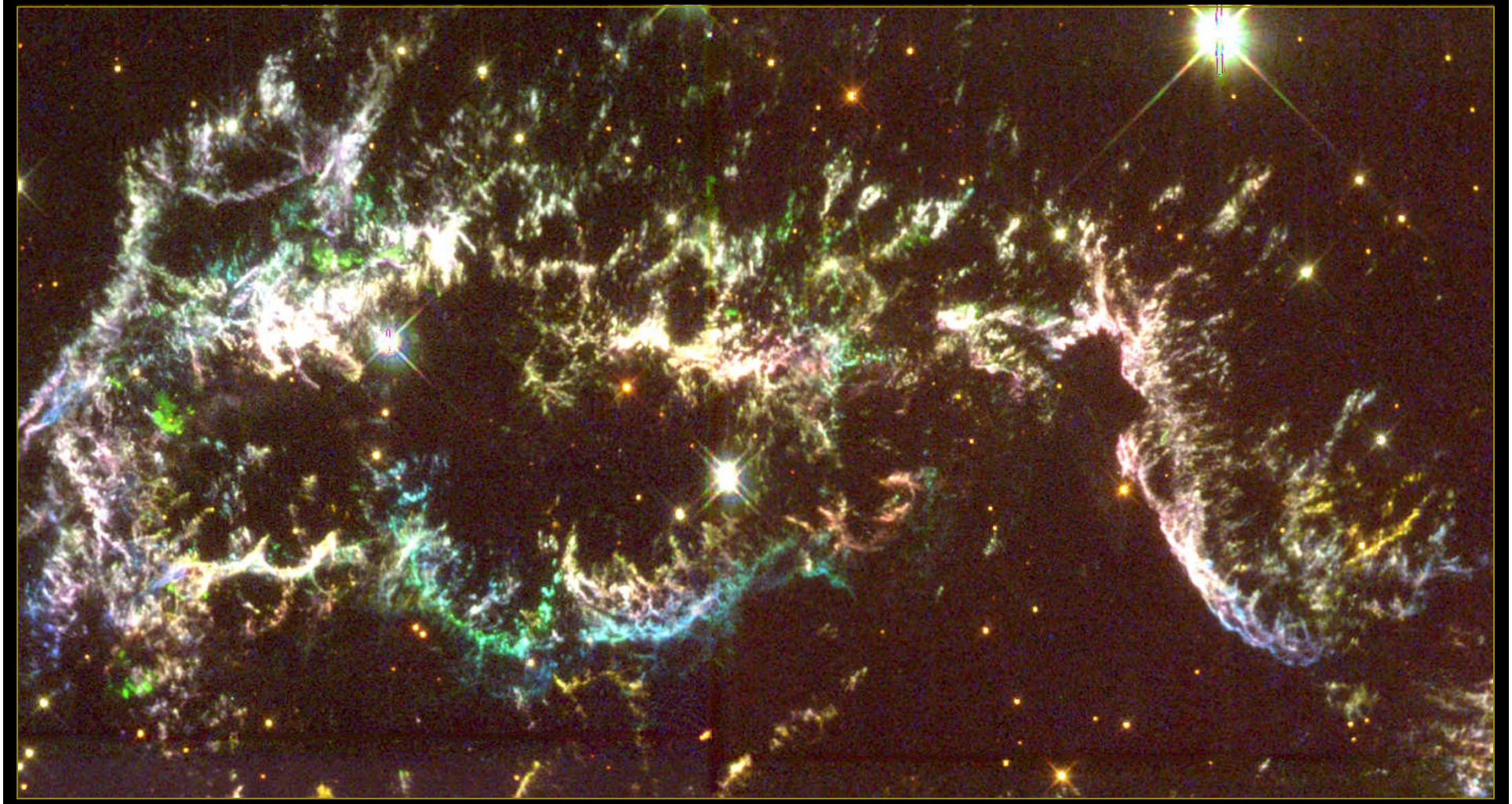
Cas A - North Ring

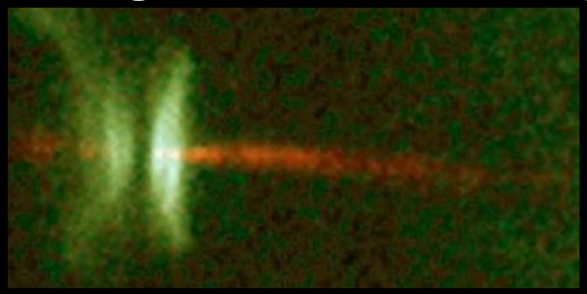


2002.0

F450W F675W F850LP
[O III] [S II]+[OII] [S III]

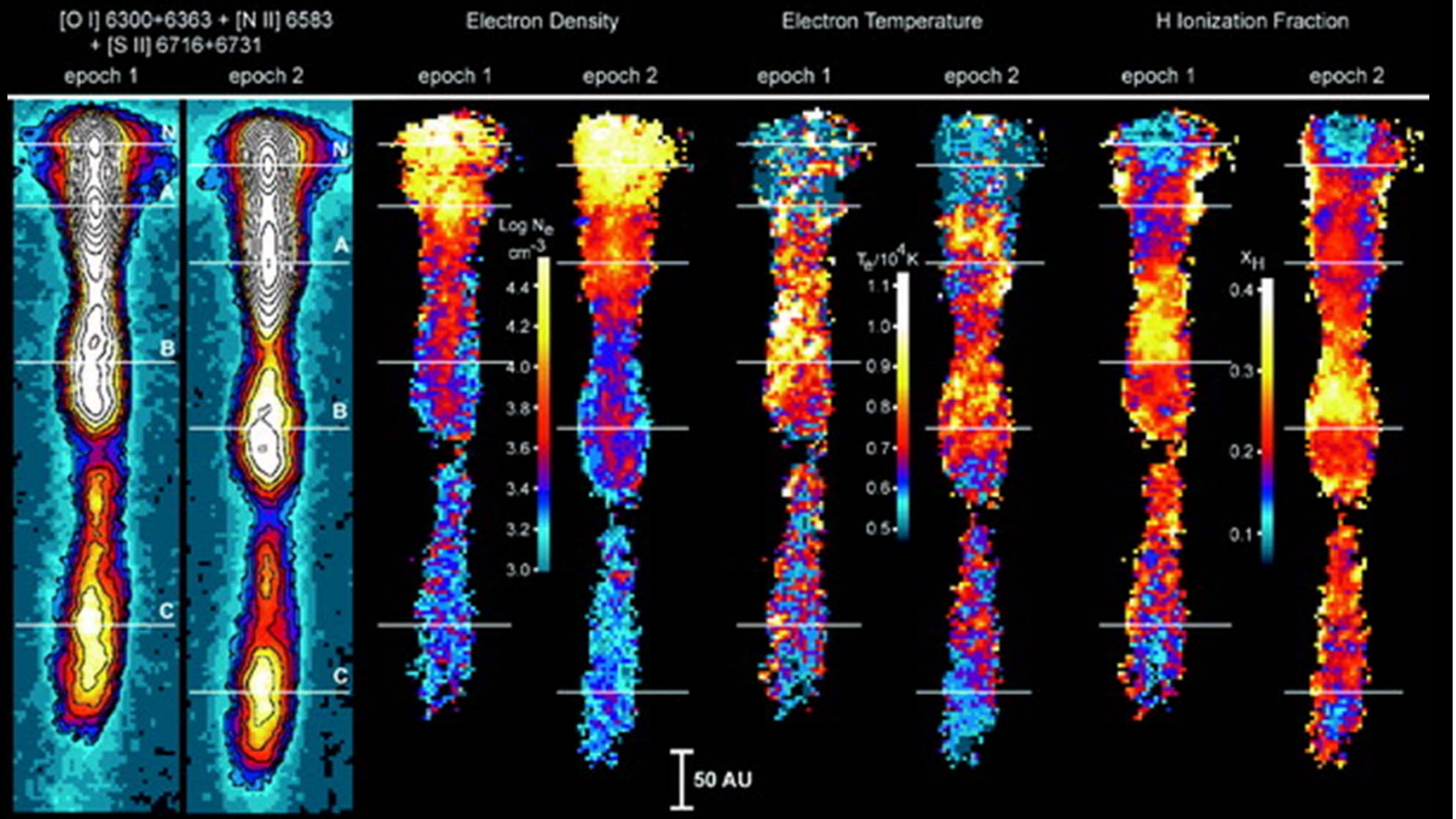
See Morse, Fesen, et al. 2004, ApJ, 614, 727

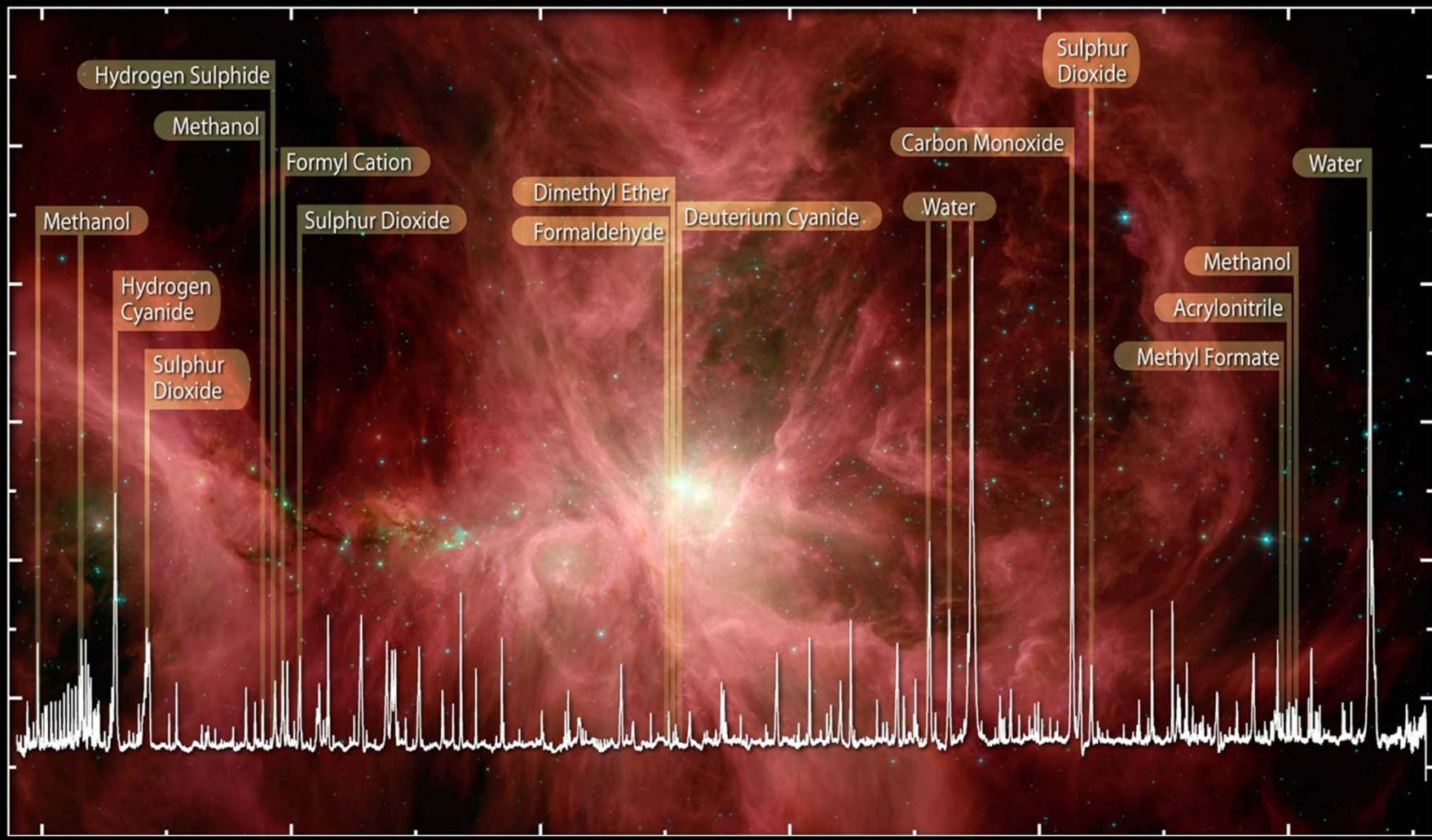
High Resolution Diagnostic Studies of Physical Conditions



HH30

Hartigan & Morse 2007, ApJ, 660, 426





HIFI Spectrum of Water and Organics in the Orion Nebula

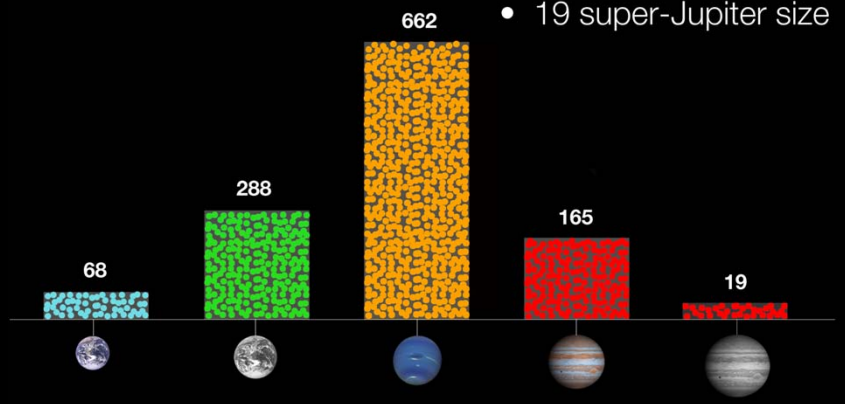
E. Bergin

Kepler Mission Results in Exoplanet Exploration

New Data Released to Public

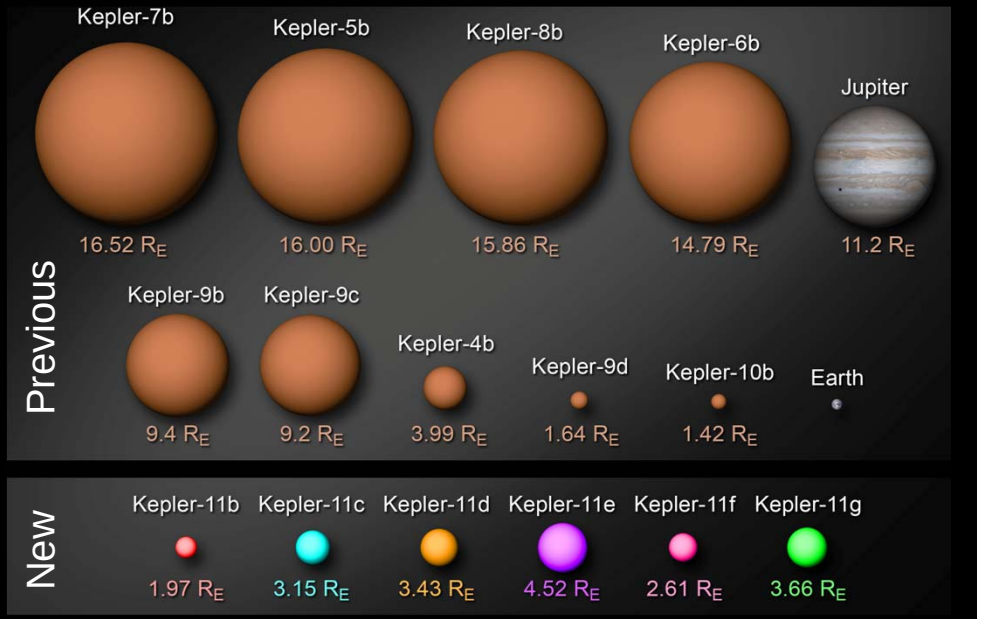
Numbers of Planet Candidates

- 68 Earth-size
- 288 super-Earth size
- 662 Neptune size
- 165 Jupiter size
- 19 super-Jupiter size



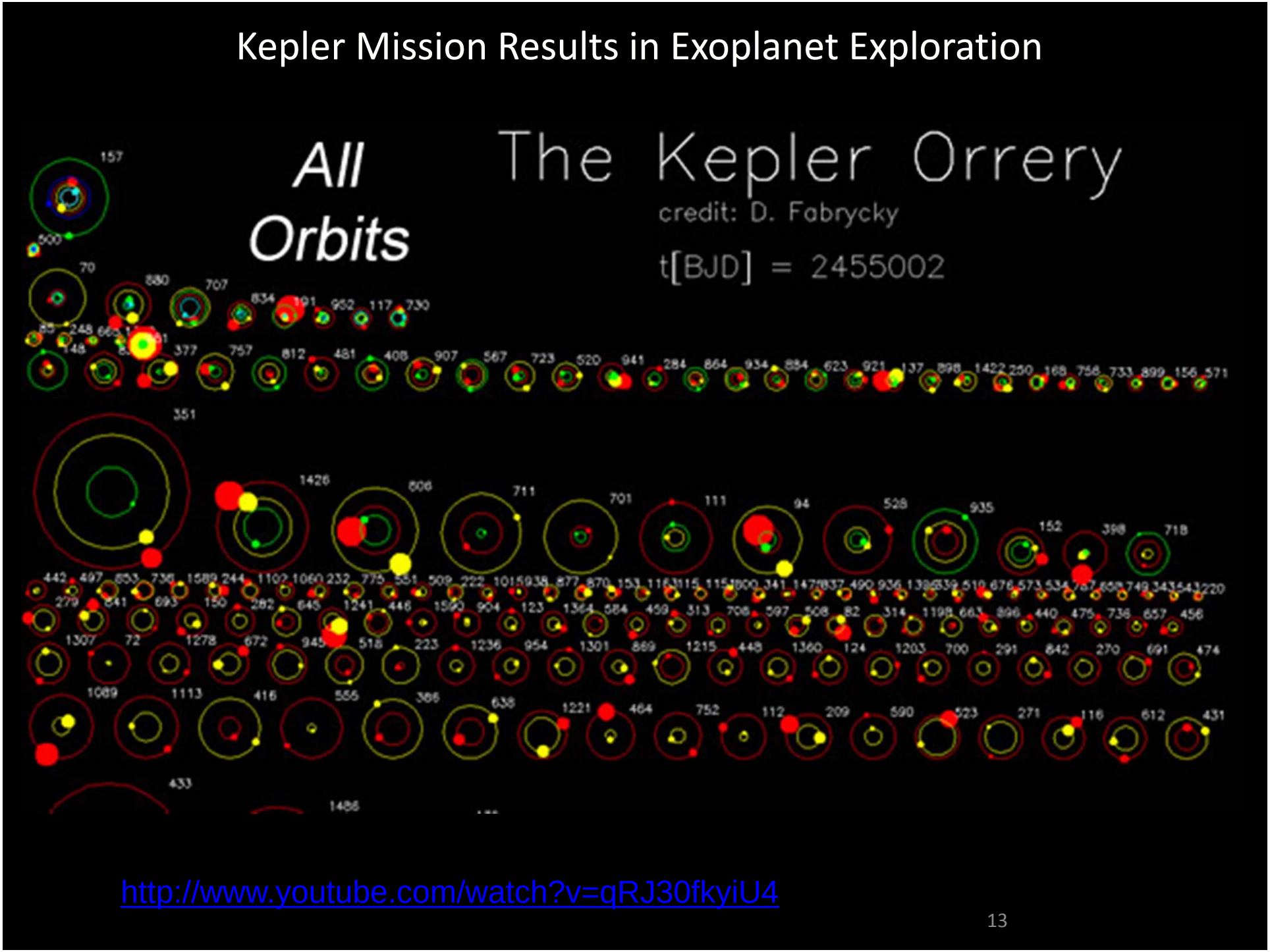
- Kepler has released data on 155,453 stars and on the 1,235 planetary candidates that it has discovered in the first 4 months of science operations.
- The planetary candidates include: 68 of Earth-size, 288 of super-Earth-size, 662 of Neptune-size, 165 of Jupiter-size, and 19 larger than Jupiter.
- 54 planetary candidates are in the habitable zone of their host stars, a region where liquid water could exist on a planet's surface. The 5 smallest of these range in size from 0.9 to twice the size of the Earth.
- 170 stars show evidence of multiple planetary candidates.
- Planet candidates still require follow-up observations to verify they are actual planets.

Six New Exoplanets Confirmed



- Kepler has found six confirmed planets orbiting a sun-like star, Kepler-11, located ~2000 light years from Earth.
- This is the largest group of transiting planets orbiting a single star yet discovered outside our solar system.
- The five inner planets comprise the most closely-spaced planetary system known, with orbits smaller than Mercury's.
- All of the planets orbiting Kepler-11 are larger than Earth, with the largest ones being comparable in size to Uranus and Neptune.
- The planets Kepler-11d, Kepler-11e and Kepler-11f have a significant amount of light gas, which indicates that they formed within a few million years of the system's formation.

Kepler Mission Results in Exoplanet Exploration



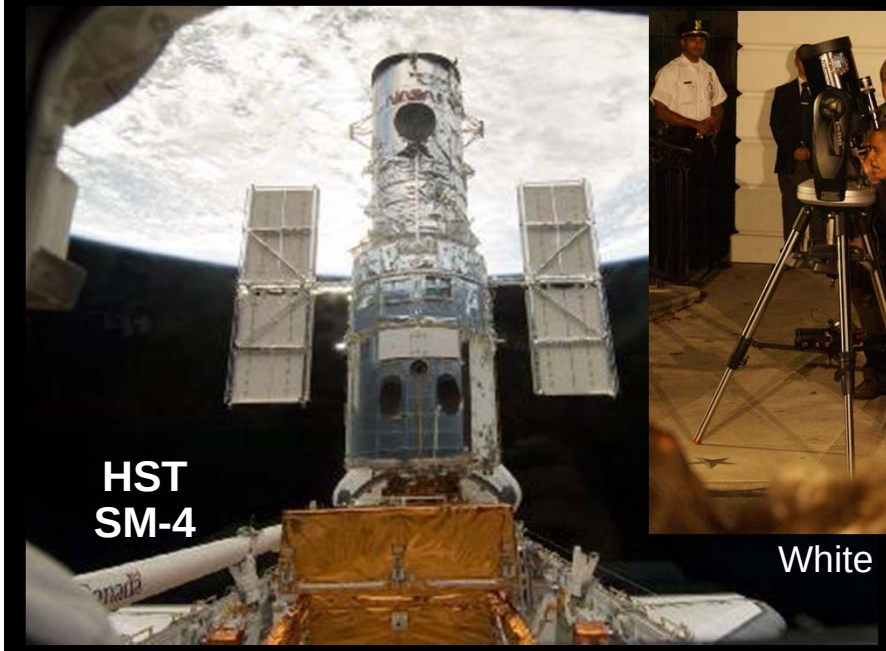
http://www.youtube.com/watch?v=qRJ30fkyiU4

Programmatic and Budgetary Landscape

Astrophysics Accomplishments

Since spring 2007…

- 7 missions now doing frontier research (Fermi, Kepler, Hubble-SM4, Herschel, Planck, WISE, SOFIA)
- Several missions in the queue (NuSTAR, Astro-H, GEMS; JWST)
- New portfolio organization, new investments in R&D and suborbital research to enable future missions
  - Best performance in SMD for ROSES awards, lowest uncosted carryover
- Structured named fellowships for long-term support
  - Hubble, Einstein, Sagan Fellowships funded at program level
  - Introduced Nancy Grace Roman Technology Fellowship
- Completed Astro2010 Decadal Survey
  - ALL recommendations being addressed, including a robust Astrophysics Explorers Program and the highest levels of R&A funding ever
- Driven towards cost realism
  - ALL missions now have realistic budgets (even JWST)



White House Star Party: Oct 7

Dec 14 @ 6:09 AM PST from VAFB

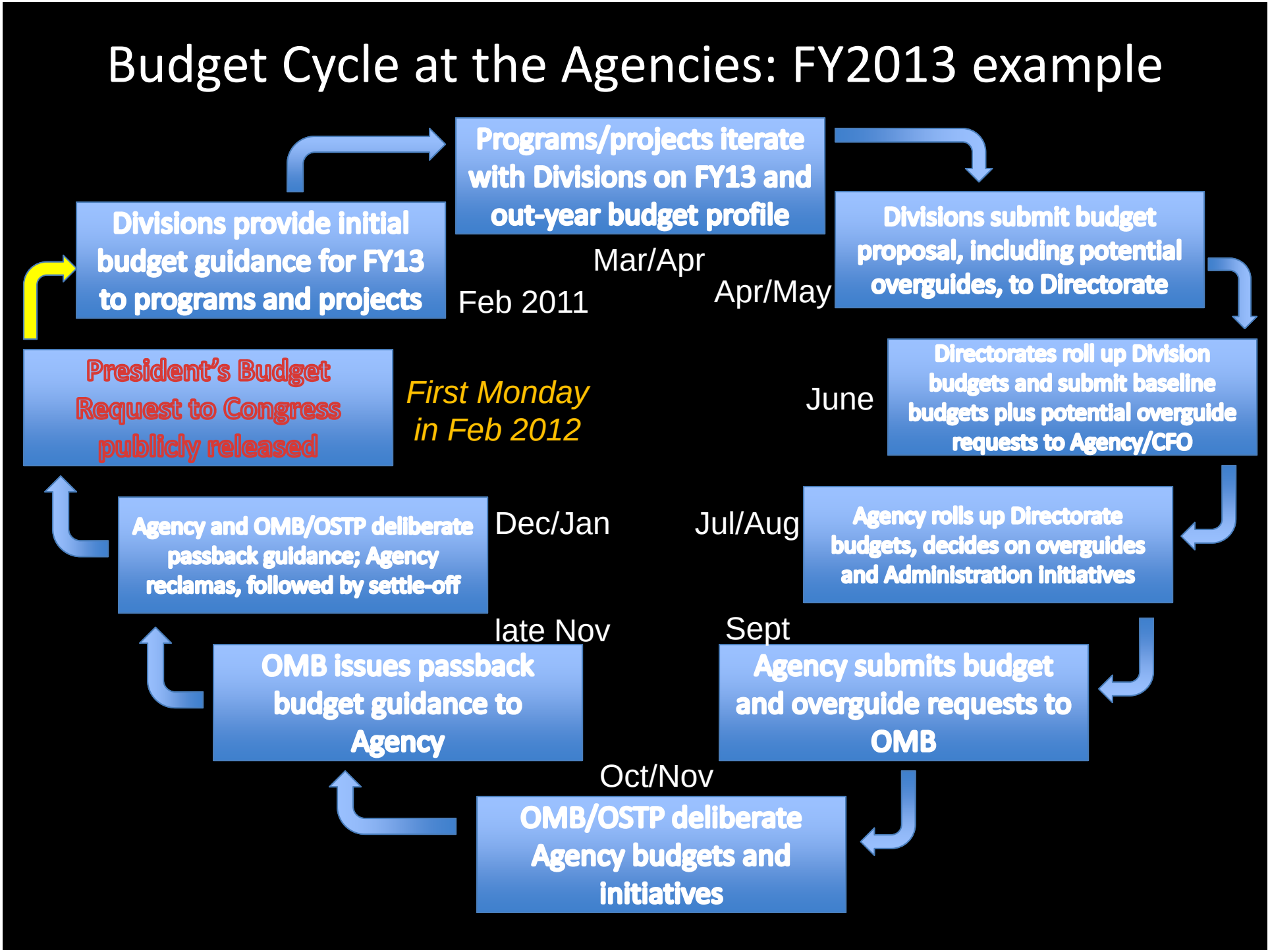
2009

May 14 @ 9:12AM EDT from Kourou

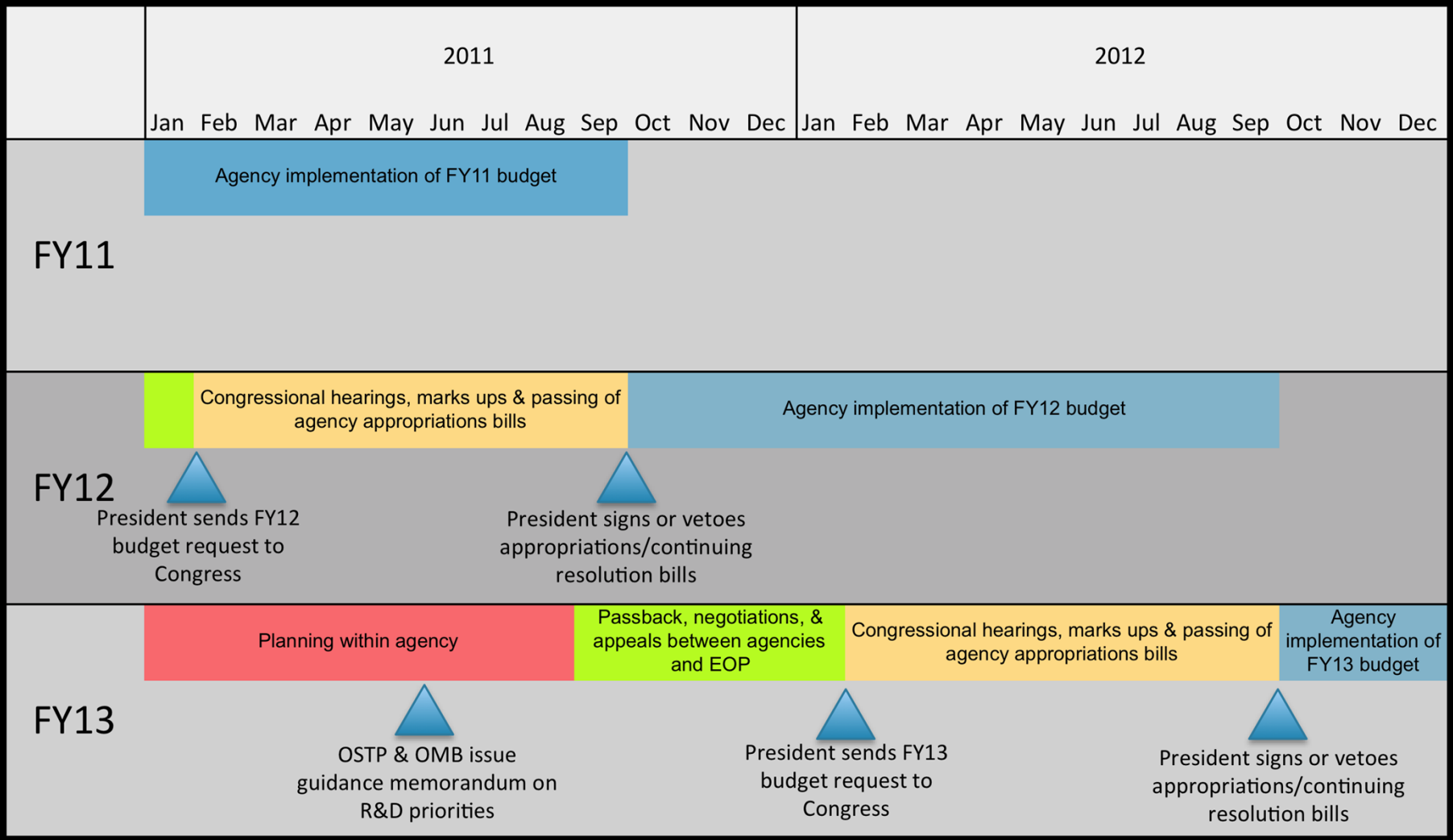
SOFIA open door flight: Dec 18

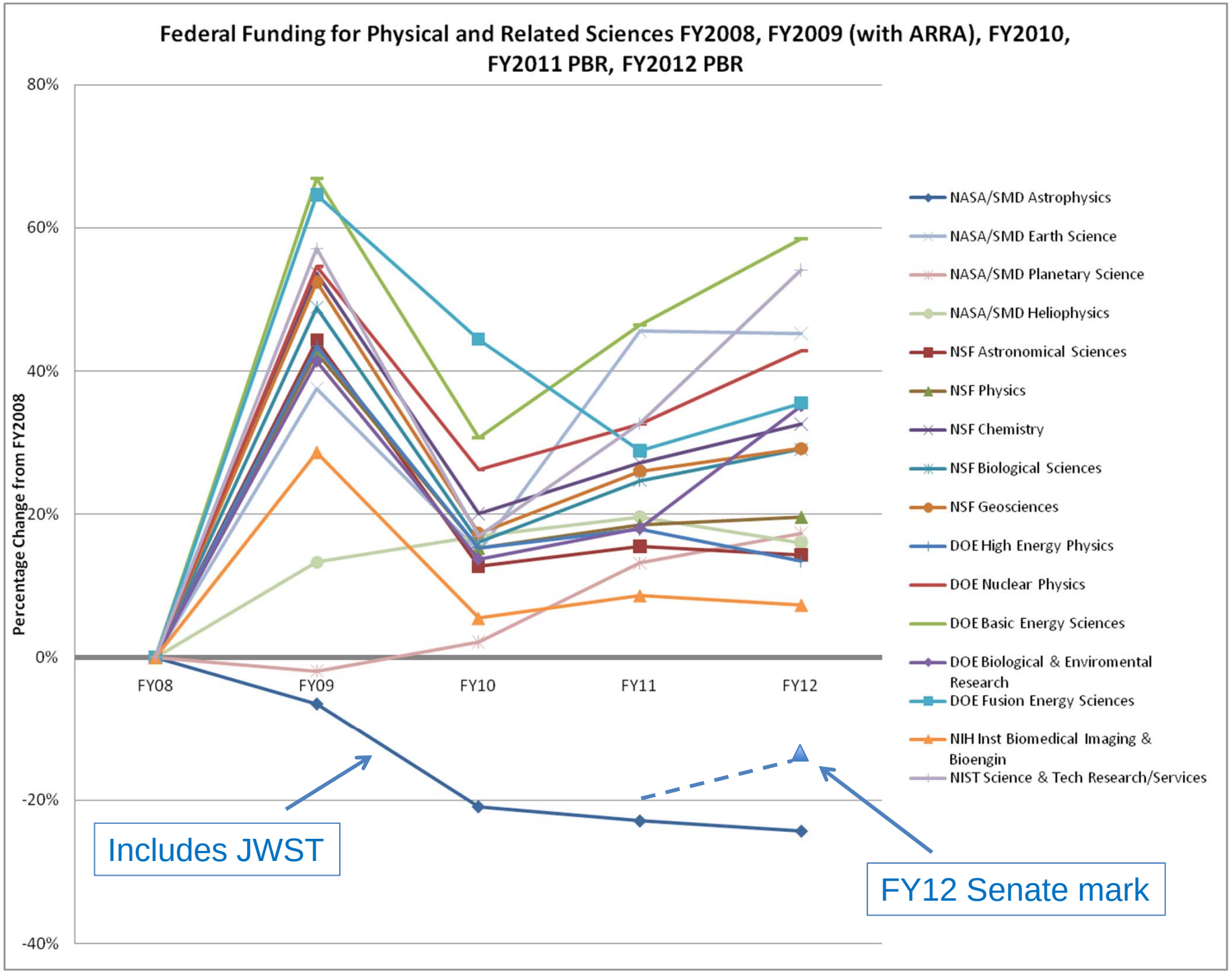
Mar 6 @ 10:48PM EDT from KSC

Budget Cycle at the Agencies: FY2013 example

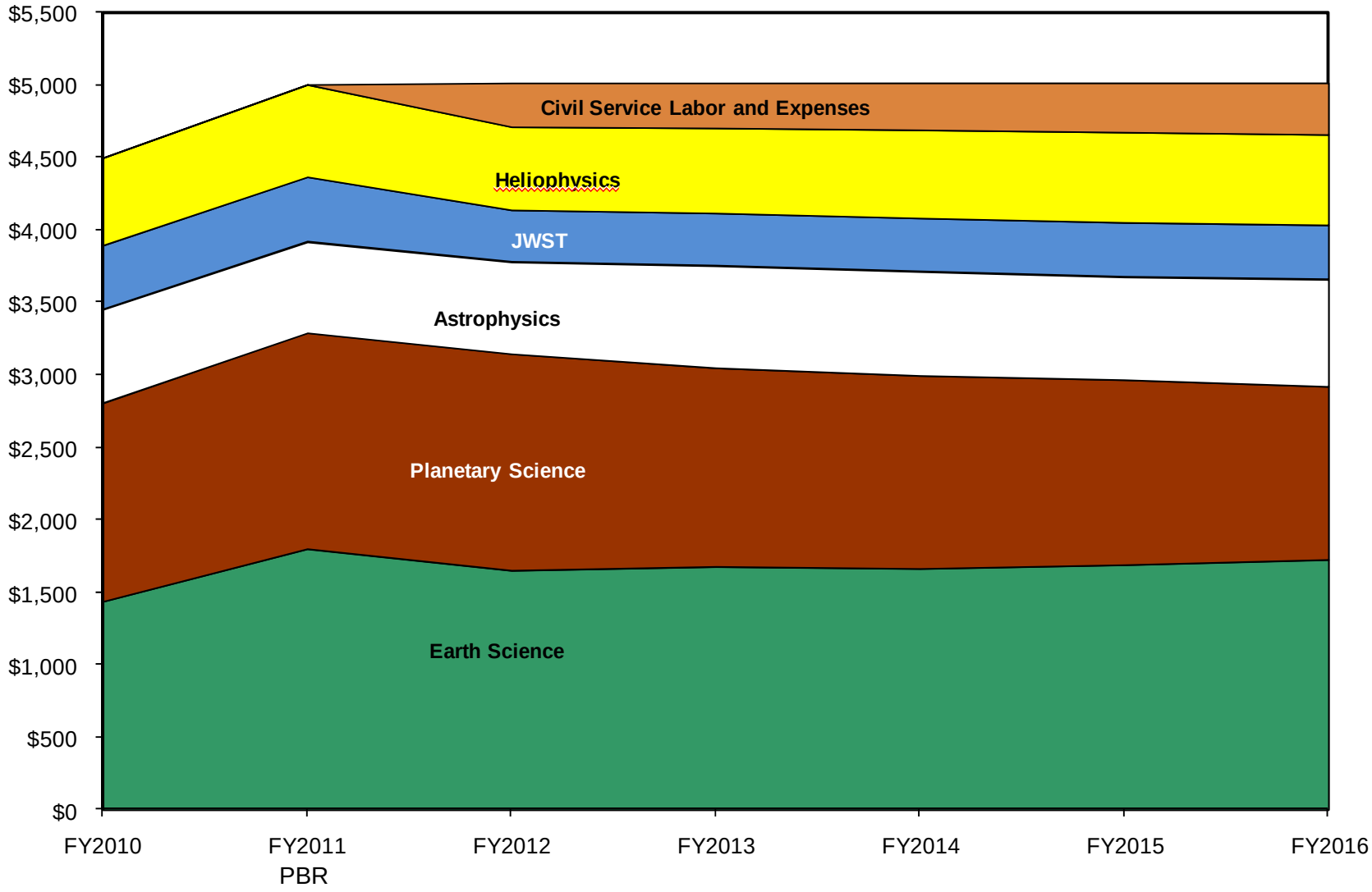


The Budget Cycle




Federal Funding for Physical and Related Sciences FY2008, FY2009 (with ARRA), FY2010, FY2011 PBR, FY2012 PBR
Percentage Change from FY2008
80%
60%
40%
20%
0%
-20%
-40%
FY08
FY09
FY10
FY11
FY12
NASA/SMD Astrophysics
NASA/SMD Earth Science
NASA/SMD Planetary Science
NASA/SMD Heliophysics
NSF Astronomical Sciences
NSF Physics
NSF Chemistry
NSF Biological Sciences
NSF Geosciences
DOE High Energy Physics
DOE Nuclear Physics
DOE Basic Energy Sciences
DOE Biological & Enviromental Research
DOE Fusion Energy Sciences
NIH Inst Biomedical Imaging & Bioengin
NIST Science & Tech Research/Services
Includes JWST
FY12 Senate mark

SMD Budget by Theme (RY $M)



From NASA presentation to the Astrophysics Subcommittee of the NAC 7/2011

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

From NASA presentation to the Astrophysics Subcommittee of the NAC 7/2011

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

From NASA presentation to the Astrophysics Subcommittee of the NAC 7/2011

NWNH Decadal Recommended Space Activities (Notional Plan)

Program Scale	Recommendation	Recommended US Share	FY 2011 PBR	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	5-year total
Large	WFIRST	$1,600	Pre-formulation planning and technology development only						
Large	Explorer Program Augmentation	$463	0.0	1.1	5.4	25.5	47.8	76.4	156.3
				1.1	5.4	25.5	47.8	76.4	156.3
Large	LISA (including ST-7)	$1,500	3.2	4.3	7.9	8.7	8.3	10.0	39.3
				1.1	4.8	5.5	5.1	6.8	23.3
Large	IXO	$3,100	2.3	3.0	6.4	7.0	7.0	7.3	30.7
				0.7	4.1	4.7	4.7	5.0	19.2
Medium	New Worlds Tech Development	$100-200	6.2	8.6	19.7	24.0	25.7	28.9	106.9
				2.4	13.5	17.9	19.6	22.7	76.1
Medium	Inflation Probe Tech Development	$60-200	0.0	0.2	3.5	4.1	4.0	5.0	16.8
				0.2	3.5	4.1	4.0	5.0	16.8
Small	Astrophysics Theory Program Augmentation	+$35M over 10 years	11.8	12.7	15.2	15.3	15.8	16.0	74.9
				0.9	3.4	3.5	3.9	4.2	15.9
Small	Definition of a future UV-optical space capability	$40M over 10 years	0.4	0.1	3.0	3.6	3.6	3.7	13.9
				-0.3	2.6	3.2	3.2	3.3	11.9
Small	Intermediate Tech Dev Augmentation	+$2M/yr, growing to +15M/yr in 2021	20.8	23.0	27.7	27.7	27.2	27.9	133.4
				2.2	6.9	6.9	6.4	7.1	29.6
Small	Laboratory Astrophysics	+$2M/yr	3.2	3.5	4.7	4.7	5.0	5.0	22.9
				0.4	1.5	1.5	1.8	1.8	6.9
Small	SPICA	$150M	Possible competed opportunity						
Small	Suborbital Program	+15M/yr	22.0	25.8	37.6	39.8	40.0	41.0	184.1
				3.8	15.6	17.8	18.0	19.0	74.3
Small	Theory and Computation Networks	+$5M/yr	0.0	0.5	3.0	3.1	3.1	4.0	13.7
				0.5	3.0	3.1	3.1	4.0	13.7

$ in millions, does not include civil servant labor

Top line: FY2012 PBR

Bottom line: augmentation above 2011

From NASA presentation to the AAS 5/2011

Decadal Survey Guidance on a Balanced Astrophysics Portfolio

2001, *Astronomy and Astrophysics in the New Millennium*

- "Ensuring the Diversity of NASA Missions: **NASA should continue to encourage the development of a diverse range of mission sizes, including small, moderate, and major, to ensure the most effective returns from the U.S. space program**." (page 28)
- "Policy recommendations for NASA: Space-based Astronomy. … The committee is concerned, however, that NASA maintain the diversity in mission size, from small to medium to large, needed to meet scientific objectives in a cost-effective manner. **The committee recommends that NASA maintain diversity in its flight programs** by ensuring that a suite of opportunities, including small, moderate, and major missions, is available to accomplish scientific goals…. **The future of astronomy in space will be at substantial risk if it must depend on the successful deployment of only a few missions per decade**." (page 194)

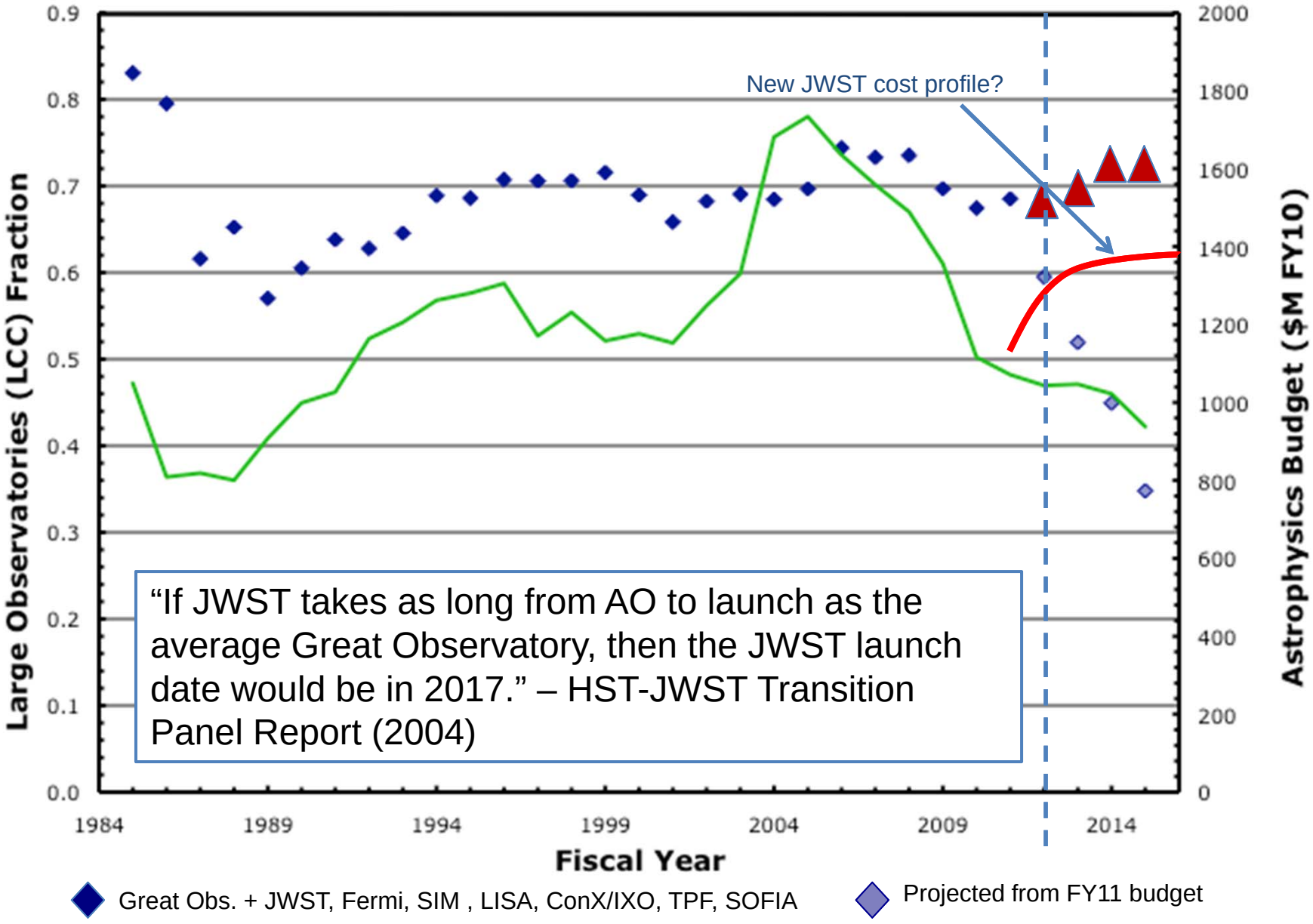
Decadal Survey Guidance on a Balanced Astrophysics Portfolio

2010, *New World, New Horizons in Astronomy and Astrophysics*

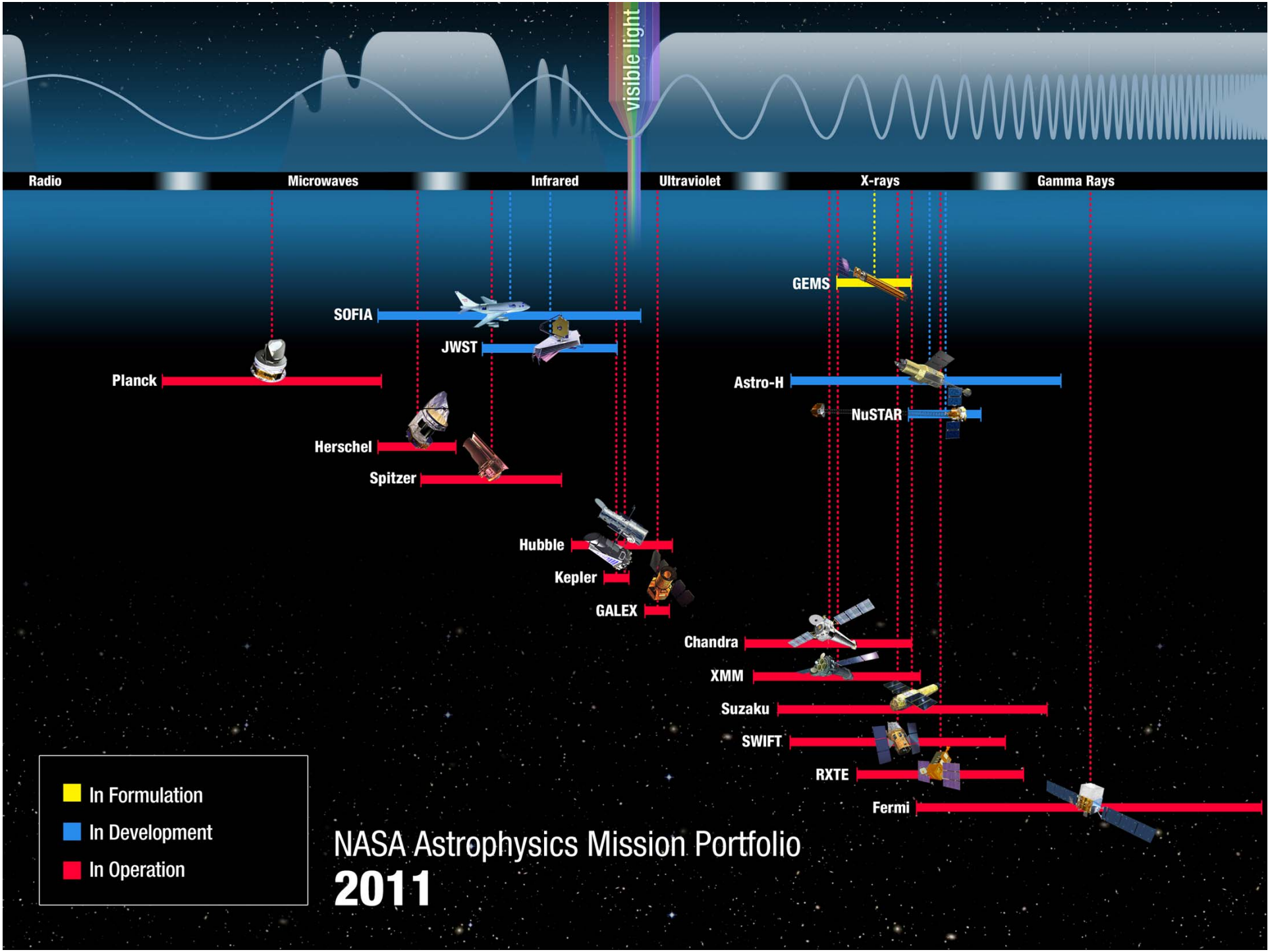
- "**The sustained success of NASA's astrophysics program rests on its effective leveraging of activities** ranging from large flagship mission[s] to smaller more focused Explorer missions, down to the suborbital, data analysis, theory, technology development, and laboratory astrophysics programs. **This diversified portfolio maximizes scientific exploitation of the missions**… During its deliberations the committee has attended to the general principle of balance in development of its recommended prioritization… In terms of mission size balance, the committee values the impressive science value per dollar achieved with a healthy Explorer program… Likewise, the committee recommends strong support for suborbital and balloon programs…. A final important balance element is between support for the development and operation of missions and the support for the archiving, analysis, and scientific interpretation of the data… **These vital elements of the Astrophysics funding must be protected from overruns elsewhere**." (pages 6-8,9)
- Budget guidance given to the Decadal Survey committee: "In the case of [NASA], the agency-projected budget [for the Astrophysics Division] is flat in real-year dollars and allows very little new activity until [JWST] is launched." (page 1-4)

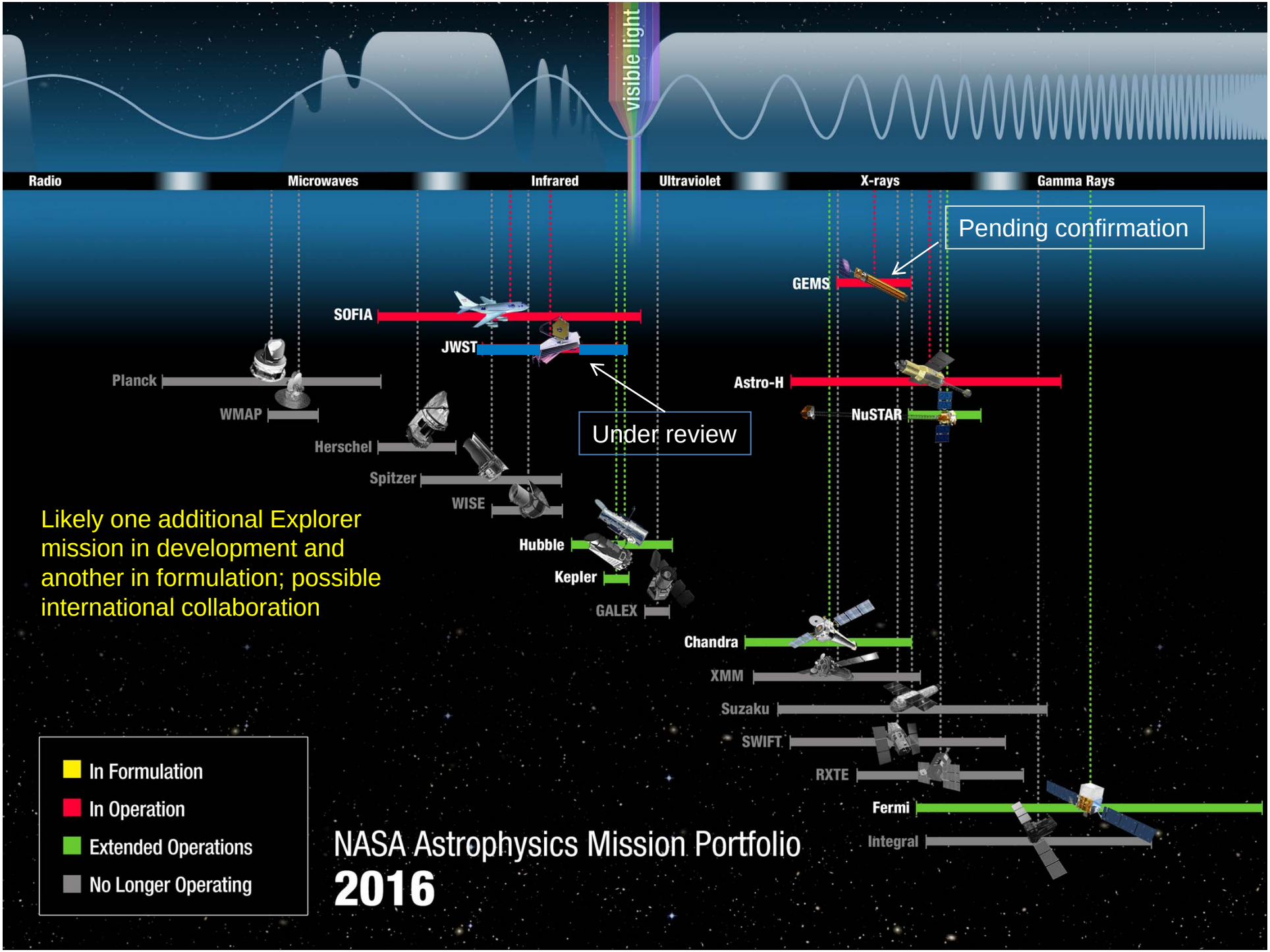
Original from Eric Smith, NASA HQ

Large Facility Funding Fraction



"If JWST takes as long from AO to launch as the average Great Observatory, then the JWST launch date would be in 2017." – HST-JWST Transition Panel Report (2004)

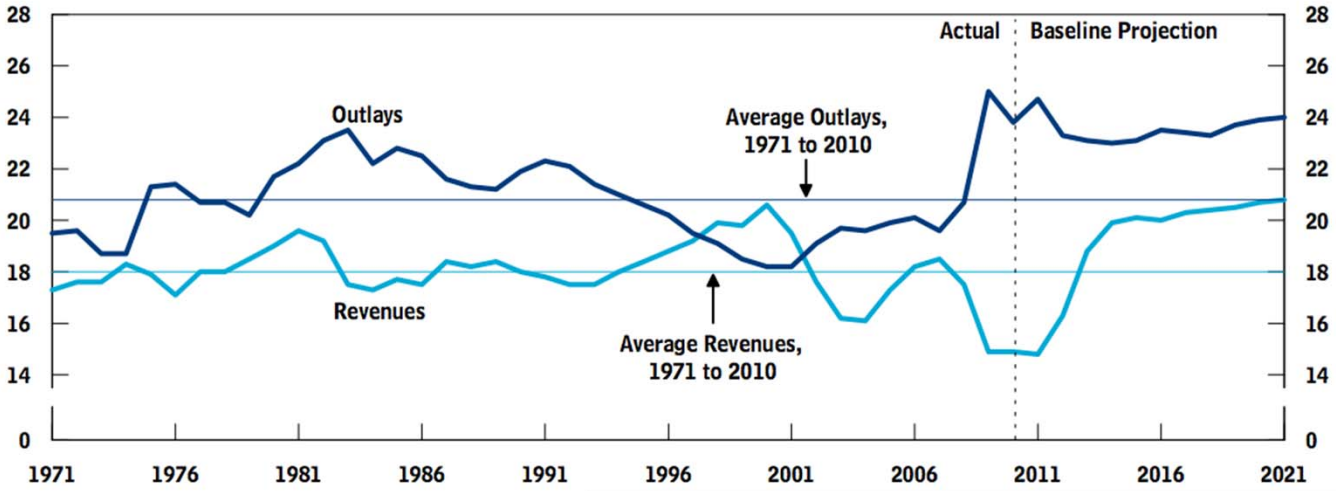

visible light
Radio
Microwaves
Infrared
Ultraviolet
X-rays
Gamma Rays
GEMS
SOFIA
JWST
Planck
Astro-H
NuSTAR
Herschel
Spitzer
Hubble
Kepler
GALEX
Chandra
XMM
Suzaku
SWIFT
RXTE
Fermi
In Formulation
In Development
In Operation
NASA Astrophysics Mission Portfolio
2011


visible light
Radio
Microwaves
Infrared
Ultraviolet
X-rays
Gamma Rays
Pending confirmation
GEMS
SOFIA
JWST
Planck
WMAP
Herschel
Spitzer
WISE
Under review
Astro-H
NuSTAR
Likely one additional Explorer mission in development and another in formulation; possible international collaboration
Hubble
Kepler
GALEX
Chandra
XMM
Suzaku
SWIFT
RXTE
Fermi
Integral
In Formulation
In Operation
Extended Operations
No Longer Operating
NASA Astrophysics Mission Portfolio
2016

CBO Deficit Analysis and Forecast

Total Revenues and Outlays, 1971 to 2021

(Percentage of gross domestic product)



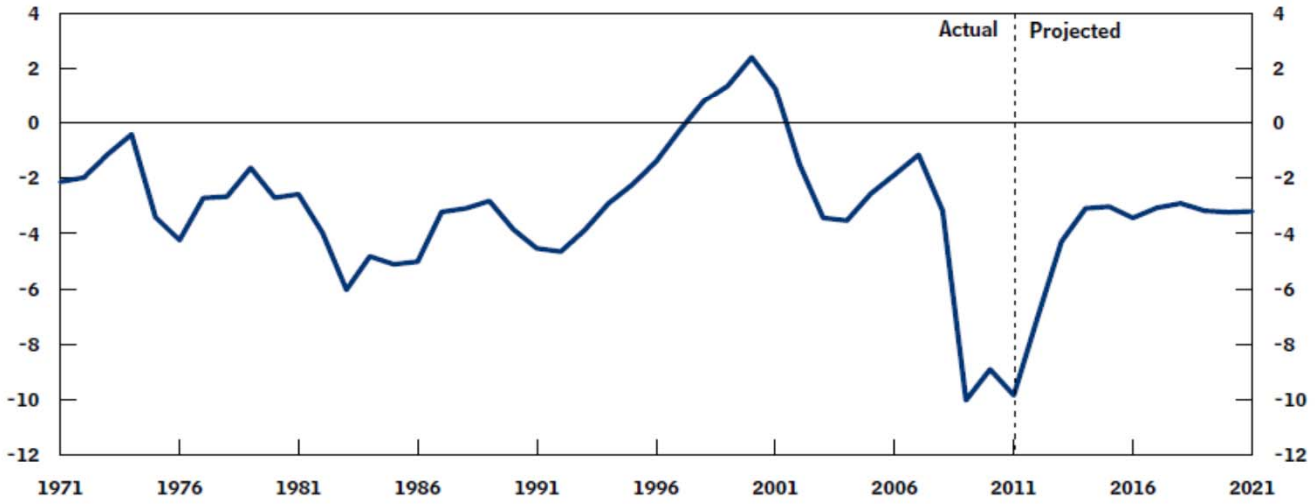
Source: Congressional Budget Office (as of January 2011).

~$500 B/yr shortfall

Assumes Bush-era tax cuts expire…

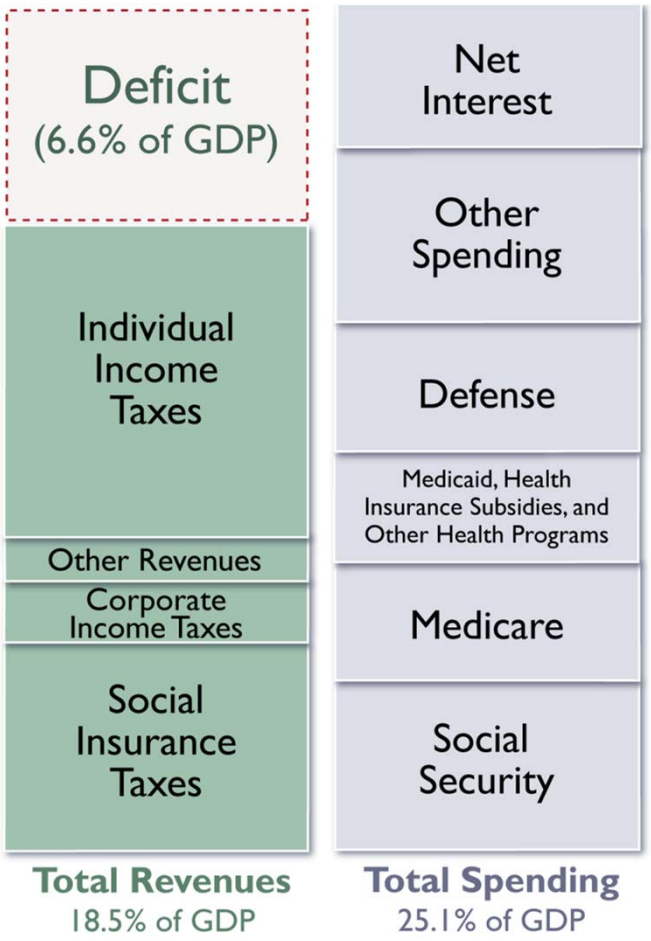
Total Deficits and Surpluses

(Percentage of gross domestic product)



Moreover …

- By 2021, we approach borrowing primarily to pay interest, which could instigate a debt spiral.
- "Tough" policies (e.g., let Bush tax cuts expire) would lead at best to stagnation; Borrowing remains high, crowding out private investment.
- Global investment could turn away from the United States.



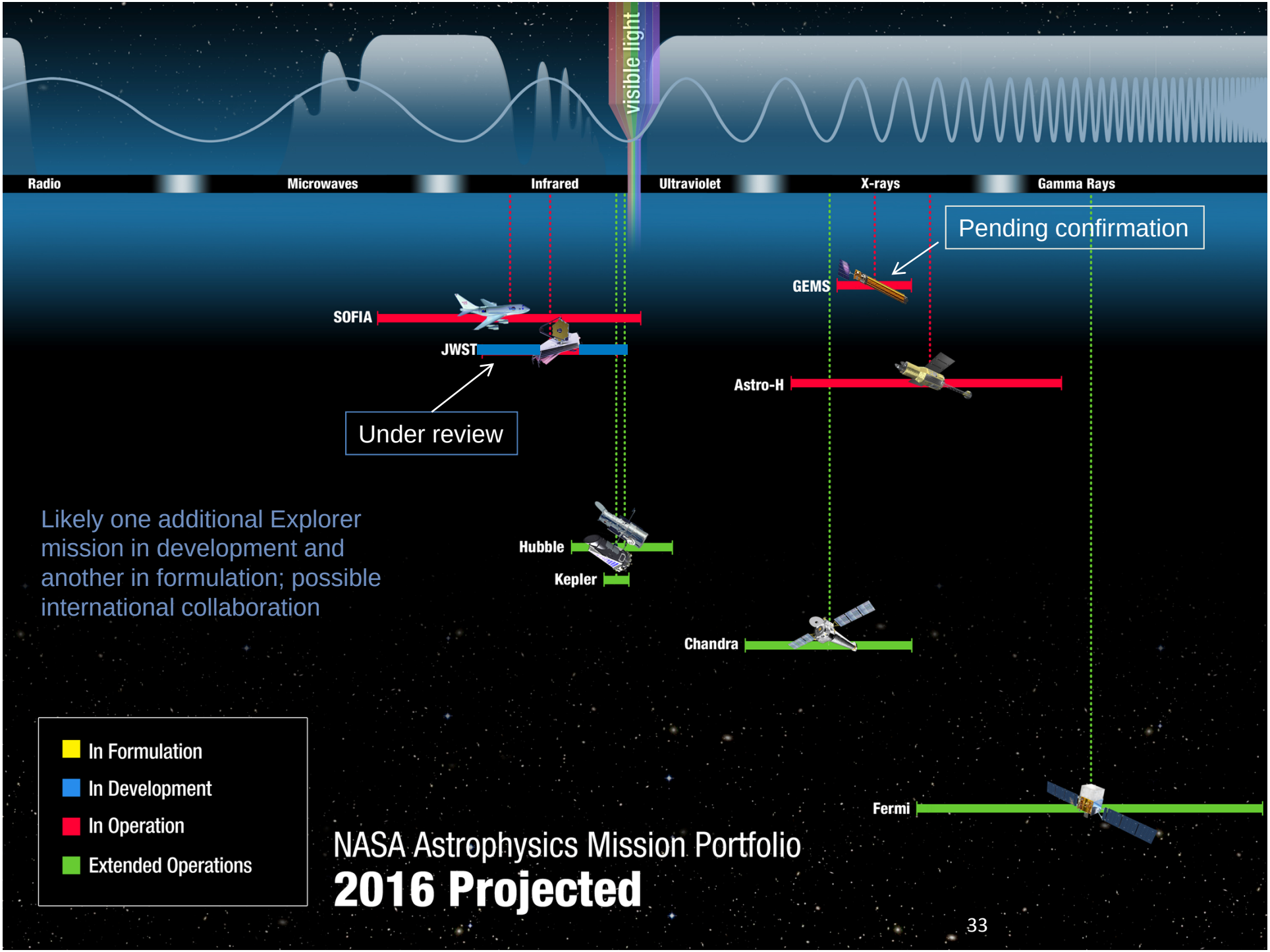
Note: Interest will have grown from 1.4% to 3.3% of GDP from 2011 to 2021.

Keys to Future Planning

If *scientific balance* (area of study)*, programmatic balance* (mission size)*, & flight rate* are important…

- When devising the next generation of frontier science missions, confront budget realities (especially in view of the post-JWST hangover) and allow *cost* to be a driver of future large mission planning or *live with large (>10 yr) gaps between missions*
- Need to enable future missions through prudent on-orbit technology demonstration of daunting performance requirements
  - JWST has failed to attain significant cost reductions through the use of advanced, largely untested, technologies (ie., faster, better, cheaper ISN'T faster or cheaper)
- Need to re-invent strategic international planning

Backup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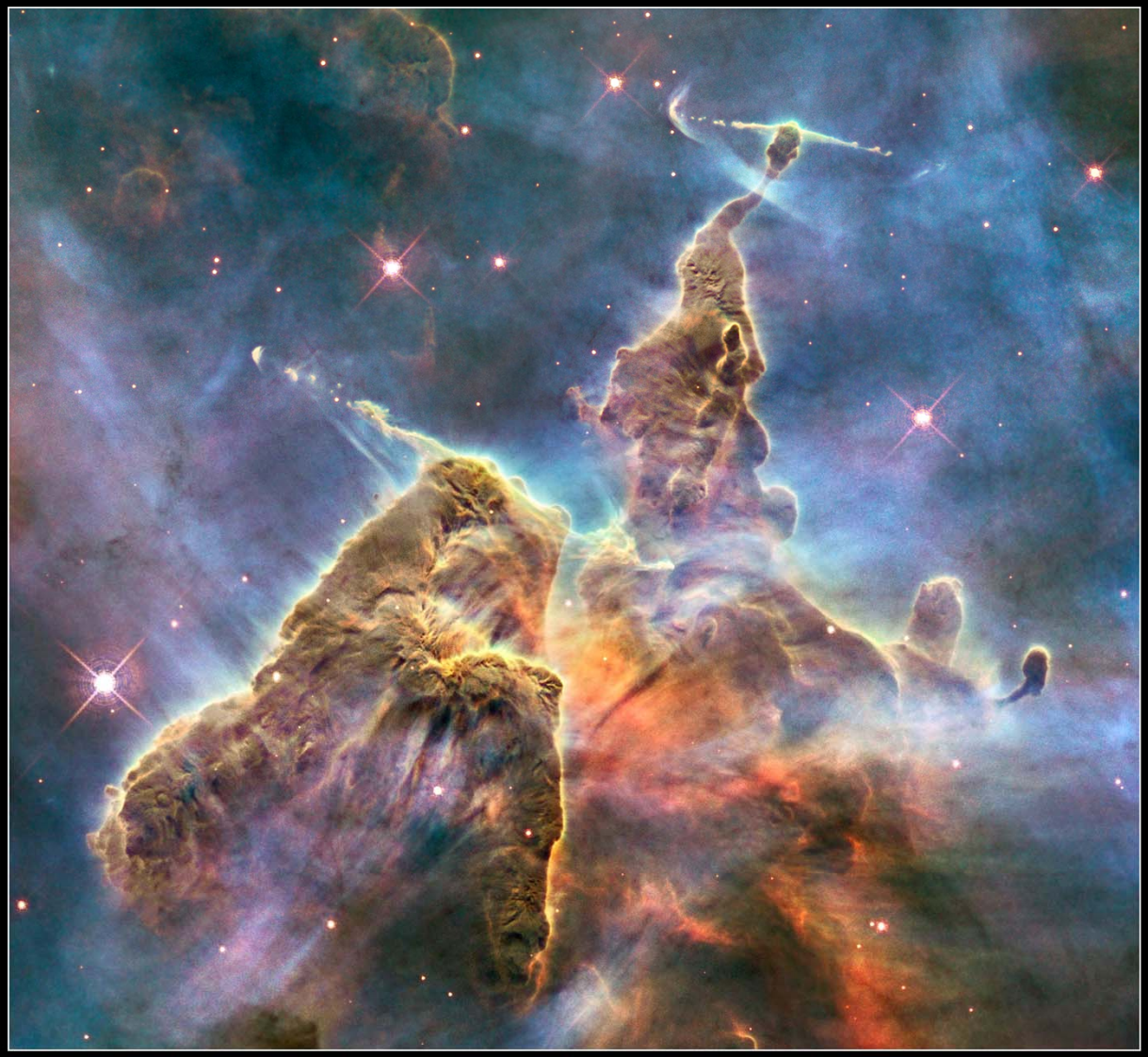
NASA Astrophysics Mission Portfolio
2016 Projected

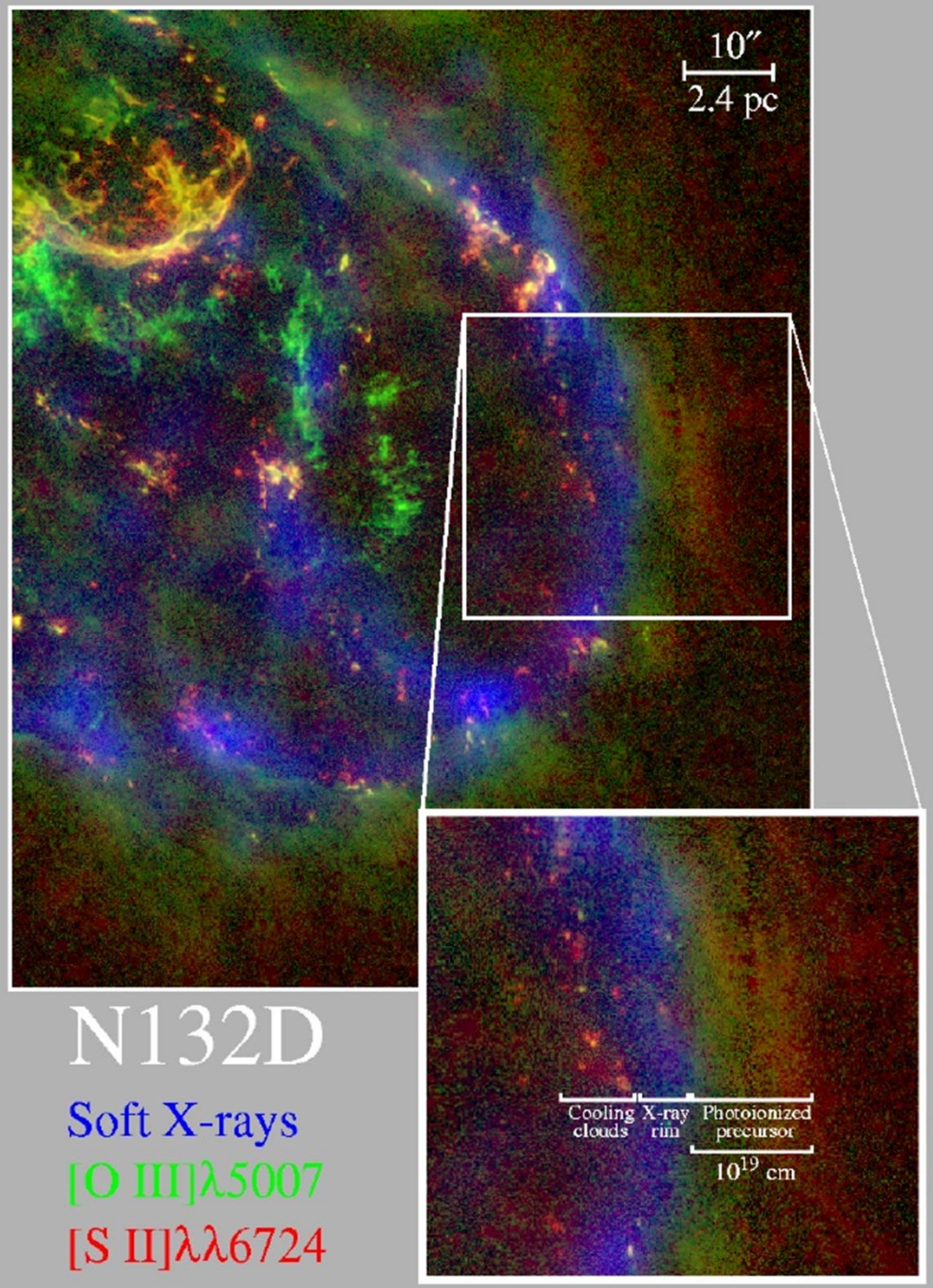


Pillar and Jets HH 901/902

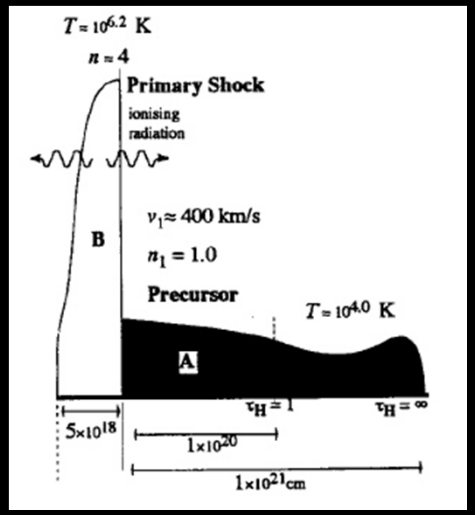
Hubble Space Telescope • WFC3/UVIS

NASA, ESA, and M. Livio and the Hubble 20th Anniversary Team (STScI)

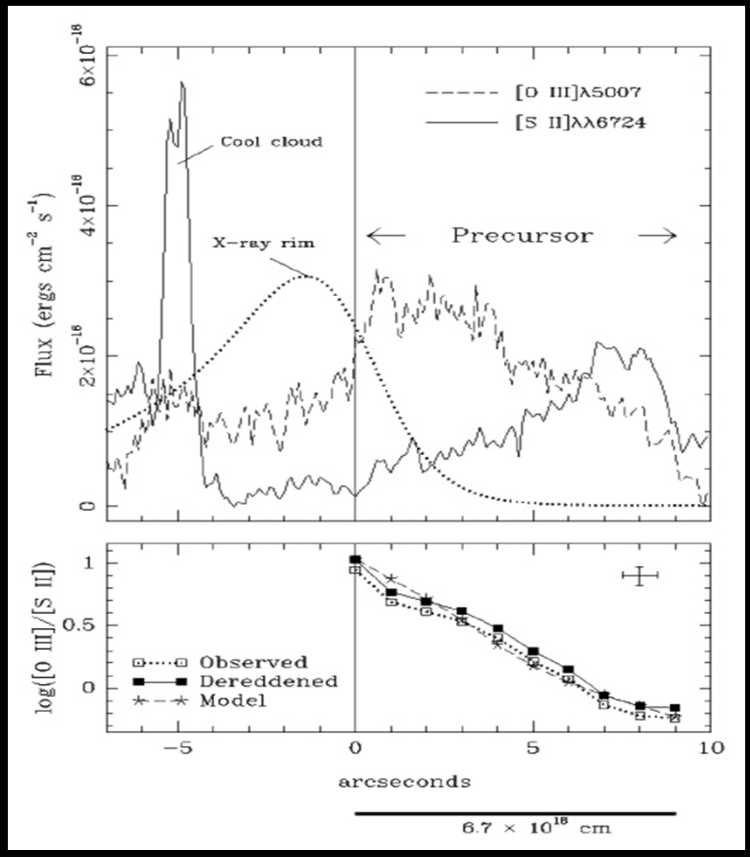
STScI-PRC10-13a



The main blastwave of N132D is one of the best examples of a Photoionizing Shock



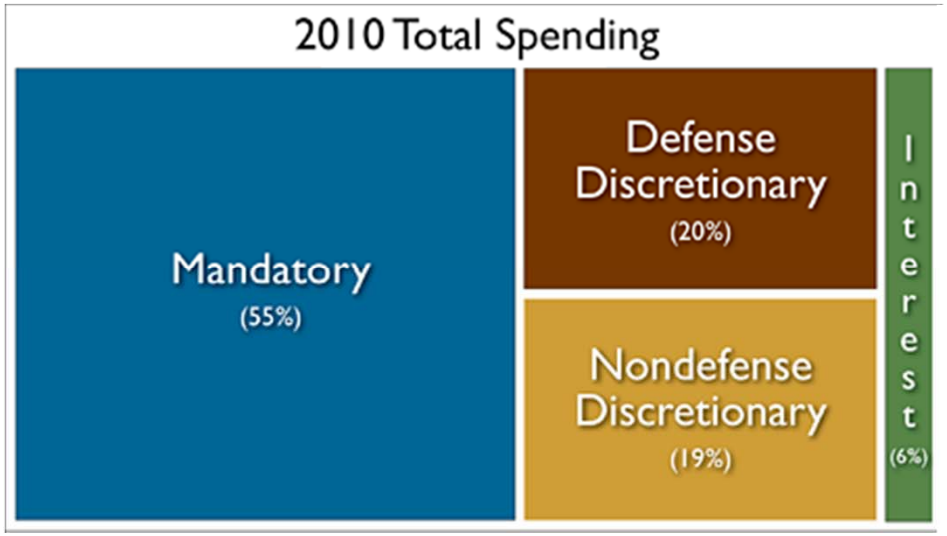
Sutherland, Bicknell, & Dopita (1993)

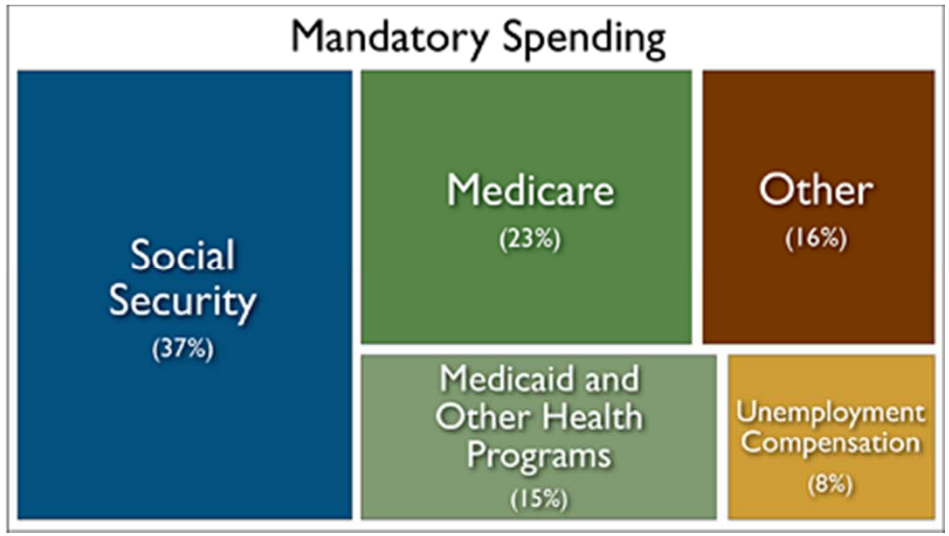


Morse et al. (1996)

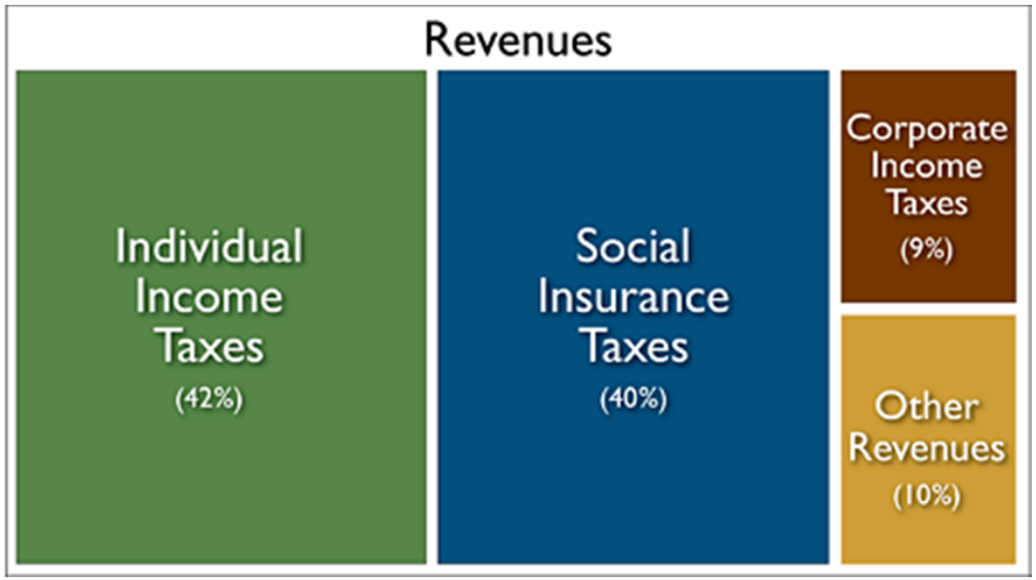
FY10: Spending and Revenue Composition

FY2010 Federal Budget expenditures: $3.5 T





Total Revenues: $2.4 T



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

From NASA presentation to the Astrophysics Subcommittee of the NAC 7/2011

Research & Analysis Distribution (notional plan)

($ in thousands, does not include civil servant labor)

	FY11 PBR	FY12	FY13	FY14	FY15	FY16
Research & Analysis	**57,881**	**64,312**	**82,836**	**83,932**	**85,105**	**87,995**
Suborbital payloads	21,964	23,779	29,604	30,803	30,992	31,958
Lab Astrophysics	3,193	3,544	4,692	4,692	4,957	5,016
Rest of APRA/APRET	20,751	22,966	27,657	27,690	27,152	27,892
Astrophysics Theory Program	11,805	12,723	15,178	15,274	15,751	15,982
Theory and Computation Networks		500	3,000	3,077	3,127	4,000
Technology Fellows		800	2,705	2,396	3,126	3,147

Large Suborbital (MO)		2,000	8,000	9,000	9,000	9,000
R&A Suborbital payloads	21,964	23,779	29,604	30,803	30,992	31,958
Total Suborbital Program	**21,964**	**25,779**	**37,604**	**39,803**	**39,992**	**40,958**

ADAP	**14,132**	**16,957**	**18,451**	**18,937**	**19,466**	**19,832**

From NASA presentation to the AAS 5/2011

Supporting Research & Technology (notional)

($ in thousands, does not include civil servant labor)

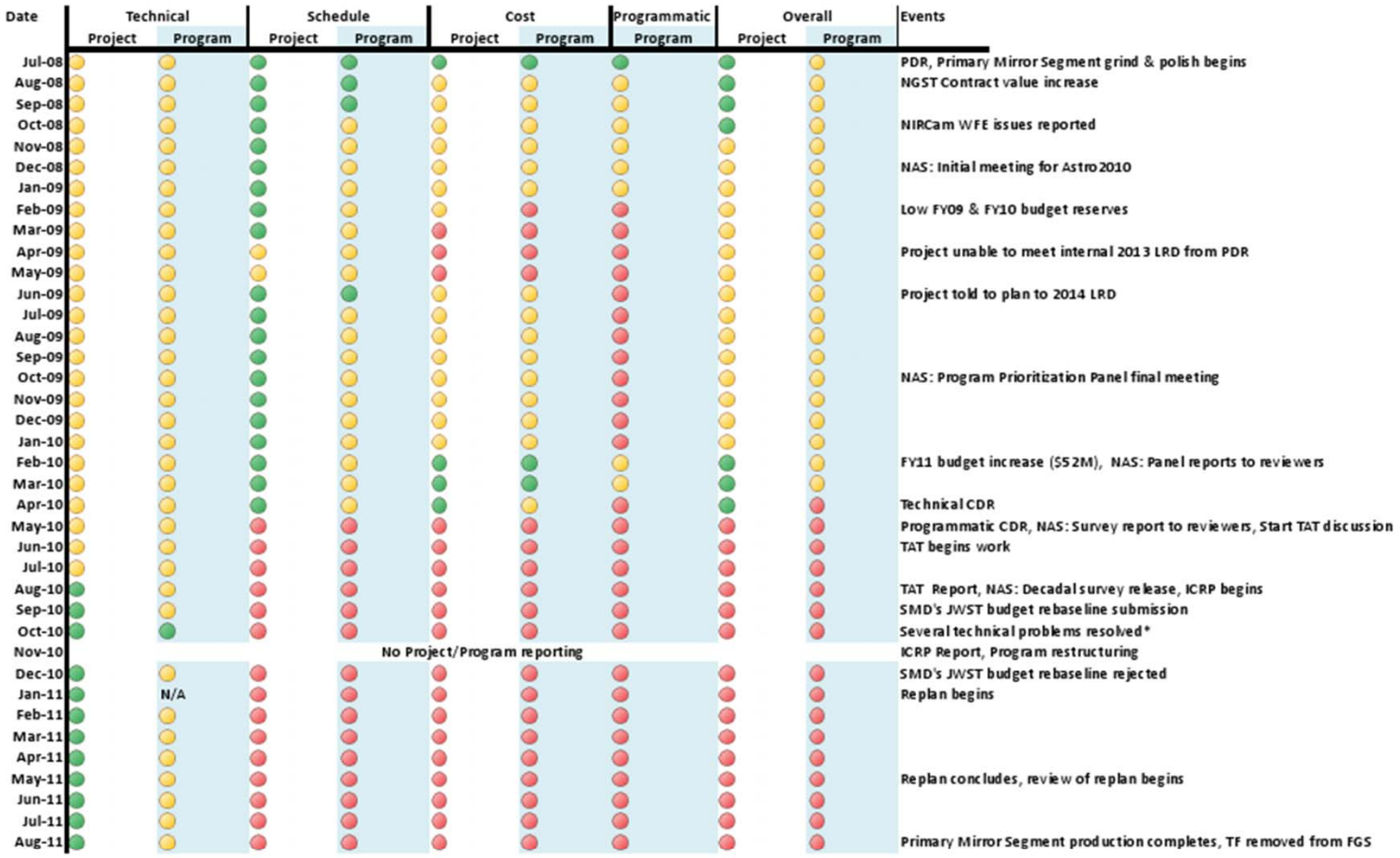
	FY11 PBR	FY12	FY13	FY14	FY15	FY16
COR SR&T	**7,343**	**9,164**	**17,341**	**19,015**	**19,040**	**19,915**
Technology (core & competed)	813	3,264	8,941	9,002	8,970	9,595
Hubble fellows	5,100	5,100	5,200	6,135	6,220	6,420
Strategic SOFIA Instr Tech	630	450				
HST development (de-orbit)	400	250	250	250	250	250
UV/Optical Space Capability	400	100	2,950	3,628	3,600	3,650

	FY11 PBR	FY12	FY13	FY14	FY15	FY16
PCOS SR&T	**9,438**	**11,442**	**22,032**	**24,460**	**24,096**	**27,178**
Technology (core & competed)	0	0	0	0	0	0
Einstein fellows	3,780	3,970	4,230	4,646	4,758	4,872
LISA tech awards	180					
Inflation probe tech		160	3,500	4,095	4,000	5,000
LISA/ST-7	3,185	3,312	7,947	8,700	8,315	10,000
IXO	2,293	3,000	6,355	7,019	7,023	7,306

	FY11 PBR	FY12	FY13	FY14	FY15	FY16
EXEP SR&T	**12,450**	**17,867**	**38,652**	**50,388**	**50,248**	**50,438**
Technology (core & competed)	6,150	8,569	19,683	24,014	25,737	28,892
Wide Field IR Imaging and Spectroscopy		1,790	10,582	18,217	16,191	13,064
Sagan Fellows	3,360	3,760	4,050	4,700	4,865	4,957
NExSci	720	1,648	2,212	2,480	2,549	2,601
Astrobiology	1,500	1,500	1,500	102		
COROT	720	600	625	875	906	924

From NASA presentation to the AAS 5/2011

JWST Project/Program Stoplight History



Progress according to plan, all commitments can be met

Area of concern, problem can be resolved within reporting organization resources

Significant Problem, Solution not identified, Needs action/help beyond reporting organization

* Delivery of microshutters to ESA, NIRCam design modifications completed, positive news on NIRSpec detectors

8/26/11

From NASA presentation to the Astrophysics Subcommittee of the NAC 7/2011