Astrophysics Division Update

Presented to the

Astronomy & Astrophysics Advisory Committee

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Science Mission Directorate
NASA Headquarters

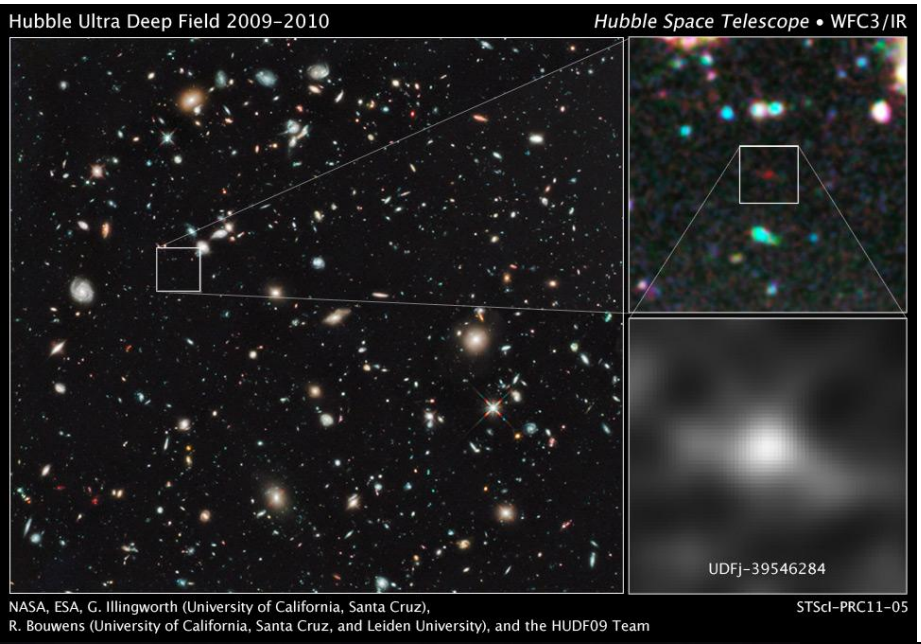
22 February 2011

Outline

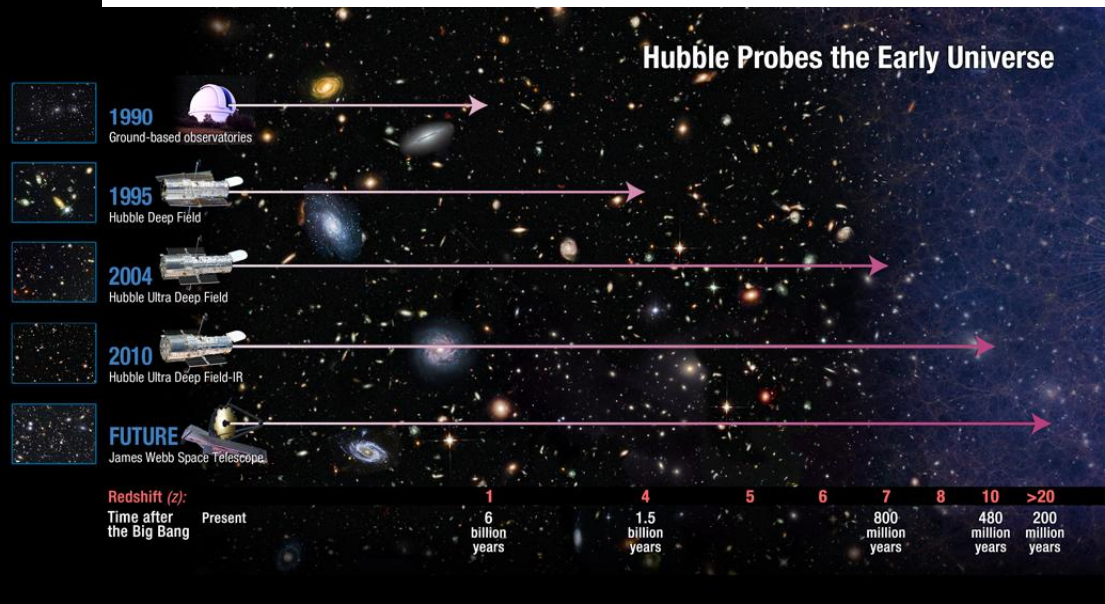
- Science Highlights
- Programmatic Update
- Budget Update
- Issues and Concerns

Hubble Finds Most Distant Galaxy Candidate Ever Seen in Universe

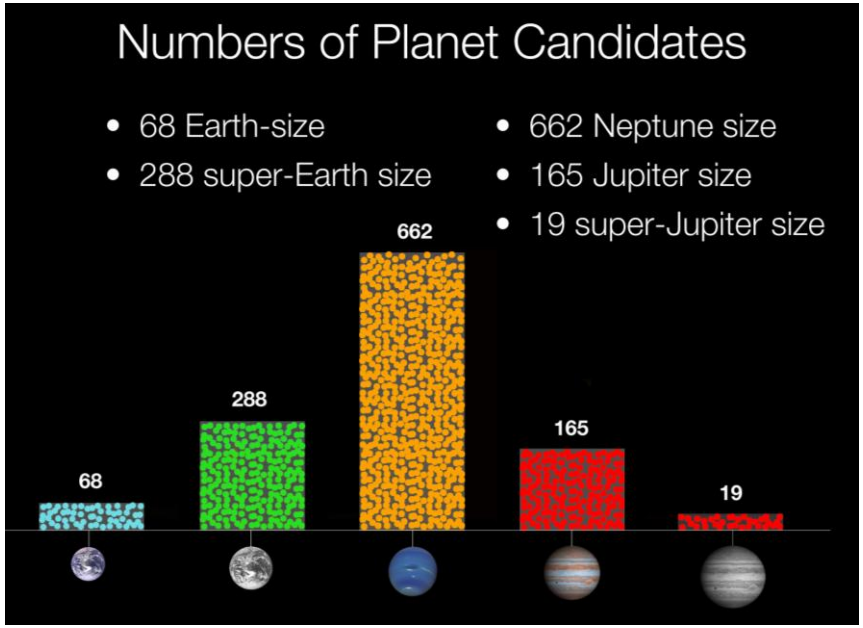
Astrophysics Division

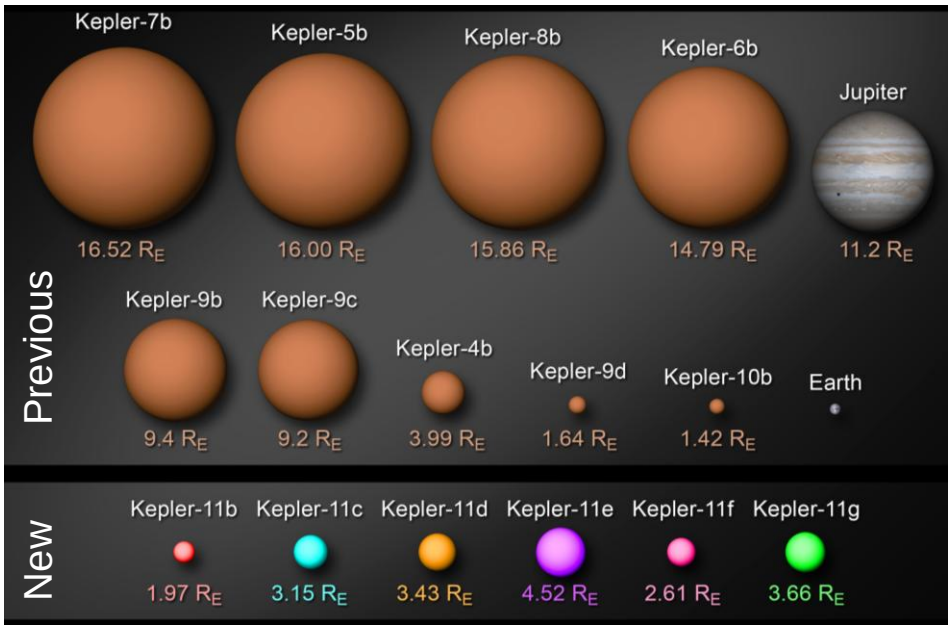


The farthest and one of the very earliest galaxies ever seen in the universe appears as a faint red blob in this ultra-deep–field exposure taken with NASA's Hubble Space Telescope. This is the deepest infrared image taken of the universe. Based on the object's color, astronomers believe it is 13.2 billion 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).



Kepler Mission Data Release



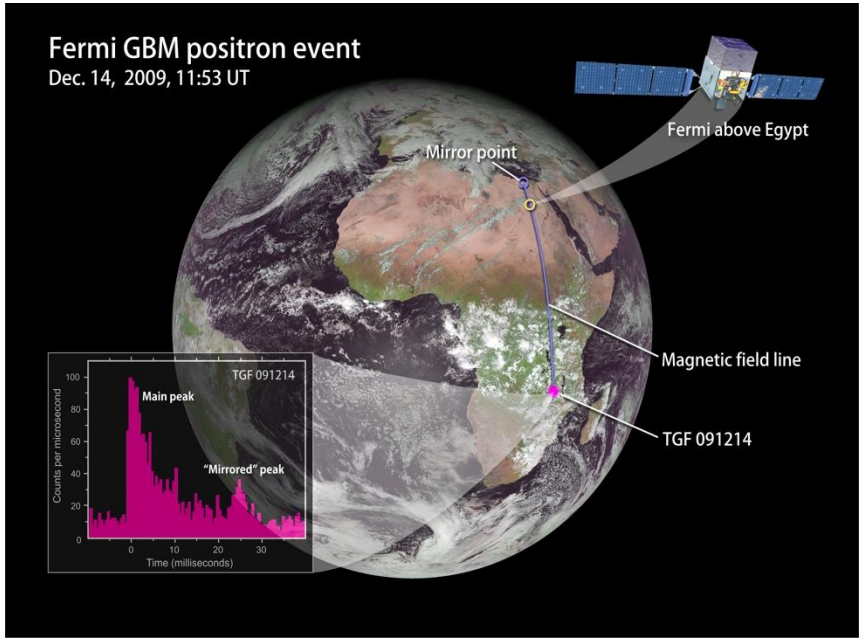


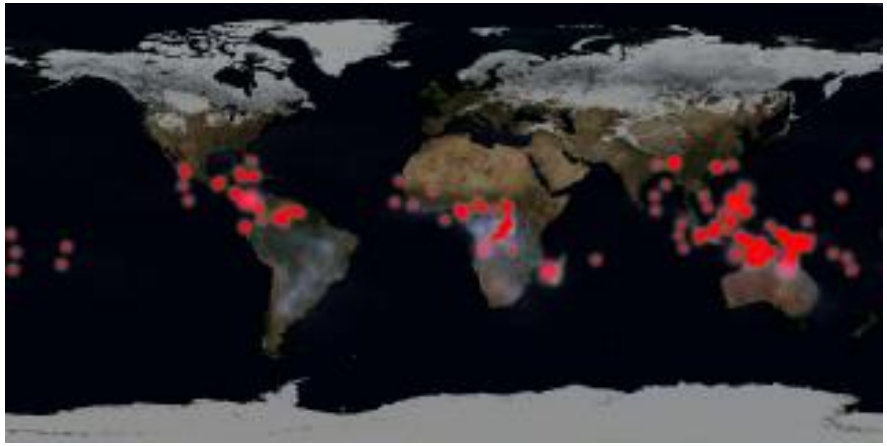
- Kepler has released data on 155,453 stars and on the 1,235 planetary candidates that it has discovered in the first 4 months of science operations.
- The planetary candidates include: 68 of Earth-size, 288 of super-Earth-size, 662 of Neptune-size, 165 of Jupiter-size, and 19 larger than Jupiter.
- 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.

- 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.

Fermi Update

- Fermi was the most productive prime mission in 2010 and in 2009 with 1.1% and 0.8 % of all science discoveries for these two years as reported by Science News .
- Call for Cycle 4 recently closed.
- More than 200 proposals received (about 10% increase from Cycle 3).



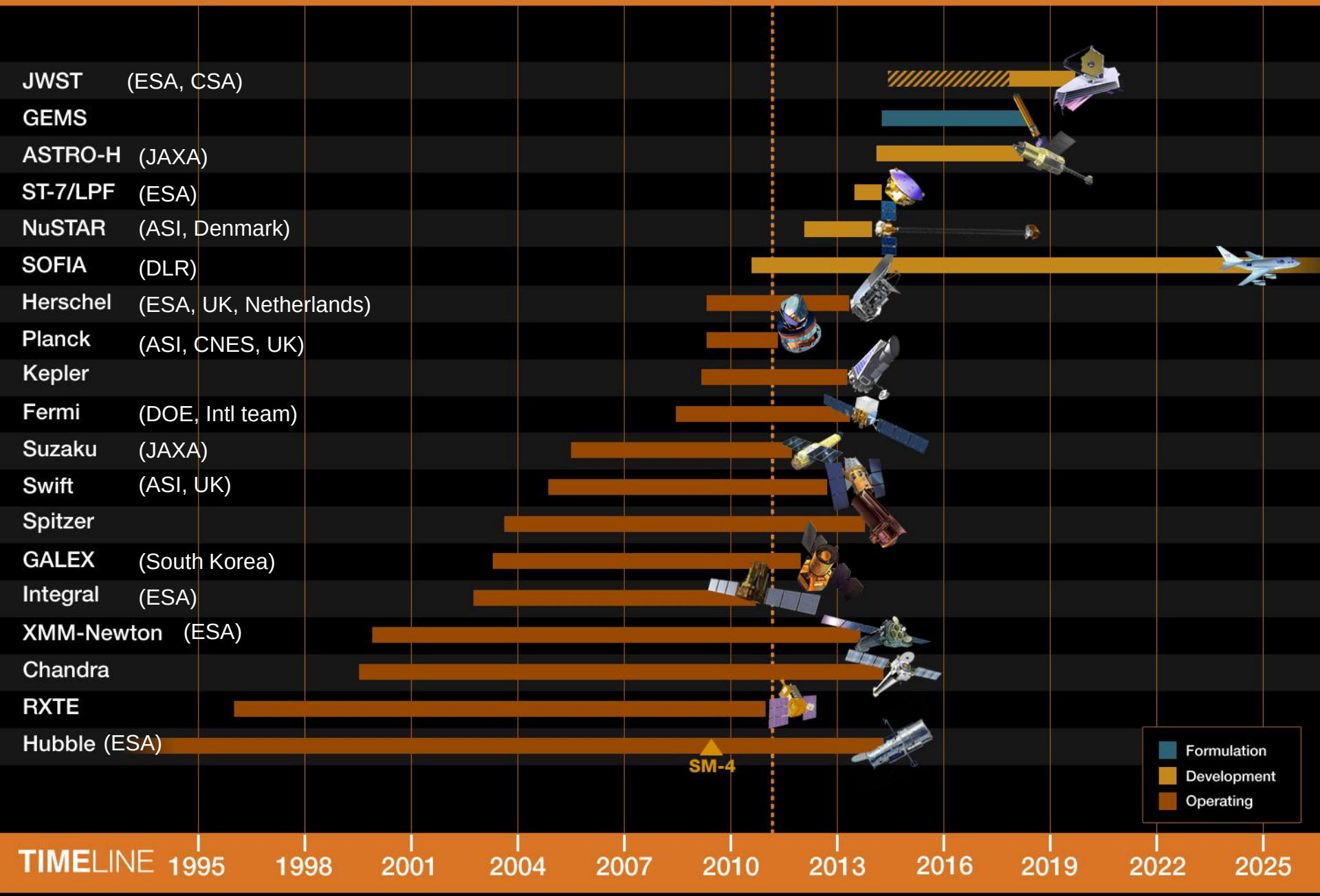


Map of all terrestrial gamma-ray flashes detected by Fermi's Gamma-ray Burst Monitor through the end of 2010.

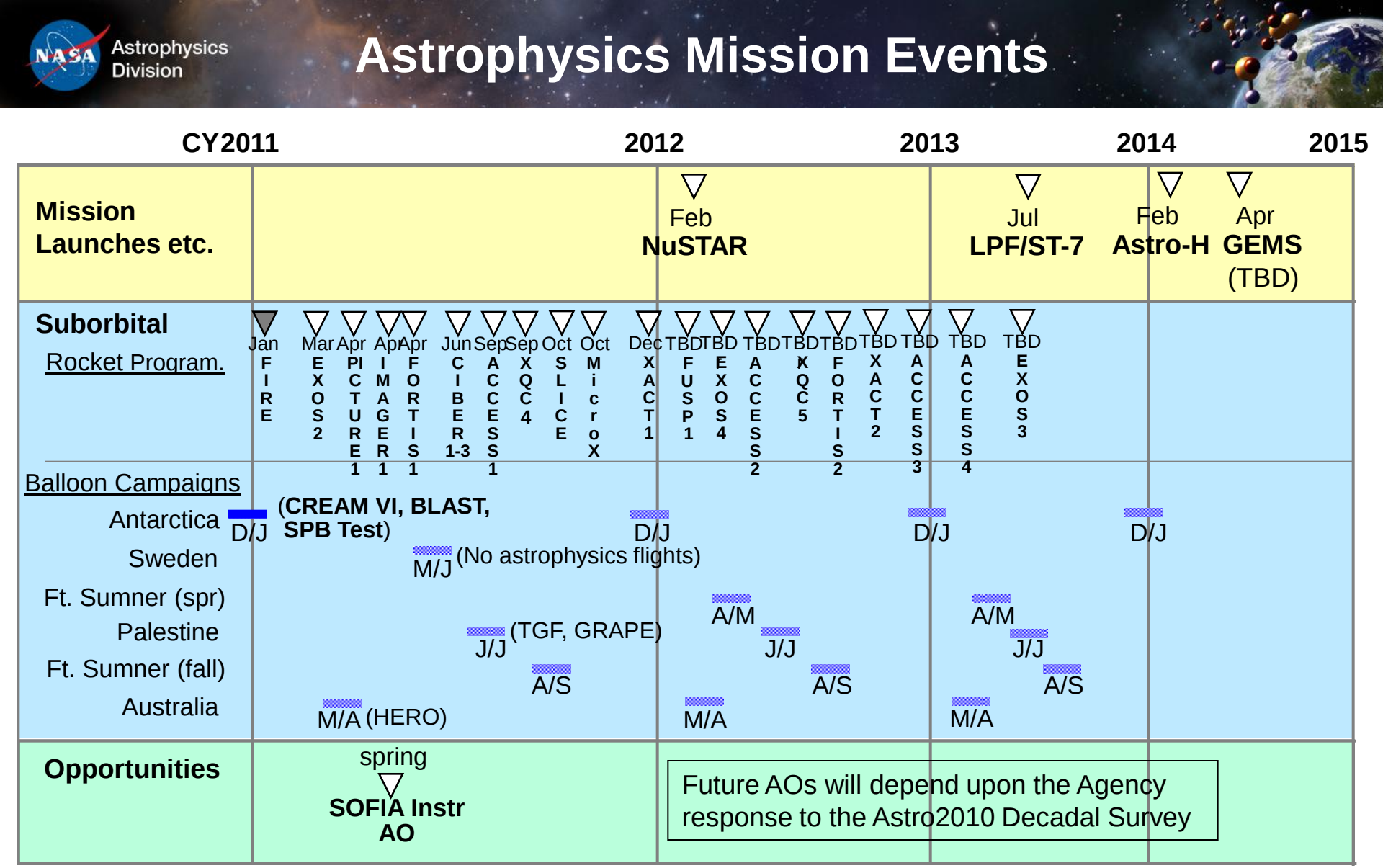
Programmatic Update

Astrophysics Missions timeline

Next Senior Review in 2012



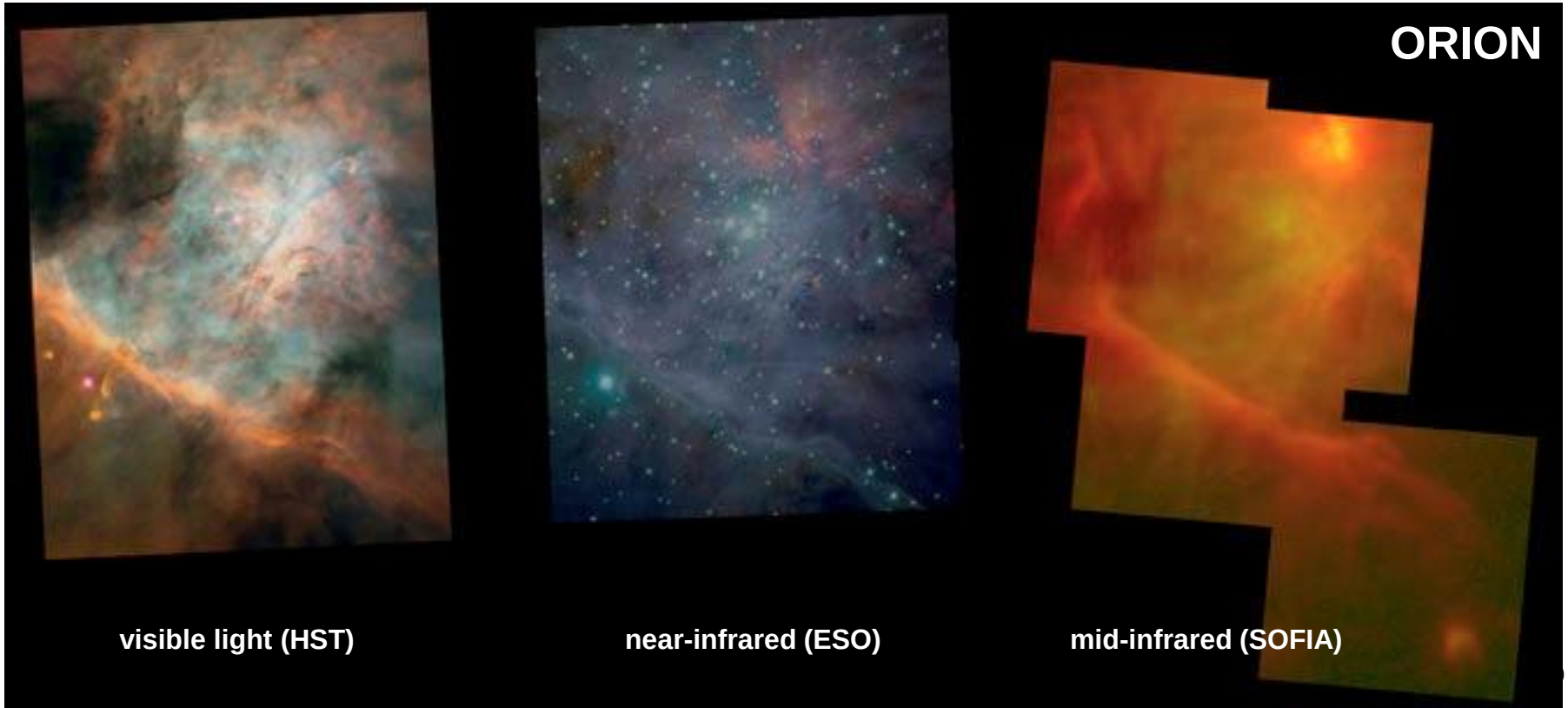
Astrophysics Mission Events



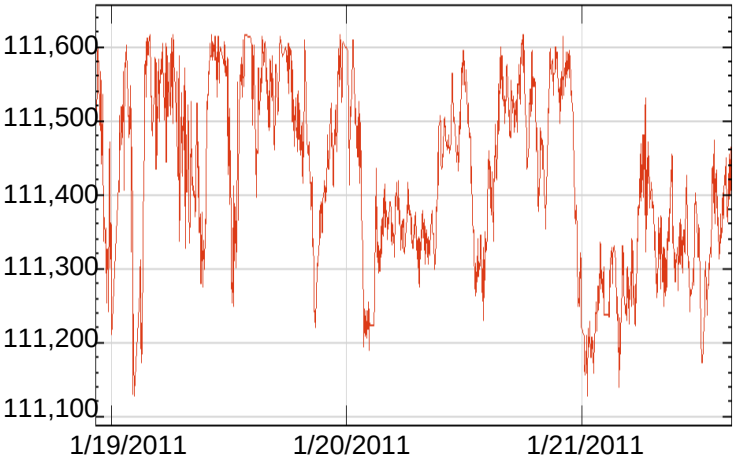
Last Updated: February 7, 2011

SOFIA

- Completed Short Science #1 Flight Series with FORCAST instrument. (see below)
- Released Draft AO for Second Generation Instruments on Dec. 15.
- Completed two nights of on-aircraft testing with GREAT simulator on Dec. 16. GREAT flights planned to start in early April 2011.
- German State Secretary, Federal Ministry of Economics and Technology, Jochen Homann, visited SOFIA Science Project at ARC on Dec. 17.



Balloon Program – Antarctic Campaign



Altitude of Superpressure Balloon in Feet

- **CREAM VI** *(Cosmic Ray Energetics & Mass) - investigating high-energy cosmic-ray particles that originated from distant supernovae explosions in the Milky Way that reach Earth. (Seo - Univ. of MD)*
  - Launched 12-20-2010.
  - Unplanned flight termination after 5 days 16 hrs. Payload recovered, with instrument intact.
  - Minimum science requirements were achieved.
  - Flight termination cause unknown pending outcome of an Anomaly Review Board.

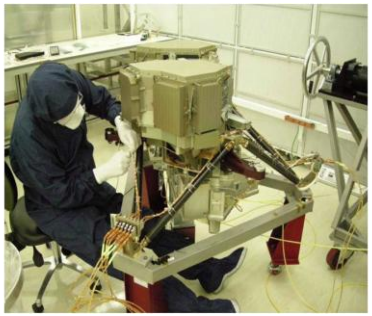
14 MCF Superpressure Balloon

- **BLAST** *(Balloon Large Aperture Submillimeter Telescope) - investigating how magnetic fields impede star formation in our galaxy. (Devlin - UPenn)*
  - Launched 12-26-2010.
  - Flew nine days with nominal science operation.
  - Payload recovery is complete.
- **14 MCF Superpressure Balloon** – *development flight*
  - Launched 1-9-2011.
  - Flew ~22 days with nominal operation
  - Payload completely recovered.

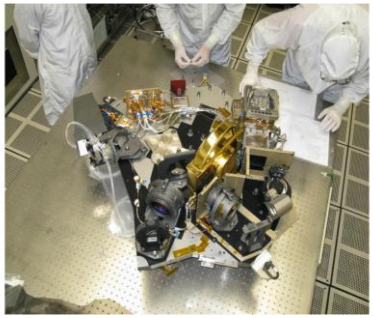
JWST Status

- Program Reorganized at HQ and GSFC
  - HQ office reports directly to SMD AA and NASA AA
  - GSFC project reports to Center Director
- Re-planning program for new launch date, process to complete in late Spring/Early Summer 2011
- CY2011 major year for hardware delivery
  - Primary segments complete late summer
  - NIRSpec, MIRI delivered Summer
  - FGS delivered Fall
  - NIRCam, late 2011

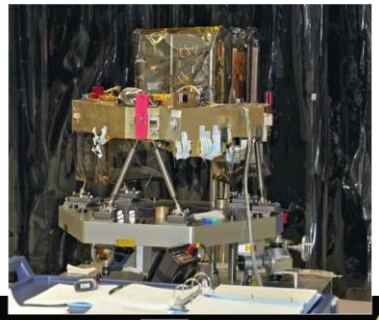
Flight MIRI



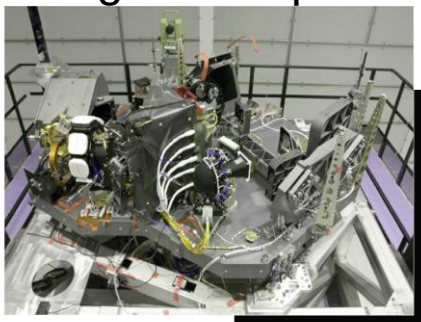
NIRCam ETU

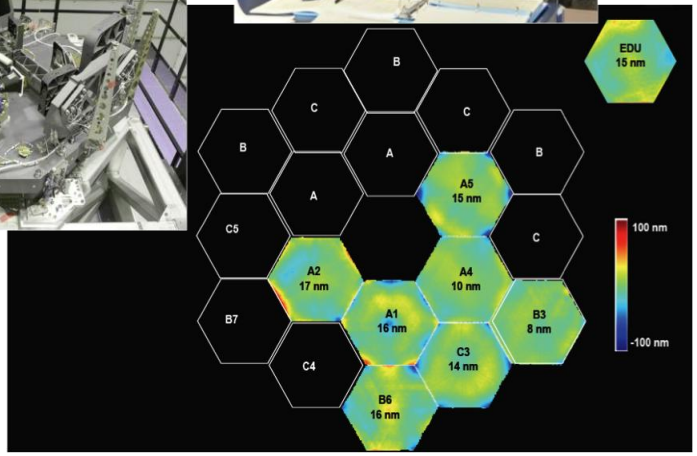


Flight FGS/TF



Flight NIRSpec





Completed Mirror Segments

WFIRST Status

- The Wide-Field Infrared Survey Telescope (WFIRST) is a NASA observatory designed to address essential questions in both exoplanet and dark energy research and to perform other large-area IR surveys of the sky.
- Astro2010's highest priority large space mission.
- Update:
  - Call for Science Definition Team (SDT) received 82 nominations.
  - SDT members selected
    - Acceptance letters sent on Dec 16, 2010
  - SDT kickoff telecon in Jan 3, 2011
  - WFIRST science booths at the Seattle AAS
  - First SDT face-to-face meeting Feb 3-4 at GSFC
- Next Steps:
  - Second in-person meeting March 10-11 at JPL
  - Delivery to NASA of interim report Summer 2011

Members of the Science Definition Team (SDT):

J. Green, CU/CASA, *Chair*
P. Schechter, MIT, *Chair*

R. Bean, Cornell University
C. Baltay, Yale
C. Bennett, JHU
D. Bennett, Univ. of Notre Dame
R. Brown, STScI
C. Conselice, Univ. of Nottingham
M. Donahue, Michigan State University
S. Gaudi, Ohio State University
T. Lauer, NOAO
B. Nichol, Univ. of Porthsmouth
S. Perlmutter. Univ. of Berkeley/LBLN
B. Rauscher, GSFC
J. Rhodes, JPL
T. Roellig, Ames
D. Stern, JPL
T. Sumi, Nagoya University
A. Tanner, Georgia State University
Y. Wang, Univ. of Oklahoma
E. Wright, UCLA

Budget Update

Science Mission Directorate Summary

Astrophysics Division

Budget Authority ($M)	FY 2010 Actual	FY 2011 CR	FY 2011 Auth Act	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Science	**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
Earth Science Research	375.8			409.6	419.0	427.3	436.7	444.6
Earth Systematic Missions	705.2			816.5	838.7	761.6	763.2	810.7
Earth System Science Pathfinder	128.4			187.8	180.6	229.5	238.4	214.3
Earth Science Multi-Mission Operations	149.0			159.9	158.8	159.4	162.9	166.6
Earth Science Technology	45.6			46.1	47.9	51.9	53.6	54.2
Applied Sciences	35.3			33.1	34.3	35.5	36.7	36.9
Planetary Science	1,364.4	-	1,485.7	1,488.9	1,365.7	1,326.4	1,271.0	1,188.9
Planetary Science Research	161.6			183.9	196.0	208.6	208.4	210.5
Lunar Quest Program	94.5			114.5	81.2	48.9	28.1	19.5
Discovery	184.5			175.6	205.1	245.7	265.5	242.8
New Frontiers	279.6			176.9	265.8	245.5	291.1	296.3
Mars Exploration	438.2			594.4	433.1	408.7	309.0	245.9
Outer Planets	100.6			120.8	80.5	82.2	84.1	88.5
Technology	105.5			122.9	104.1	86.6	84.9	85.4
Astrophysics	647.3	-	1,076.3	637.7	708.3	721.0	713.5	741.9
Astrophysics Research	149.1			161.6	200.1	211.8	229.3	238.6
Cosmic Origins	225.3			219.7	219.4	209.9	195.2	184.5
Physics of the Cosmos	116.0			100.3	112.4	111.9	98.1	96.8
Exoplanet Exploration	43.4			48.2	65.5	63.6	62.1	69.8
Astrophysics Explorer	113.5			107.8	110.9	123.7	128.7	152.0
James Webb Space Telescope	438.7	-	-	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
Heliophysics Research	171.8			144.5	147.5	149.3	149.5	150.8
Living with a Star	221.9			204.7	202.2	200.9	336.3	354.9
Solar Terrestrial Probes	148.0			163.5	170.4	171.9	50.2	38.0
Heliophysics Explorer Program	65.1			65.2	70.8	90.2	91.1	84.9
New Millennium	1.2							
SCMD Civil Service Labor and Expenses	-	-	-	304.7	313.2	326.5	342.2	358.6

FY13-FY16 estimates are notional

Astrophysics Program Budget Strategy

- Respond to decadal survey recommendations with augmentations to the Explorer program, Balloon program, Astrophysics research program, and technology development, but defer initiating the next large mission beyond JWST
- Support missions in prime operations (Herschel, Planck, Fermi, Kepler, and HST)
- Complete integration of NuSTAR for a Feb 2012 launch
- SOFIA will continue to ramp up science flight hours to achieve full operating capability (FOC) by 2014 and will develop the second generation of instruments
- Continue development/implementation of Astro-H for a Feb 2014 launch
- Continue formulation and development of GEMS for an Apr 2014 launch
- Use Senior Review recommendations to prioritize funding for missions in extended operations

Innovate, Educate, Build

"To reach new heights and reveal the unknown so that what we do and learn will benefit all humankind."

What's Changed and What's the Same

What's changed:

- JWST project was moved to its own Theme within the Science Mission Directorate
- The Explorer program is being split into two pieces such that Astrophysics and Heliophysics will manage their own Explorers resources beginning in 2012
- **A Future Astrophysics Explorer missions budget was created in response to the Decadal Survey recommendation to increase the flight rate of astrophysics missions and missions of opportunity.**
- Support for concept planning and technology development for decadal survey large mission priorities (WFIRST, LISA, IXO) under supporting research and technology lines
- Augmented budgets for decadal survey medium &small technology and R&A initiatives
- **SOFIA budget increased to restore science and preserve 2nd generation instrument selection and development**
- NuSTAR LRD now February 2012 to accommodate launch services availability
- ASTRO-H confirmed for implementation; GEMS approved for Phase B and budget re-phased
- Extended support for top ranked missions in the 2010 Senior Review, but support for RXTE and GALEX extended operations and the INTEGRAL and Suzaku Guest Observer programs will terminate by the end of FY2011
- JDEM &SIM projects have been closed out; not recommended by the Decadal Survey
- Reductions to operations and guest observer programs for Chandra, HST, and Swift

What's the same:

- Herschel, Kepler, Fermi, and Keck operations

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

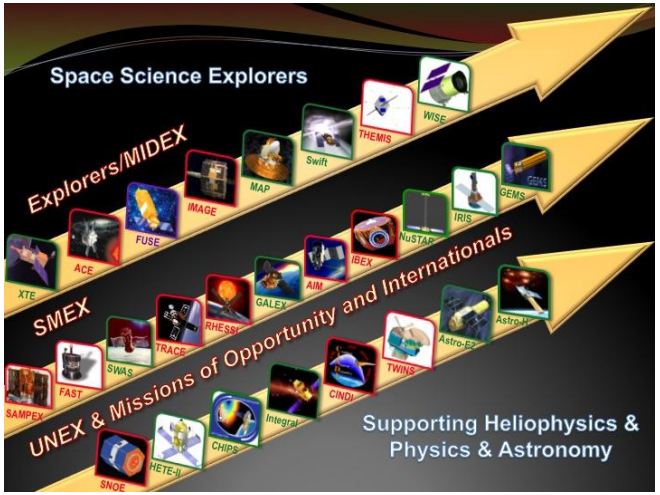
Astro2010 Decadal Survey Summary

- New Worlds, New Horizons Decadal Survey science themes well aligned to those of NASA's Astrophysics Program:
  - Cosmic Dawn → Cosmic Origins
  - New Worlds → Exoplanet Exploration
  - Physics of the Universe → Physics of the Cosmos
- The survey chose a budget scenario comprising constant FY10 dollars into the future, which is higher than NASA's guidance and the projected Astrophysics budget
- This was the first NRC decadal survey for NASA that included independent cost analysis of candidate mission concepts
- The survey aimed for an integrated scientific program of space-based and ground-based observation and science.
- Agency Response:
  - Support for mission concept planning and technology development relevant to the survey's highest priority Large space mission: Wide Field Infrared Survey Telescope (WFIRST). NASA is also exploring a potential partnership with the European Space Agency (ESA) on its proposed Euclid dark energy mission consistent with Option B (A Joint WFIRST/Euclid Mission) from the National Research Council's "Report of the Panel on Implementing Recommendations from the New Worlds, New Horizons Decadal Survey."
  - A Future Astrophysics Explorer missions budget was created to increase the flight rate to achieve the recommended four missions and four missions of opportunity selected by the end of the decade.
  - Augmenting investments in core research and technology programs, including the suborbital program (sounding rockets and balloons), theory, laboratory astrophysics, etc.

Explorer Augmentation

- NWNH Recommendation:

The committee therefore recommends, as its second priority in the large category of space-based projects, that NASA should support the selection of two new astrophysics MIDEX missions, two new astrophysics SMEX missions, and at least four astrophysics MoOs over the coming decade. AOs should be released on a predictable basis as close to annually as possible, to facilitate Missions of Opportunity. Further, the committee encourages inclusion of suborbital payload selections, if they offer compelling scientific returns.



- A Future Astrophysics Explorer missions budget was created to increase the flight rate to achieve the recommended four missions and four missions of opportunity selected by the end of the decade:

	FY11 PBR	FY12	FY13	FY14	FY15	FY16
Astro Explorers Future Missions		9	57	96	127	151

- Notional Mission Selection Dates:
  - 2012 EX 1 (current AO)
  - 2014 SMEX 1
  - 2016 EX 2
  - 2018 SMEX 2

FY13-16 are notional estimates

NWNH Decadal Recommended Space Activities (Notional Plan)

Astrophysics Division

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

Research & Analysis Distribution (notional)

($ 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**

Planning and Coordination

- DSIAC formation progress/process
  - NASA is working with the NRC and other agencies to establish appropriate advisory structure to fulfill the functions described in NWNH
  - Must be compatible with needs and mechanisms for agency chartering and funding of NRC panels/committees; NASA Advisory Council structure and role; Congressionally-chartered Astronomy and Astrophysics Advisory Committee (AAAC) role; and the advisory needs of other relevant agencies (NSF, DOE) and other SMD divisions who have their own decadal surveys…
- International planning
  - How to plan strategic coordination and cooperation
    - Working with other space agencies with similar goals and interests (e.g., ESA Cosmic Vision process, etc.)
  - Considering possible 2012 conference…

Issues & Concerns

- FY 2011 Budget completion
- JWST re-baseline
- Usage of advisory structure
- Future implementation of WFIRST, LISA, IXO; SPICA
- ST-7 timeliness
- FY12 budget reduction ramifications (GALEX, Suzaku,…)

Backup Slides

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	3,185	3,338	7,000	8,200	8,300	10,000
ST-7		974	947	500	15	
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

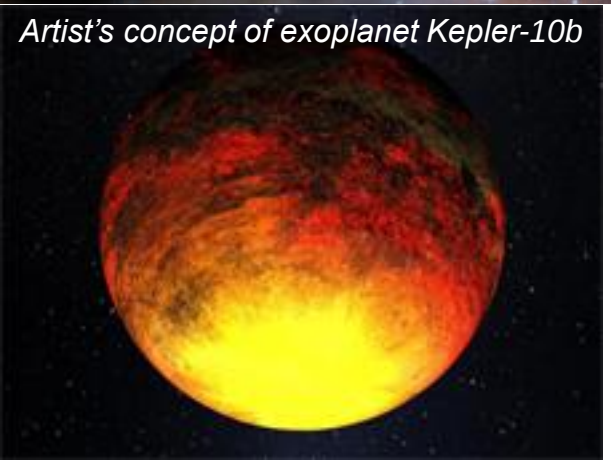
Press Releases at AAS

	Project	Subject
1	Chandra	Image of M82
2	Chandra	A black hole with remarkable X-ray variability
3	Fermi	Variability/Gamma-ray flares in the Crab Nebula
4	Fermi	Electron-positron annihilation in thunderstorms
5	Hubble	Hanny's Voorwerp
6	Hubble	NICMOS image of M-51
7	Hubble	Highest redshift galaxies to-date
8	Hubble	Red dwarf flaring at galactic bulge
9	Kepler	First Kepler rocky planet
10	Planck	Catalogue release and candidate characteristics
11	SOFIA	First science image: Orion Nebula
12	Spitzer	Interpreting cepheid variables (universe's age/fate)
13	Spitzer	Proto cluster of galaxies (first billion years)
14	WISE	Image of M81 and M82

Press Releases Since AAS

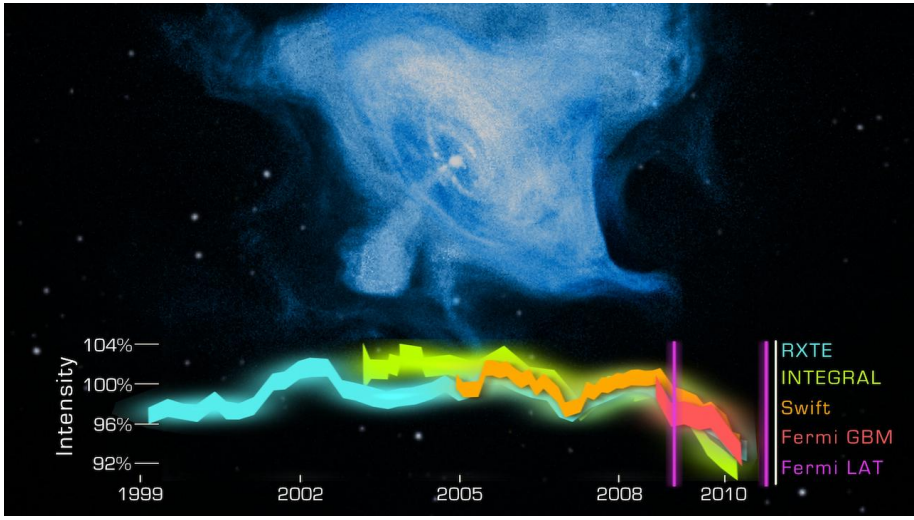
Date	Project	Subject
Jan 20	Fermi	Peter Michelson (Stanford) and Bill Atwood (UC, Santa Cruz) win the ROSSI prize
Jan 26	Hubble	Most distant Galaxy candidate ever seen
Feb 1	WISE	NEOWISE completes scan for asteroids and planets
Feb 2	Kepler	Earth-size planet candidates in habitable zone
Feb 2	Kepler	Six small planets orbiting a sun-like star
Feb 9	Chandra	Chandra image release of "giant ring of black holes"

Three Results from the American Astronomical Society Meeting

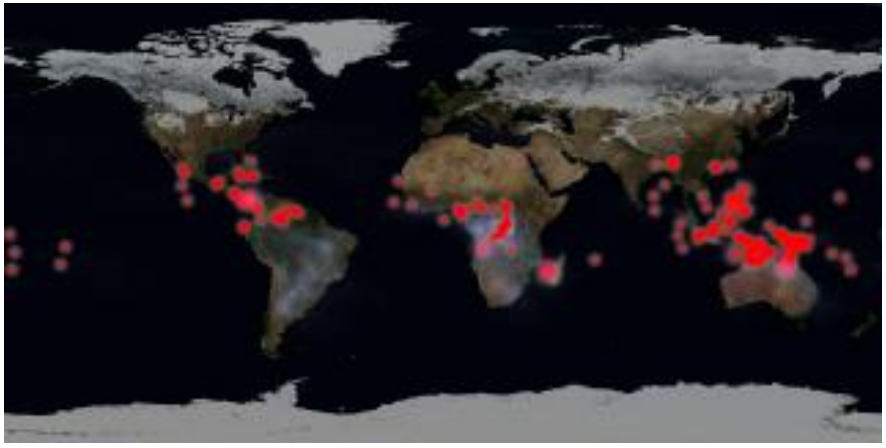


Artist's concept of exoplanet Kepler-10b

NASA's Kepler mission confirmed the discovery of its first rocky planet, named Kepler-10b. Measuring 1.4 times the size of Earth, it is the smallest planet ever discovered outside our solar system. It has a mass 4.6 times that of Earth, with an average density of 8.8 grams per cubic centimeter – similar to that of an iron dumbbell.



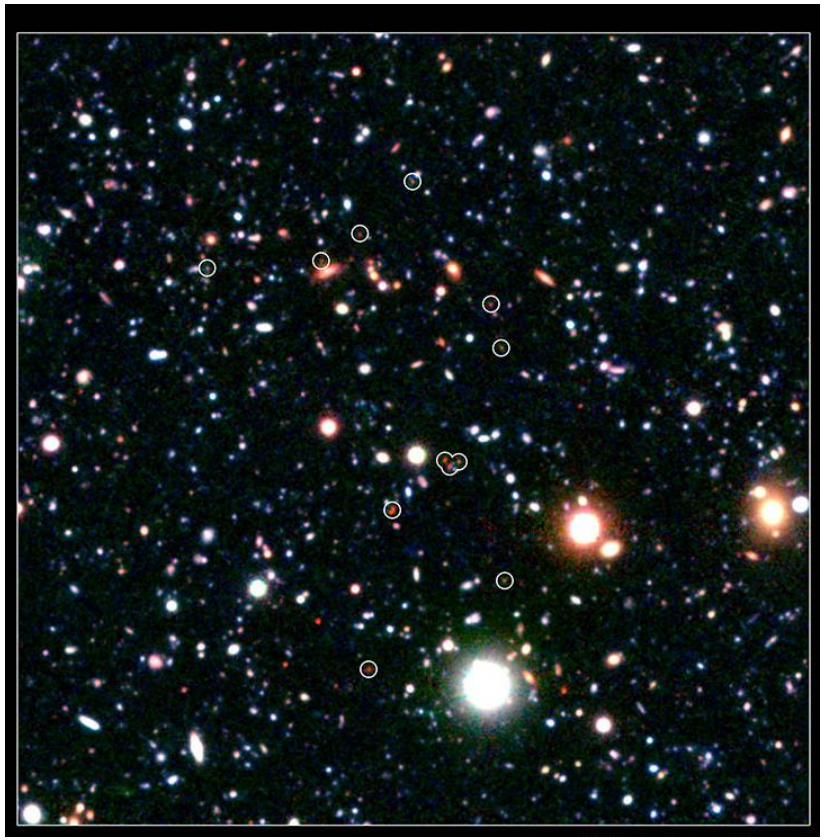
The Crab Nebula, created by a supernova seen nearly a thousand years ago, is one of the sky's most famous "star wrecks." For decades, most astronomers have regarded it as the steadiest beacon at X-ray energies, but data from NASA and ESA orbiting observatories show unexpected variations, telling astronomers their hard X-ray "standard candle" is not as steady as they once thought.



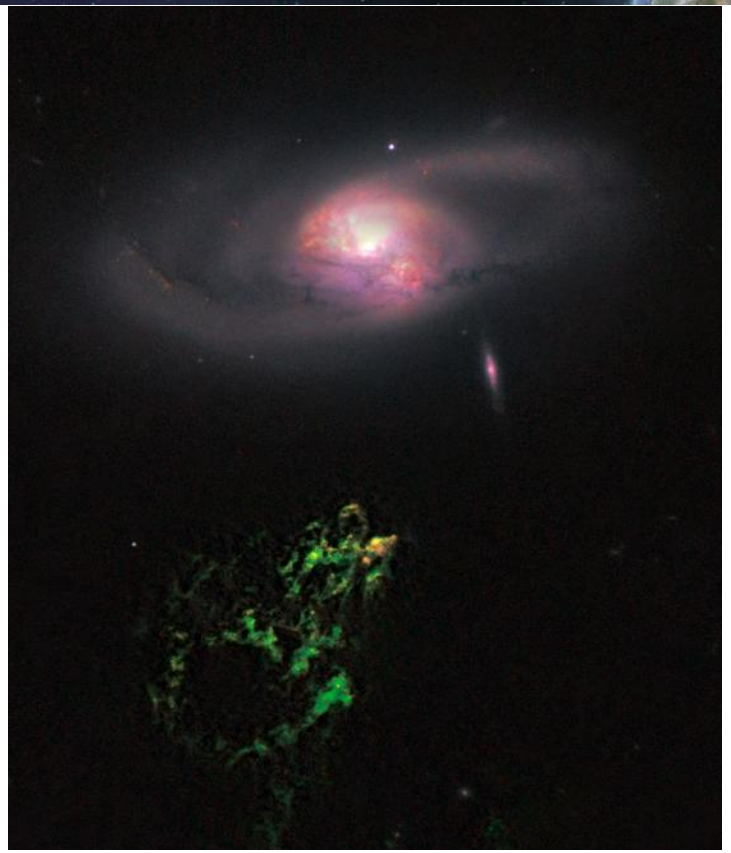
Map of all terrestrial gamma-ray flashes detected by Fermi's Gamma-ray Burst Monitor through the end of 2010.

Scientists using NASA's Fermi Gamma-ray Space Telescope have detected beams of antimatter produced above thunderstorms on Earth, a phenomenon never seen before. Scientists think the antimatter particles were formed in a terrestrial gamma-ray flash (TGF), a brief burst produced inside thunderstorms and shown to be associated with lightning. It is estimated that about 500 TGFs occur daily worldwide, but most go undetected.

More Results from the American Astronomical Society Meeting



Astronomers have uncovered a burgeoning galactic metropolis, the most distant known in the early universe. The developing cluster, named COSMOS-AzTEC3, was discovered and characterized by multi-wavelength telescopes, including NASA's Hubble, Chandra and Spitzer space telescopes, and the ground-based W.M. Keck Observatory and Japan's Subaru Telescope. Scientists refer to this growing lump of galaxies as a proto-cluster. COSMOS-AzTEC3 is the most distant massive proto-cluster known, and also one of the youngest, because it is being seen when the universe itself was young.



In this Hubble Space Telescope image, an unusual, ghostly green blob of gas appears to float near a normal-looking spiral galaxy. The object, dubbed Hanny's Voorwerp (Hanny's Object in Dutch), is the only visible part of a 300,000-light-year-long streamer of gas stretching around the galaxy, called IC 2497. The greenish Voorwerp is visible because a searchlight beam of light from the galaxy's core illuminated it. This beam came from a quasar, a bright, energetic object that is powered by a black hole. The quasar may have turned off about 200,000 years ago.

GEMS and ST-7 Update

GEMS:

- GEMS is in Phase-B with proactive steps being taken to reduce risk and prepare for a successful Confirmation Review to enter development later this year
  - SAIC conducted an independent an ICE as the request of APD and was completed in January 2011
  - Project is currently performing a rebaseline assessment per Astrophysics Division direction, due March 11, 2011
- Polarimeter TRL-6 activities continue to make progress and will be completed prior to instrument PDR

ST-7:

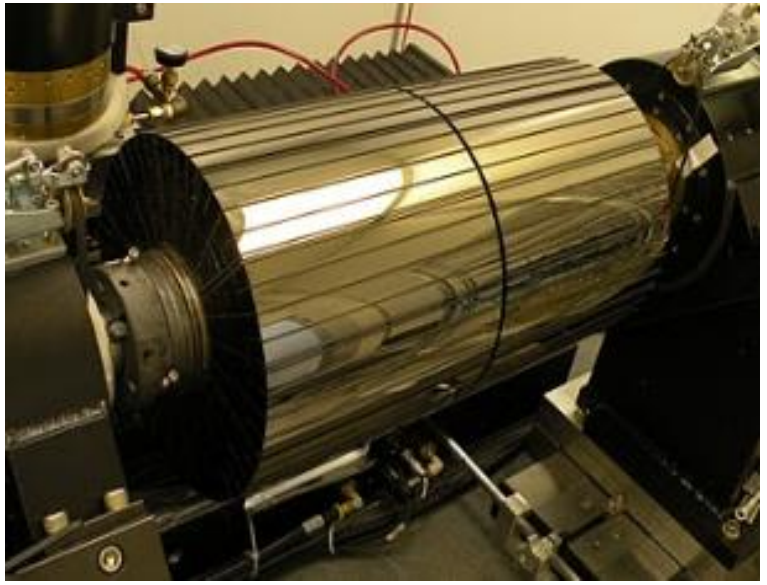
- Extended lifetests of microcolloid thrusters are underway and yielding acceptable results to date.
- ESA continues to experience difficulties with their FEEP thruster development. They are undertaking a trade study to evaluate four different options for moving forward. One of the four is to implement the NASA microcolloid thrusters as the primary positioning thrusters. ESA has requested NASA technical expertise and data support for the trade study.

ST-7 flight design microcolloid thruster assembly

NuSTAR and Astro H Update

NuSTAR

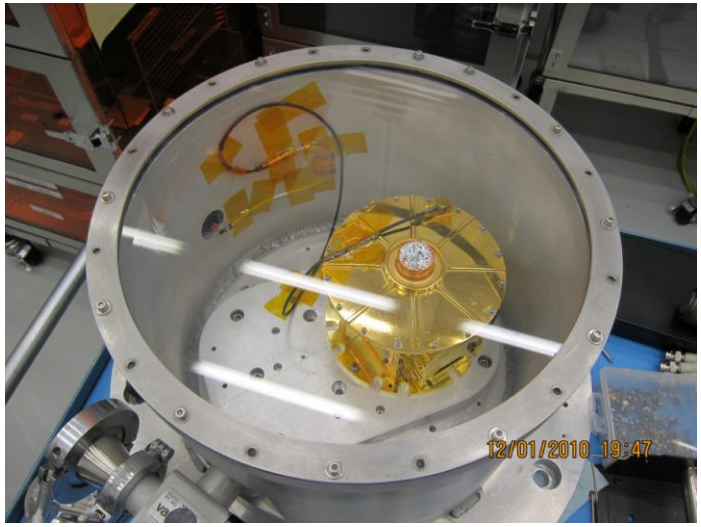
- Instrument I&T currently in progress at JPL, with completion planned for mid-April.
- Reaction wheels were pulled from the spacecraft to be sent to Honeywell for cleaning the contaminated lubricant.
- NuSTAR System Integration Review Jan. 27-28 at Caltech.
- NuSTAR Observatory completion currently planned for November 2011 in support of a February 2012 launch from Kwajalein Island.



NuSTAR Flight Optics Module nearing completion

Astro-H

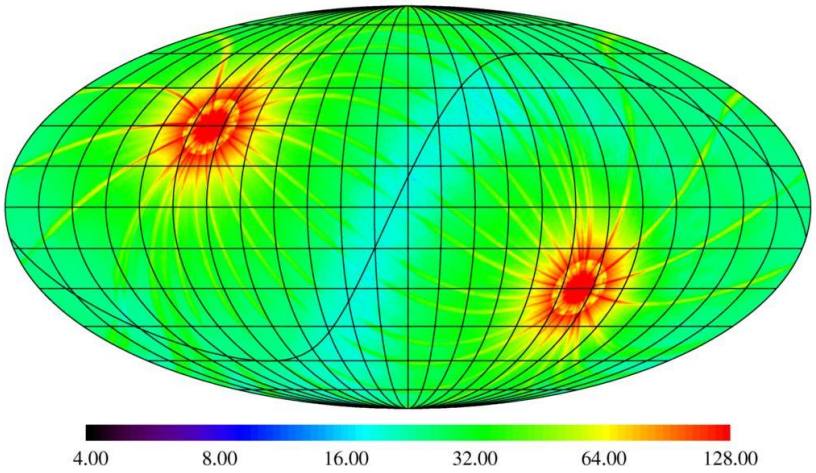
- SMD DPMC held February 8, 2014. Project presented detailed plan to maintain schedule while working within approved 70% CL profile. DPMC approved release of $7.2M in cost reserves ($3.8M in FY11, $3.4M in FY12).
- Astrophysics Division will conduct a formal review of project's progress during April 2011 to evaluate whether the new plan is on track.
- Design Meeting at JAXA is 2/21-2/22.
- Science Working Group Meeting at JAXA 2/23-2/24.



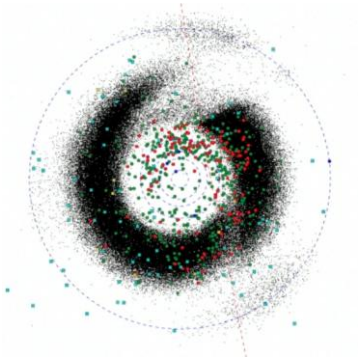
Astro-H SXS EM Detector Assembly inside text fixture for vibration test

WISE: Mapping the Infrared Sky

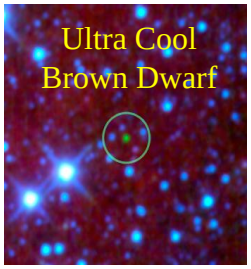
Astrophysics Division



Exposures per Position



NEOs, Asteroids, Comets



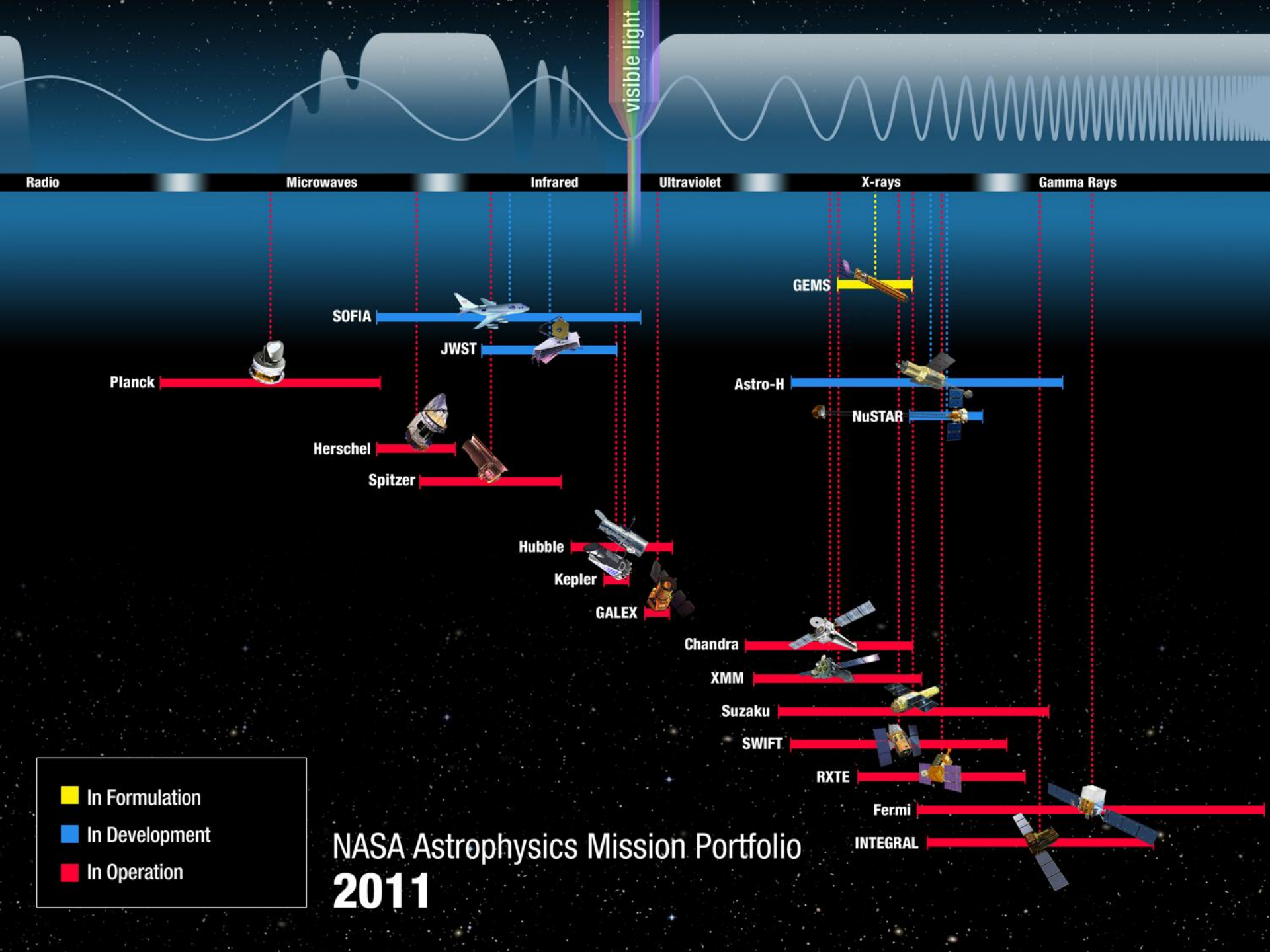
- Initially Proposed in 1998
- Re-proposed in 2001
- Launched Dec. 14, 2009
- First Light Image Released Jan. 6, 2010
- Survey Started Jan. 14
- Early Release Observations Feb. 17
- First Pass on Sky Completed July 17

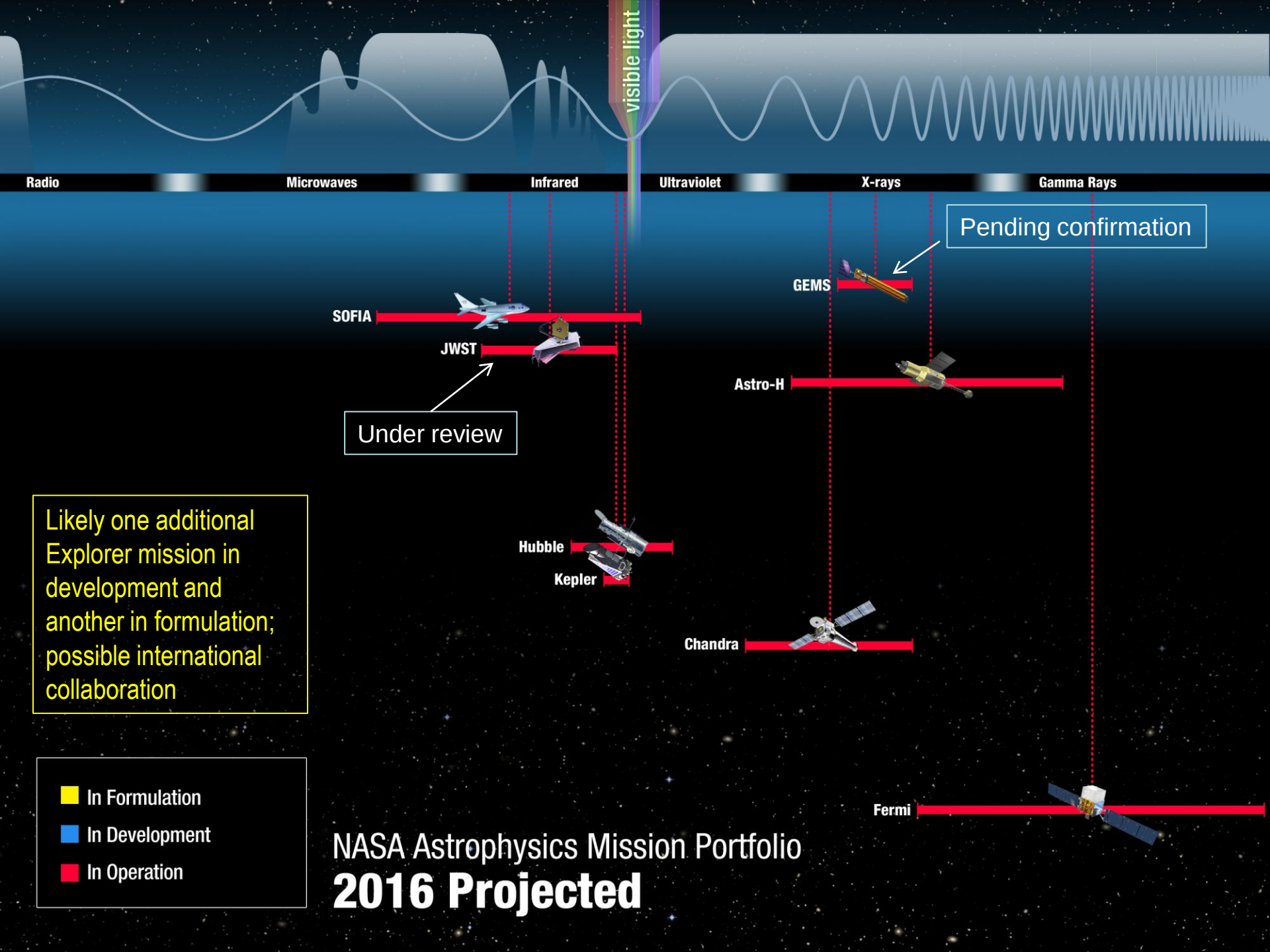
- **Cryogenic Survey Ended Sept. 30**
- **Completed Post Cryo NEOWISE Survey Oct. 1, 2010 - Feb. 1, 2011**
- **Started Decommission Procedures Feb. 1, 2011**

- Preliminary Data Release April 2011
- Final Data Release March 2012

Upcoming Events

- **Explorer/MoO Proposals due today!**
- AAAC telecon Feb 22-23
- WISE decommissioning end of Feb
- Fermi: Users group meeting 2/22
- Astro-H: SXS Design Meeting at JAXA, 2/21-22.
- Keck/IRTF MOWG Meeting 2/14-16, Keck Observatory Office, Waimea and U. of Hawaii, IRTF Project Office, Hilo, HI
- Planck: Workshop 2/21-23, Princeton
- NuSTAR: KDP-D planned for 3/7
- WFIRST SDT**:** Face-to-face meeting at JPL, 3/10-11.
- Scientific conference on "Signposts of Planets", NASA GSFC, 3/12-14
- JWST: SWG meeting at Redondo Beach, CA on 3/9-10
- SPICA Focal Plane Array Science Reviews, 3/14
- Astrophysics Archives Senior Review, 5/17-19
- AAS #218: Boston 5/22-26
- GEMS: Preliminary Design Review, Second half of 2011
- SOFIA: begins Early Science GO observations, Summer 2011
- SOFIA: Instrument AO issued, Late Spring 2011


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
INTEGRAL
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
Under review
Astro-H
Hubble
Kepler
Chandra
Fermi
Likely one additional Explorer mission in development and another in formulation; possible international collaboration
In Formulation
In Development
In Operation
NASA Astrophysics Mission Portfolio
2016 Projected

SPICA

- **SP**ace **I**nfrared telescope for **C**osmology and **A**strophysics (SPICA)
- 3.0m-class Infrared Space Telescope
- Operating at < 6K (sky-limited)
- Wavelength range: 5-210 mm
- 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 mm - 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; 5-27mm, contrast <10-4 - Japan)
- **SAFARI** (far-IR imaging spectrometer [FTS]: 35-210 mm, R~20-2000 - ESA)
- **"US Instrument"** (far-IR/sub-mm spectrometer; ~40-400 mm, R~700 - NASA)
- **FPC** (near-IR Focal Plane Cameras for science & guiding; 1-5 mm - Korea)

Focal Plane Instrument (FPI) Science Review – late-March to end-June 2011

Astrophysics Division - Science Mission Directorate

January 31, 2011

Resource Management
Holly Degn +
David Darbouze +

Director
Jon Morse
Deputy Director
Geoff Yoder

Lead Secretary: Kelly Johnson
Secretary: Leslie Allen
Program Support Specialist: Sheila Gorham

Asst Dir for Innovation & Technology: Michael Moore (acting)
Asst Dir for Policy & Planning: Stephen Merkowitz (acting)

Communications

Division PAO POC: Ilana Harrus *
Division E/PO POC: Hashima Hasan
Information Manager: Lisa Wainio *

Astrophysics Research

Program Manager: Linda Sparke

Astrobiology: Doug Hudgins
Astrophysics Data Analysis: Doug Hudgins
Astrophysics Theory: Thierry Lanz *
Cosmic Ray: Vernon Jones
Gamma Ray/X-ray: Ilana Harrus *
Lou Kaluzienski
Wilt Sanders *
IR/Submillimeter/Radio: Doug Hudgins
Bill Danchi *
Chris Davis *
Optical/Ultraviolet: Mario Perez *
Hashima Hasan
ADCAR/Archives: Thierry Lanz
Astrophysics POC for Sounding rockets: Wilt Sanders *
Balloons Program: Vernon Jones (PS), Mark Sistilli (PE)

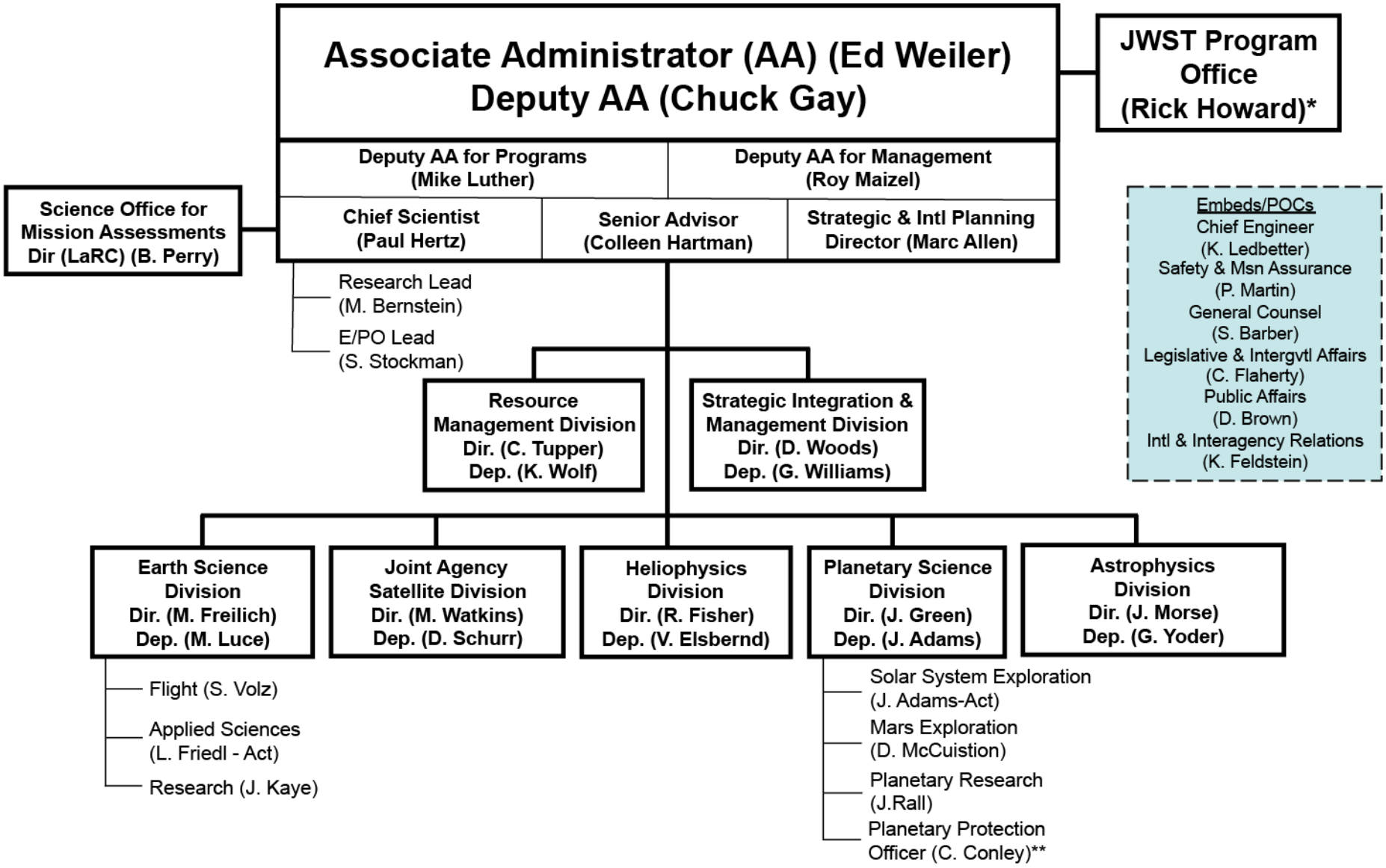
Programs / Missions

	Program Scientist	*Program Executive*
Exoplanet Exploration (EXEP)		
LEADS	**Doug Hudgins**	**Lia LaPiana**
Keck	Mario Perez *	Mario Perez *
Kepler	Doug Hudgins	Jaya Bajpayee *
LBTI	Mario Perez *	Michael Moore
NExScI	Mario Perez *	Lia LaPiana
WFIRST	Rita Sambruna	Lia LaPiana
Cosmic Origins (COR)		
LEADS	**TBD**	**Michael Moore**
Herschel	Bill Danchi *	Jaya Bajpayee *
HST Ops	Richard Griffiths *	John Gagosian
JWST	Hashima Hasan (acting)	N/A
SOFIA	Paul Hertz **	John Gagosian
Spitzer	Bill Danchi *	Jaya Bajpayee *
Physics of the Cosmos (PCOS)		
LEADS	**Rita Sambruna**	**Jaya Bajpayee ***
Chandra	Wilt Sanders *	Jaya Bajpayee *
Euclid	Richard Griffiths *	Lia LaPiana
Fermi	Ilana Harrus *	Jaya Bajpayee *
IXO	Wilt Sanders *	Michael Moore
LISA	Wilt Sanders *	Anne-Marie Novo-Gradac
Planck	Bill Danchi *	Jaya Bajpayee *
ST-7/LPF	Wilt Sanders *	Anne-Marie Novo-Gradac
XMM-Newton	Lou Kaluzienski	Jaya Bajpayee *
Astrophysics Explorers (APEX)		
LEADS	**Wilt Sanders ***	**(Willis Jenkins ***)**
Astro-H	Lou Kaluzienski	Anne-Marie Novo-Gradac
GALEX	Mario Perez *	Jaya Bajpayee *
GEMS	Lou Kaluzienski	Lia LaPiana
NuSTAR	Lou Kaluzienski	Mark Sistilli
RXTE	Ilana Harrus *	Jaya Bajpayee *
Suzaku	Lou Kaluzienski	Jaya Bajpayee *
Swift	Ilana Harrus *	Jaya Bajpayee *
WISE	Bill Danchi *	Jaya Bajpayee *
WMAP	Bill Danchi *	Jaya Bajpayee *

\+ *Member of the Mgmt & Policy Division*
* *Detailee, IPA, or contractor*
** *Member of the SMD Front Office*

**** Member of the Heliophysics Division*
JWST now part of JWST Program Office.

SMD Organization



* Direct report to NASA Associate Administrator
** Co-located from the Front Office

January 2011