Astrophysics Division Update

Presented to the

Astronomy & Astrophysics Advisory Committee

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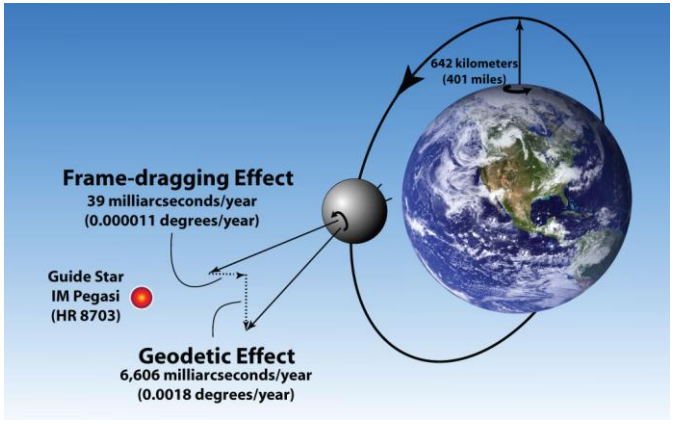
Director, Astrophysics Division
Science Mission Directorate
NASA Headquarters

6 May 2011

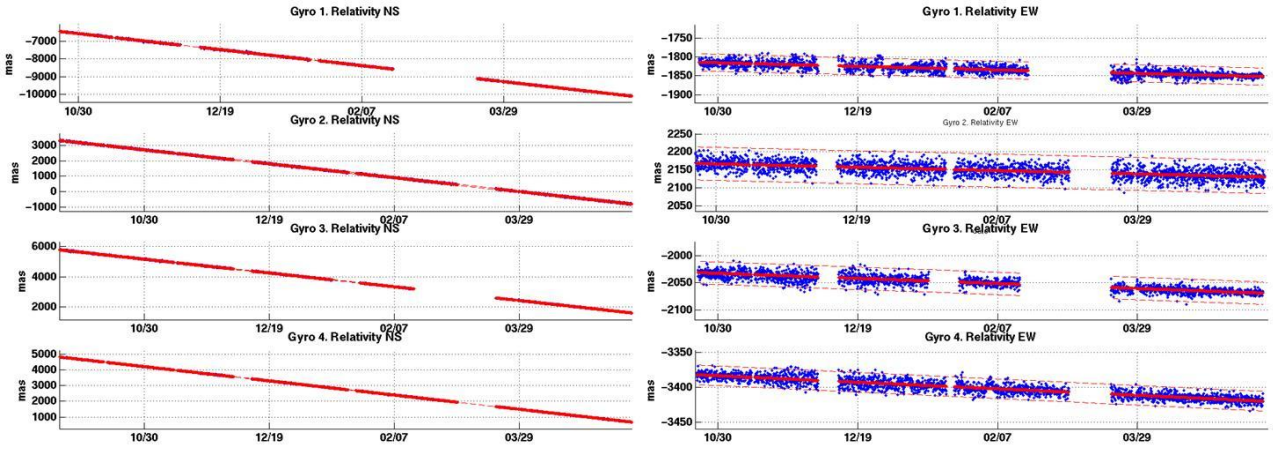
Gravity Probe - B Results Announced

Astrophysics Division

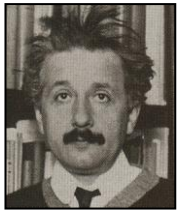
Short results paper accepted in *Physical Review Letters* (5/1/11) – NASA Press Event (5/4/11)



East-West Precession
Geodetic Effect

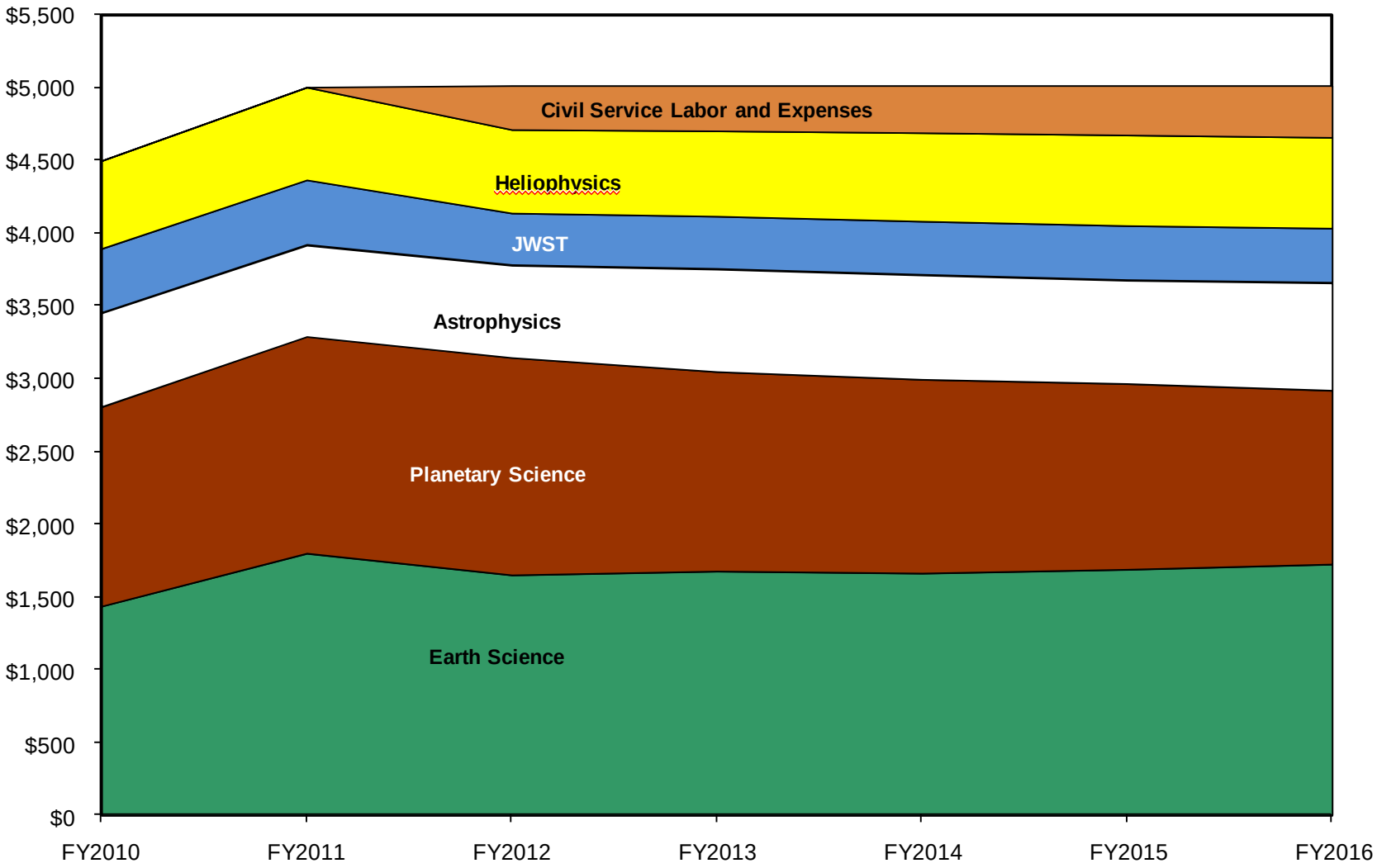


North-South Precession
Frame-dragging Effect



	GR Prediction	GP-B Results
r_{NS} (geodetic)	– 6,606.1	– 6,601.8 ± 18.3
r_{WE} (frame-dragging)	– 39.2	– 37.2 ± 7.2

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 2012-2016 amounts do not include CSLE; FY13-16 budget estimates are notional

Explorers

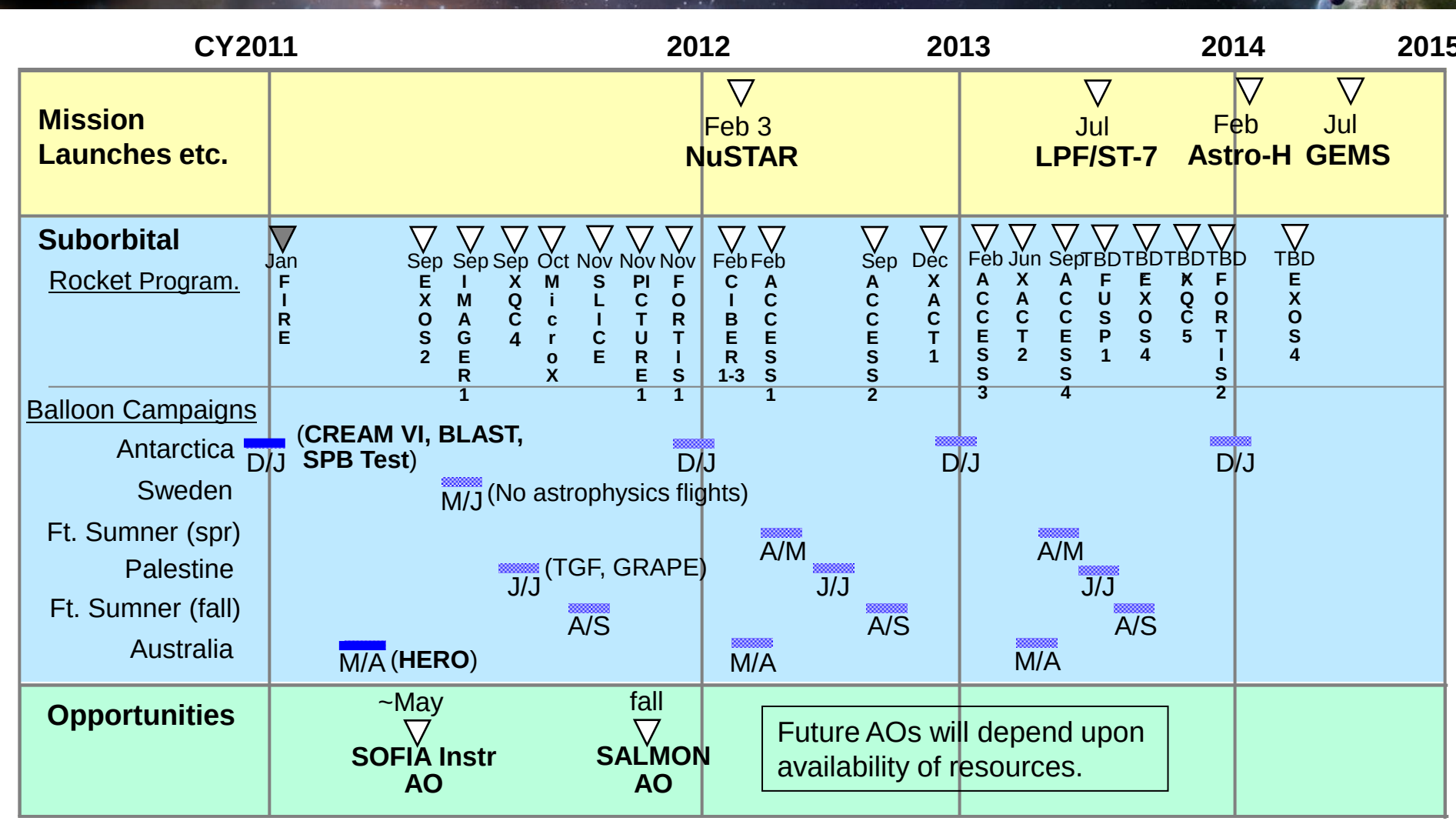
- The schedule for the current round of NASA Explorer proposals is:
  - Step 1 Selections announced (target) .....Sept 2011
  - Phase A Concept Study Reports due (target) ....August 2012
  - Down-selection for flight (target) .....February 2013

- There are:
  - 15 Astrophysics EX mission proposals - $200M plus launch costs
  - 11 Astrophysics SALMON/Missions of Opportunity proposals - $55M includes both Partner MOs and Small Complete Missions

- APD expects to release the next SALMON/MoO AO late-2011

- As recommended by NWNH, 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. Notional Mission Selection Dates:
  - 2013 EX 1 (current AO)
  - 2014/15 SMEX 1
  - 2017 EX 2
  - 2018/19 SMEX 2

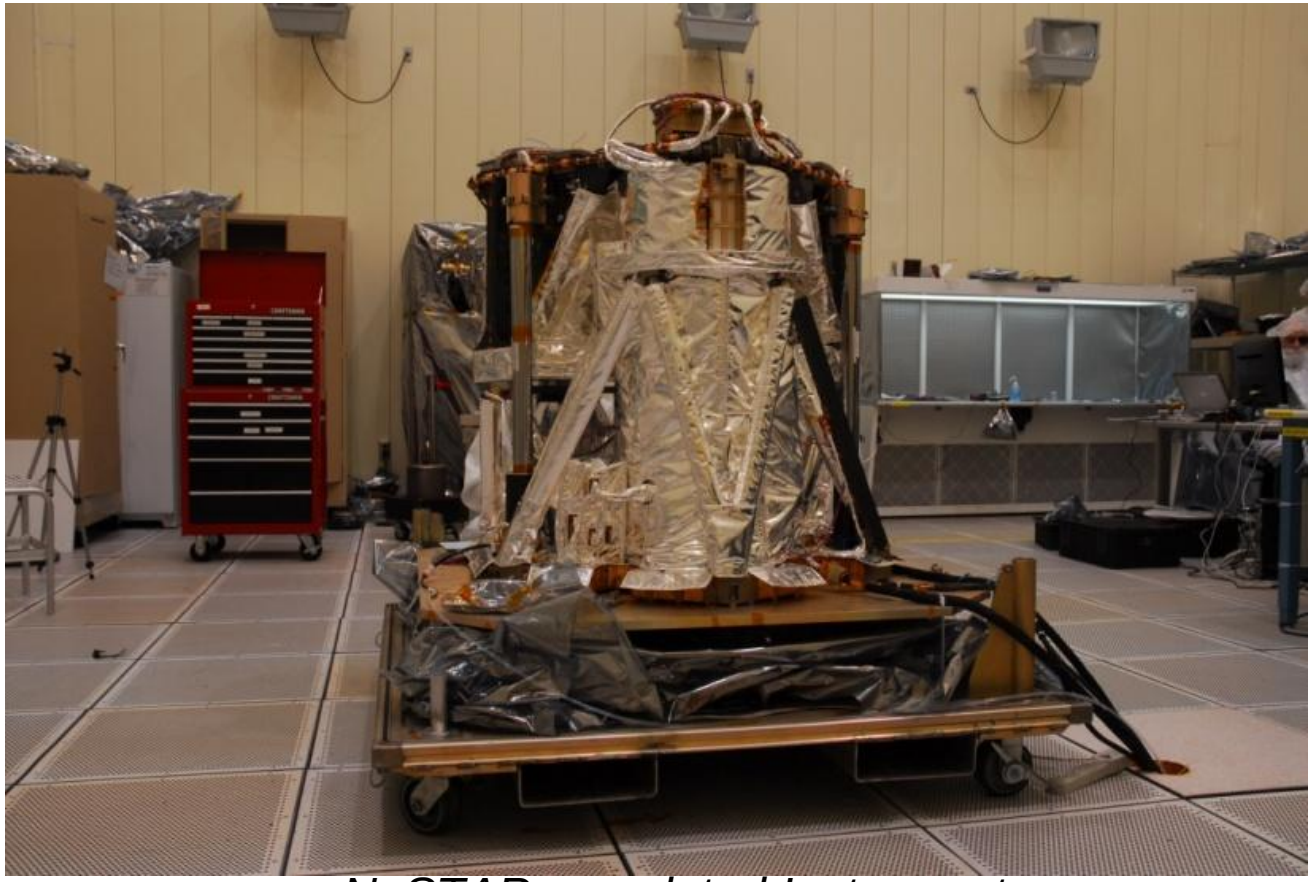
Astrophysics Mission Events



Last Updated: April 25, 2011

NuSTAR

- NuSTAR Instrument Integration and Testing at JPL completed, with Instrument shipped to OSC April 25, 2011 to begin NuSTAR Observatory Integration and Testing.



NuSTAR completed Instrument

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

WFIRST

- 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 an IR survey of the sky.
- Astro2010's highest priority large space mission.
- Update:
  - SDT members selected
  - SDT kickoff telecon on Jan 3, 2011
  - 2 Face-to-face meetings have been held
  - Subgroups have been formed on focused report topics and have meet via telecons
  - NASA Administrator and ESA DG exchanged letters regarding discussion of possible joint mission
  - NASA SMD AA and DOE Office of Science Director exchanged letters leaving the door open to possible collaboration on a future space-based mission that addresses dark energy science
- Next Steps:
  - Next face-to-face meeting May 9-10 at GSFC
  - Delivery to NASA of ad-interim report June 2011
  - ESA M1/M2 downselect to be announced Oct 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

LISA and IXO

- 3 candidate concepts were competing for ESA's L1 2020 opportunity: LISA, IXO and EJSM/Laplace, each with a significant NASA partnership
- None of these were recommended as top priority by the US decadal surveys
- The decadal rankings combined with the constrained projected out-year resources in the FY12 President's Budget Request led ESA to conclude that a 2020 schedule is not feasible for any of the 3 candidates
- An exploratory ESA activity has started to see if any and which of the science goals of the three L missions could be implemented as an Europe-led mission targeting an early 2020's launch date
  - European "Science Teams" are being formed with rapid mission definition effort
  - A "NASA HQ-empowered scientist" will participate on each of the three Science Teams
  - L1 plan to be discussed at June ESA SPC meeting; tentative plan for downselect foreseen at Feb 2012 SPC meeting
- Consideration of the LISA and IXO concepts with the scale and partnerships as proposed to the NWNH decadal survey is ended
- NASA plans to continue the base funding for the US LISA and IXO teams through FY11
- NASA will consult with the community about strategic investments in gravity wave and X-ray astrophysics in future years in the context of the NWNH recommendations and projected resource availability (after the JWST re-baseline is known)
  - APD will engage community through discussions and possible solicitations for new concept studies, in parallel with on-going interactions with ESA re-scoped L1 mission candidates

Theory and Computational Networks

- NWNH recommended a small scale addition to the Core Research Program to enable “large coordinated theory and computational efforts.”
- In initial discussions, NASA and NSF recognized:
  - the value and the higher visibility of a joint program, with a joint call and review, along with coordinated selections.
  - the need for one or two community workshops (for instance, co-located with an AAS meeting) to help define the scope and size of the program, the objectives achievable within a decade from the current state-of-the-art, and initial prioritization of a few science areas.
- The AAAC could play a significant role in shepherding this community process and produce a report to help guide the implementation of a joint program taking the specific missions of each Agency into consideration.
- Schedule: NASA is aiming at a start in FY13; to release a call for proposals in time, the AAAC report needs to be available **by March 2012**.

International Portfolio Planning

- Looking at options for instrument concept studies for contributions to international missions (e.g. M3, L1, SPICA)
- 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…

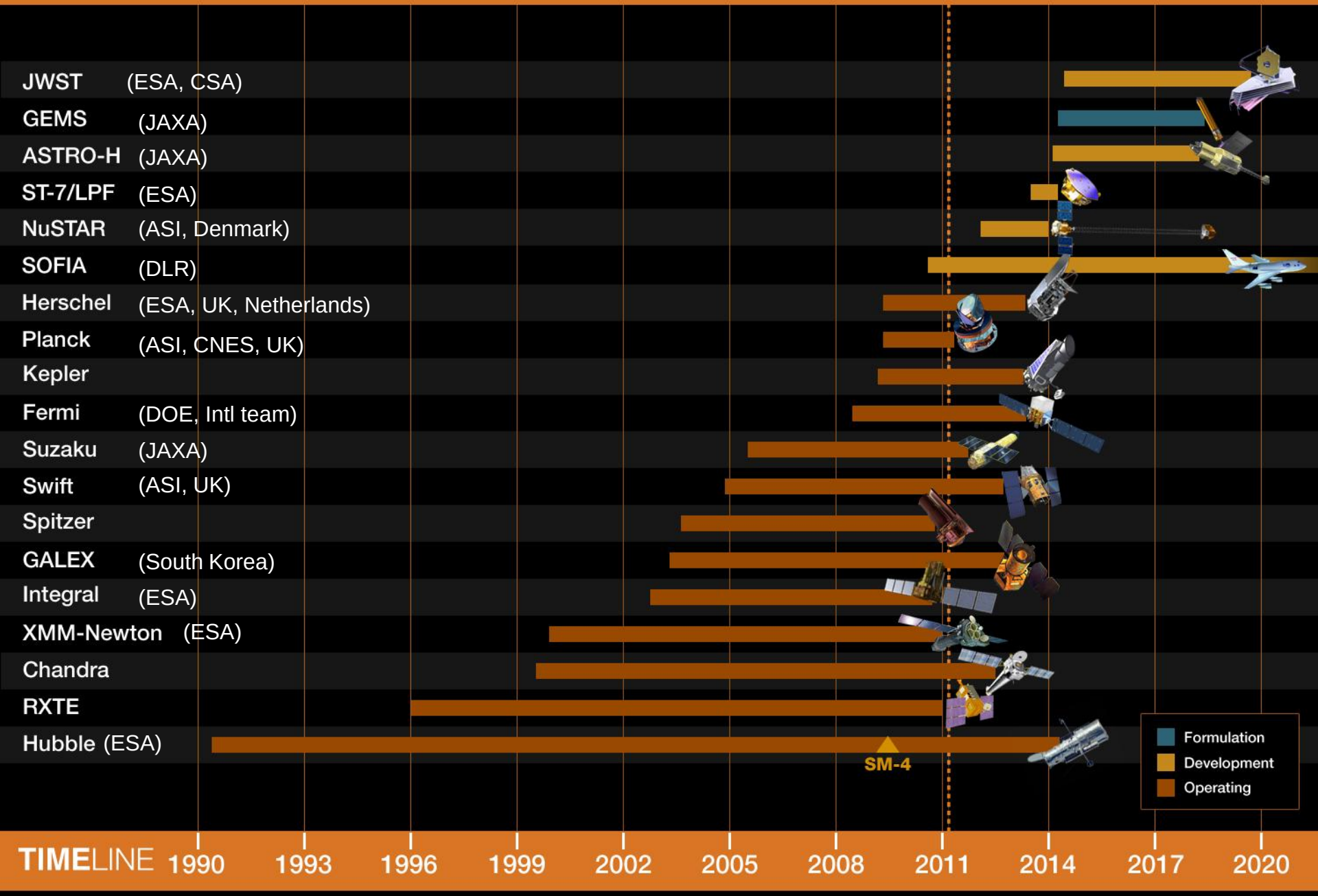
Issues & Concerns

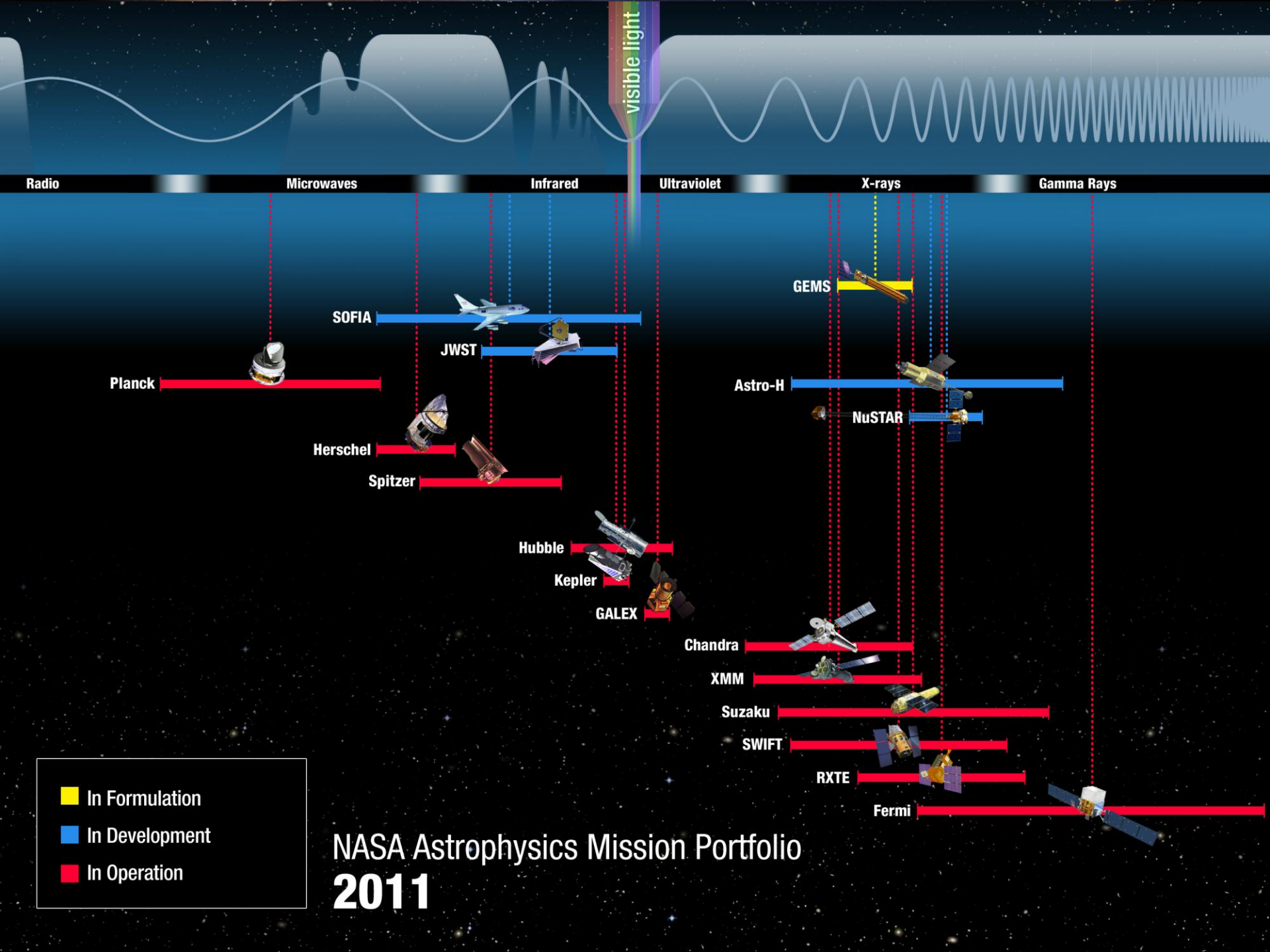
- FY 2011 Budget completion
- JWST re-baseline
- Usage of advisory structure
- Future implementation of WFIRST, LISA, IXO; SPICA
- ST-7 timeliness
- FY12 budget reduction ramifications (GALEX, Suzaku,…)

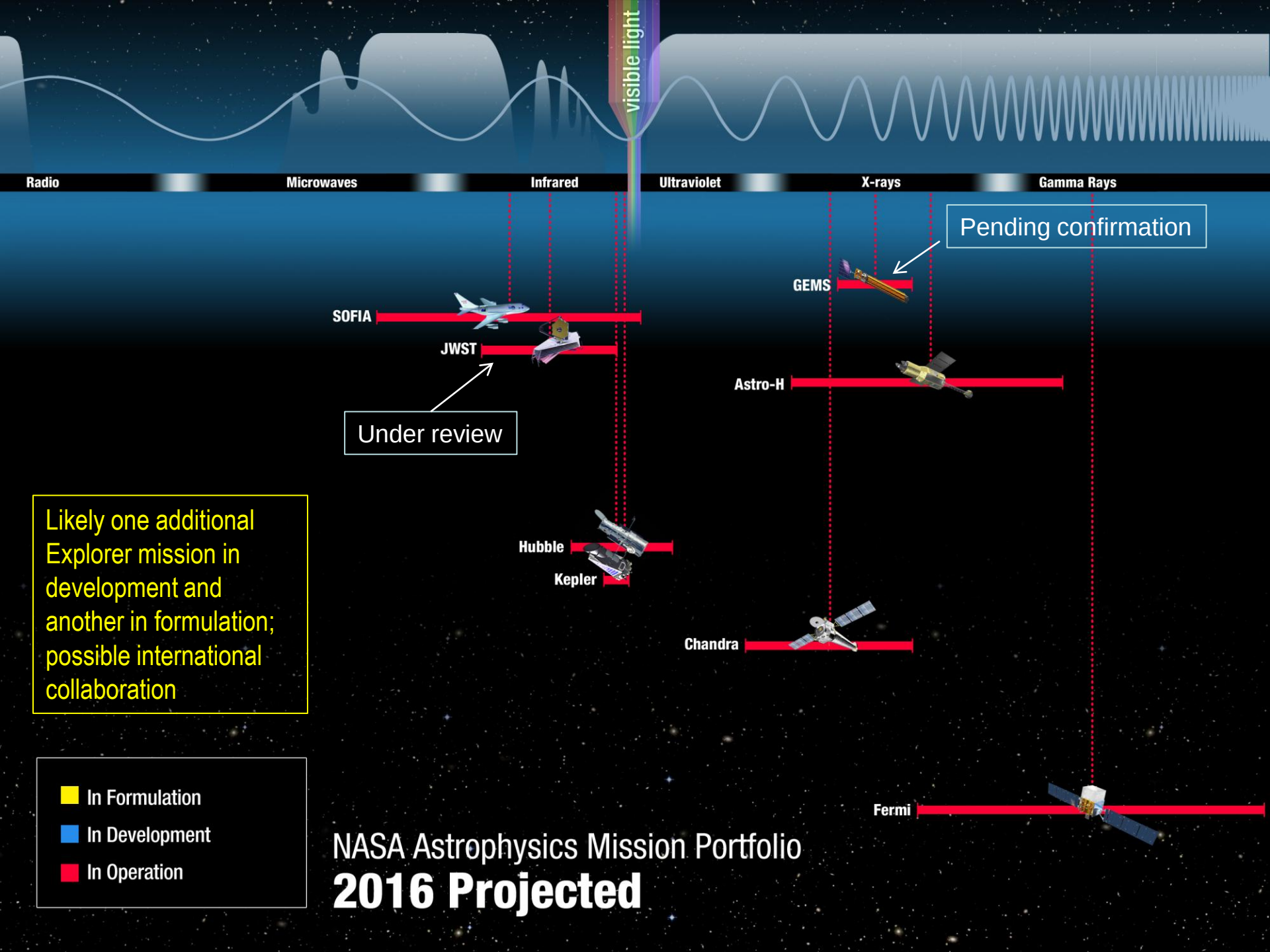
Backup Slides

Astrophysics Missions timeline

Next Senior Review in 2012

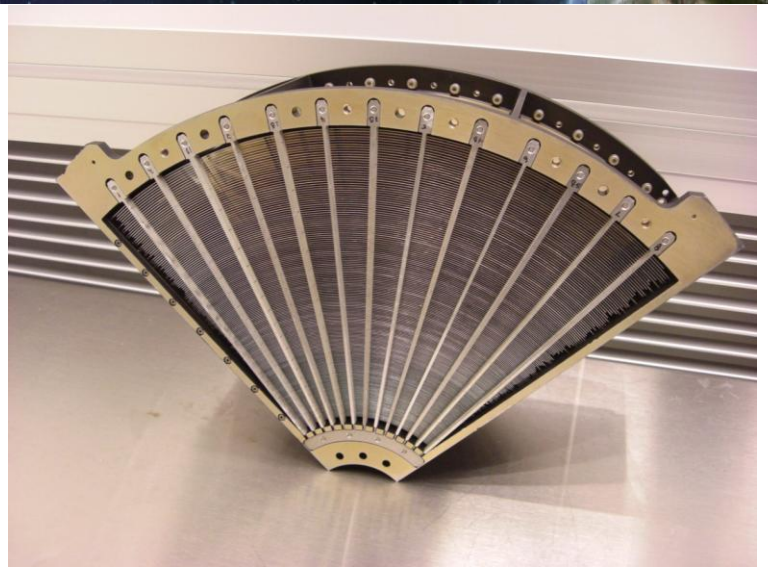



visible light
Radio
Microwaves
Infrared
Ultraviolet
X-rays
Gamma Rays
GEMS
SOFIA
JWST
Planck
Astro-H
NuSTAR
Herschel
Spitzer
Hubble
Kepler
GALEX
Chandra
XMM
Suzaku
SWIFT
RXTE
Fermi
In Formulation
In Development
In Operation
NASA Astrophysics Mission Portfolio
2011

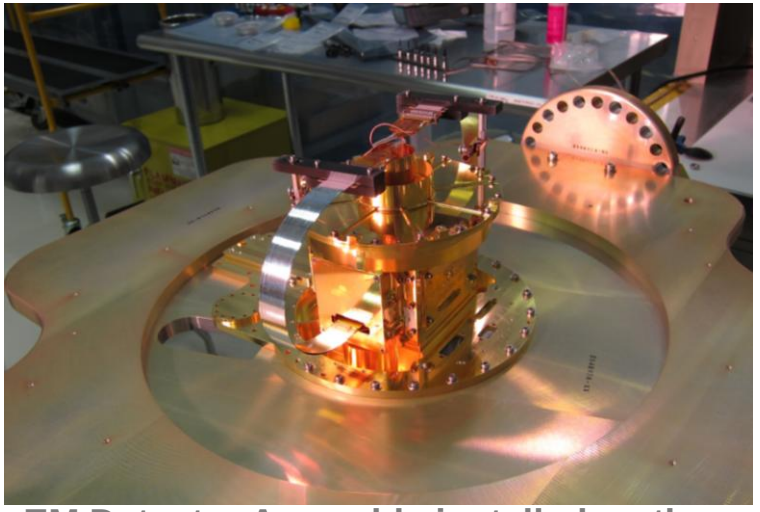

visible light
Radio
Microwaves
Infrared
Ultraviolet
X-rays
Gamma Rays
Pending confirmation
GEMS
SOFIA
JWST
Astro-H
Under review
Likely one additional Explorer mission in development and another in formulation; possible international collaboration
Hubble
Kepler
Chandra
Fermi
In Formulation
In Development
In Operation
NASA Astrophysics Mission Portfolio
2016 Projected

Astro-H

- Project working to maintain cost and schedule.
  - New Instrument Manager and financial team brought on board in March.
- Japanese Disaster has had modest impact to Astro-H thus far.
  - Delays in environmental testing for JAXA hardware due to black-outs and energy conservation efforts in Tokyo area during first few weeks after disaster.
  - Some procurement issues due to damage at vendors. NASA team helping identify alternatives.
  - JAXA has asked NASA to maintain our existing schedule and interfaces.
- Engineering Model (EM) Mirror nearing completion.
- EM model Adiabatic Demagnetization Refrigerator (ADR) has begun performance testing at cryogenic temperatures.
- Next Design Meeting will be held at JAXA 6/1–6/2.
- Next Science Working Group Meeting will be held at SLAC 7/18-7/19.
- NASA hardware Critical Design Review (CDR) to be held 6/21-6/23 at GSFC.



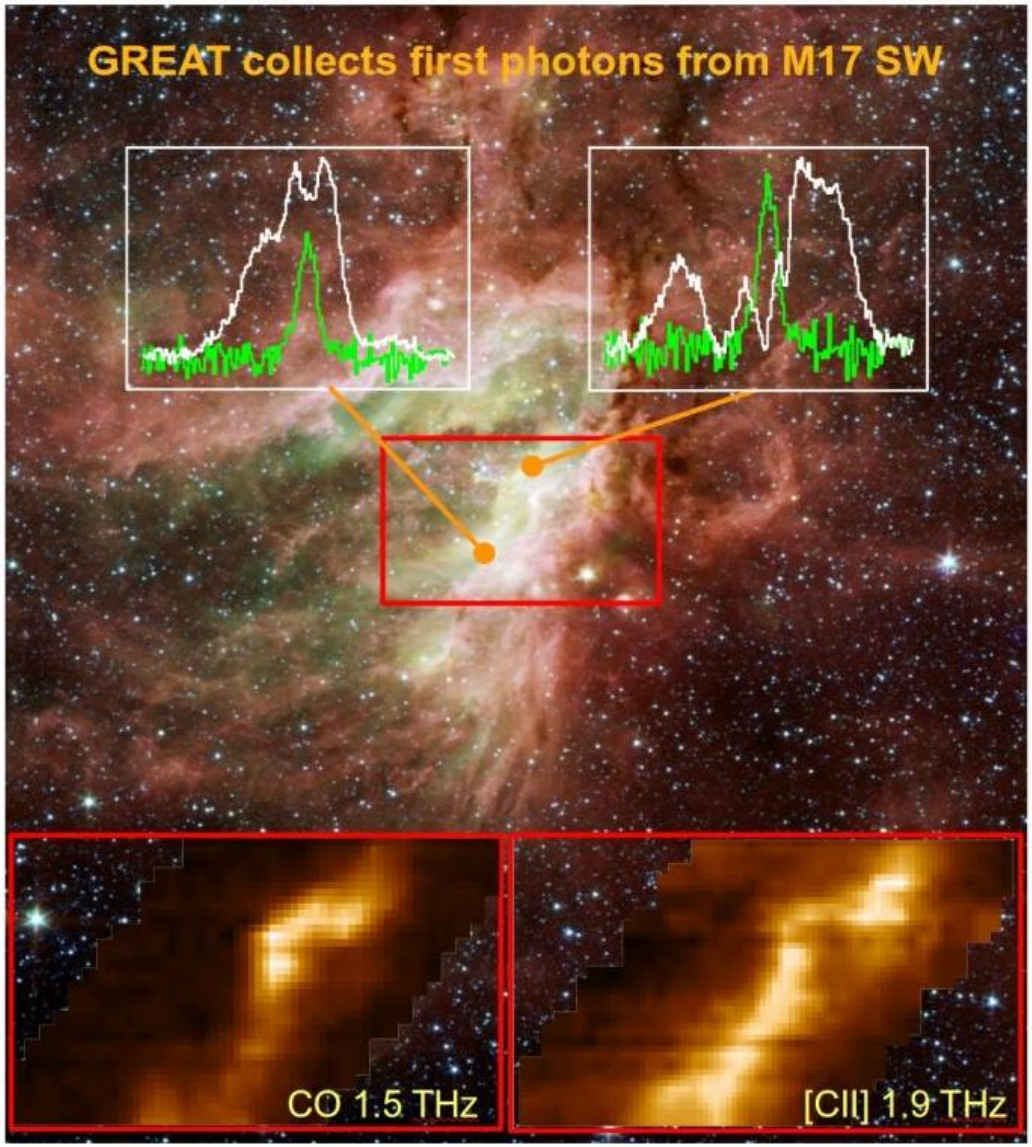
Assembly of the Astro-H EM mirror quadrant for the Soft X-ray Telescope



EM Detector Assembly installed on the EM Calorimeter plate at GSFC – first EM delivery is to EM CSI I&T

SOFIA

- Completed Short Science #2 Flight Series (3 flights)
  - German Receiver for Astronomy at Terahertz Frequencies (GREAT) Instrument and Observatory performed well
  - Image released after first flight (at right)
- Aircraft received approval for Reduced Vertical Separation Minima (RVSM) which greatly increases Observatory flexibility/capability
  - Can fly anywhere in CONUS airspace between 29,000 and 41,000 feet
  - International certification will come after avionics upgrades are complete
- Basic Science campaign (shared risk guest observations) will begin in early May



Australia Balloon Flight of HERO

Alice Springs, Northern Territory, Australia

- HERO (High Energy Replicated Optics)
  - Hard X-ray focusing telescope system carrying high-frequency optics to provide high-energy focused images of cosmic sources.
  - The ability to collect focused hard X-ray images has potential to observe objects in space that are 10 to 100 times fainter than those that can be detected with current instruments.
  - Very smooth launch using the 40 MCF zero pressure balloon in accordance with new NASA Ground and Flight Safety Procedures
  - All flight support systems worked nominally throughout the flight
  - Parachute separation was nominal and the payload landed upright
  - PI reports excellent data received

Flight Statistics

Launched 18 April 2011 / 22:13 Z
Terminated 20 April 2011
Recovered 21 April
Flight Time: 34 hr, 37 min > 115 kft
Float Altitude: 127.8 kft
Initial Results: Highly Successful
PI: Brian Ramsey / MSFC

2011 Fellowships

Sagan Fellows

Name	Host Institution
David Kipping	SAO, Cambridge, Mass.
Bryce Croll	MIT
Wladimir Lyra	JPL
Katie Morzinski	Univ. of AZ, Tucson
Sloane Wiktorowicz	UC Santa Cruz

Einstein Fellows

Name	Host Institution
Akos Bogdan	SAO
Sam Gralla	UM, College Park
Philip Hopkins	UC Berkeley
Matthew Kunz	Princeton Univ.
Laura Lopez	MIT
Amy Reines	NRAO
Rubens Reis	Univ. of MI
Ken Shen	LBNL
Jennifer Siegal-Gaskins	Caltech
Lorenzo Sironi	Harvard Univ.

Hubble Fellows

Name	Host Institution
Gurtina Besla	Columbia Univ.
Jo Bovy	Inst for Adv Study
Sean Couch	Univ. of Chicago
Nathalie Degenaar	Univ. of MI, Ann Arbor
Steven Finkelstein	Univ. of Texas, Austin
Evghenii Gaburov	Northwestern Univ.
Markus Janson	Princeton Univ.
Linhua Jiang	ASU Tempe
Jeyhan Kartaltepe	NOAO
Mansi Kasliwal	Carnegie Obs.
Christiaan Ormel	UC Berkeley
Joshua Peek	Columbia Univ.
Daniel Perley	Caltech
Ralph Schoenrich	Ohio State Univ. Columbus
Roman Shcherbakov	UM College Park
Daniel Stark	UA Tucson
John Tobin	NRAO

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

Events

- Fermi International Finance Committee (IFC) meeting May 9
- Fermi Symposium (Rome), May 9-12
- Spitzer Users Panel, May 9-10
- Team America Rocketry Plains, VA, May 14-15
- ADCAR: Archives Senior Review panel meeting on May 17-19
- AAS #218: Boston May 22-26.
- IAU Symposium #280: "The Molecular Universe“, Toledo, Spain, May 30 - June 3
- ExoPAG #4 June 2-3
- SOFIA: Media Day at DAOF, June 8
- STScI “Very Wide Field Surveys in the Light of Astro-2010”, June 13-16
- Chandra: Cycle 13 GO proposal peer review
- Astro-H: Instrument CDR, June 21-23
- 2011 Chandra Science Workshop “Structure in Clusters and Groups of Galaxies” July 12-14, Boston.
- 2011 Sagan summer workshop “Exploring Exoplanets with Microlensing” on July 25-29 at Caltech.

Press Highlights

The Division's portfolio continues to be a large part -- typically around 20%-- of the **total number** of press releases sent out by the AAS press service

Highlights since February include:

- First evidence for superfluid in Neutron Star's core (Chandra)
- Exploring Tycho's Supernova stripes (Chandra)
- Matter spotted millisecond away from doom (Integral)
- Spitzer discovers time-delayed jets around young stars
- Swift/Hubble/Chandra Observe unprecedented explosion
- SOFIA first flight with the GREAT instrument
- WISE release their data to the community
- Swift & Hubble team up to probe Asteroid Collision debris.
- Gravity Probe B Confirms Einstein's General Relativity

Interacting Galaxies Arp 273