National Aeronautics and Space Administration

Astronomy and Astrophysics Advisory Committee

June 10, 2014

Astrophysics

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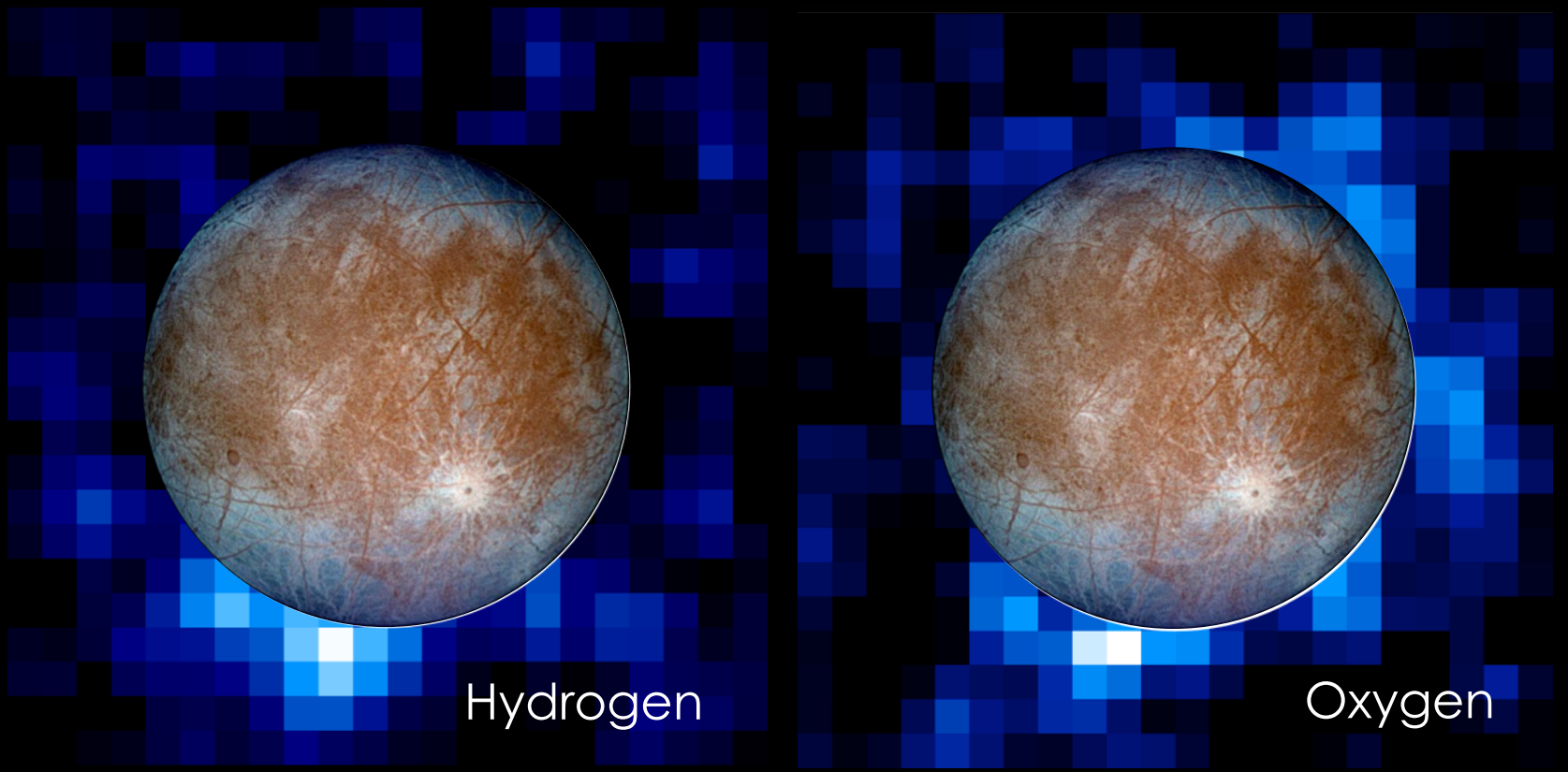
Astrophysics Division
Science Mission Directorate

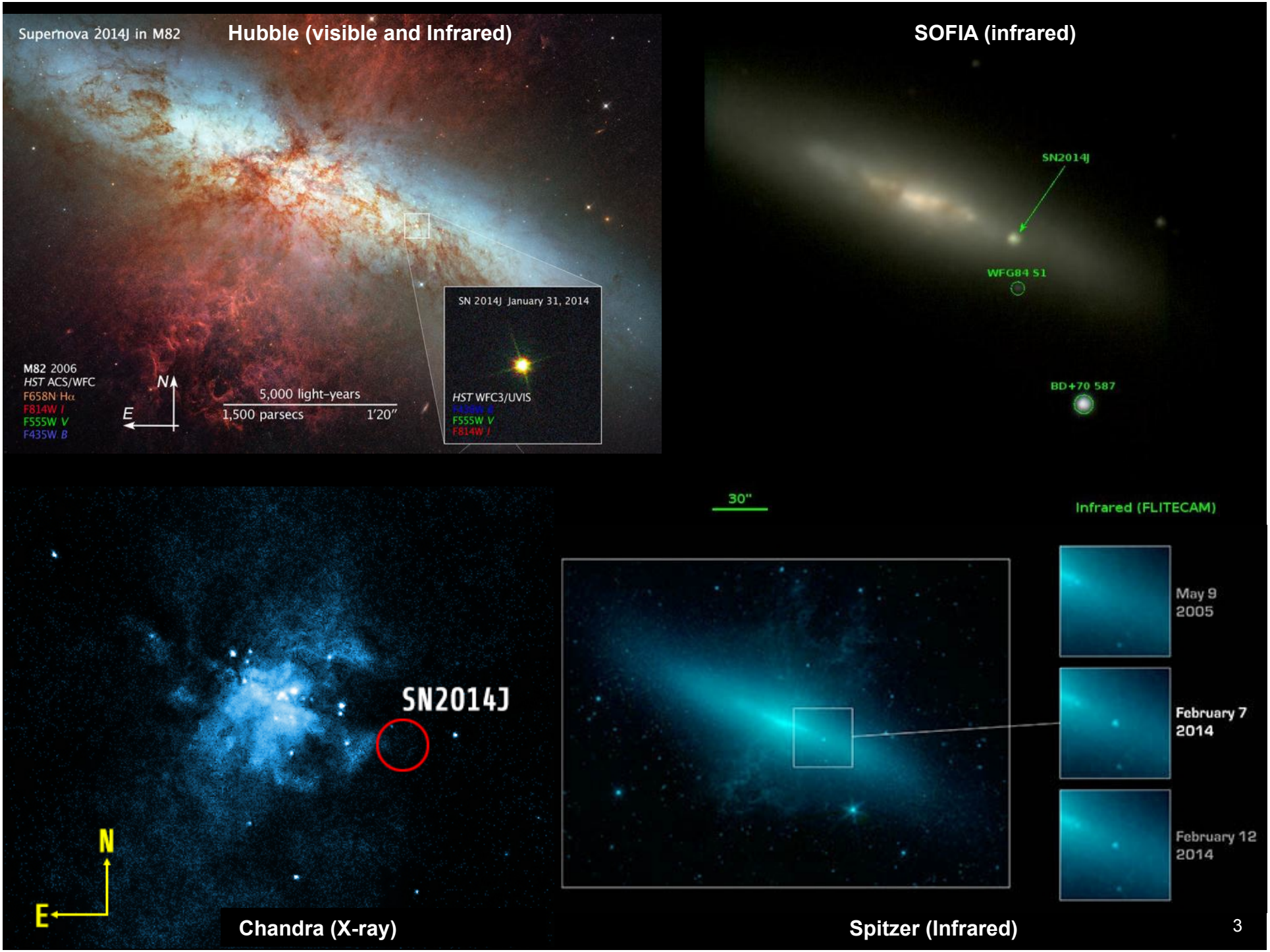
www.nasa.gov

HST sees Water Vapor Plumes on Europa

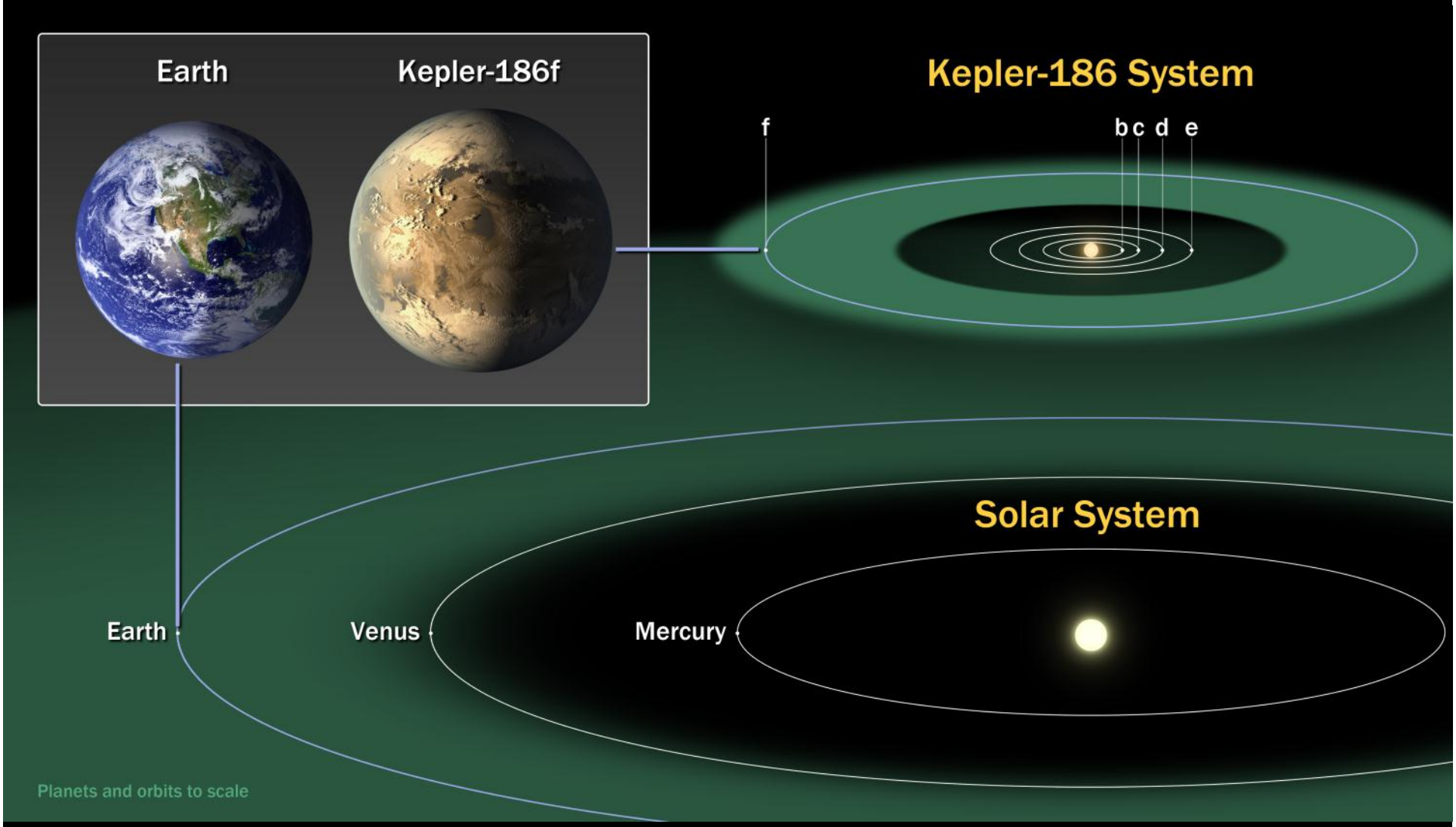


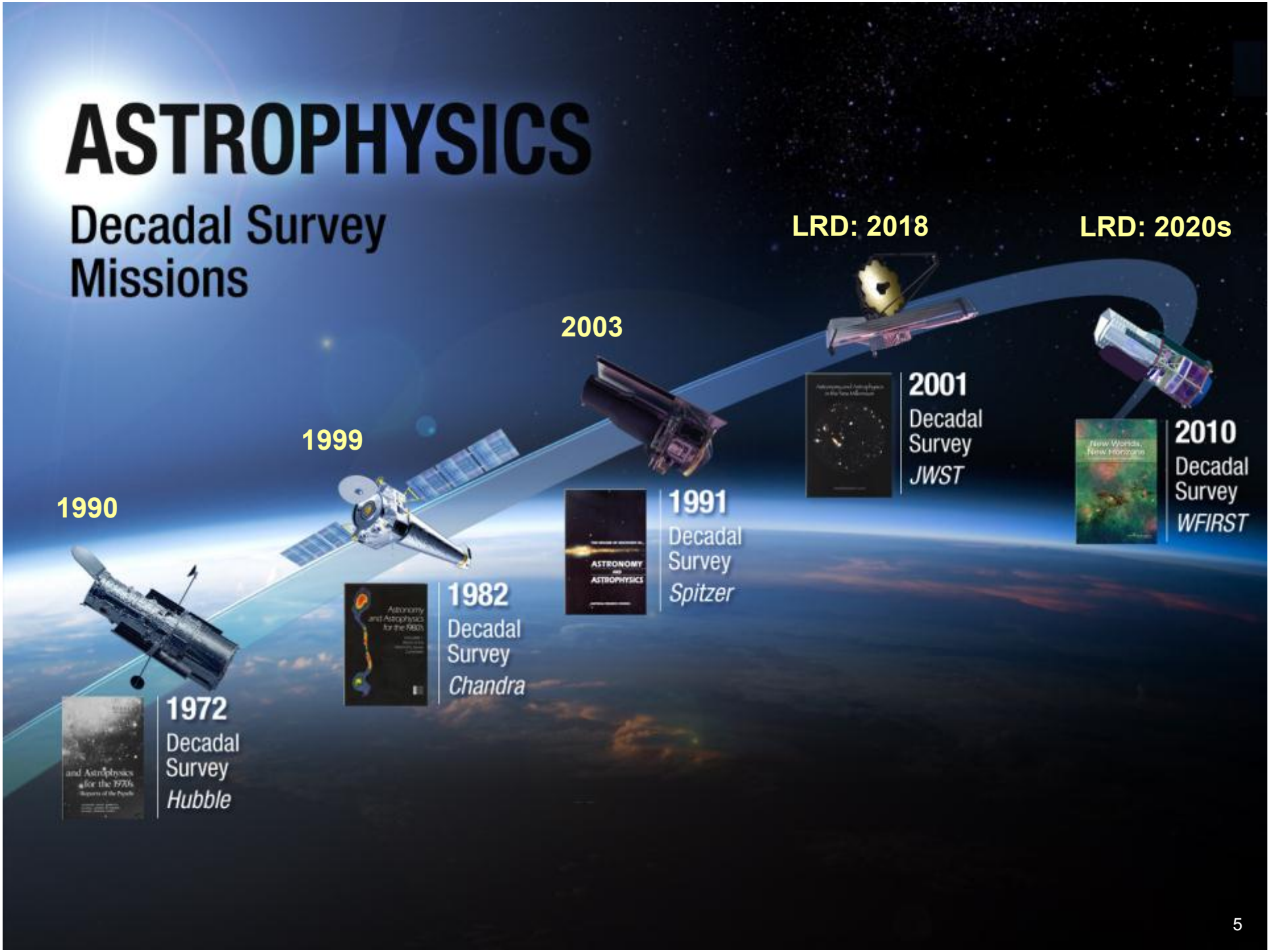
Hydrogen and oxygen emission lines from Hubble Space Telescope with superimposed Europa image from Galileo

Roth et al. (2013). *Science.*


Supernova 2014J in M82
Hubble (visible and Infrared)
SOFIA (infrared)
SN2014J
WFG84 S1
BD+70 587
SN 2014J January 31, 2014
HST WFC3/UVIS
F555W V
F814W I
M82 2006
HST ACS/WFC
F658N Hα
F814W I
F555W V
F435W B
N
E
5,000 light-years
1,500 parsecs
1'20"
30"
Infrared (FLITECAM)
May 9
2005
February 7
2014
February 12
2014
SN2014J
N
E
Chandra (X-ray)
Spitzer (Infrared)

Kepler 186f:
First Earth-Size Planet in 'Habitable Zone'



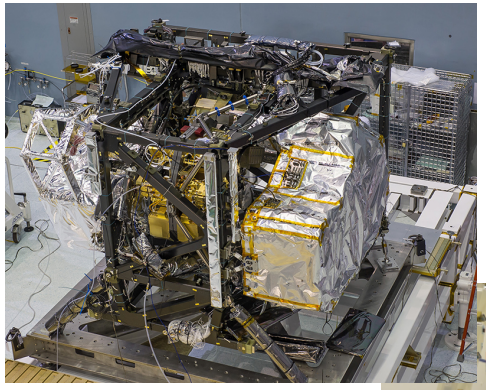

ASTROPHYSICS
Decadal Survey
Missions
LRD: 2018
LRD: 2020s
2003
1999
1990
2001
Decadal
Survey
JWST
2010
Decadal
Survey
WFIRST
1991
Decadal
Survey
Spitzer
1982
Decadal
Survey
Chandra
1972
Decadal
Survey
Hubble

Progress Toward 2010 Decadal Survey Priorities

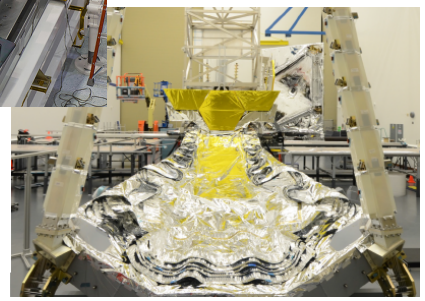
The NASA FY14 Appropriation, the President's FY15 Budget Request, and its notional out years support:	
L1. WFIRST	Preformulation and focused technology development for WFIRST/AFTA (a 2.4m version of WFIRST with a coronagraph) underway to enable a new start NET FY17.
L2. Augmentation to Explorer Program	Increased to ~$140M/yr by FY16; supports decadal cadence of AOs including AO for SMEX in Fall 2014. MIDEX in approx 2017.
L3. LISA	Strategic astrophysics technology (SAT) investments including LISA Pathfinder, plus discussing partnership on ESA's L3 gravitational wave observatory.
L4. IXO	Strategic astrophysics technology (SAT) investments plus discussing partnership on ESA's L2 X-ray observatory.
M1. New Worlds Technology Development Program	Focused technology development for a coronagraph on WFIRST; exoplanet probe mission concept studies and strategic astrophysics technology (SAT) investments
M2. Inflation Probe Technology Development Program	Three balloon-borne investigations, plus strategic astrophysics technology (SAT) investments
Small. Research Program Augmentations	Increased from $65M (FY07) to $74M (FY10) to $82M (FY12 and beyond)

JWST Progress

- Program remains on track for October 2018 launch and within budget
- All science instruments installed into ISIM for cryo-vacuum testing this month
- First two of 5 flight sunshields being manufactured, 5 engineering sunshields being used for deployment testing
- Spacecraft bus under construction
- Good progress continues on telescope flight backplane testing and backplane pathfinder

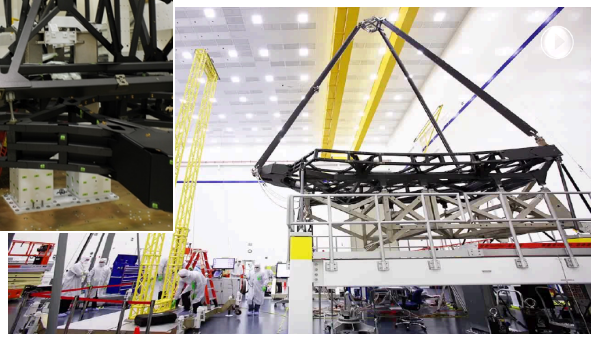


ISIM with all instruments



5 engineering sunshields folded for deployment testing

Flight telescope backplane & backplane support fixture



Pathfinder (backplane center section with secondary mirror structure)

WFIRST / AFTA

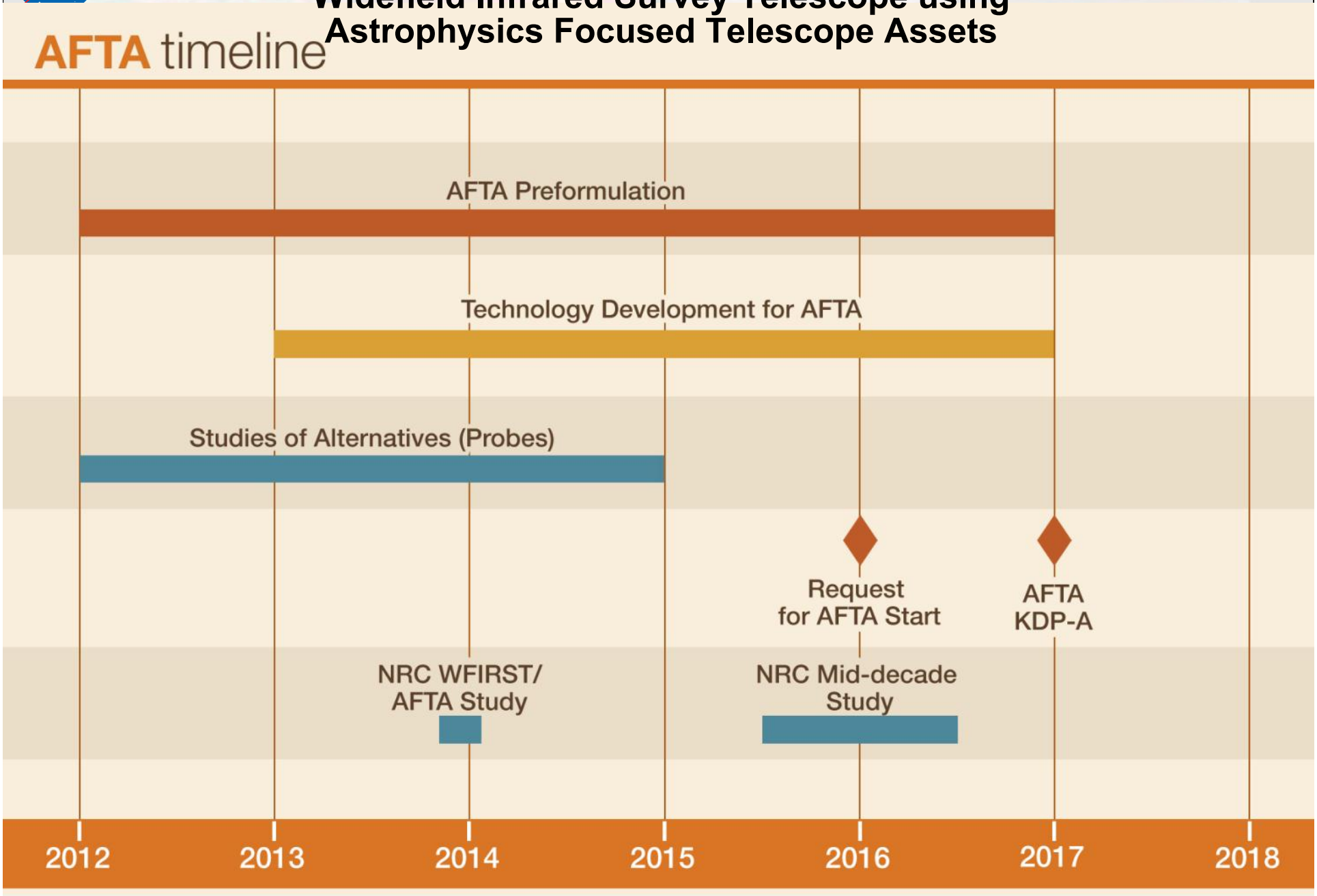
Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

- FY14 appropriation supports pre-formulation of WFIRST/AFTA, including technology development for detectors and coronagraph (with Space Technology Mission Directorate).
- FY15 request supports Agency/Administration decision for formulation to begin no earlier than (NET) FY 2017, should funding be available.

- Recent NRC study on WFIRST/AFTA offers positive view of WFIRST/AFTA with concerns about technology and cost risks.

Plan for WFIRST-AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets



WFIRST Preparatory Science

- New ROSES Element, announced April 21.
- Proposals due July 11.
- Purpose: bridge from basic theory to observational modeling for WFIRST/AFTA.
- Proposals must be both:
  - Relevant to WFIRST's primary astrophysics goals.
  - Predominantly WFIRST-specific development of detailed simulations and models.
- Anticipate selecting ~12 proposals, total $1.8M in first year.
- Intend to select a range of scales (smaller and larger) and periods of performance (1,2,3 yr).
- Investigators selected will coordinate efforts with WFIRST Study Office and WFIRST/AFTA Science Definition Team.
  - Annual summary white paper on progress.

SOFIA
Stratospheric Observatory for Infrared Astronomy

- **World's Largest Airborne Observatory**
- 2.5-meter telescope
- Capable of observing from the visible to the far infrared
- 80/20 Partnership between NASA and the German Aerospace Center (DLR)
- Mission Ops based at NASA-Armstrong
- Science Ops based at NASA-Ames
- Six First-Generation instruments
  - Four U.S., two German
  - Imaging, Spectroscopy, and Photometry

CURRENT STATUS:

- Achieved Full Operational Capability (FOC) February 2014.
- Began Cycle 2 Science Observations February 2014.
- Completed commissioning flights for Field-Imaging Far-Infrared Line Spectrometer (FIFI-LS) April 2014 (5th instrument).
- Initiated commissioning of Echelon-Cross-Echelle Spectrograph (EXES) April 2014 (6th instrument).
- Demonstrating high cadence science operations in April/May 2014
- Formally entered Operational Phase May 2014.
- Second generation instruments under development (1 U.S., 1 German)
  - HAWC+: far infrared imager and polarimeter
  - upGREAT: multi-pixel heterodyne spectrometer

SOFIA Path Forward

- SOFIA's high operating costs cannot be accommodated within the reduced FY 2015 Astrophysics budget request.
- The Administration's FY 2015 budget request to Congress proposes to place SOFIA into storage by FY 2015.
- NASA and DLR are executing SOFIA's baseline schedule of operations for FY 2014, consistent with NASA's approved FY 2014 Operating Plan.
- A joint NASA/DLR Working Group analyzed several scenarios to establish SOFIA's path forward within the range of possible outcomes from the U.S. budget process.
- The U.S. appropriations process continues within the House and Senate.
  - The House NASA FY 2015 Authorization Bill directs NASA not to spend FY 2014 funding in terminating SOFIA.
  - The House FY 2015 Commerce-Justice-Science (CJS) Appropriations Bill, which includes NASA, proposes $70M in FY 2015 for operating SOFIA.
  - The Senate FY 2015 CJS Appropriations Bill, which includes NASA, proposes $87M in FY 2015 for operating SOFIA.

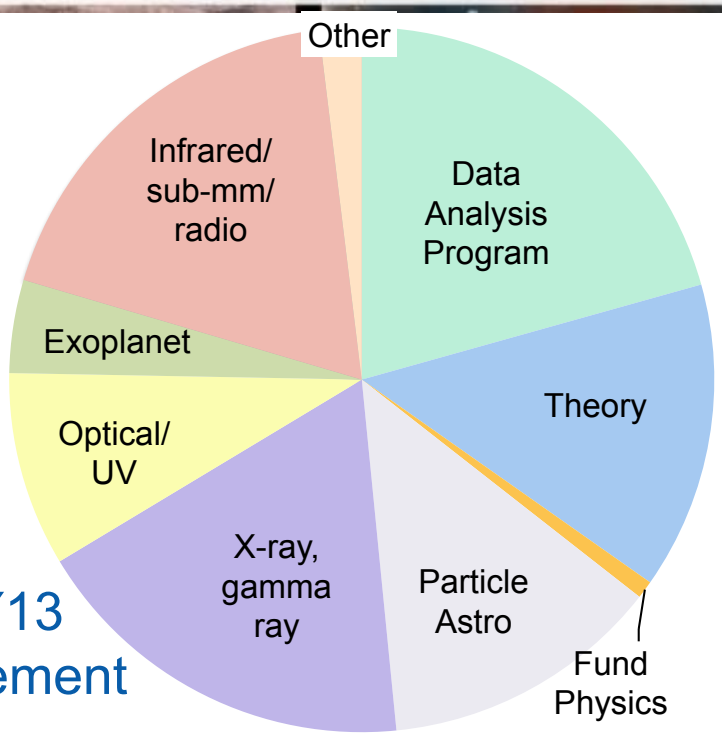
Other Project Highlights

- **Neutron Star Interior Composition Explorer (NICER)** was confirmed (KDP-C) in February 2014.
- NASA delivered **ASTRO-H** Soft X-ray Spectrometer (SXS) calorimeter spectrometer insert to JAXA in March 2014.
- **Transiting Exoplanet Survey Satellite (TESS)** is on track for confirmation in Fall 2014.
- A SMEX + MO **Explorers AO** is planned for Fall 2014 (draft AO in early Summer 2014).
- NASA is supporting **ESA's L2 X-ray observatory** mission concept studies during 2014.
- Astrophysics Division is **consolidating limited FY14 E/PO** activities at the Program level.

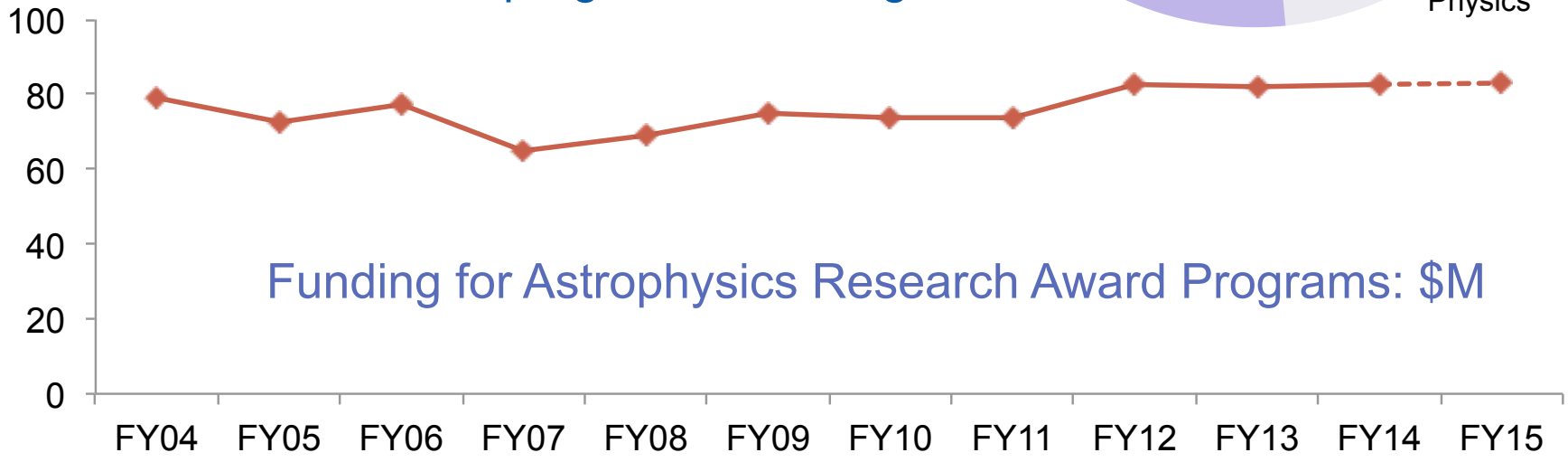
Astrophysics Research Program Funding

Most recent year:

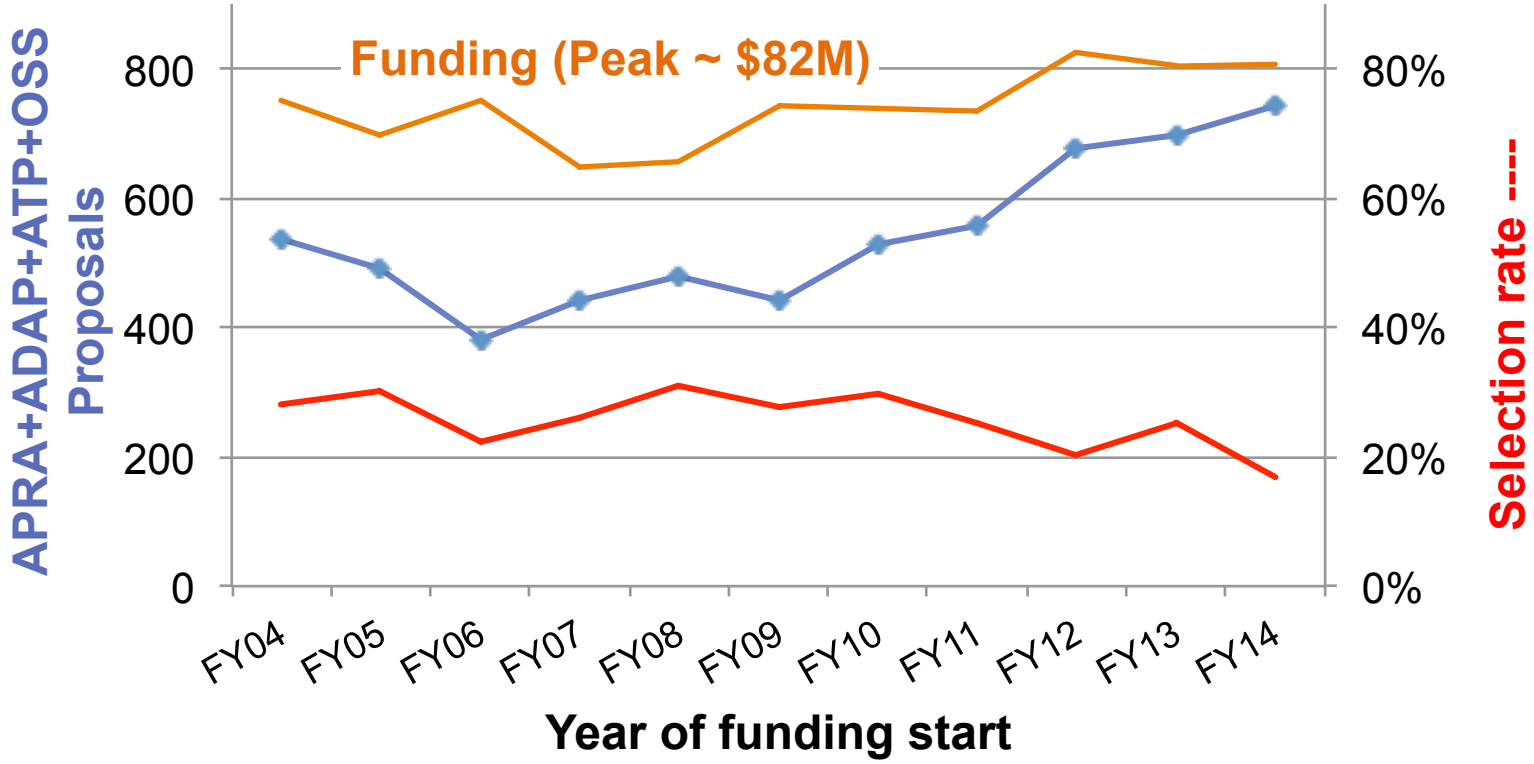
	Proposals Rec'd	Year-1 $M	selected	Success Rate
RTF-12	12	0.6	2	17%
APRA-12	178	13.6	37	21%
SAT-12	38	5.2	9	24%
ADAP-13	276	4.4	41	15%
OSS-13	39	0.9	7	18%
ATP-13	181	3.9	27	15%



Split of $81.967M spent in FY13
PI award programs + management



Astrophysics ROSES selection rates

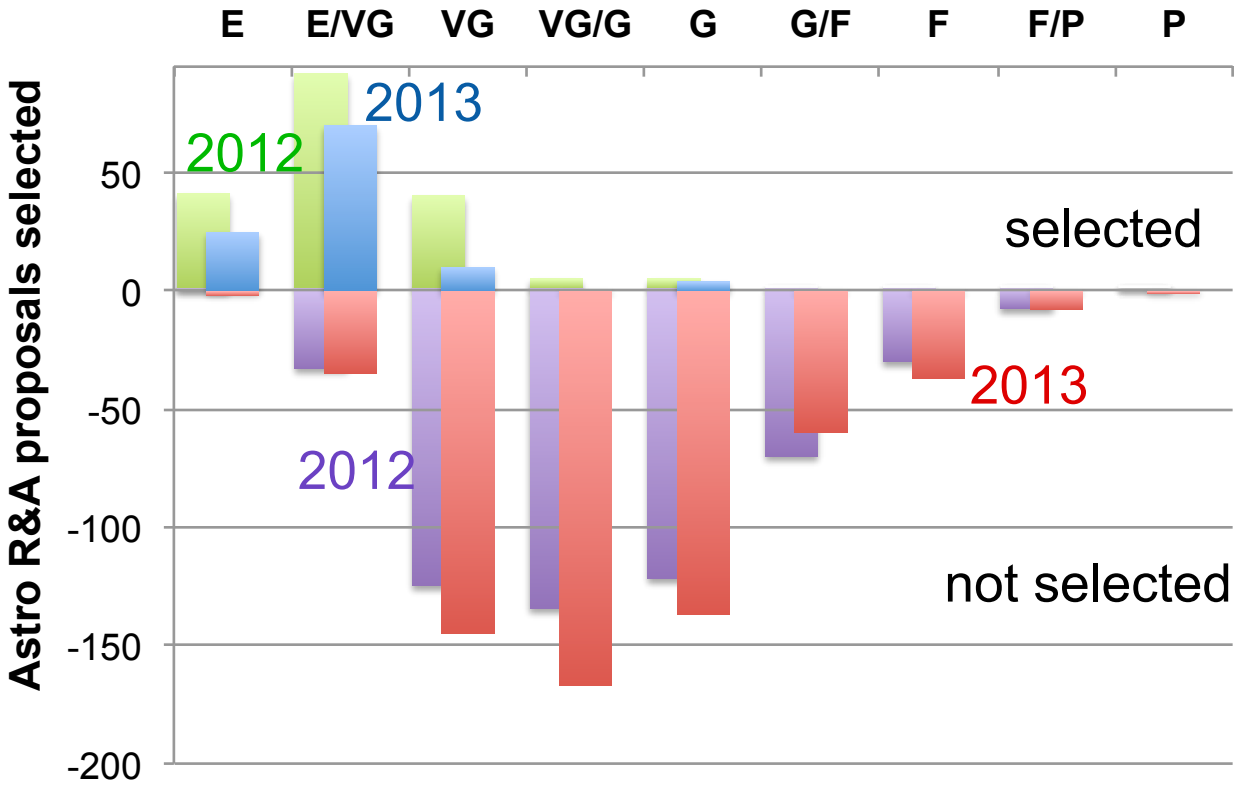


Last year, the Astrophysics Research Program received twice as many proposals as in 2006.

Funding for the program has risen 25% since 2006, but it has not doubled; so the success rate has fallen.

Total funding per successful proposal has been steady at $500k-$600k – this is an average over theory investigations, flight payloads, etc.

Astrophysics ROSES selections by rating



Of 726 proposals to the Astrophysics core R&A program (ADAP, APRA, SAT, ATP, OSS) in 2012, 25% were selected (green); 75% were declined (purple). Of 339 proposals rated VG or better, 51% were selected.

Of 713 proposals to these programs in 2013, 17% were selected (blue); 83% were declined (red). Of 299 proposals rated VG or better, 39% were selected.

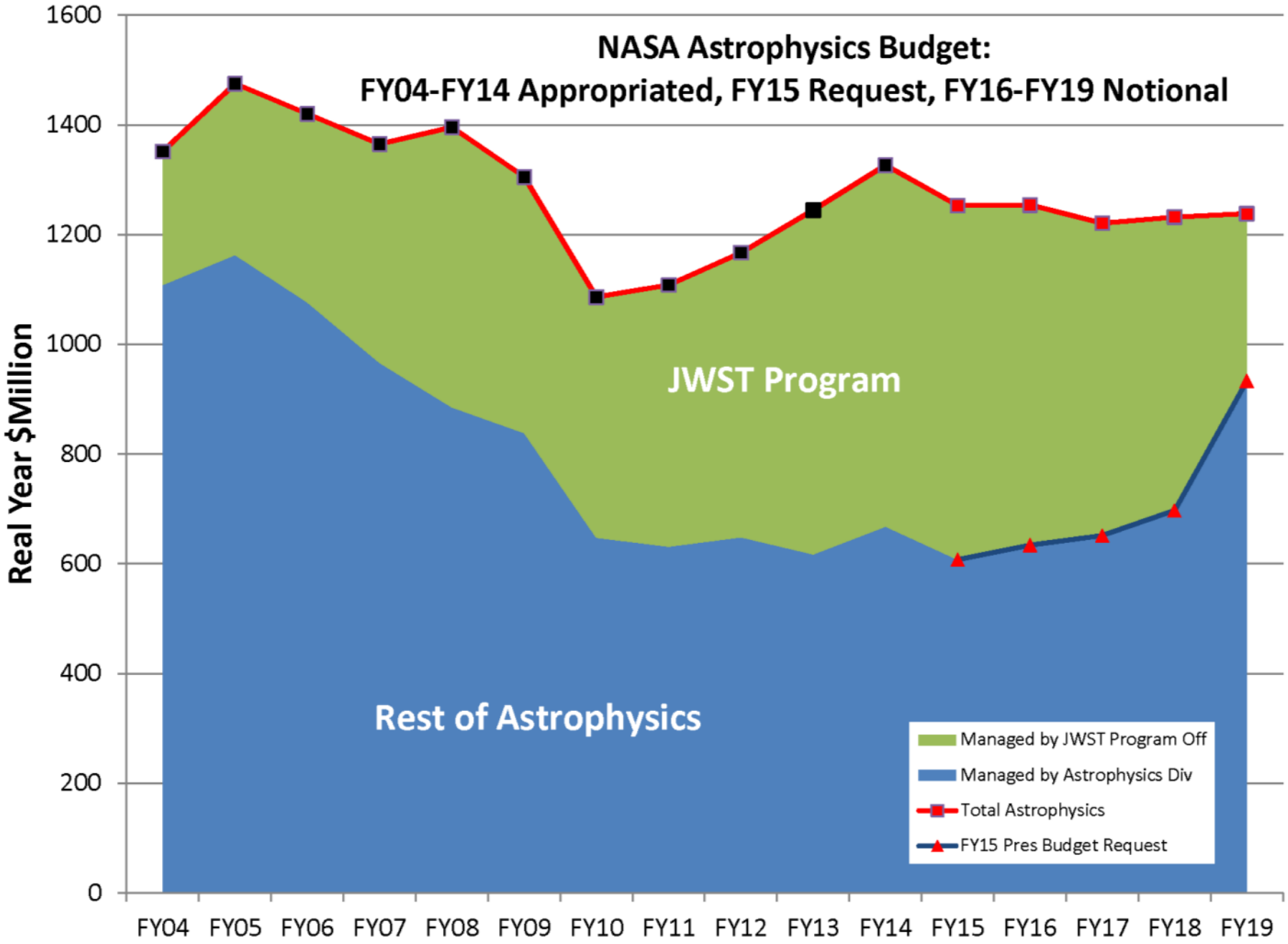
Astrophysics 2014 Senior Review

- Hubble Space Telescope: extension approved
- Chandra X-ray Observatory: extension approved
- Swift Gamma-ray Burst Explorer: extension approved
- Nuclear Spectroscopic Telescope Array (NuSTAR): extension approved and new GO program
- X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission): extension approved and augmented GO program
- Fermi Gamma-ray Space telescope: extension approved
- Kepler Space Telescope: K2 extension approved
- Spitzer Space Telescope: mission not extended
- Suzaku (JAXA mission): extension approved
- Planck (ESA mission): augmentation approved
- MaxWISE: data analysis proposal not approved

http://science.nasa.gov/astrophysics/2014-senior-review-operating-missions/

FY15 (next year) Appropriation

- Administration request is $607M for Astrophysics and $645M for JWST.
- House Appropriations bill includes $680M for Astrophysics, $645M for JWST
  - Restores $5M reduction in Hubble operations
  - Rejects SOFIA termination; recommends $70M (an increase of $58M) to "support the aircraft's fixed costs (flight crews, required maintenance, etc.) as well as a base level of scientific observations. NASA shall continue seeking third-party partners whose additional funding support would restore SOFIA's budget to its full operational level."
  - Recommends $30M (an increase of $15M) to "proportionally reallocate these funds among the SMD divisions, resulting in a dedicated budget line for each division's own EPO activities."
- Senate appropriations bill includes $708M for Astrophysics plus $42M for SMD education, $645M for JWST
  - Recommends $87M for SOFIA; restores $23M for Hubble; recommends $56M for WFIRST.
- Next steps:
  - Senate bill must be reconciled with House version (there are significant differences)
  - Votes by House and Senate, then signed into law by the President


NASA Astrophysics Budget:
FY04-FY14 Appropriated, FY15 Request, FY16-FY19 Notional
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
JWST Program
Rest of Astrophysics
Managed by JWST Program Off
Managed by Astrophysics Div
Total Astrophysics
FY15 Pres Budget Request
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19

FY15 Planned Accomplishments

- The **TESS** Explorer Mission will be confirmed to begin implementation (KDP-C) in FY15
- The **ISS-CREAM** experiment will be launched to the International Space Station (KDP-E) in FY15
- The Step 1 selection (KDP-A) will be made for the next Small Astrophysics **Explorer** and Explorer Mission of Opportunity in FY15
- ESA's **LISA Pathfinder** with NASA's ST-7 experiment will launch (KDP-E) in FY15
- The **WFIRST/AFTA** science definition team report will be completed in FY15
- Manufacture, assembly, and test of the **Euclid** flight detectors will continue in FY15
- JAXA's **ASTRO-H** mission spacecraft system level test will take place in FY15
- The Astrophysics **Archives Senior Review** will be held in FY15
- **Hubble** will achieve 25 years of operation in FY15
- The NRC **Mid-Decade Review** will begin in FY15
- Four **Balloon** campaigns in FY15
- Five **Sounding Rocket** launches in FY15