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

AFTA timeline

AFTA Preformulation

Technology Development for AFTA

Studies of Alternatives (Probes)

NRC WFIRST/AFTA Study

NRC Mid-decade Study

Request for AFTA Start

AFTA KDP-A

2012 2013 2014 2015 2016 2017 2018
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

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

• 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
SOFA 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:

<table>
<thead>
<tr>
<th>Program</th>
<th>Proposals Rec'd</th>
<th>Year-1 $M</th>
<th>Year-1 selected</th>
<th>Year-1 success rate</th>
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<td>27</td>
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</tbody>
</table>

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

**Funding for Astrophysics Research Award Programs: $M**

27 March 2014  
Astrophysics Research Program
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.
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.
• 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
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