Setting the Agenda: Preparing for the 2020s

Joint PAG Meeting at the IAU General Assembly
Honolulu, HI
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Astrophysics

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www.nasa.gov
Astrophysics Driving Documents

http://science.nasa.gov/astrophysics/documents
Astrophysics Missions Launched

- Fermi – June 2008
- Kepler – March 2009
- NuSTAR – June 2012
- SOFIA – May 2014 (full operations)
<table>
<thead>
<tr>
<th>Mission</th>
<th>Estimated Start Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>LISA Pathfinder</td>
<td>11/2015 NET</td>
<td>ESA-led Mission, NASA supplied the ST7/Disturbance Reduction System (DRS)</td>
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<tr>
<td>ASTRO-H</td>
<td>11/2015 NET</td>
<td>JAXA-led Mission, NASA supplied the Soft X-ray Spectrometer (SXS) instrument</td>
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<tr>
<td>NICER</td>
<td>8/2016</td>
<td>NASA Mission, Neutron Star Interior Composition Explorer</td>
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<tr>
<td>TESS</td>
<td>8/2017</td>
<td>NASA Mission, Transiting Exoplanet Survey Satellite</td>
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<tr>
<td>JWST</td>
<td>10/2018</td>
<td>NASA Mission, James Webb Space Telescope</td>
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<tr>
<td>Euclid</td>
<td>2020</td>
<td>ESA-led Mission, NASA is supplying the NISP Sensor Chip System (SCS)</td>
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Astrophysics Missions in Pre-Formulation

SMEX / MO – 2019/2020
- SPHEREx (J. Bock)
- PRAXyS (K. Jahoda)
- IXPE (M. Weisskopf)
- LiteBIRD (A. Lee)
- GUSTO (C. Walker)

MIDEX / MO – 2022/2023
- WFIRST-AFTA – 2024/2025
- Athena – 2028

all launch dates notional
Astrophysics SMEX/MO Missions in Formulation

**SPHEREx**
PI: J. Bock, Caltech
An All-Sky Near-IR Spectral Survey

**PRAXyS**
PI: K. Jahoda, GSFC
Polarimeter for Relativistic Astrophysical X-ray Sources

**IXPE**
PI: M. Weisskopf, MSFC
Imaging X-ray Polarimetry Explorer

**PI: A. Lee, UC Berkeley**
US Participation in JAXA's LiteBIRD CMB Polarization Survey

**PI: C. Walker, U. Arizona**
GUSTO: Gal/Xgal U/LDB Spectroscopic - Stratospheric Terahertz Observatory
NASA Astrophysics Budget:
FY04-FY15 Appropriated, FY16 Requested, FY17-FY20 Notional Planning

- Managed by JWST Program Off
- Managed by Astrophysics Div
- Total Astrophysics

Real Year $Million
FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

Rest of Astrophysics
includes SMD E/PO and SMD STEM activities
NASA Astrophysics Budget:
FY04-FY15 Appropriated, FY16 Requested, FY17-FY20 Notional Planning

Real Year $Million

JWST Program

Rest of Astrophysics

includes SMD E/PO and SMD STEM activities

Managed by JWST Program Off
WFIRST
Managed by Astrophysics Div
Total Astrophysics
Plan for WFIRST/AFTA Preformulation

Widefield Infrared Survey Telescope using
Astrophysics Focused Telescope Assets
### Progress Toward Decadal Survey Priorities

The NASA FY15 Appropriation, the President’s FY16 Budget Request, and the notional out year budget planning guidance in the President’s FY16 Budget Request, support:

| Large-scale 1. WFIRST (wide-field infrared survey telescope) | Preformulation and focused technology development for WFIRST-AFTA (a 2.4m version of WFIRST with a coronagraph) underway to enable a new start NET FY2017. Budget line established for an Astrophysics Decadal Strategic Mission. |
| Large-scale 2. Augmentation to Explorer Program | Astrophysics Explorers planning budget increased to support decadal cadence of AOs including SMEX AO in Fall 2014 and MIDEX AO in late 2016/early 2017. |
| Large-scale 3. LISA (large GW space observatory) | Partnership discussions for ESA’s L3 gravitational wave observatory; Participating in ESA-led assessment in 2014-2015; Strategic astrophysics technology (SAT) investments; Continued support of LISA Pathfinder. |
| Large-scale 4. IXO (large X-ray observatory) | Partnership plans for ESA’s L2 Athena X-ray observatory, Athena study phase, with U.S. participation, is underway; Strategic astrophysics technology (SAT) investments. |
| Medium-scale 1. New Worlds Technology Development Program | Focused technology development for a coronagraph on WFIRST-AFTA; Strategic astrophysics technology (SAT) investments; Exoplanet probe mission concept studies; Partnership with NSF to develop extreme precision Doppler spectrometer as facility instrument; Exozodi survey using NASA-developed LBTI. |
The NASA FY15 Appropriation, the President’s FY16 Budget Request, and the notional out year budget planning guidance in the President’s FY16 Budget Request, support:

| Medium-scale 2. Inflation Probe Technology Development Program | Balloon-borne investigations; strategic astrophysics technology (SAT) investments. |
| Small-scale. Research Program Augmentations | Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16. Within R&A: established Theoretical and Computational Astrophysics Networks (TCAN) program with NSF; funding available for astrophysics theory; funding available for lab astrophysics; funding available for suborbital payloads. |
| Small-scale. Intermediate Technology development Augmentation | Established competed Strategic Astrophysics Technology (SAT) program element; directed technology funding for WFIRST and other decadal priorities. |
| Small-scale. Future Ultraviolet-Visible Space Capability | Strategic Astrophysics Technology (SAT) investments. |
| Small-scale. SPICA (U.S. contribution to JAXA-led large infrared space telescope) | Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity. |
Preparing for the 2020 Decadal Survey
Large Mission Concepts

• Study 3-4 large mission concepts as candidate prioritized large missions
  - Science case
  - Technology assessment
  - Design reference mission with strawman payload
  - Cost assessment

• Charge to the PAGS (December 2014)
  - “I am charging the Astrophysics PAGs to solicit community input for the purpose of commenting on the small set [of large mission concepts to study], including adding or subtracting large mission concepts.”

• NASA Plan for Community Input
  - 2015: PAGs gather community input on selecting concepts for study
  - 2016: Appoint STDT and Center study office, STDT assesses technology
  - 2017: Fund technology development through SAT, STDT develops DRM
  - 2018: STDT submits DRM for cost assessment
  - 2019: STDT issues report and provides input to Decadal Survey
Preparing for the 2020 Decadal Survey
Large Mission Concepts

Community workshops
• January 3, 2015: PAGs charged @ AAS, Seattle. All PAGs meet.
• February 10-11, 2015: ExoPAG SIG #1 meeting @ JPL, Pasadena
• March 10, 2015: COPAG Virtual Town Hall
• March 19, 2015: Joint PAG EC meeting @ STScI, Baltimore
• April 11-14, 2015: PhysPAG SIGs meet @ Am Phys Soc, Baltimore
• June 2, 2015: ExoPAG Virtual Meeting
• June 3-5, 2015: COPAG Far-IR Workshop @ Pasadena
• June 13-14, 2015: ExoPAG meeting @ AbSciCon, Chicago
• June 25-26, 2015: COPAG UV/Vis SIG meeting @ Greenbelt
• July 1, 2015: PhysPAG session @ HEAD Symposium, Chicago
• July 3, 2015: Joint PAG EC Chair telecon
• July 13, 2015: Joint PAG EC Chair telecon with Paul Hertz
• July 14, 2015: ExoPAG Virtual Meeting
• August 7, Joint PAG Splinter Session @ IAU GA, Honolulu
• August 18, 2015: ExoPAG Virtual Meeting
• August 20, 2015: COPAG Virtual Town Hall
• August 31, 2015: Joint PAG Present @ AIAA Space 2015 Pasadena
• October 7, 2015: Deliver reports to Hertz
• October 21-22, 2015: Astrophysics Subcommittee Meeting
Preparing for the 2020 Decadal Survey
Large Mission Concepts

The initial short list (in alphabetical order):

- **FAR IR Surveyor** – The Astrophysics Visionary Roadmap identifies a Far IR Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.

- **Habitable-Exoplanet Imaging Mission** – The 2010 Decadal Survey recommends that a habitable-exoplanet imaging mission be studied in time for consideration by the 2020 Decadal Survey.

- **UV/Optical/IR Surveyor** – The Astrophysics Visionary Roadmap identifies a UV/Optical/IR Surveyor as contributing through improvements in sensitivity, spectroscopy, high contrast imaging, astrometry, angular resolution and/or wavelength coverage. The 2010 Decadal Survey recommends that NASA prepare for a UV mission to be considered by the 2020 Decadal Survey.

- **X-ray Surveyor** – The Astrophysics Visionary Roadmap identifies an X-ray Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.
Preparing for the 2020 Decadal Survey
Thinking about Probes

• What was done 10 years ago?
    • ROSES call for quick (~9 month) paper concept studies
    • ~9 concepts selected in 2004; total ~$1M ($100K average)
  - Astrophysics Mission Concepts Study (AMCS; 2007)
    • ROSES call for ~1 year concept studies with mission design lab run
    • ~19 ASMC concepts selected in 2007; total $13M ($700K average)
  - Was this effective? Efficient? Appropriately impactful?

• Possibilities this time
  - Real mission concept studies
    • Just like we are doing for large mission concepts
    • How would we select them? Where does funding come from?
  - Paper mission concept studies, with or without mission design lab run
    • Just like AMCS or Origins Probes, but limited to Probes
  - Self selected, self funded
    • Anybody can submit a white paper to the 2020 Decadal Survey

• Awaiting input from the PAG reports
Preparation for the 2020 Decadal Survey
Thinking about Probes

• Suggestion for the Decadal Survey: Recommend a Probe AO
  - Similar to Planetary Science Division’s New Frontiers AO
  - Recent Probe-class missions include
    • Spitzer, Fermi, Kepler
    • New Horizons, JUNO, OSIRIS-Rex (New Frontiers missions)
  - Community identifies to the Decadal Survey mission concepts that could plausibly be done as Probes
  - Decadal Survey prioritizes a short list of mission concepts that should be accomplished on a Probe budget for the Probe AO
  - NASA issues a Probe AO and selects a Probe proposal that is responsive in a compelling manner to Decadal Survey identified science objectives for one of the mission concepts (determined by peer review) and can be accomplished as a Probe (determined by TMC review)
• Funding allotted to Probes “slows down” the large mission(s) that follow WFIRST
• NASA Astrophysics expects to announce a path toward Probe input for the Decadal Survey by the January 2016 AAS meeting
Astrophysics Timeline

- Decadal Survey Mission
- MIDEX/MO (AO NET 2016)
- Euclid (ESA)
- SMEX/MO (AO 2014)
- JWST (ESA, CSA)
- TESS
- NICER
- ASTRO-H (JAXA)
- ST-7/LPF (ESA)
- ISS-CREAM (South Korea)
- SOFIA (DLR)
- NuSTAR (ASI, Denmark)
- Kepler
- Fermi (DOE, Intl team)
- Suzaku (JAXA)
- Swift (ASI, UK)
- Spitzer
- XMM-Newton (ESA)
- Chandra (SRON)
- Hubble (ESA)

TIMELINE CY

- 2000
- 2003
- 2006
- 2009
- 2012
- 2015
- 2018
- 2021
- 2024

Dates beyond 2016 are contingent upon the results of the 2016 Senior Review.