NASA Astrophysics Diversity and Inclusion

• The NASA Astrophysics Division is actively taking steps to advance diversity, inclusion, and equal opportunity in the NASA workforce and among NASA grantee institutions.

• NASA Astrophysics is committed to:
  – Setting the expectancy of diversity and inclusion in the composition of: proposal teams, peer review panels, science and technology definition teams, and mission and instrument teams.
  – Promoting diversity on NASA-selected groups (e.g., advisory groups, peer review panels, science teams, etc.).
  – Recruiting a diverse Astrophysics Division staff.
  – Working with the NASA Office of the Chief Scientist and our peer review contractors to address unconscious bias in peer reviews.
  – Sharing best practices in peer reviews with other agencies.
  – Observing the demographics of R&A proposers and awardees as an indicator of issues.

• The demographics of R&A proposers and awardees – we notice that:
  – The inferred gender balance of awardees does reflect that of proposers.
  – The inferred gender balance of proposers does not always reflect that of the community.
NASA Astrophysics

A Balanced Plan
A Strategic Vision
Why Astrophysics?

*Astrophysics is humankind’s scientific endeavor to understand the universe and our place in it.*

- How did our universe begin and evolve?
- How did galaxies, stars, and planets come to be?
- Are we alone?

Enduring National Strategic Drivers

- 1972
- 1982
- 1991
- 2001
- 2010
Astrophysics Strategic Planning

2016 update includes:
• Response to Midterm Assessment
• Planning for 2020 Decadal Survey

To be updated in 2018 (per GPRAMA)

https://science.nasa.gov/astrophysics/documents
Astrophysics Big Picture

• The FY18 budget request would provide funding for NASA astrophysics to continue its planned programs, missions, projects, research, and technology.
  – Total requested funding for FY18 (Astrophysics including Webb) remains at ~$1.35B.
  – FY18 President’s Budget Request balances current science and future missions; Congressional markups, if enacted without additional funding, would put that balance at risk.

• NASA continues to prioritize implementation of the recommendations of the 2010 Decadal Survey.
  – Webb making good progress toward launch.
  – WFIRST independent external Technical/Management/Cost review (WIETR) has led to direction to make design changes in WFIRST to stay within the $3.2B cost target.
  – NASA is conducting large and medium mission concept studies for the 2020 Decadal Survey.
February

NASA, in a major scientific discovery, announces that a star system less than 40 light-years away contains seven Earth-size planets, at least three of which appear to have a Starbucks.
Current Program:  
an integrated strategic plan

We are executing a balanced strategic program for Astrophysics

• Operating missions, large and small, continue to deliver paradigm changing science
# Astrophysics Missions in Operation

<table>
<thead>
<tr>
<th>Mission</th>
<th>Launch Date</th>
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<tbody>
<tr>
<td>Hubble</td>
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</tr>
<tr>
<td>Chandra</td>
<td>7/1999</td>
</tr>
<tr>
<td>XMM-Newton</td>
<td>12/1999</td>
</tr>
<tr>
<td>Spitzer</td>
<td>8/2003</td>
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<tr>
<td>Hubble Space Telescope</td>
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<tr>
<td>Chandra X-ray Observatory</td>
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<tr>
<td>X-ray Multi Mirror - Newton</td>
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<td>Spitzer Space Telescope</td>
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<td>Swift</td>
<td>11/2004</td>
</tr>
<tr>
<td>Fermi</td>
<td>6/2008</td>
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<tr>
<td>Kepler</td>
<td>3/2009</td>
</tr>
<tr>
<td>NuSTAR</td>
<td>6/2012</td>
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<tr>
<td>Swift Gamma-ray Burst Explorer</td>
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<tr>
<td>Fermi Gamma-ray Space Telescope</td>
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<tr>
<td>Kepler Space Telescope</td>
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<tr>
<td>Nuclear Spectroscopic Telescope Array</td>
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<td>SOFIA</td>
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<tr>
<td>ISS-NICER</td>
<td>6/2017</td>
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<tr>
<td>ISS-CREAM</td>
<td>8/2017</td>
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<tr>
<td>Stratospheric Observatory for Infrared Astronomy</td>
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<tr>
<td>Neutron Star Interior Composition Explorer</td>
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<tr>
<td>Cosmic Ray Energetics And Mass</td>
<td></td>
</tr>
<tr>
<td>XMM-Newton ESA-led Mission</td>
<td></td>
</tr>
</tbody>
</table>
Some NASA Science Stories of 2017
Current Program: an integrated strategic plan

We are executing a balanced strategic program for Astrophysics

• Operating missions, large and small, continue to deliver paradigm changing science

• Large strategic missions under development …
  – Are next generation great observatories
  – Will rewrite textbooks
  – Can only be done by NASA
Webb
James Webb Space Telescope

2017 Accomplishments
- Completed Science Payload vibration, and acoustics testing
- Solicited and selected Early Release Science proposals
- Received All Sunshield membranes
- Completed cryovacuum testing of the science payload
- Integrated the sunshield and spacecraft forming the Spacecraft Element (SCE)
- Completed first flight hardware sunshield deployment test

2018 Plans
- Complete Spacecraft Element testing
- Receive and Review Cycle 1 GO proposals
- Integrate the Science Payload to the SCE, forming the Observatory
- Begin testing the Observatory

Webb remains within its replan budget guidelines

Large Infrared Space Observatory
Top priority of 2000 Decadal Survey

Science themes: First Light; Assembly of Galaxies; Birth of Stars and Planetary Systems; Planetary Systems and the Origins of Life

Mission: 6.5m deployable, segmented telescope at L2, passively cooled to <50K behind a large, deployable sunshield

Instruments: Near IR Camera, Near IR Spectrograph, Mid IR Instrument, Near IR Imager and Slitless Spectrograph

Operations: 2019 launch for a 5-year prime mission

Partners: ESA, CSA
Webb OTIS after Thermal Vacuum Testing
## Webb Director’s Discretionary Early Release Science Program

<table>
<thead>
<tr>
<th>Project Title</th>
<th>PI:</th>
<th>Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through the Looking GLASS: A JWST Exploration of Galaxy Formation and Evolution from Cosmic Dawn to Present Day</td>
<td>Tommaso Treu (University of California - Los Angeles)</td>
<td>Galaxies and the IGM</td>
</tr>
<tr>
<td>A JWST Study of the Starburst-AGN Connection in Merging LIRGs</td>
<td>Lee Armus (California Institute of Technology)</td>
<td>Galaxies and the IGM</td>
</tr>
<tr>
<td>The Cosmic Evolution Early Release Science (CEERS) Survey</td>
<td>Steven Finkelstein (University of Texas at Austin)</td>
<td>Galaxies and the IGM</td>
</tr>
<tr>
<td>TEMPLATES: Targeting Extremely Magnified Panchromatic Lensed Arcs and Their Extended Star Formation</td>
<td>Jane Rigby (NASA Goddard Space Flight Center)</td>
<td>Galaxies and the IGM</td>
</tr>
<tr>
<td>Q-3D: Imaging Spectroscopy of Quasar Hosts with JWST Analyzed with a Powerful New PSF Decomposition and Spectral Analysis Package</td>
<td>Dominika Wylezalek (European Southern Observatory - Germany)</td>
<td>Massive Black Holes and their Galaxies</td>
</tr>
<tr>
<td>Nuclear Dynamics of a Nearby Seyfert with NIRSpec Integral Field Spectroscopy</td>
<td>Misty Bentz (Georgia State University Research Foundation)</td>
<td>Massive Black Holes and their Galaxies</td>
</tr>
<tr>
<td>The Transiting Exoplanet Community Early Release Science Program</td>
<td>Natalie Batalha (NASA Ames Research Center)</td>
<td>Planets and Planet Formation</td>
</tr>
<tr>
<td>High Contrast Imaging of Exoplanets and Exoplanetary Systems with JWST</td>
<td>Sasha Hinkley (University of Exeter)</td>
<td>Planets and Planet Formation</td>
</tr>
<tr>
<td>ERS observations of the Jovian System as a Demonstration of JWST’s Capabilities for Solar System Science</td>
<td>Imke de Pater (University of California - Berkeley)</td>
<td>Solar System</td>
</tr>
<tr>
<td>Radiative Feedback from Massive Stars as Traced by Multiband Imaging and Spectroscopic Mosaics</td>
<td>Olivier Berne (Université Toulouse)</td>
<td>Stellar Physics</td>
</tr>
<tr>
<td>IceAge: Chemical Evolution of Ices during Star Formation</td>
<td>Melissa McClure (Universiteit van Amsterdam)</td>
<td>Stellar Physics</td>
</tr>
<tr>
<td>Establishing Extreme Dynamic Range with JWST: Decoding Smoke Signals in the Glare of a Wolf-Rayet Binary</td>
<td>Ryan Lau (California Institute of Technology)</td>
<td>Stellar Physics</td>
</tr>
<tr>
<td>The Resolved Stellar Populations Early Release Science Program</td>
<td>Daniel Weisz (University of California - Berkeley)</td>
<td>Stellar Populations</td>
</tr>
</tbody>
</table>
CURRENT STATUS:

- Completed three-year technology development activities on WFIRST’s two critical mission technologies (near infrared detectors and coronagraph technologies)
- WFIRST Formulation Science Working Group and Science Investigation Teams selected
- Conducted WFIRST Independent External Technical/Cost/Management Review (WIETR) in response to findings and recommendations in National Academies’ Midterm Assessment
- WFIRST directed by SMD AA to modify the current WFIRST design in order to reduce cost and complexity sufficient to have a cost estimate consistent with the $3.2B cost target set at the beginning of Phase A.
  - Coronagraph is technology demonstration instrument
  - An independent cost assessment will be conducted to validate the estimated cost as being consistent with the $3.2B cost target.
  - SRR/MDR planned for February 2018.
  - KDP-B planned for March/April 2018.
- Jeff Kruk is Project Scientist following loss of Neil Gehrels

https://wfirst.gsfc.nasa.gov/
WFIRST Direction Following WIETR Findings

https://www.nasa.gov/feature/nasa-receives-findings-from-wfirst-independent-review-team

- Goddard Space Flight Center to modify the WFIRST design to reduce cost and complexity to have a cost estimate consistent with the $3.2B target set at the beginning of Phase A
- Basic architecture retained, including the existing widefield instrument, 2.4m telescope, and coronagraph instrument
- Reductions taken in widefield instrument and coronagraph instrument; coronagraph instrument treated as technology demonstration
- Cost of science investigations reduced
- Additional use of commercial subsystems for the spacecraft; serviceability for both the spacecraft and the payload retained
- Report the results of the re-scoping study at the System Requirements Review / Mission Design Review in February 2018, followed by independent cost assessment
Approach to Re-scoping WFIRST

• Project estimate of cost to Science Mission Directorate has been reduced from ~$3.6B to ~$3.2B.

• Changes include the following:
  – Coronagraph Instrument treated as technology demonstration instrument
  – Contribution to coronagraph technology demonstration instrument by NASA Space Technology Mission Directorate
  – Reduced some Wide Field Instrument capabilities
  – Contributions to mission by international partners
  – Improved budget profile and accelerated schedule; pulls in launch date 6 months
  – Additional mission risk reduction (sparing, testing, parts, etc.)
Current Program: an integrated strategic plan

We are executing a balanced strategic program for Astrophysics

• Operating missions, large and small, continue to deliver paradigm changing science

• Large strategic missions under development …
  – Are next generation great observatories
  – Will rewrite textbooks
  – Can only be done by NASA

• A high cadence of Explorers has been resumed
Astrophysics Explorers Program

Small and Mid-Size Missions

Missions of Opportunity

- **Swift**
- **NuSTAR**
- **Arcus**
- **FINESSE**
- **SPHEREx**
- **CASE**
- **COSI-X**
- **ISS-TAO**
- **MIDEX**
- **SMEX**
- **2011**
- **2014**
- **2016**
- **2019** (planned)
- **XARM**
- **Swift**
- **NuSTAR**
- **Arcus**
- **FINESSE**
- **SPHEREx**
- **CASE**
- **COSI-X**
- **ISS-TAO**
- **MIDEX**
- **SMEX**
- **2011**
- **2014**
- **2016**
- **2019** (planned)
- **XARM**
Medium Explorer (MIDEX) Mission
PI: G. Ricker (MIT)
Mission: All-Sky photometric exoplanet mapping mission.
Science goal: Search for transiting exoplanets around the nearby, bright stars.
Instruments: Four wide field of view (24x24 degrees) CCD cameras with overlapping field of view, operating in the Visible-IR spectrum (0.6-1 micron).
Operations: NLT June 2018 launch with a 3-year prime mission including 2 years of spacecraft operations and an additional 1 year ground-based observations and analysis. High-Earth elliptical orbit (17 x 58.7 Earth radii).

CURRENT STATUS:
• Both instrument and spacecraft bus completed and integrated.
• Observatory environmental testing completed.
• Spare camera long-duration testing has shown no unexpected focus drift anomalies to date.
• Cycle 1 Guest Investigator proposals received October 6, 2017.

SCHEDULE:
• July 2017 – SIR
• August 2017 – KDP-D
• Sept 2017 – PER
• October – Vibration testing
• November – TVAC testing
• Late Jan 2018 – Observatory I&T complete
• Early Feb 2018 – Delivery to KSC payload processing facility
• February 2018 – Selection of Cycle 1 GOs
• March 2018 – Launch readiness date from Cape Canaveral FL

https://tess.gsfc.nasa.gov/
https://tess.mit.edu/
X-ray Astronomy Recovery Mission (XARM)

- XARM is the successor to ASTRO-H/Hitomi. Mission will include an X-ray microcalorimeter and an X-ray imager.
- NASA will provide same hardware contribution as for Hitomi: X-ray microcalorimeter and X-ray mirrors.
- Critical Design Review completed in November 2017
- XARM now in Phase C.
- U.S. Community Involvement
  - U.S. Participating Scientists on XARM Science Team: proposals received in December 2017 and currently under review.
  - U.S. Scientists on Guaranteed Time Observing (GTO) Target Teams: to be selected approx. 1 year before launch.
  - General Observing (GO) Program: Open to U.S. scientists starting 6-9 months after launch.
### Astrophysics Explorers in Competitive Phase A

<table>
<thead>
<tr>
<th>Explorer</th>
<th>PI/Institution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arcus</td>
<td>R. Smith/SAO</td>
<td>High resolution x-ray spectroscopy to explore the origin of galaxies</td>
</tr>
<tr>
<td>FINESSE</td>
<td>M. Swain/JPL</td>
<td>NIR transit spectroscopy to explore exoplanet atmospheres</td>
</tr>
<tr>
<td>SPHEREx</td>
<td>J. Bock/Caltech</td>
<td>NIR spectral survey addressing cosmology, galaxy evolution, and origin of ices</td>
</tr>
<tr>
<td>CASE</td>
<td>M. Swain/JPL</td>
<td>Contribution of detectors to ESA’s ARIEL</td>
</tr>
<tr>
<td>COSI-X</td>
<td>S. Boggs/UCB</td>
<td>ULDB balloon mission to study origin of elements in the galaxy</td>
</tr>
<tr>
<td>ISS-TAO</td>
<td>J. Camp/GSFC</td>
<td>All-sky x-ray survey to study transients and search for GW sources</td>
</tr>
</tbody>
</table>
Current and Future Explorer AOs

• NASA is maintaining a cadence of 4 Astrophysics Explorers AOs per decade, as recommended by Decadal Survey and validated by Midterm Assessment.
  – Midterm Assessment Recommendation 4-3: “NASA’s Astrophysics Division should execute its current plan, as presented to the committee, of at least four Explorer Announcements of Opportunity during the 2012-2021 decade, each with a Mission of Opportunity call, and each followed by mission selection.”

• Most recent Astrophysics Explorers Program AO, released in September 2016, was for a MIDEX and Mission of Opportunity (MO).
  – Three MIDEX mission proposals and three Mission of Opportunity proposals selected in August 2017 for 9-month competitive Phase A studies
  – Down-selection: Early 2019 (target)
  – MIDEX launch readiness date no later than December 2023
  – MO launch readiness date no later than December 2022, except for Partner MOs whose launch date is set by the host mission.

• Next Astrophysics Explorers Program AO will be for a SMEX and MO and is targeted for release in 2019.

• Subsequent Astrophysics Explorers Program AO is for a MIDEX and MO and is targeted for release in late 2021.
Current Program: an integrated strategic plan

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• Operating missions, large and small, continue to deliver paradigm changing science

• Large strategic missions under development …
  – Are next generation great observatories
  – Will rewrite textbooks
  – Can only be done by NASA

• A high cadence of Explorers has been resumed

• International partnerships extend science opportunities for all
## Astrophysics Missions in Development

<table>
<thead>
<tr>
<th>Mission</th>
<th>Launch Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Webb</strong></td>
<td>2019</td>
<td>NASA Mission: James Webb Space Telescope</td>
</tr>
<tr>
<td><strong>Euclid</strong></td>
<td>2020</td>
<td>ESA-led Mission: NASA is supplying the NISP Sensor Chip System (SCS)</td>
</tr>
<tr>
<td><strong>IXPE</strong></td>
<td>2021</td>
<td>NASA Mission: Imaging X-ray Polarimetry Explorer</td>
</tr>
<tr>
<td><strong>GUSTO</strong></td>
<td>2021</td>
<td>NASA Mission: Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory</td>
</tr>
<tr>
<td><strong>XARM</strong></td>
<td>2021</td>
<td>JAXA-led Mission: NASA is supplying the SXS Detectors, ADRs, and SXTs</td>
</tr>
<tr>
<td><strong>MIDEX/MO</strong></td>
<td>2022/2023</td>
<td>NASA Mission: Arcus, FINESSE, or SPHEREx CASE, COSI-X, or ISS-TAO</td>
</tr>
<tr>
<td><strong>WFIRST</strong></td>
<td>Mid 2020s</td>
<td>NASA Mission: Wide-Field Infrared Survey Telescope</td>
</tr>
</tbody>
</table>
Astrophysics Missions in Pre-Formulation

**Athena**

- ESA-led Mission
- Late 2020s
- NASA is supplying elements for both instruments

**LISA**

- ESA-led Mission
- Mid 2030s
- NASA is developing technology for both the payload and the mission
LISA
Laser Interferometer Space Antenna

CURRENT STATUS:

• Selected as Third ESA Cosmic Vision Large Mission in June 2017
  - Phase 0 ended December 2017
  - Phase A starts January 2018
• NASA has established a LISA Study Office at GSFC.
• NASA is funding five US-based technologies with the aim of reaching TRL 5/6 by Adoption (nominally 2022-2024).
• NASA and U.S. community participating in LISA Science Study Team and the LISA Consortium.
  - Kelly Holley-Bockelman (Vanderbilt), David Shoemaker (MIT), and Robin (Tuck) Stebbins (Colorado) are NASA nominated members to ESA LISA Science Study Team
• NASA established a NASA LISA Study Team to interface with NASA LISA Study Office, LISA Consortium, and Decadal Survey
  - Chair is Kelly Holley-Bockelman (Vanderbilt)

Third ESA Cosmic Vision Large mission
- ESA mission with NASA participation
- Decadal Survey recommendation
- Space-based gravitational wave observatory

Launch Date: 2034

Science Objective: Study astrophysical phenomena and the universe using gravitational waves

U.S.-based Technologies in Development:
- Lasers
- Telescopes
- Microthrusters
- Phasemeters
- Charge Management System

https://lisa.nasa.gov/
LISA Preparatory Science

• The LISA Preparatory Science (LPS) is a new program element of ROSES-2018.

• The LPS Program will provide support for US investigators involved in analysis and interpretation of simulated LISA data.
  – It is **not** intended to support hardware work, which is funded separately, or to develop mission concepts.

• Proposals to the LPS Program may request support for:
  – Performing high-fidelity simulations of the expected waveforms for LISA sources;
  – Developing data analysis and statistical techniques useful for the extraction of scientific measurements from LISA data (e.g., parameter estimators, etc.);
  – Developing prototype data analysis tools, including innovative approaches to instrument simulation, that take into account the anticipated LISA mission performance;
  – Evaluating the capability of LISA data for enabling astrophysics investigations;
  – Conducting astrophysics investigations that prepare for the analysis and interpretation of the LISA data.

• Proposals will need to clarify how the proposed project fits in or augments ongoing efforts at the Study Office or in the LISA Consortium.
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- Large strategic missions under development …
  - Are next generation great observatories
  - Will rewrite textbooks
  - Can only be done by NASA

- A high cadence of Explorers has been resumed

- International partnerships extend science opportunities for all

- Investing in the community has been prioritized
  - R&A, technology development, supporting capabilities, …. 
Astrophysics Research Elements

**Supporting Research and Technology**
- Astrophysics Research & Analysis (APRA)
- Strategic Astrophysics Technology (SAT)
- Astrophysics Theory Program (ATP)
- Theoretical and Computational Astrophysics Networks (TCAN)
- Exoplanet Research Program (XRP)
- Roman Technology Fellowships (RTF)
- System-Level Segmented Telescope Design

**Data Analysis**
- Astrophysics Data Analysis (ADAP)
- GO/GI programs in ROSES for:
  - Fermi
  - Kepler/K2
  - Swift
  - NuSTAR
  - TESS
  - NICER (anticipated)

**Mission Science and Instrumentation**
- SOFIA next-generation instrumentation
- Sounding rocket, balloon, cubesat, and ISS payloads through APRA
- XARM Participating Scientists
- LISA Preparatory Science (anticipated)

**Separately Solicited**
- GO/GI/Archive/Theory programs for:
  - Chandra
  - Hubble
  - SOFIA
  - Spitzer
  - Webb
- Postdoctoral Fellowships (Einstein, Hubble, Sagan)
- Graduate Student Fellowships (NESSF)
DXL Rocket Payload

- The Diffuse X-rays from the Local galaxy (DXL) investigation aims to study the sources of X-rays that hurtle toward Earth from elsewhere in our galaxy. DXL seeks to gain a better understanding of the nature and characteristics of these sources.

- DXL was launched on a Black Brant IX rocket at 07:17 ET on Jan 19, 2018 from the Poker Flat Research Range in Alaska.

- The payload functioned well with all events occurring. Counter were overwhelmed with counts. Science Team is investigating data quality and space weather environment.

Credits: NASA/Berit Bland
2017 Antarctica Balloon Campaign

- Winter FY18 Conventional Balloon Campaign in Antarctica (single payload campaign)
  - Super-TIGER (Super Trans-Iron Galactic Element Recorder), PI Robert Binns/Washington University, was flight ready.
  - 16 launch attempts were made before the vortex started to change and the campaign was ended without a successful launch.
  - Super-TIGER will winter over in Antarctic.
Growth in R&A Support

<table>
<thead>
<tr>
<th>Program</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
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<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
<th>FY21</th>
<th>FY22</th>
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<td>$73 M</td>
<td>$74 M</td>
<td>$85 M</td>
<td>$83 M</td>
<td>$80 M</td>
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<td>$87 M</td>
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<td>$91 M</td>
<td>$92 M</td>
<td>$100 M</td>
<td>$101 M</td>
<td>$103 M</td>
<td>$103 M</td>
</tr>
</tbody>
</table>

FY2018 President’s Budget Request
Growth in Total Community Support

Does not include SAT or science teams for flight projects (e.g. Webb, WFIRST, Explorers).

GO programs funded from Chandra, Fermi, Hubble, Kepler/K2, NuSTAR, SOFIA, Spitzer, Swift, TESS, Webb, XARM, XMM; does not include possible extensions following the 2019 Senior Review.
Proposal Pressure

Research Funding ($M)

Success rate (%)

Year of Funding Start

APRA + ADAP + ATP + XRP Proposals

Success Rate (%) Research Funding ($M)
<table>
<thead>
<tr>
<th>Proposal Status Update</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proposal Due Date</strong></td>
</tr>
<tr>
<td>Astrophysics Theory</td>
</tr>
<tr>
<td>Swift GI – Cycle 13</td>
</tr>
<tr>
<td>K2 GO – Cycle 5</td>
</tr>
<tr>
<td>NuSTAR GO – Cycle 3</td>
</tr>
<tr>
<td>NESSF-17</td>
</tr>
<tr>
<td>Fermi GI – Cycle 10</td>
</tr>
<tr>
<td>Chandra GO – Cycle 19</td>
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<tr>
<td>Roman Tech Fellowship</td>
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<tr>
<td>SAT (Technology)</td>
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<tr>
<td>APRA (Basic Research)</td>
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<tr>
<td>Hubble GO – Cycle 25</td>
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<tr>
<td>ADAP (Data Analysis)</td>
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<tr>
<td>Exoplanet Research</td>
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<tr>
<td>SOFIA GI – Cycle 6</td>
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<td>Swift GI – Cycle 14</td>
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<td>TESS – Cycle 1</td>
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<tr>
<td>K2 GO – Cycle 6</td>
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<tr>
<td>XARM Participating Sci.</td>
</tr>
</tbody>
</table>

**R&A Selection Rate = 19%**  
**GO Selection Rate = 29%**
Look-ahead to R&A in 2018

- Introducing mandatory Notices of Intent to propose (NOIs) for Astrophysics R&A (APRA) and Strategic Astrophysics Technology (SAT)
  - Mandatory NOIs due January 25, 2018, for ROSES-17
- No Astrophysics Theory Program (ATP) solicitation in 2018
  - ATP solicitations are in alternate years
- New ROSES element for LISA Preparatory Science (LPS) planned
- New ROSES element for NICER GO program planned
  - After NICER completes prime mission
- Continue best practices in managing our R&A programs, reviews, and awards, including:
  - Actively taking steps to advance diversity, inclusion, and equal opportunity in the NASA workforce and among NASA grantee institutions
  - Planning to integrate results of high-risk/high-impact research review by advisory committees
## Upcoming Proposal Opportunities through April 2018

<table>
<thead>
<tr>
<th>Proposal Description</th>
<th>Proposal Due Date</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitable Worlds</td>
<td>January 17, 2018</td>
<td>ROSES-17 E.4</td>
</tr>
<tr>
<td>NuSTAR Guest Observer - Cycle 4</td>
<td>January 19, 2018</td>
<td>ROSES-17 D.10</td>
</tr>
<tr>
<td>Theoretical and Computational Astrophysics Networks (TCAN)</td>
<td>January 25, 2018</td>
<td>ROSES-17 D.12</td>
</tr>
<tr>
<td>System-Level Segmented Telescope Design</td>
<td>February 1, 2018</td>
<td>ROSES-17 D.15</td>
</tr>
<tr>
<td>NASA Earth and Space Science Fellowships (NESSF)</td>
<td>February 1, 2018</td>
<td>NSPIRES</td>
</tr>
<tr>
<td>Fermi Guest Investigator - Cycle 11</td>
<td>February 23, 2018</td>
<td>ROSES-17 D.6</td>
</tr>
<tr>
<td>Chandra General Observer - Cycle 20</td>
<td>March 15, 2018</td>
<td>cxc.harvard.edu</td>
</tr>
<tr>
<td>Roman Technology Fellowship</td>
<td>March 15, 2018</td>
<td>ROSES-17 D.9</td>
</tr>
<tr>
<td>Strategic Astrophysics Technology (SAT)</td>
<td>Mandatory NOI: Jan 25, 2018</td>
<td>ROSES-17 D.8</td>
</tr>
<tr>
<td>Astrophysics Research and Analysis (APRA)</td>
<td>Mandatory NOI: Jan 25, 2018</td>
<td>ROSES-17 D.3</td>
</tr>
<tr>
<td>Spitzer General Observer – Cycle 14</td>
<td>April 16, 2018</td>
<td>spitzer.caltech.edu</td>
</tr>
<tr>
<td>Webb General Observer - Cycle 1</td>
<td>April 6, 2018</td>
<td>jwst.stsci.edu</td>
</tr>
<tr>
<td>K2 Guest Observer – Cycle 6</td>
<td>April 19, 2018</td>
<td>ROSES-17 D.7</td>
</tr>
<tr>
<td>SOFIA Next-Generation Instrumentation</td>
<td>TBD</td>
<td>ROSES-17 D.13</td>
</tr>
</tbody>
</table>
We are executing a balanced strategic program for Astrophysics

• Operating missions, large and small, continue to deliver paradigm changing science

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  – Are next generation great observatories
  – Will rewrite textbooks
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• Investing in the community has been prioritized
  – R&A, technology development, supporting capabilities, ….

• Planning for the future is underway
  – Mission concept studies, technology investments
Planning for the Future

Base Program: R&A, Explorers, Operating Missions, Technology/Studies, etc.
Preparing for the 2020 Decadal Survey

• Large Mission Concept Studies
  - Cosmic Dawn Intensity Mapper (A. Cooray)
  - Cosmic Evolution through UV Spectroscopy Probe (W. Danchi)
  - Galaxy Evolution Probe (J. Glenn)
  - High Spatial Resolution X-ray Probe (R. Mushotzky)
  - Inflation Probe (S. Hanany)
  - Multi-Messenger Astrophysics Probe (A. Olinto)
  - Precise Radial Velocity Observatory (P. Plavchan)
  - Starshade Rendezvous Mission (S. Seager)
  - Transient Astrophysics Probe (J. Camp)
  - X-ray Timing and Spectroscopy Probe (P. Ray)

• Medium (Probe) Concept Studies
  - HabEx
  - LUVOIR
  - Lynx
  - OST

https://science.nasa.gov/astrophysics/2020-decadal-survey-planning
<table>
<thead>
<tr>
<th>Technology Surveyor</th>
<th>Addressed</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>HabEx</td>
<td>12 of 12</td>
<td>• mirror coatings, starshade starlight suppression, starshade controlling scattered sunlight, starshade lateral formation sensing, starshade petal position accuracy, starshade petal shape and stability, <em>telescope vibration control</em>, deformable mirrors, <strong>visible detectors</strong>, <em>large aperture primary mirror</em>, <em>wavefront sensing and control</em>, <strong>coronagraph optics and architecture</strong></td>
</tr>
<tr>
<td>LUVOIR</td>
<td>7 of 9</td>
<td>• closed-loop segment phasing, <em>vibration isolation</em>, <strong>wavefront sensing and control</strong>, mirror segments, <em>high-contrast segmented-aperture coronagraphy</em>, deformable mirrors, near infrared detectors, <strong>visible detectors</strong>, mirror coatings</td>
</tr>
<tr>
<td>Lynx X-ray Surveyor</td>
<td>4 of 5</td>
<td>• high-resolution lightweight X-ray optics, non-deforming X-ray reflecting coatings, <em>megapixel X-ray imaging detectors</em>, <em>large-format, high resolution X-ray detectors</em>, X-ray grating arrays</td>
</tr>
<tr>
<td>Origins Space Telescope</td>
<td>2 of 5</td>
<td>• far-infrared (FIR) detectors, cryogenic readouts for large-format FIR detectors, warm readout electronics for large-format FIR detectors, <em>sub-Kelvin Coolers</em>, cryogenic FIR mirror segments</td>
</tr>
</tbody>
</table>

- **Purple**: technologies being advanced through SAT or directed development,
- **Bold**: technologies being advanced by WFIRST or ATHENA
- **Italic**: technologies being worked on through the STDT’s design studies
- **Additional gaps**: being addressed through APRA but not tallied here
Segmented Mirror Telescope Technology

NASA is committed to advance and mature key mirror technologies for future large telescopes that could be recommended in the upcoming decade.

- **Genesis**: RFI issued on February 6, 2017 (NNG17FB01RFI), multiple responses received; informed planning.
- **Phase 1**: ROSES NRA (D.15) issued on December 1, 2017; $2.5M available in FY18 to fund one or more 1-year system-level segmented telescope design studies; proposals due February 1, 2018.
  - NASA is soliciting industry proposals to carry out system-level engineering design and modeling studies of large segmented-aperture telescopes, with integrated coronagraphs, that will lead to the identification of priority technology investments.
  - For astronomy at ultraviolet, visible, and near-infrared wavelengths a key technology priority is sub-nanometer wavefront stability.
  - For astronomy at mid- and far-infrared wavelengths, a key technology priority is to dramatically reduce mirror manufacturing and verification costs.
- **Phase 2**: RFP for 2-years soliciting testbed and laboratory demonstrations of key technologies; $10M for FY19 and FY20 (planned).
- **Phase 3**: Post-Decadal, RFP for 3-years soliciting maturing key technologies; $15M for FY21-23 (tentative, depends on Decadal Survey priorities).
NASA Astrophysics

Budget Update
## Federal Budget Cycle

<table>
<thead>
<tr>
<th>FY 2018</th>
<th>Negotiate Operating Plan</th>
<th>Execute Fiscal Year Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negotiate &amp; finalize budget proposal w/OMB via passback &amp; appeals</td>
<td>Budget Release</td>
</tr>
<tr>
<td>FY 2019</td>
<td>· Budget Resolution</td>
<td>· 302(a) &amp; (b) alloc.</td>
</tr>
<tr>
<td></td>
<td>Agencies receive strategic guidance from OMB</td>
<td>Agencies submit budget proposals</td>
</tr>
<tr>
<td>FY 2020</td>
<td>Planning within Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Budget Resolution</td>
<td>· 302(a) &amp; (b) alloc.</td>
</tr>
<tr>
<td></td>
<td>Write, pass, and conference twelve appropriations bills</td>
<td></td>
</tr>
</tbody>
</table>

**We are here.** Continuing resolution through ??????  

Start of Calendar Year 2018  

Start of Calendar Year 2019

Adapted by Kevin Marvel (AAS)  
https://aas.org/files/budgetprocess_adaptedfromaaas.jpg  
from budget presentation by Matt Hourihan (AAAS)  
http://www.aaas.org/page/presentations
FY18 Appropriation Markups

• Both Markups
  – Follow the Decadal Survey
  – Webb must be $533.7M (= requested) but do not overrun
  – STEM Activation must be $44.0M (= request); other language

• House Markup
  – Core R&A must be $74.1M (= request)
  – SOFIA must be $85.2M (+$5.3M over request, = FY17 level); other language
  – WFIRST must be $126.6M (= request) but spend $20M on starshade technology
  – Language on high energy observatories, astrophysics probes, finding target(s) for interstellar probe

• Senate Markup
  – WFIRST must be $150.0M (+23.4M over request); review; data w/ Hubble, Webb
  – Hubble must be $98.3M (+$15M over request)
  – At least $10M on “life detection technology”; consistent with request (maybe)

<table>
<thead>
<tr>
<th></th>
<th>FY18 PBR</th>
<th>FY18 Markups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Astrophysics</td>
<td>$1,350.5 M</td>
<td>$1,350.5 M</td>
</tr>
<tr>
<td>Line Item Projects</td>
<td>$941.6 M</td>
<td>$995.3 M</td>
</tr>
<tr>
<td>Rest of Astrophysics</td>
<td>$408.9 M</td>
<td>$355.2 M</td>
</tr>
</tbody>
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* Combined House and Senate markups
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NASA Astrophysics

Backup