



## FY 2016 NASA Budget Comparison Update 3

This document provides an overview of the **President’s FY 2016 NASA Budget request** in comparison with the **House passed Commerce, Justice, Science Appropriations Bill**, the **Senate Appropriations Committee (SAC) passed Commerce, Justice, Science Appropriations Bill** and the **FY 2016 Omnibus**. The first section provides a comparison of funding levels provided by each top-line item. The analysis then looks in detail at the proposal within Science, Exploration, Space Operations, and Space Technology.

### NASA Budget Proposals Overview – FY 2016 Funding

Budget Authority, \$ in millions	Consolidated Approps, 2015 (P.L. 112-235)	President’s FY 2016 NASA Base Budget Request	House Passed Commerce, Justice, Science Approps Bill (H.R. 2578)	Senate Approps Committee (SAC) Passed Commerce, Justice, Science Approps Bill (H.R. 2578)	FY 2016 Omnibus
Science	5,244.700	5,288.6	5,237.5	5,295	5,589.4
Aeronautics Research	651.000	571.4	600	527.4	640
Space Technology	596.000	724.8	625	600	686.5
Exploration	4,356.700	4,505.9	4,759.3	3,831.2	4,030
Space Operations	3,827.800	4,003.7	3,957.3	4,756.4	5,029.2
Education	119.000	88.9	119	108	115
Safety, Security, and Mission Services (formerly Cross- Agency Support)	2,758.900	2,843.1	2,768.6	2,784	2,768.6
Construction and Environmental		465.3			

<b>Compliance and Restoration</b>	419.100		425	352.8	388.9
<b>Inspector General</b>	37.0005	37.4	37.4	37.4	37.4
<b>Total</b>	<b>18,010.2005</b>	<b>18,529.1</b>	<b>18,529.1</b>	<b>18,292.2</b>	<b>19,285</b>



## Science

Budget Authority, \$ in millions	Consolidated Approps, 2015 (P.L. 112-235)	President's FY 2016 NASA Budget Request	House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	FY 2016 Omnibus
Earth Science	1,772.5	1,947.3	1,682.9	1,931.6	1,921
Planetary Science	1,437.8	1,361.2	1,557	1,321	1,631
Astrophysics	684.8	709.1	735.6	730.6	730.6
<i>James Webb Space Telescope</i>	645.4	620	620	620	620
Heliophysics	662.2	651	642	649.8	649.8
Education	42	--	--	42	37
<b>Total</b>	<b>5,244.7</b>	<b>5,288.5</b>	<b>5,237.5</b>	<b>5,295</b>	<b>5,589.4</b>

### President's FY 2016 Budget Request for Overall Science Portfolio

In FY 2016, the President's base budget requested \$5,288.5 million for Science missions, \$43.8 million above the funds appropriated for Science missions in FY 2015.

### FY 2016 Congressional Action

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$5,237.5 million for Science, \$51 million below the President's FY 2016 request.

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$5,295 million for Science, \$6.5 million above the President's FY 2016 request.

#### FY 2016 Omnibus

- The omnibus appropriates \$5,589.4 million for Science, \$300.8 million above the President's FY 2016 request.

## Earth Science

### About

From space, NASA satellites can view Earth as a planet and enable the study of it as a complex, dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life. The Nation's scientific community can thereby observe and track global-scale changes, connecting causes to effects. Through partnerships with agencies that maintain forecasting and decision support systems, NASA improves national capabilities to predict climate, weather, and natural hazards, manage resources, and support the development of environmental policy.

- President's FY 2016 Earth Science Missions:



- \$348.4 million for Earth Science Research and Analysis;
- \$136.9 million for Computing and Management;
- \$127.4 million for Ice, Cloud, and land Elevation Satellite-2;
- \$15.9 million for Soil Moisture Active and Passive;
- \$66.3 million GRACE Follow-On;
- \$78.3 million for Surface Water and Ocean Topography
- \$607.4 million for Other Missions and Data Analysis within Earth Systematic Missions;
- \$185.2 million for Venture Class Missions;
- \$825 million for Other Missions and Data Analysis within Earth Systems Science Pathfinder Missions;
- \$190.7 million for Earth Science Multi-Mission Operations;
- \$60.7 million for Earth Science Technology;
- \$47.6 million for Applied Sciences;
- “Building on NASA’s successful launch of the NASA/USGS Landsat Data Continuity Mission (LDCM)/Landsat-8 mission in February 2013, the Administration’s new Sustainable Land Imaging (SLI) program will provide US users with high-quality, global, land imaging measurements that are compatible with the existing 42-year record. The proposed program will address near- and longer-term issues of continuity risk; and will evolve flexibly and responsibly through investment in, and introduction of, new sensor and system technologies.”
- The new SLI system is multi-decadal in nature and “involves three NASA mission/development activities, including initiation of Landsat 9 immediately in FY 2015, along with a fourth activity combining technology investments and detailed system engineering to design and build a full-capability Landsat 10 satellite.”
- NASA and NOAA Earth-observing satellite responsibilities are rearranged in the FY2016 budget request “to leverage NASA Earth Science’s expertise in developing Earth-observing satellites while allowing NOAA to focus its development efforts on its weather satellites and weather forecasting mission.”
- Accordingly, “NOAA will be responsible only for satellite missions that contribute directly to NOAA’s ability to issue weather and space weather forecasts and warnings to protect life and property,” While “NASA will be responsible for other nondefense Earth-observing satellite missions.”
  - Beginning in FY16, responsibility for “TSIS-1 and future ocean altimetry missions (following Jason-3, which remains a NOAA mission)” will be transferred to NASA, while “geostationary and polar-orbiting weather satellites, radio occultation satellites, and space weather satellites” will remain NOAA’s responsibility.

### **FY 2016 Congressional Action**

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$1,682.9 million for Earth Science, \$264.1 million below the President’s FY 2016 request.
- The committee report states that the reduced budget still “maintains most programs at the fiscal year 2015 operating level and adopts reductions proposed in the budget request for the Soil Moisture Active and Passive satellite; the Global Precipitation Measurement Project; and GRACE follow-on activities.”
- Funds were not authorized for the Thermal-Infrared Free-Flyer, in lieu of authorizing to appropriate \$32.9 million for Landsat-9, “ in accordance with direction on the Landsat program provided in the statement accompanying Public Law 113—235.” Accordingly, the committee report orders NASA to “provide a report no later than 90 days after enactment of this Act regarding cost, schedule, and milestones toward achieving a launch of Landsat-9 no later than 2023.”
- Finally, “NASA shall ensure that the Earth Science portfolio is focused on the science priorities as outlined in the 2007 Earth Science decadal survey.”

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$1,931.6 million for Earth Science, \$15.4 million below the President’s FY 2016 request.

- The SAC bill includes \$100 million “to continue formulation and development of Landsat-9 as a copy of Landsat-8” and directs NASA “to maintain a target launch date for Landsat-9 of 2020 so that the risk of losing the 16-day revisit cycle is minimized by having Landsat-9 on orbit before Landsat-7 fails.”
- However, “the Committee has not provided funding for an additional free flying thermal infrared instrument ahead of Landsat-9. “
- The committee’s recommendation additionally includes \$75 million “for the Pre-Aerosol, Clouds, and Ocean Eco- system [PACE] mission. The Committee expects NASA to clarify the proposed cost baseline for PACE, including the treatment of science operations and the science definition team’s instrument recommendations.”

#### FY 2016 Omnibus

- The omnibus appropriates \$1,921 million for Earth Science, \$26.3 million below the President’s FY 2016 request.
- The bill includes \$100 million for Landsat-9, of which up to \$58 may be derived from prior year balances. NASA is directed to “develop Landsat- 9 as a copy of Landsat-8” and to maintain a target launch date in 2020.
- The agreement “reiterates House and Senate language regarding the Thermal Infrared Free-Flyer.”
- NASA is also “encouraged to continue technology development activities that will reduce the cost of Landsat-10.”
- Finally, the agreement includes Senate direction on Pre-Aerosol, Clouds, and Oceans Ecosystem (PACE). NASA shall not count carryover from fiscal year 2015 toward the \$75 million included for PACE in the agreement.”

## **Planetary Science**

#### About

To answer questions about the solar system and the origins of life, NASA sends robotic space probes to the Moon, other planets and their moons, asteroids and comets, and the icy bodies beyond Neptune.

- President’s FY 2016 Planetary Science Missions:
  - \$162.5 million for Planetary Science Research and Analysis;
  - \$7.1 million for Directorate Management;
  - \$50.0 million for Near Earth Object Observations;
  - \$56.7 million for Other Missions and Data Analysis within Planetary Science Research;
  - \$92.1 million for InSight;
  - \$64.0 million for Other Missions and Data Analysis within Discovery;
  - \$189.7 million for Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer;
  - \$69.3 million for Other Missions and Data Analysis within New Frontiers;
  - \$411.9 million for Mars Exploration;
  - \$116.2 million for Outer Planets;
  - \$141.7 million for Technology;
- NASA’s “two highest priority flagships” are the Mars 2020 Rover and the initiation of a Europa mission.
- The President’s FY16 budget request includes \$228 million for Mars Rover 2020. In 2015, “The Mars Rover 2020 mission will complete Phase A/Formulation with the SRR/Mission Definition Review and begin Phase B/Formulation.”
- The President’s FY16 budget request includes \$30 million for Europa exploration, marking the first time that the President’s budget “supports the formulation and development of a Europa Mission” and “allowing NASA to begin project formulation, Phase A.”

## **FY 2016 Congressional Action**

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$1,557 million for Planetary Science, \$195.8 million more than the President’s FY16 request.
- The committee report states that “NASA’s request for Planetary Science once again proposes a decrease



- below appropriated levels and would have a negative impact on both planned and existing mission”
- The committee also specifies that \$50 million is to be spent for near earth object observations, and \$175 million is “for Discovery, including restoration of \$19 million for the Lunar Reconnaissance Orbiter program.”
  - The report also authorizes to appropriate \$448 million for Mars Exploration, of which “not less than \$250 million is for a Mars Rover 2020 mission that meets scientific objectives from the most recent Planetary Science decadal survey.” Further, “the Committee is convinced that additional early funding for the Mars 2020 mission will enable overall economies to be achieved by procuring elements identical to the Curiosity Rover successfully operating on Mars.” Accordingly, “the recommendation also restores \$13.700 million for the Mars Opportunity Rover which the budget proposed to eliminate.”
  - The committee report directs NASA to “create an Ocean World Exploration Program whose primary goal is to discover extant life on another world using a mix of Discovery, New Frontiers and flagship class missions consistent with the recommendations of current and future Planetary Decadal surveys.”
  - The bill also authorizes to appropriate \$226 million, “of which not less than \$140 million is for the Jupiter Europa Clipper, or comparable mission, to support the process of finalizing the mission design concept that meets the scientific objectives described in the most recent Planetary Science decadal survey.”
  - “To support sustained momentum” in the Ocean Worlds program, “NASA shall ensure that future funding requests are consistent with achieving a launch no later than 2022, with the goal of launching on a Space Launch System platform...”

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$1,321 million for Planetary Science, \$40.2 million below the President’s FY 2016 request.
- The SAC bill includes \$228 million for the Mars 2020 Rover, \$50 million for Near Earth Object Observations within Planetary Science Research, and \$189.7 million for the Origins Spectral Interpretation Resource Identification and Security Regolith Explorer – all funded at the President’s FY 16 request.
- Additionally, the SAC bill provides \$7 million for New Frontiers Future Missions, \$5 million above the President’s FY 16 request, “to enable NASA to accelerate the next New Frontiers Announcement of Opportunity to a date before February 1, 2016.”
- In addition, “the Committee welcomes the rendezvous of New Horizons with Pluto scheduled for July 14, 2015, and encourages NASA to continue the momentum generated by this mission to carry over for future research on the outer planets, including Uranus.”
- Finally, “the Committee supports Advanced Sterling Radioisotope Generator research and development to enable planetary and other science research.”
- The committee report emphasizes that “a mission to Europa represents one of the highest large mission priorities of the Planetary Science Decadal Survey,” and describes the May 2015 announcement by NASA of nine scientific instruments for the mission. In order for NASA “to capitalize on investments it has made in producing a heavy lift launch vehicle capability... the Committee directs NASA, in setting the baseline Europa mission highlighted in the decadal survey, to use the Space Launch System as the launch vehicle. “

#### FY 2016 Omnibus

- The omnibus appropriates \$1,631 million for Planetary Science, \$269.8 million above the President’s FY 2016 request.
- The appropriation includes \$261 million for Outer Planets, of which \$175 million is for the Jupiter Europa clipper mission and “clarifies that this mission shall include an orbiter with a lander that will include competitively selected instruments and that funds shall be used to finalize the mission design concept with a target launch date of 2022.”
- The agreement provides \$189 million “for Discovery to support the current selection as well as funds to enable a 2017 announcement of opportunity to support Discovery missions that reflect decadal survey priorities and maximize the participation of the academic community” and \$197 million for Planetary

Science Technology, “to include no less than \$25 million as recommended by the House for icy satellites surface technology.”

- The agreement also provides \$15 million for plutonium-238 activities and provides \$250 million for the Mars 2020 mission. “Within funding for Near Earth Object Observations, \$6.1 million is for Asteroid Impact and Deflection Assessment (AIDA). In future requests, NASA shall identify total resources for AIDA and the associated Double Asteroid Redirection Test funded within AIDA.”

## **Astrophysics**

### About

Having measured the age of the universe, the scientific community now seeks to explore its ultimate extremes: its birth, the edges of space and time near black holes, and the mysterious dark energy filling the entire universe. Scientists have recently developed astronomical instrumentation sensitive enough to detect planets around other stars.

- President’s FY 2016 Astrophysics Missions:
  - \$72.3 million for Astrophysics Research and Analysis;
  - \$34.2 million for Balloon Project;
  - \$81.1 million for Other Missions and Data Analysis within Astrophysics Research;
  - \$97.1 million for Hubble Space Telescope;
  - \$85.2 million for Stratospheric Observatory for Infrared Astronomy;
  - \$17 million for Other Missions and Data Analysis within Cosmic Origins;
  - \$107.6 million for Physics of the Cosmos;
  - \$64.2 million Exoplanet Exploration;
  - \$88 million for Transiting Exoplanet Survey Satellite;
  - \$62.4 million for Other Missions and Data Analysis within Astrophysics Explorer;
- The President’s FY16 Budget Request “restores funding for the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission,” and notes that “the 2016 Senior Review panel will evaluate SOFIA’s scientific productivity.”

## **FY 2016 Congressional Action**

### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$735.6 million for astrophysics, \$26.5 million above the President’s FY 2016 request.
- As a result of the Kepler Mission’s revelation that “the Milky Way Galaxy is teeming with exoplanets,” the Committee “recommends that NASA accelerate its exoplanet program goals to discover, characterize, and eventually identify exoplanet candidates that could harbor life.” Accordingly, “an increase of \$35,800,000 is recommended to develop capabilities within the Exoplanet Exploration program to directly image exoplanets on the Wide-Field Infrared Survey Telescope (WFIRST) mission with a coronagraph and to develop technology for future potential missions, consistent with the priorities in the Astrophysics Decadal Survey for WFIRST and exoplanet technology.”
- The committee report includes \$85.2 million to fully fund SOFIA at the President’s FY16 request.
- According to the committee report, “NASA is planning to conduct a Senior Review of Operating Missions for SOFIA in early 2016.” The committee also “understands that as determined by policy established in the NASA authorization Act, NASA conducts such senior reviews of programs that have exceeded planned operational life; completed the mission/operational activities designed to meet its initial, approved science objectives and requirements; are beyond prime mission; or will not still be in its prime mission when the subsequent review occurs two years hence.”
- SOFIA began its prime mission in 2014 and has a designed operational life of up to 20 years. Accordingly, “NASA shall not commence a review of SOFIA until it meets the requirements for such senior reviews as outlined above.
- *Regarding Education and Public Outreach (EPO)*, “the recommended level for the Astrophysics Division includes \$32,000,000 for Science Mission Directorate (SMD)-wide EPO activities. NASA shall, in the fiscal



year 2016 spending plan, proportionally reallocate these funds among the SMD divisions, resulting in a dedicated budget line for each division's own EPO activities. This approach will still permit competition among projects for the best use of funds and focus that competition among projects that are more easily compared to one another and provide better stability for the educational communities in each major SMD discipline."

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$730.6 million for Planetary Science, \$21.5 million above the President's FY 2016 request.
- The SAC bill provides \$98.3 million for the Hubble Space Telescope, \$1.2 million than the President's FY 2016 request; \$85.2 to fully-fund the Stratospheric Observatory for Infrared Astronomy (SOFIA) at the President's FY 2016 request, and \$90 million for the Wide-Field Infrared Survey Telescope (WFIRST).
- Regarding SOFIA, "the Committee includes the full budget request for SOFIA, a program that had been previously proposed for cancellation in fiscal year 2015 after operations began in May 2014. The Committee understands NASA is now proposing a Senior Review panel evaluation of the program's scientific productivity in 2016, 3 years ahead of schedule. Typically, a NASA program is given 4 to 5 years to prove the merit of its science before undergoing a Senior Review. Therefore, the Committee directs that any early Senior Review of SOFIA shall only be for the purposes of allowing SOFIA to undergo such a review in preparation for future evaluation and that the results of this review shall not be used to justify early cancellation."
- In addition, "the Committee has provided funding for completion of pre-formulation and initiation of formulation of the WFIRST mission using the Astrophysics Focused Telescope Assets, with the goal of completing Key Decision Point-A no later than January 15, 2016. The Committee has accelerated this key mission recommended by the decadal survey and expects it to achieve overlap and scientific synergy with Hubble and the James Webb Space Telescope, including linking science operations and the science archive."
- Regarding Explorers, "small- and medium-sized Explorer missions have been recognized by decadal surveys as missions that meet multiple goals of providing frequent flight opportunities; allowing students and Principal Investigators to gain hands on flight experience; responding rapidly to new developments in science; providing path- finders for larger missions; and providing value when comparing science productivity to cost. The Committee continues its strong support of Astrophysics and Heliophysics Explorers and expects NASA to provide adequate resources within the amount provided to increase frequency of Explorer Announcements of Opportunity [AO]. Explorer AOs should occur at least every 3 years, and NASA's goal should be to increase the frequency to every 2 years."
- Within Astrophysics, the request includes \$20 million for education funding within the Science Mission Directorate [SMD]. For FY16, "the Committee provides no less than \$42 million for education as reflected in a more transparent single line within the SMD funding chart. This includes the \$20 million education funding included in the budget submission within the Astrophysics program. However, the Committee supports the recommendation that the Astrophysics program administer this SMD-wide education funding. The Committee encourages NASA to prioritize funding for on-going education efforts linked directly to its science missions and to encourage SMD-funded investigators to be directly involved in outreach and education efforts. The Committee notes that the \$42 million is well below the authorized mandate that 1 percent of all NASA science funds are allocated to education-related efforts. Thus, this amount does not represent a cumulative total of all on-going and longstanding education activities that will be conducted throughout SMD in fiscal year 2016."

#### FY 2016 Omnibus

- The omnibus appropriates \$730.6 million for Astrophysics, \$21.5 million above the President's FY 2016 request.
- The appropriation includes \$90 million for the Wide-Field Infrared Survey Telescope (WFIRST) and "adopts Senate direction with regard to WFIRST, a mission being developed to meet decadal survey goals in observation of dark energy and exoplanets." It also provides \$85.2 million for the Stratospheric Observatory for Infrared Astronomy (SOFIA) and "acknowledges that NASA has determined that it will not include SOFIA in its 2016 Astrophysics Senior Review since SOFIA has not yet met established





requirements for inclusion in a Senior Review. The Committees support this decision and do not provide any funds in this Act for the inclusion of SOFIA in such a review.”

## **James Webb Space Telescope**

### About

The James Webb Space Telescope (JWST) is a large, space-based astronomical observatory. The mission is a logical successor to the Hubble Space Telescope, extending beyond Hubble’s discoveries by looking into the infrared spectrum, where the highly red-shifted early universe must be observed, where relatively cool objects like protostars and protoplanetary disks emit infrared light strongly, and where dust obscures shorter wavelengths.

### President’s FY 2016 James Webb Space Telescope:

- \$620 million for James Webb Space Telescope

### **FY 2016 Congressional Action**

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$620 million for JWST to fully fund the President’s FY 2016 request.
- The committee report notes that “According to the most recent GAO report, JWST officials note that the project remains within its cost cap and is maintaining its 2018 launch date, but that the program is entering the critical integration stage and issues persist that may impact the overall schedule.”
- The report requires NASA to continue providing the committee with “quarterly briefings on JWST’s technical status and achievement of program milestones, and budget and schedule performance.”

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$620 million for JWST to fully fund the President’s FY 2016 request.
- The committee report expresses the committee’s appreciation for “GAO’s continuing work to monitor JWST progress, costs, and schedule,” and states that since “JWST has reached a level of development where 100 percent of the telescope’s mass is now beyond Key Decision Point-C, a milestone that indicates that significant progress has been made towards its 2018 launch date,” the bill maintains an “overall development cost ceiling for JWST at \$8 billion,” which “the Committee intends to hold NASA and its contractors to.” The Committee additionally “expects to be kept fully informed on issues relating to program and risk management, achievement of cost and schedule goals, and the program’s technical status.”

#### FY 2016 Omnibus

- The omnibus appropriates \$620 million for JWST to fully fund the President’s FY 2016 request.

## **Heliophysics**

### About

Using a fleet of sensors on various spacecraft in Earth orbit and throughout the solar system, NASA seeks to understand how and why the Sun varies, how Earth responds to the Sun, and how human activities are affected. The science of heliophysics enables the predictions necessary to safeguard life and society on Earth and outward journeys of human and robotic explorers.

#### President’s FY 2016 Heliophysics Missions:

- \$34 million for Heliophysics Research and Analysis;
- \$48.3 million for Sounding Rockets;
- \$21.6 million for Research Range;
- \$54.6 million for Other Missions and Data Analysis within Heliophysics Research;
- \$230.4 million for Solar Probe Plus;
- \$62.9 million for Solar Orbiter Collaboration;
- \$49.7 million for Other Missions and Data Analysis within Living with a Star;



- \$30.1 million for Magnetospheric Multiscale;
- \$20.4million Other Missions and Data Analysis within Solar Terrestrial Probes;
- \$49.8 million for ICON;
- \$49.2 million for Other Missions and Data Analysis within Heliophysics Explorer Program;
- The President’s FY16 budget request “supports a gradual increase with a goal of fully implementing [the] DRIVE [Diversify, Realize, Integrate, Venture, Educate initiative] by the end of the decade.
- “The Heliophysics Explorer Program provides frequent flight opportunities for world-class scientific investigations on focused and timely science topics.” NASA selects participants through a competitively-selected announcements of opportunity process. “Based on available funding, there is an expected three-year cadence. “Based on current funding projections, NASA can release the next Explorers AO no earlier than FY 2016.”
  - Under the Heliophysics Explorer Program, the President’s FY16 Budget Request supports continued development of ICON for launch in 2017.
- The President’s FY16 budget request includes \$230.4 to continue development of Solar Probe Plus, part of the Living with a Star program. The Solar Probe Plus will be ready for launch by 2018.

### **FY 2016 Congressional Action**

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$642 million for Heliophysics, \$9 million below the President’s FY 2016 request.

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$649.8 million to fund Heliophysics, \$1.2 million below the President’s FY 2016 request.
- The Committee also provides \$230.4 million “for the Solar Probe Plus mission, the same as the budget request. The Committee strongly affirms its multiyear commitment to a 2018 launch for the solar probe plus mission and fully expects that all future NASA budget submissions will adhere to a funding profile that guarantees a 2018 launch.”

#### FY 2016 Omnibus

- The omnibus appropriates \$649.8 million for Heliophysics, \$1.2 million below the President’s FY 2016 request.

## Exploration

Budget Authority, \$ in millions	Consolidated Approps, 2015 (P.L. 112-235)	President's FY 2016 NASA Budget Request	House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	FY 2016 Omnibus
Exploration Research and Development	306.4	399.2	350	321.2	350
Commercial Crew	805.0	1,243.8	1,000	--	--
Orion Multipurpose Crew Vehicle(s)	1,194.0	1,096.3	1,096.3	1,200	1,270
Space Launch System	1,700.0	1,356.5	1,850	1,900	2,000
SLS Integration	--	--	53	--	--
Exploration Ground Systems	351.3	410.1	410	410	410
<b>Total</b>	<b>4,356.7</b>	<b>4,505.9</b>	<b>4,759.3</b>	<b>3,831.2</b>	<b>4,030</b>

### President's FY 2016 Budget Request for Overall Exploration Portfolio

In FY 2016 the President base budget requested \$4,505.9 million for Exploration missions, \$149.2 million above the funds appropriated for Exploration missions in FY 2015.

### FY 2016 Congressional Action

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$4,759.3 million to fund Exploration \$253.4 million above the President's FY 2016 request.
- Because "the goals of the program beyond EM-2 are not well-defined," the committee directs that "within one year of enactment of this Act, NASA shall provide the Committee with a comprehensive, multi-year plan outlining long-term exploration goals beyond EM-2, using the 130 metric ton SLS or a comparable launch vehicle."
- The above-described plan "shall assess and propose alternative payloads, mission capabilities, necessary propulsion, crewed and uncrewed options and alternative destinations, such as Mars or Europa."
- Further, "this plan shall include yearly funding estimates and define quarterly milestones by mission directorate that will be necessary to achieve a range of possible missions, which will enable a more frequent SLS launch tempo than currently projected by NASA."



- Finally, “this plan shall also incorporate funding estimates and milestones necessary to complete the EUS for EM–2 and additional missions beyond EM–2.”

SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$3,831.2 million to fund Exploration, \$674.7 million below the President’s FY 2016 request. However, “for fiscal year 2016, the Exploration account does not include funds for Commercial Crew, which are now located under ISS Crew and Cargo transportation in the Space Operations account.”
- The committee report states, “Space Launch System [SLS], Orion multi-purpose crew vehicle [Orion], and Exploration ground systems are all critical to the timely and successful initial launch of Exploration Mission-1 [EM– 1]. To date, both SLS and Exploration ground systems have completed Key Decision Point-C reviews, and Orion is expected to complete its review in the third quarter of 2015. Once that point is reached, NASA intends to develop an integrated schedule by the end of calendar year 2015 that will solidify the schedule for EM– 1, and provide the necessary guidance to ensure EM–1 is launched as early in 2018 as possible.”
- The committee is disappointed, however, “that the funding requested by NASA for SLS and Orion once again bears little relation to necessary funding levels or to amounts provided in previous years. The lack of support for these programs indicates that NASA is allowing an artificially low development funding profile and inefficient decision processes to create unnecessary risks to the EM–1 schedule. The Committee has repeatedly been compelled to provide appropriate funding to keep the human exploration program from incurring costly setbacks and to maintain development schedules. Continued insufficient funding proposals from NASA for all aspects of related to EM–1 and its crewed follow on test flight will only lead to cost escalation and unnecessary schedule delays that will then have to be addressed in future budget years.”

FY 2016 Omnibus

- The omnibus appropriates \$4,030 million for NASA’s Exploration portfolio, and “emphasizes House and Senate language regarding human spaceflight safety standards.”

## **Space Launch System**

About

The NASA Authorization Act of 2010 directed NASA to develop an evolvable heavy-lift rocket that will allow human exploration beyond low Earth orbit.

- President’s FY 2016 Space Launch System (SLS):
- NASA FY 2016 budget justification documents note that “The vehicle's capabilities will evolve using a block upgrade approach, driven by near- and long-term exploration mission requirements.”
  - First, “SLS will carry over 70 metric tons to low Earth orbit and nearly 30 metric tons to the exploration proving ground near the Moon.”
  - Next, “follow-on upgrades, including an advanced Exploration Upper Stage (EUS) will improve vehicle lift performance to 105 metric tons to low Earth orbit and 40 metric tons to the lunar proving ground, significantly increasing mission capability.”
  - Finally, “SLS will evolve to carry over 130 metric tons to low Earth orbit, necessary to launch the large elements needed for human exploration of Mars.”
- EUS “leverages technology investments made by the STMD in areas such as cryogenic fluid management and advanced composites.” NASA has already begun leveraging “this close coordination demonstrated between STMD and HEOMD” to serve as the basis for “future exploration technologies and capabilities needed to explore Mars in the 2030s.”
- The President’s FY16 request for SLS funding keeps the SLS EM-1 on track for launch capability readiness in November 2018.

## **FY 2016 Congressional Action**

House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)



- The House passed FY 2016 CJS bill would appropriate \$1,850 million for SLS, \$493.5 million above the President’s FY 2016 request.
- Of that SLS funds, no less than \$50 million is to be used for “continued enhanced upper stage (EUS) development.”
- The report directs NASA to provide the committee with a report “no later than 120 days after enactment of this Act describing investments to date on the EUS and a spend plan with milestones for the funds provided in fiscal year 2016.”
- NASA also is instructed to continue providing quarterly reports on SLS by major program element, “as first required in the statement accompanying Public Law 112–55.”
- Last, the committee directs NASA “to the maximum extent possible,” to “ensure that all vehicle development funding leverages existing investments; promotes efficiency through commonality of design and simultaneous development; and minimizes the need for redesigns or other costly changes affecting future SLS vehicle configurations.”

SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$1,900 million for SLS, \$543.5 million below the President’s FY 2016 request.
- The Committee “reiterates its unwavering support of the Space Launch System [SLS] and the ability for SLS to open the human exploration of space to a wide range of missions,” stating that “SLS has successfully passed its Key Decision Point-C [KDP–C] milestone and the program is diligently working towards its first flight in 2018. While KDP–C defines a readiness date of November 2018, the current progress of SLS will result in the vehicle being delivered ahead of its planned schedule.”
- The Committee also finds that “the budgetary resources provided for SLS in the fiscal year 2016 budget request are insufficient and do not take into account the current management schedule for flight readiness, nor does the funding level present a path forward beyond EM–1. In February 2015, the U.S. Government Accountability Office [GAO] reported that NASA’s cost estimates for both SLS and Orion do not extend beyond the first flight of the combined system. GAO further reported that NASA’s budget estimates do not include the development costs for upper-stage development for SLS or production costs for the second test flight scheduled for 2021. GAO also stated that NASA’s funding requests do not meet SLS program requirements. While the Committee has chosen to correct the funding shortfalls in fiscal year 2016, NASA is directed to address these issues identified by GAO in future budget submissions.”
- The Committee is also concerned “that NASA will attempt to take the Interim Cryogenic Propulsion Stage [ICPS] that will be used for EM–1 and create a human rated variant. In doing so, NASA would spend \$150,000,000 to develop a human rated engine that would be used only once, before being replaced by the Exploration Upper Stage [EUS]. Such planning wastes valuable time and funding resources that should be used for developing the EUS from the beginning so that it will be available for all crewed SLS missions.”
- Toward a goal “to ensure proper funding,” the Committee provides that “no less than \$100,000,000 provided for the direct development of the EUS to be used for EM–2. This funding level is necessary in order for the SLS to continue its progress towards a successful EM–1 launch as early as possible in 2018, to facilitate development of essential EUS propulsion hardware, and to begin the procurement process of long lead items for a crewed launch in 2021.”

FY 2016 Omnibus

- The omnibus appropriates \$2,000 million for SLS, \$643.5 million more than the President’s FY16 request.
- Within amounts provided for SLS, the agreement provides “no less than \$85 million for development of an enhanced upper stage that is intended to be the human-rated upper stage engine for Exploration Mission (EM) -2. NASA shall not expend funds human rating the interim cryogenic propulsion stage.”

**Orion Multi-Purpose Crew Vehicle**

About

NASA’s FY 2016 budget justification documents states that Orion MPCV will be capable of carrying “a crew of four astronauts beyond Earth orbit and provide habitation and life support for up to 21 days.” The spacecraft



has three components: a crew module, service module, and launch abort system, with a separate adapter to connect the crew and launch vehicles.

- The crew module is described as a “familiar capsule shape on the outside, but inside it contains state of the art crew systems.” During a mission the Orion MPCV will “house the crew, providing a safe environment within which to live and work.” In addition, “Its advanced heat shield will protect the crew from the reentry heating during a high-speed return from beyond Earth orbit.”
- The service module “is comprised of a crew module adapter and an ESA-designed and developed service module section, and together they provide in-space power, propulsion, and other life support systems.”
- The launch abort system sits “atop the crew module,” and “in the event of an emergency during launch or climb to orbit, will activate within milliseconds to propel the crew module away from the launch vehicle to safety.” Further, the launch abort system “provides a protective shell that shields the crew module from dangerous atmospheric loads and heating during descent.” The spacecraft will jettison the system “once Orion is out of the atmosphere and safely on its way to orbit.”
- A successful EFT-1 Flight Test of the Orion Capsule was conducted in December 2014, the data from which “will help NASA to understand better many of the top risks to astronauts who will fly on Exploration Mission (EM)-2 and future missions.”
- Next, “Orion will continue design, development, and testing, focusing on EM-1 and EM-2,” while “NASA continues working toward a capability to launch EM-1, which includes launching an uncrewed vehicle to demonstrate the performance of an integrated SLS rocket and uncrewed Orion vehicle prior to EM-2, a crewed flight.... An integrated EM-1 launch date will be determined once the SLS, EGS, and Orion have completed their respective Critical Design Reviews.”

#### **FY 2016 Congressional Action**

##### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$1,096.3 million for Orion to fully fund the President’s FY 2016 request.
- In addition, NASA is directed to “provide quarterly briefings to the Committee on efforts to address parachute issues that arose during the December 2014 test flight and to address heat shield issues that NASA has been working to resolve since 2013. These updates shall include the overall status of Orion and its ability to ride on SLS for Exploration Mission (EM)–1.”
- The committee also states its concern that that “NASA’s current schedule does not provide adequate time to fully test all systems necessary to support humans prior to EM–2.” Accordingly, “NASA shall provide the Committee with an assessment, no later than the second quarter of fiscal year 2016, of its ability to test all human-rated systems on EM–1.”

##### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$1,200 million for Orion, \$103.7 million above the President’s FY 2016 request.
- The committee states that “Orion is an essential component of NASA’s human exploration goals that extend beyond low-Earth orbit. However, in the same report by GAO that cited issues with funding levels for SLS, GAO also concluded that NASA is not budgeting for the production, operations, and sustainment costs associated with Orion beyond this first successful test flight. GAO has found that technical risks and budgetary uncertainty threaten Orion’s future success. Moreover, current NASA plans lack sufficient requests for funding needed to build and test systems essential for crew such as environmental control, life support, and critical displays. The Committee looks forward to a successful result for Orion’s KDP–C review.”

##### FY 2016 Omnibus

- The omnibus appropriates \$1,270 million for Orion, \$173.7 million more than the President’s FY16 request.

#### **Integrated Launch Readiness**

• The President’s FY16 request did not include a portion called Integrated Launch Readiness.



## FY 2016 Congressional Action

### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$53 million for Integrated Launch Readiness, which did not exist in the President's FY 2016 request.
- The committee report states that the funds are to address coordination issues among Orion, SLS, and ground systems "and ensure that they are progressing in tandem toward EM-1 and future missions."
- The committee also directs NASA to notify the committee no later than 10 days after the decision regarding the date for the EM-1 mission. That decision should be made by December 2015.
- Further, "to provide the Committee with a greater understanding of the complete costs of an integrated SLS/Orion program, NASA shall submit a comprehensive plan, with yearly budgets by component including various ground facilities and quarterly milestones, to achieve an integrated launch readiness dates for EM-1 and EM-2. This report shall also provide an analysis of various capabilities that will be provided with 70, 105, and 130 metric ton capabilities, to include the yearly costs necessary to proceed with this incremental approach."
- The committee also stresses safety, noting that that it "understands that various risks need to be retired in the integrated program prior to safely transporting humans. Nothing in this report or accompanying Act directs NASA to proceed with any human spaceflight programs until all of the risks have been retired."

### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- "To ensure that NASA follows its own guidance and does not require SLS and Orion to incur a higher risk profile than other major missions, the bill directs NASA to formulate a reliable and realistic Joint Confidence Level. In doing so, NASA shall provide the Committee with an annual budget profile based upon NASA's own 70 percent JCL standard which is to be submitted concurrently with the annual budget submission. Any JCL that is less than 70 percent shall be justified and documented, and NASA shall still provide the Committee with the full cost estimates that would be needed to achieve a 70 percent JCL."

### FY 2016 Omnibus

- The omnibus also includes up to \$50 million for integration of SLS and Orion.
- No less than \$55 million is provided "for a habitation augmentation module to maximize the potential of the SLS/Orion architecture in deep space. NASA shall develop a prototype deep space habitation module within the advanced exploration systems program no later than 2018 and provide a report within 180 days after enactment, and annually thereafter, regarding the status and obligation of funding for the program. The first such report shall include an analysis to determine the appropriate management structure for this program."
- The omnibus agreement also "adopts House and Senate language regarding funding to human rate all systems prior to EM-2 and notes that additional funds above the request have been provided to address this untenable gap presented by NASA in its budget request. The agreement modifies House reporting requirements for integrated launch readiness and exploration goals and directs that NASA submit a comprehensive report within one year of enactment, utilizing the 130 metric ton SLS, that addresses items as directed by the House."

## Commercial Crew

### About

With an eye to the future of human spaceflight, NASA is looking to the U.S. private sector to develop and operate safe, reliable, and affordable crew transportation to low Earth orbit, including to the International Space Station (ISS).

- In 2016, "commercial crew industry CCtCap teams will accomplish significant milestones under their contracts, such as Boeing's Integrated Parachute System Drop Tests and service module hot fire launch abort test and SpaceX's plans for uncrewed flight to ISS and Launch Site Operational Readiness Review."

## FY 2016 Congressional Action



#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$1,000 million for Commercial Crew, \$244 million below the President's FY 2016 request.
- The Committee report shares the concerns of the committee that "some project milestones have slipped for a variety of reasons" and directs NASA to "continue submitting quarterly reports on the status of the Commercial Crew Integrated Capability and Commercial Crew Transportation Capability contracts. NASA also shall provide an assessment within 90 days of enactment of this Act on the need to reserve flights on the Soyuz capsule in tandem with the Commercial Crew program in 2017 and 2018."

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- For purposes of the 2016 budget, the Senate version of the appropriations bill For fiscal year 2016, "the Exploration account does not include funds for Commercial Crew, which are now located under ISS Crew and Cargo transportation in the Space Operations account."

#### FY 2016 Omnibus

- In the omnibus, the Exploration account does not include funds for Commercial Crew, which are included in the Space Operations account; however, the act does provide "up to \$1,243.8 million for NASA's Commercial Crew Transportation Capability to safely send the Nation's astronauts to and from the ISS by 2017. The Committees note that NASA notified Congress in an August 2015 letter of its decision to modify an existing contract with the Russian government for crew transportation services beyond 2017. That decision was made prior to any final action by Congress on NASA's 29 Commercial Crew Transportation Capability funding for fiscal year 2016. The funds provided in this Act enable NASA to follow the fastest path to independence from Russia by providing for continuing development of a domestic crew launching capability."
- "If necessary, NASA may derive resources for milestone payments from funds set aside for Russia by NASA for ISS crew launches scheduled to occur after U.S. providers will be operational in 2017. NASA shall reevaluate its need to procure additional seats from Russia in consideration of the funding level being provided within the Space Operations account."
- "The agreement adopts Senate language providing for the availability of funds related to Space Shuttle Program closeout activities. NASA shall use prior year unobligated balances or recoveries within Space Operations to pay administrative expenses associated with these activities."



# Space Operations

Budget Authority, \$ in millions	Consolidated Approps, 2015 (P.L. 112-235)	President's FY 2016 NASA Budget Request	House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	FY 2016 Omnibus
International Space Station	-	3,105.6	3,075.6	3,951.6	Not specified
Space and Flight Support	-	898.1	881.7	Not specified, but logic dictates 804.8	Not specified
<b>Total</b>	<b>3,827.8**</b>	<b>4,003.7</b>	<b>3,957.3</b>	<b>4,756.4</b>	<b>5,029.2</b>

\*\* The ISS and Space and Flight Support sub-numbers are not broken out for this account.

## President's FY 2016 Budget Request for Overall Space Operations Portfolio

In FY 2016 the President base budget requested \$4,003.7 million for Space Operations missions, \$175.9 million above the funds appropriated for Space Operations missions in FY 2015.

- President's FY 2016 Space Operations:
  - \$1.1061 billion for ISS Systems Operations and Maintenance;
  - \$394 million for ISS Research
  - \$1.6055 for ISS Crew and Cargo Transportation
  - \$23.3 million for 21<sup>st</sup> Century Space Launch Complex
  - \$539.7 million for Space Communications Networks
  - \$92.7 million for Space Communications Support
  - \$108.5 million for Human Space Flight Operations
  - \$86.7 million for Launch Services
  - \$47.2 for Rocket Propulsion Test

### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$3,957.3 million to fund Space Operations, \$46.4 million below the President's FY 2016 request.

### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$4,756.4 million for Space Operations, \$751.2 million above the President's FY 2016 request.
- New for FY16, "the Committee has chosen to fund all activities related to the ISS within the same account to consolidate funding required for the supply and operation of this national asset and to allow the ISS to be managed as a whole program, within the budgetary resources provided. This realignment and unification of ISS activities will allow NASA's programs associated with operating the ISS, developing crew capabilities, and supporting human activity in low-Earth orbit, to be analyzed and evaluated in its entirety. This budgetary adjustment will only affect the structure of ISS-related funding and will not alter



the many aspects of the ISS program, or its management structures that are currently in place within Human Exploration and Operations.”

#### FY 2016 Omnibus

- The omnibus appropriates \$5,029.2 million for Space Operations, \$1,025.5 more than the President’s FY16 request.

### **International Space Station**

#### About

As the world’s only space-based multinational research and technology testbed, ISS is critical to the future of human space activities. The facility enables scientists to identify and quantify risks to human health and performance and to develop and test countermeasures and technologies to protect astronauts during extended human space exploration. In addition, ISS offers unique opportunities for research and development, allowing scientists to investigate biological and physical processes in an environment very different from that on Earth.

#### **FY 2016 Congressional Action**

##### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$3,075.6 million for ISS, \$30 million below the President’s FY 2016 request.
- The Committee states that it is concerned, “particularly in light of NASA’s proposal to extend the life of the Station through 2024, that annual ISS operations costs are increasing.”
- The report directs NASA to “continue to implement cost savings measures with the goal of slowing and reducing the ISS operations budget while maximizing research opportunities.”
- In addition, “all reductions from the request level shall be implemented in the operations budget rather than ISS research or crew and cargo transportation.”
- The committee is also of the belief that “NASA’s budget request continues to allocate insufficient funding and effort to ISS research,” and “that this imbalance must be addressed by directing a greater share of research funding to actual physical and biological science research.”
- Accordingly, NASA is directed “to provide a strategy for accomplishing this goal over the next five fiscal years, which shall be provided “no later than 120 days after the enactment of this Act.

##### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill would appropriate \$3,951.6 million for ISS, \$846 million above the President’s FY 2016 request to fund ISS Operations, Research, Crew, and Cargo Services.
- The committee report states that “the committee has consistently supported the construction and operation of the ISS on the premise that it would support world-class science conducted by the United States, as well as our international partners. The Committee encourages NASA to work with its international partners to support the ISS through 2024, to maintain a high level of safety, and maximize the return of scientific research. In addition, the Committee considers astronaut safety its highest priority and NASA must ensure that safety standards for transportation are not compromised as NASA begins to replace its reliance on existing Russian capabilities with purchasing services from domestic crew transportation providers.”
- This version of the bill moves ISS Crew and Cargo Transportation from the Exploration account to the Space Operations account, where “the Committee recommends \$2,505.5 million to fund ISS cargo resupply and crew transportation, including \$900 million for development milestone payments to U.S.-based ISS Crew providers.”
- The Committee emphasizes that “that the initial rounds of development funding for ISS Crew capabilities represented a \$1,90 million investment prior to awarding another \$6,800 million in potential payments for two ISS Crew providers to finish development of their vehicles and conduct initial flights. At the end of this final round of vehicle development and testing of this capability, NASA will have paid a total of \$8,700 million to conduct a competition between several companies. This substantial investment from the Federal Government comes prior to NASA purchasing future crew services for the ISS from these domestic providers.”



- “Given the significant sums being invested by NASA,” the committee says that “it is incumbent that these funds are regularly reviewed.” “To date, milestones intended to show progress in the development of the ISS Crew capability have already begun to be delayed. More technically challenging milestone completion dates are about to be reached or may be potentially postponed further. It is the intent of the Committee to continue to closely monitor and review progress of the ISS Crew capability through the quarterly reports that are provided by NASA.”
- The committee expresses serious concern regarding a Notice of Intent issued by NASA on February 6, 2015, “to purchase another six seats from the Russians during the 2018–2019 time period. While NASA appears to be protecting its access to ISS, the Committee notes NASA has consistently stated that domestically launched crew transportation capabilities will be ready during this time period so that the United States can end our reliance on such vehicles. Particularly concerning is that the notice of intent specifically states that ‘NASA needs to secure crew transportation with a known reliable provider to ensure a continued U.S. presence aboard the ISS.’ Such statements are deeply concerning and indicate that even NASA, which has continual insight and oversight of the ISS crew program, does not have confidence that even with significant financial and technical support, the availability of a reliable domestic ISS crew capability by 2017 is guaranteed.”
- Finally, the Committee states that it “has provided the requested amount for ISS Cargo in anticipation that during fiscal year 2016, the companies contracted to provide cargo services will be capable of delivering cargo to, and returning it from, the ISS, consistent with current agreements.”

#### FY 2016 Omnibus

- The Space Operations account includes “resources for the ISS which is the proving ground for technologies that will support human exploration farther into space while also testing technologies for improving life on Earth.”

### **Space and Flight Support**

#### About

Space and Flight Support consists of multiple programs providing Agency-level capabilities critical to the success of NASA missions and goals.

#### **FY 2016 Congressional Action**

##### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The House passed FY 2016 CJS bill would appropriate \$881.7 million for Space and Flight Support, \$16.4 million below the President’s FY 2016 request.
- The committee’s recommendation includes the requested \$23.2 million for the 21st Century Space Launch Complex program, which is “designed to modernize and upgrade both Wallops Flight Facility and Kennedy Space Center launch and range complexes.”
- NASA is directed to “provide periodic updates to the Committee regarding status of the Wallops Flight Facility and its ability to resume commercial launches.”
- The Committee “supports maintaining launch sites serving the International Space Station at both the Kennedy Space Center and the Wallops Flight Facility to ensure uninterrupted domestic cargo access to the Station.”
- When launch failures occur in the commercial cargo program, “NASA shall submit a report within 180 days of enactment of this Act on all anomalies and losses in the commercial cargo program and how any such anomalies have been corrected.”

##### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The SAC passed FY 2016 CJS bill does not specify how much the committee would authorize to appropriate for the space and flight support sub-account; however, because it does specify the total Space Operations budget and does specify the ISS sub-account, logic dictates that the committee would appropriate \$804.8 million for Space and Flight Support, \$93 million below the President’s FY 2016 request.
- This version of the bill provides \$30.3 million for the 21st Century Space Launch Complex, \$7 million above the President’s FY16 request. The Committee “is concerned about the ability of commercial space



launch providers to plan for the future, given the preponderance of funding that is dedicated from the 21st Century Space Launch Complex to the facilities at Kennedy Space Center. The program's authorized purposes include projects at all NASA-owned launch facilities. The Committee directs that any new Commercial Space Flight infrastructure investment proposals for the 21st Century Space Launch Complex program take into account the cargo mission needs also demonstrated at the Wallops Flight Facility [WFF], which is expected to complete repairs on the launch pad and return to flight in fiscal year 2016. There are now growing capacity issues at WFF that, if not resolved, could soon prevent the center from taking on small and large missions due to limitations associated with facilities related to spacecraft processing and fueling. Therefore, the Committee provides the increased funding to fill maintenance gaps at the WFF launch complex, and further directs NASA to take into consideration the full potential of all NASA-owned launch complexes."

- The Committee also "recognizes and appreciates the complexities involved in sustaining NASA's Near Earth, Space, and Deep Space communications networks and infrastructure that support NASA's scientific and exploration activities," and therefore "directs NASA to develop a plan, budget, and timeline for sustainment of the existing network and infrastructure up-grades within 180 days of enactment of this act."

#### FY 2016 Omnibus

- The omnibus bill does not specify how much the committee would authorize to appropriate for the space and flight support sub-account; however, "not less than \$15 million is to continue satellite servicing activities; additional funds for satellite servicing activities are included within the Space Technology Account. The recommendation includes \$30.3 million as directed by the Senate for the 21st Century Space Launch Complex program. The agreement acknowledges that recoveries of prior year obligations are available in this account."

# Space Technology

Budget Authority, \$ in millions	Consolidated Approps, 2015 (P.L. 112-235)	President's FY 2016 NASA Budget Request	House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)	FY 2016 Omnibus
Space Technology Research and Development (formerly, the separate Crosscutting Space Technology and Exploration Technology Development)	-	491.0	Not specified	Not specified	Not specified
Agency Technology and Innovation	-	33.0	Not specified	Not specified	Not specified
SBIR and STTR	-	200.9	Not specified	Not specified	Not specified
<b>Total</b>	<b>596.0</b>	<b>724.9</b>	<b>625</b>	<b>600</b>	<b>686.5</b>

### President's FY 2016 Budget Request for Overall Space Technology Portfolio

In FY 2016, the President's base budget requested \$724.9 million for Space Technology missions, \$128.9 million above the funds appropriated for Space Technology missions in FY 2015.

### FY 2016 Congressional Action

#### House Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The Committee recommends \$625 million for Space Technology, which is \$99.9 million below the President's FY16 request.
- The committee recommendation "includes no less than \$25 million for icy satellite surface technology and test-bed activities."
- The committee recommendation also "includes no less than \$20 million for nuclear propulsion technologies for space transportation and exploration" and directs that within 180 days of enactment, "NASA shall provide a report on ongoing nuclear propulsion re- search and how NASA intends to employ this technology to support various exploration programs."

#### SAC Passed Commerce, Justice, Science Appropriations Bill (H.R. 2578)

- The Committee recommends \$600 million for Space Technology, which is \$124.9 million below the President's FY16 request.
- Included in the Space Technology budget, the Committee recommends \$150 million "for satellite servicing to continue the pathfinder mission [RESTORE-L] to refuel Landsat-7 or another U.S. Government-owned satellite in low-Earth orbit no later than 2019." since "Pathfinder technologies were funded and proven on the International Space Station. The Committee recommendation includes funding for a full-scale, stand- alone demonstration which will benefit multiple NASA mission directorates and, therefore, is more appropriately funded within Space Technology. The mission shall be co-managed and led by the Science Mission Directorate."



- The committee report notes that “in allocating funding for RESTORE–L, NASA shall not include amounts carried over from previous fiscal years. The Committee has also included bill language for this initiative so it continues in a timely fashion and to avoid lingering drains on satellite servicing funds that have been diverted to other purposes in earlier years. Celebrations of the 25th anniversary of the Hubble Space Telescope demonstrated the value of repair, upgrades, and life extension for productive but expensive Government-owned space assets. Given constraints imposed by the Budget Control Act, satellite servicing offers a unique and valuable means to stagger the capital requirements for new satellites by significantly extending the useful life of existing ones. The funds set aside for the RESTORE–L Path- finder mission should lead to the immediate funding of efforts to formulate a rapid mission, done in partnership with and overseen by NASA’s existing satellite servicing expertise. The Administrator shall furnish the Committee with a written schedule to accomplish the execution of RESTORE–L not later than 30 days after the enactment of this act.”
- Space Technology also encompasses the Small Business Innovation Research (SBIR) program, which has had “previous success in commercialization of results from federally funded research and development projects. The SBIR program encourages domestic small businesses to engage in Federal research and development, and creates jobs. The Committee therefore directs NASA to place an increased focus on awarding SBIR awards to firms with fewer than 50 employees.”
- Finally, “within the funds provided for Cross- cutting Space Technology Development, the Committee provides \$20 million for Flight Opportunities. The Committee notes that NASA initiated a program during fiscal year 2015 to promote the development of nano-launch orbital capabilities within Flight Opportunities, and directs NASA to further pursue the design and development of an affordable system that can carry nanosatellites to low-Earth orbit from within the funds provided.”

#### FY 2016 Omnibus

- The omnibus appropriates \$686.5 million for Space Technology, \$84.4 million less than the President’s request for FY16.
- \$133 million “is for satellite servicing/RESTORE-L activities as described in the Senate report. This funding is in addition to any funding within Space Operations to continue International Space Station (ISS)-unique satellite servicing activities. The Space Technology funding for satellite servicing shall not support any activities needed solely for the Asteroid Redirect Mission but may support activities that support both projects such as manipulators or software development.”
- Also, “along with the spending plan required under section 534 and any subsequent updates, NASA shall identify any shared technologies, along with the funding resources required to support that technology development and how those technologies are required by RESTO REL.”
- In addition, “in lieu of Ho use language on nuclear propulsion technologies, the agreement provides up to \$20 million for these activities.”
- “No funds are recommended for icy satellites surface technology in this account as proposed by the House; instead, \$25 million is provided for these activities within the Planetary Science program.”
- Finally, “in lieu of Senate language on Flight Opportunities, the recommendation includes \$15 million for these activities.”

#### **About the Space Foundation**

Founded in 1983, the Space Foundation is the foremost advocate for all sectors of space, and is a global, nonprofit leader in space awareness activities, educational programs and major industry events, including the annual [Space Symposium](#), in support of its mission "to advance space-related endeavors to inspire, enable and propel humanity." Space Foundation World Headquarters in Colorado Springs, Colo., USA, has a public [Discovery Center](#), including El Pomar Space Gallery, Northrop Grumman Science Center featuring Science On a Sphere® and the Lockheed Martin Space Education Center. The Space Foundation has a field office in Houston and conducts government affairs from its Washington, D.C., office. It annually publishes [The Space Report: The Authoritative Guide to Global Space Activity](#), and through its [Space Certification™](#) and [Space Technology Hall of Fame®](#) programs, recognizes space-based innovations that have been adapted to improve life on Earth.

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