



## **NASA'S FY2017 BUDGET REQUEST**

On April 30, 2017, congressional leaders reached agreement on a FY2017 omnibus appropriations bill. NASA is funded as part of the Commerce-Justice-Science (CJS) appropriations bill, which is Division B of the omnibus legislation. NASA would receive a substantial increase over President Obama's request and more than either the House or Senate Appropriations committees approved: \$19.653 billion. The bill (H.R. 244 as amended) and explanatory statement are posted on the House Rules Committee's [website](#).

The appropriations committees approved their respective versions of the FY2017 CJS bill (see Table 1) during the 114<sup>th</sup> Congress, but neither chamber passed those bills by the time the fiscal year began on October 1, 2016. NASA has been funded by a series of Continuing Resolutions (CRs) since then at its FY2016 level. The new omnibus bill is expected to clear Congress and be signed into law before Friday, May 5, when the most recent CR expires.

The 114<sup>th</sup> Congress did not complete action on a new NASA authorization bill either, but Congress continued work on it in the 115<sup>th</sup> Congress and a bill (S. 442) was passed and signed into law (P.L. 115-10) in March 2017. The bill is summarized below beginning on page 12. Authorization bills set policy and recommend funding, but do not actually provide any money.

### **Overview**

President Obama submitted a very complicated FY2017 budget request for NASA. It contains "discretionary" and "mandatory" components that together total \$19.025 billion. That is the figure NASA uses in its FY2017 budget presentations and is \$260 million less than the \$19.285 billion appropriated by Congress for FY2016.

Of the \$19.025 billion, \$18.262 billion was requested for appropriated funds from the discretionary portion of the federal budget – the source of NASA's funding since the agency opened its doors in 1958. Another \$663 million was supposed to come from the mandatory portion of the federal budget that funds Social Security and Medicare, for example, and another \$100 million from a tax the President wanted to levy on oil companies.

This unique approach to budgeting is discussed below for historical purposes, but was irrelevant. Both the House and Senate Appropriations Committees ignored what they called a "gimmick" and considered just the \$18.262 billion requested in appropriated funds – the only funds over which they have jurisdiction.

Both committees approved not only more than the \$18.262 billion, but more than the FY2016 appropriated level of \$19.285 billion. As discussed below (beginning on page 8), the Senate committee approved \$19.306 billion and the House committee approved \$19.508 billion. The final omnibus appropriations bill approves even more: \$19.653 billion.

This fact sheet has five tables:

- Table 1 compares what Congress appropriated for FY2016, President Obama's FY2017 request using the numbers in NASA's budget presentations that total \$19.025 billion as well as the amount (\$18.262 billion) without "mandatory" spending, and congressional action on authorization and appropriations legislation through the date of this report.
- Table 2 shows the FY2017 request separated into its discretionary (\$18.262 billion) and mandatory (\$763 million) components.
- Table 3 compares the funding levels recommended in the FY2016-2017 NASA authorization bill (H.R. 2039) [approved](#) by the House Science, Space and Technology Committee on April 30, 2015 the [Senate-passed](#) FY2017 NASA Transition Authorization Act, S. 3346. The bill died at the end of the 114<sup>th</sup> Congress, however, and is included here for historical purposes only.
- Table 4 shows NASA's funding for its "Asteroid Initiative," which includes the Asteroid Redirect Mission (ARM). Those activities are not grouped together in NASA's budget documents and are spread across several NASA Headquarters organizations. This table brings it all together using data provided by NASA.
- Table 5 consolidates the funding for the Space Launch System (SLS), which is spread across three subaccounts. The Further Continuing and Security Assistance Appropriations Act, under which NASA is funded through April 28, 2016, keeps SLS funding at its FY2016 level, but allows NASA to spend money in such a manner as to maintain the late 2018 launch date for the first SLS.

## **NASA's FY2017 Budget Request: \$18.3 Billion or 19 Billion – An Analysis**

President Obama requested \$19.025 billion for NASA for FY2017, but only \$18.262 billion of that is through the appropriations process. Another \$663 million was from mandatory spending that President Obama wanted to redirect to NASA as part of a budget strategy to fund federal R&D programs in excess of budget caps that he and Congress [agreed to](#) in October 2015. A White House Office of Science and Technology Policy (OSTP) [fact sheet](#) said "\$4 billion of the overall \$152 billion investment in R&D [in FY2017] is new mandatory funding" that ensures adequate R&D investments. Several other agencies or offices also requested funding in this manner.<sup>1</sup>

A further \$100 million was to come from a tax President Obama wanted to levy on oil companies to fund a 21<sup>st</sup> Century clean transportation initiative. All \$100 million would go to

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<sup>1</sup> The American Institute of Physics (AIP) [FYI newsletter](#) identifies the other agencies as: the Department of Energy's Office of Science, the National Science Foundation, the National Institute of Standards and Technology, the science and technology portion of the Department of Defense budget, the National Oceanic and Atmospheric Administration, and the National Institutes of Health (NIH).

NASA's aeronautics program. The \$663 million plus the \$100 million – \$763 million – were referred to jointly as mandatory spending in the context of the NASA budget debate.

The \$18.262 billion in appropriated funds plus the \$763 million from other sources brought the total to \$19.025 billion from the Obama Administration's perspective. Without that \$763 million, the request was a dramatic reduction – \$1 billion – from the FY2016 funding level.

Explaining the distinction between the \$18.262 billion and \$19.025 billion is complicated and not very important in the long run since the request was just that, a request, and Congress makes its own decisions on how much money to allocate to NASA.

Appropriations committees do not have jurisdiction over mandatory spending. In fact, there is no evident congressional process for getting money to NASA separate from appropriations. Considering how difficult it is just to pass appropriations bills, getting an additional amount of money through other legislation that would be crafted through an unknown, untried process in an election year when the congressional schedule is tightly constrained would have been a pretty high hurdle.

Indeed, the House and Senate Appropriations Committees rejected President Obama's approach, so this discussion is only for historical purposes for those who are interested. **Those who are not should skip to page 5 for background on key issues or page 8 for congressional action.**

***Discretionary Versus Mandatory Funding.*** The federal budget is divided into mandatory and discretionary spending. Mandatory spending, as the term implies, must be spent because of laws already in force that set out requirements for the funds to be paid, such as Social Security or Medicare payments to people eligible for benefits. Mandatory spending also includes interest that must be paid on the national debt, for example.

Discretionary spending is the money that Congress chooses to spend (or not) each year. Congress has a process in place to set and allocate those funds through a Budget Resolution that then translates into how much money each of the 12 appropriations subcommittees may spend. Appropriators decide how to allocate the funds after holding hearings and markups. The resulting appropriations bills then are voted on by the full House and Senate and ultimately signed into law (or vetoed) by the President. For more on congressional procedures, see our "[What's a Markup](#)" fact sheet.

NASA Chief Financial Officer David Radzanowski explained during a media teleconference the day the budget was released (February 9, 2016) that mandatory spending consumes approximately three-quarters of the federal budget, with discretionary spending making up the other quarter.

Since it opened its doors in 1958, NASA has received its funding from the discretionary part of the budget through the appropriations process.

For the first time, in FY2017 the White House sought to partially fund NASA and several other R&D agencies or offices by redirecting money from the mandatory side of the budget. It is unclear as to how that would happen. Appropriations committees have no control over mandatory spending and what committees or congressional process would be responsible for

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considering the proposal to move money from one category to the other and make it available to an agency to spend is not explained in the budget request.

***Why Did the Obama Administration Do This?*** The underlying reason for this approach to budgeting was to find a way to fund NASA and other federal R&D agencies above the budget caps that President Obama and Congress [agreed to](#) in October 2015. The \$18.3 billion request for NASA fit within the caps. The \$19 billion did not, but was what NASA and the White House argued was necessary to continue the programs approved in FY2016.

In one sense, the Obama Administration's proposal was reminiscent of its [Opportunity, Growth and Security Initiative \(OGSI\) in the FY2015 budget](#). However, in that case, the Obama Administration proposed extra funding above the budget caps in a separate proposal. NASA requested a "base" budget that did not include the OGSI funding, while explaining how it would spend the OGSI funds if they were approved. Congress ignored the OGSI and acted on the base budget request. This time, the extra funds were integrated into the base budget request.

***OMB's Explanatory Documents.*** The authoritative source for the President's budget request is the White House Office of Management and Budget (OMB) and its [Budget of the U.S. Government: Fiscal Year 2017 book](#) and associated tables and reports.

OMB's Table S-11, "Funding Levels for Appropriated ('Discretionary') Programs by Agency," clearly showed that the President's request for NASA is \$18.3 billion in appropriated funds.

Text on page 28 of that report, however, stated that the total request was \$19 billion, including \$763 million in "mandatory" spending. [Table 29-1](#) in the associated Analytical Perspectives showed where that \$763 million was in NASA's request. The lines were annotated as "legislative proposal, subject to PAYGO, mandatory."<sup>2</sup>

The Budget of the U.S. Government document had a chapter entitled "Cuts, Consolidations, and Savings" that stated that the request included "117 cuts, consolidations, and savings proposals, which are projected to save over \$14 billion in 2017." That was comprised of \$5.9 billion in savings under the discretionary part of the budget and \$8.2 billion in savings in mandatory spending. Some of those savings would have been redirected to other purposes as detailed in Table S-9 of the OMB document. There was no linkage between any specific cut and increase. Table S-9 simply was a long list of projected savings and expenditures that showed NASA receiving \$664 million to be spent over three years (\$325 million in FY2017, \$283 million in FY2018, and \$56 million in FY2019).

Separately, President Obama proposed a 10-year "21st Century Clean Transportation System" funded by a \$10-per-barrel fee to be paid by oil companies. OSTP Director John Holdren explained at a February 9, 2016 budget briefing that NASA's aeronautics program would receive part of those funds – \$100 million in FY2017 – to develop a low carbon emission aircraft. (The \$100 million appeared on page 377 of Table 29-1, instead of under the Aeronautics heading on page 374.)

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<sup>2</sup> OMB's Table 29-1 shows both Budget Authority (BA) and outlays (O). This fact sheet deals only with BA, not O.

The \$664 million to be obtained from cuts to mandatory spending and redirected to NASA, plus the \$100 million for NASA's aeronautics program from the 21st Century Clean Transportation System, comprised the \$763 million (the \$1 million difference is due to rounding) that OMB collectively described as “mandatory.”

***Did it Matter?*** The short answer is no. Republicans, who control the House and Senate and their appropriations committees, immediately labeled it a gimmick and turned their attention to the \$18.262 billion requested in appropriated funds.

The long answer is that it made no difference in how much money Congress allocates to NASA (a process that is not yet complete), but it complicates the analysis of congressional action compared to the “President’s request” since there were two versions of the request – with and without the \$763 million.

Typically, congressional appropriations reports, and analytical reports such as this, compare the request to congressional action as an indication of where there is agreement or disagreement on priorities. The House and Senate appropriations committee reports are written in terms of comparing the request WITHOUT the \$763 million, whereas most other analyses use NASA’s budget documentation, which includes the \$763 million, making such comparisons confusing.

Initially, this report followed NASA’s lead and used the \$19.025 billion figure, but because Congress rejected that approach, this report has been modified. Unless otherwise stated, all comparisons are to the FY2016 appropriated levels, not to either version of President Obama’s request.

## **Background on Key Issues**

The budget request fueled the same debates as those of the past several years over earth science, planetary science, and the future of human spaceflight – the Space Launch System (SLS), Orion, commercial crew, and the Asteroid Redirect Mission (ARM). These issues are explained in [previous editions](#) of this report and much of the background will not be repeated here. The following narrative provides background only on these issues. **Congressional action is explained later in this report.**

### **Earth Science**

The Obama Administration proposed another increase in NASA’s earth science program despite objections from congressional Republicans that NASA should focus on understanding and exploring the universe, not Earth. NASA received \$1.921 billion for earth science in FY2016. The FY2017 request for appropriated funds is \$1.972 billion (if mandatory funds are included, the request is \$2.032 billion).

While many of the congressional critics are climate change skeptics, the argument is rarely couched in those terms. Instead, the line of reasoning is that other federal agencies study the Earth, but only NASA sends probes to other places in the solar system, launches telescopes into space, or supports human exploration of space. They argue those are NASA’s core missions, not earth science. Supporters of NASA’s earth science program note that the 1958 National

Aeronautics and Space Act that created NASA lists “expansion of human knowledge of phenomena in the atmosphere and space” first among the agency’s objectives.

Sen. Barbara Mikulski (D-MD) was the top Democrat on the Senate Appropriations Committee until the end of 2016 when she retired after 30 years in the Senate. She was an ardent supporter of NASA’s earth science program (much of which is executed by NASA’s Goddard Space Flight Center in Maryland) and successfully defended the earth science program against dramatic cuts. Who, if anyone, will pick up the gauntlet now remains unclear.

### **Planetary Science and the Europa Mission**

Congress is a strong supporter of NASA’s planetary science program on a bipartisan basis. Attempts by the Obama Administration to cut funding for planetary science in recent years were firmly rejected.

One program – robotic exploration of Jupiter’s moon Europa -- has particularly enthusiastic support from Rep. John Culberson (R-TX), who chairs the House appropriations Commerce-Justice-Science (CJS) subcommittee that funds NASA.

Culberson has added substantial amounts to NASA’s budget over the past three years to initiate a Europa mission even though NASA had no plans to do so. That did not deter Culberson, who led the effort to fund Europa at \$175 million in FY2016 (\$30 million was requested). NASA is working on a mission design for a spacecraft that would be launched in the late 2020s on an Evolved Expendable Launch Vehicle (EELV) and orbit Jupiter, with multiple flybys of Europa. Culberson wants a lander in addition to the orbiter/flyby and launch in 2022 on the Space Launch System, which is much larger than an EELV and could allow the spacecraft to reach Europa in a shorter period of time. He included language in NASA’s FY2016 appropriations bill to that effect.

Despite Congress’s interest in planetary science, the Obama Administration proposed an overall reduction from FY2016 either with or without the mandatory funds. Regarding Europa, it requested \$49.7 million (of which \$33 million is from the mandatory category), compared to the \$175 million in FY2016; recommended against accelerating the mission from the late 2020s to 2022 because of the detrimental impact it could have on the rest of NASA’s science portfolio; and proposed using an EELV, not SLS, for launch (though use of SLS is not precluded).

As required by Congress, NASA submitted a budget projection for how much it would cost to launch a Europa mission by 2022, but it is for NASA’s current orbiter/flyby mission, not adding a lander: \$194 million in FY2017, \$272 million in FY2018, \$456 million in FY2019, \$678 million in FY2020, and \$482 million in FY2021.

### **SLS/Orion**

The FY2017 budget request continued the long standing tension between Congress and the Obama Administration over the relative priority of building the Space Launch System (SLS) and Orion spacecraft to take astronauts beyond low Earth orbit (LEO) versus development of “commercial crew” systems to take them back and forth to the International Space Station (ISS),



which is in LEO. That history is explained in editions of this fact sheet from [earlier years](#) and will not be repeated here.

For FY2017, the Obama Administration once again requested significantly less funding for SLS and somewhat less funding for Orion than Congress appropriated for FY2016 (see Table 1). NASA insisted that the funding level would allow it to meet its commitment to launch the first SLS in 2018 and the second in 2023, while still working towards the possibility of moving the 2023 launch up to 2021 thanks to the additional funds Congress provided in FY2016. Congress also wants NASA to build the Exploration (or Enhanced) Upper Stage (EUS), which is needed for most SLS missions, now rather than waiting. The FY2016 appropriations bill directed NASA to spend \$85 million in FY2016 on EUS. For FY2017, NASA insisted that it would continue with its plan to build an interim upper stage (Interim Cryogenic Propulsion Stage) first.

SLS is a key congressional priority for both Republicans and Democrats involved in NASA funding. Sen. Richard Shelby (R-AL) is the prime advocate for SLS, which is managed by Marshall Space Flight Center in Huntsville, AL. He chairs the Senate Appropriations Commerce-Justice-Science (CJS) subcommittee.

### **Commercial Crew**

The request for commercial crew was not affected by President Obama's unique approach to budgeting. The request was the same with or without the mandatory funding and slightly less than FY2016 as development funding tails off. It is \$1.185 billion in FY2017 versus \$1.244 billion appropriated for FY2016. Republicans and Democrats in Congress have argued for years that the Obama Administration favors the commercial crew program, which was a Presidential initiative, over SLS and Orion, which Congress directed NASA to build in the 2010 NASA authorization act. Until now, commercial crew and SLS/Orion have competed for funds within the Exploration part of NASA's budget. In FY2016, however, Congress moved commercial crew out of Exploration and into Space Operations, so the competition is less direct now.

Congress agrees with the goal of the commercial crew program – to restore America's ability to launch people into space using American rockets from American soil, which has not been possible since the space shuttle was terminated in 2011. However, skepticism remains about whether the commercial crew program will succeed or if the government will end up paying much more than expected. Commercial crew is a Public Private Partnership (PPP) where the government and private sector share development costs and the government guarantees a certain market for the resulting services. The goal is to reduce costs, but if NASA continues to be the only market, it is not clear how that will be achieved.

FY2016 was the first year Congress appropriated the full amount requested for commercial crew. NASA had hoped to see the first test launches of the two commercial crew systems – SpaceX's Crew Dragon and Boeing's CST-100 Starliner -- in FY2017, but by the end of 114<sup>th</sup> Congress, both companies had conceded that the launches would not take place until calendar year 2018.

### **Asteroid Redirect Mission (ARM)**

President Obama's proposal to send astronauts to an asteroid by 2025 as the next step in human space exploration has been described in earlier editions of this report. It has evolved over time

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and the current plan is for a robotic probe to be sent to an asteroid, pick up a boulder from its surface, and move the boulder into a Lunar Distant Retrograde Orbit where it will be visited by astronauts in an Orion spacecraft and the date for astronauts to interact with the boulder has slipped to 2026.

This Asteroid Redirect Mission (ARM) has been controversial since it began.

ARM involves a number of tasks, from locating candidate asteroids to developing high power solar electric propulsion (SEP) to developing a robotic probe and capture system to pluck a boulder from an asteroid's surface and move it to lunar orbit to developing the systems to take astronauts to collect a sample and bring it back to Earth.<sup>3</sup> Thus it involves many different parts of NASA and the funding is very difficult to track.

Table 4 displays figures provided to SpacePolicyOnline.com for FY2014-2016 by NASA in February 2015. The request for FY2017 was explained in response to a question during a NASA FY2017 budget teleconference on February 9, 2016.

NASA describes ARM in two parts: the Asteroid Redirect Robotic Mission (ARRM) and the Asteroid Redirect Crewed Mission (ARCM). ARRM must be launched first in order to obtain and move the boulder into lunar orbit. NASA requested \$66.8 million in the Human Exploration and Operations Mission Directorate (HEOMD) for ARRM in FY2017, almost twice what HEOMD requested last year.

NASA officials had been saying that ARRM would be launched in 2020, but in [March 2016](#), ARM Program Director Michele Gates told the NASA Advisory Council that ARRM has slipped to 2021 and ARCM to 2026. NASA Administrator Charlie Bolden repeatedly stated that the robotic portion would cost no more than \$1.25 billion (excluding launch and operations), but Gates [conceded](#) in August 2016 that the cost had grown to \$1.4 billion.

Congress supports development of SEP, which can be used for many missions, not just ARM, and the search for asteroids funded in the Science Mission Directorate. It is lukewarm, at best, however, about the idea of moving part of an asteroid to lunar orbit where it can be visited by astronauts. ARM has been harshly criticized by some Republicans as a waste of money and Democrats do not defend it. The House Science, Space, and Technology Space Subcommittee held a [hearing](#) on February 4, 2016 where criticism of ARM and other NASA human spaceflight plans continued.

## **NASA FY2017 Appropriations – Congressional Action**

NASA's appropriations are part of the Commerce-Justice-Science (CJS) bill, one of 12 appropriations bills on which Congress is supposed to act in each fiscal year. The House and Senate Appropriations Committees have CJS subcommittees.

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<sup>3</sup> One goal of ARM is to return a sample of an asteroid to Earth, but ARM should not be confused with NASA's OSIRIS-REx robotic mission that also will return an asteroid sample to Earth. OSIRIS-REx is scheduled for launch in September 2016 and the sample should be back on Earth in 2023.



The Senate and House Appropriations Committees sharply criticized and rejected the Obama Administration's "gimmick" of combining mandatory and discretionary funding in its request.

Ultimately the President's unique budgetary approach did not matter since both committees approved funding levels greater than the President's total request. As explained earlier, the primary impact is on reports like this where comparisons are typically made between a President's request and congressional action to indicate areas of agreement or disagreement.

The committee reports compare their recommended funding levels to the President's request WITHOUT the mandatory spending – the \$18.262 billion request, not the \$19.025 billion request. One therefore must take care in reading the committees' reports whenever they state that the amount recommended is in comparison to "the request."

To avoid confusion, **the only comparisons in the narrative below are to the FY2016 funding level, not to either version of the FY2017 request.**

**Senate.** The Senate CJS subcommittee held its NASA hearing on March 10, 2016 and marked up the CJS bill on April 19. The full committee approved the bill on April 21 (S. 2387, S. Rept. 114-239). The funding figures that were approved are shown in Table 1.

In total, the committee approved \$19.306 billion, \$21 million more than FY2016. Regarding the issues highlighted in this report, the committee took the following actions:

- Approved \$1.984 billion for earth science, \$63 million more than FY2016. Of that amount, \$130 million is for Landsat 9, with a target launch date of 2020. Also, \$90 million is specified for the PACE mission.
- Approved \$1.356 billion for planetary science, a reduction of \$338 million compared to current spending. Support for a Europa mission is expressed, but no dollar amount is specified. A report from NASA is required on whether it is better to launch a lander and orbiter together or separately. The total includes \$387.7 million for Mars 2020; \$60 million for Near Earth Object Observations (of which \$16.1 million is for AIDA-DART); \$44 million for OSIRIS-REx; and \$14 million for data analysis for the New Horizons mission that flew by Pluto last year.
- Approved \$2.150 billion for SLS, \$150 million more than FY2016. Of that amount, \$300 million is for EUS. Orion was funded at \$1.3 billion, \$30 million more than FY2016.
- Approved \$1,184.8 million for commercial crew.
- The report is silent on ARM.

**House.** The House CJS subcommittee held a hearing on NASA's Ocean Worlds program on March 3, 2016 and on the entire NASA budget on March 15. The subcommittee marked up its version of the appropriations bill on May 18 and the full committee approved the bill on May 24.

The House committee approved \$19.508 billion, an increase of \$223 million above the FY2016 appropriation.

Regarding the issues highlighted in this report, the committee took the following actions:

- Approved \$1.690 billion for earth science, \$231 million less than FY2016. It directs NASA to focus on the science priorities in the most recent earth science Decadal Survey and to prioritize funding for Landsat 9, adding that NASA and its partners should evaluate commercially available data in the event there is a data gap in the Landsat program. During full committee markup on May 24, Rep. Mike Honda (D-CA), the top Democrat on the CJS subcommittee, offered an amendment to add \$342 million for earth science, but withdrew the amendment because he did not have offsetting cuts elsewhere to recommend. (Offering and immediately withdrawing amendments is a common practice in committee markups to allow members to express concern about an issue even while knowing they do not have the votes to prevail.)
- Approved \$1.846 billion for planetary science, \$215 million more than FY2016. Regarding the mission to Europa, the committee recommended \$348 million for “Outer Planets and Ocean Worlds,” of which not less than \$260 million is for the Europa Orbiter and Lander, with launch of the orbiter in 2022 and the lander in 2024.
- Approved \$2.0 billion for SLS, the same as the FY2016 appropriation. Of the \$2 billion, no less than \$250 million is for the EUS. NASA is directed to submit a long term plan for using SLS, including to launch the Europa orbiter/flyby spacecraft and lander. Orion would receive \$1.350 billion, \$80 million more than FY2016. The committee states that nothing in the bill or report “shall be construed as directing NASA to proceed with any human spaceflight until all of the risks have been retired.”
- Expressed concern that some milestones in the commercial crew program have slipped and required a number of reports on the status of the program, the planned “operational tempo” including numbers of astronauts per flight and per provider, how many seats are for international partners, and the cost and need to reserve seats on foreign partner capsules (i.e., Russian Soyuz spacecraft) in 2018 and beyond. The committee’s report does not specify how much funding is provided for commercial crew. It is part of the Space Operations portion of the NASA budget, which is funded at \$4.890 billion, \$139 million less than FY2016, but it is a broad account that includes funding for the International Space Station, commercial cargo, and space and flight support so how much, if any, of that reduction would be applied to commercial crew cannot be ascertained.
- Approved zero funding for planning for ARM. Instead, it directed NASA to develop plans for returning humans to the Moon before sending them to Mars. [SpacePolicyOnline.com](http://SpacePolicyOnline.com) published an article specifically about the committee’s recommendation on May 23, 2016 that provides more information.

In other matters of particular note, the committee –

- Encouraged NASA to make funds available for external competitive funding to **study well-preserved and easily accessible impact craters** in the United States to provide researchers and educators the simultaneous opportunity to expand our understanding of the history of Earth and the solar system and to show students research in action as part of STEM education.
- Directed NASA to submit within one year of the bill’s enactment an **interstellar propulsion technology assessment report** with a draft conceptual roadmap. Efforts to develop interstellar propulsion are to be focused on enabling a scientific probe to be launched to Alpha Centauri in 2069, the 100<sup>th</sup> anniversary of the Apollo 11 landing on

the Moon, and achieving a cruise velocity of 0.1c (one tenth the speed of light). Propulsion concepts may include fusion-based implementations, matter-antimatter annihilation reactions, multiple forms of beamed energy approaches, and immense “sails” that intercept solar photons or the solar wind.

- Approved \$25 million for **additive manufacturing** technology research for use in rocket engines and structures.
- Approved no less than \$35 million for **nuclear thermal propulsion technology**.
- Approved no less than \$45 million for suborbital and orbital technology demonstration of **small launch technology platforms** able to carry a 200-300 kilogram satellite to low Earth orbit.
- Approved no less than \$75 million for development of a demonstration deep space habitation module.
- Required NASA to submit a report no later than 180 days after enactment of the law detailing ongoing and planned low-cost missions, including by commercial companies, academia and international space agencies, to **explore and characterize the lunar surface and sub-surface**, particularly in-situ water resources to support future robotic and astronaut operations.
- Continued language from prior appropriations bills prohibiting NASA or the White House Office of Science and Technology Policy from engaging in bilateral activities with **China** unless authorized by Congress. The committee now requires that the FBI (in addition to NASA or OSTP) certify that the activities pose no risk of technology transfer or involve knowing interactions with officials involved in violating human rights.

### **Final Omnibus Appropriations (H.R. 244)**

The 114<sup>th</sup> Congress did not pass either of the FY2017 CJS bills as they emerged from committee. NASA has been operating under a series of Continuing Resolutions (CRs) since the fiscal year began on October 1, 2016. On April 30, 2017, congressional leaders reached agreement on a FY2017 omnibus appropriations bill, H.R. 244 as amended,<sup>4</sup> that combines 11 of the 12 regular appropriations bills, including CJS. The bill has not yet been passed by the House or Senate, however. Congress hopes to complete action on this bill before midnight on May 5 when the most recent CR expires. Table 1 below compares these figures with FY2016 funding and the FY2017 request and other congressional action thereon.

Key provisions in the bill for NASA are the following (see Table 1 for more detail).

- **Science: \$5.765 billion**
  - **Earth science: \$1.921 billion**, including \$90 million for PACE and \$130.9 million for Landsat 9 (President Trump has proposed canceling PACE in his FY2018 budget request).
  - **Planetary science: \$1.846 billion**, including \$363 million for outer planets of which \$275 million is for the Europa mission.
  - **Astrophysics: \$750 million**, including \$105 million for WFIRST, \$85.2 million for SOFIA, and \$98.3 million for Hubble.

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<sup>4</sup> Congress is using H.R. 244 as the legislative vehicle for the FY2017 omnibus appropriations act. It originated as a bill on an unrelated topic (HIRE Vets). It is common for Congress to use an unrelated bill that has already passed through some of the legislative process for appropriations measures like this in order to speed them along.

- **James Webb Space Telescope: \$569.4 million.**
- **Heliophysics: \$678.5 million.**
- Education and Public Outreach: \$37 million to be derived equally from planetary science and astrophysics and administered by the Astrophysics Division (this amount is included in the \$750 million for astrophysics, not in addition to it, according to a table in the report accompanying the bill)
- **Aeronautics: \$660 million.**
- **Space Technology: \$686.5 million**, including \$35 million for nuclear propulsion, \$30 million for small launch capabilities, \$35 million for additive manufacturing, \$25.718 million for optical communications, and \$66.6 million for solar electric propulsion.
- **Exploration: \$4.324 billion**, including direction that NASA continue to develop advanced propulsion, asteroid deflection and grappling technologies associated with the **Asteroid Redirect Mission** but "these activities should not distract from the overarching goal of sending humans to Mars" and \$75 million is designated for habitation augmentation activities.
- **Space Operations: \$4.951 billion**, including the full request of \$1.185 billion for commercial crew and "up to" \$1.028 billion for commercial cargo. No further breakdown was provided.
- **Education: \$100 million**, including \$18 million for EPSCoR, \$40 million for Space Grant, \$32 million for MUREP, and \$10 million for STEM Education and Accountability Projects (President Trump has proposed eliminating NASA's Office of Education in his FY2018 budget request).
- **Safety, Security and Mission Services: \$2.769 billion.**
- **Construction and Environmental Compliance and Restoration (CECR): \$360.7 million**
- **Office of Inspector General: \$37.9 million**

Because President Obama's request was so convoluted, it is difficult to make comparisons between the request and what Congress is proposing. In general, planetary exploration and human exploration benefitted the most from congressional generosity and NASA's internal accounts that pay for day-to-day operations and construction at its field centers around the country lost the most. Overall, however, Congress increased the total amount available to NASA to pay for the programs it considers to be of highest priority -- including robotic exploration of the outer planets (especially Jupiter's moon Europa) and human exploration beyond low Earth orbit (the Space Launch System, Orion, and Exploration Ground Systems) – rather than taking the money from other NASA programs.

## **NASA Authorization Bills**

(Not sure of the difference between an appropriation and an authorization? See our "[What's a Markup](#)" Fact Sheet.)

NASA's authorization ("oversight") committees are the House Science, Space, and Technology (SS&T) Committee and Senate Commerce, Science, and Transportation Committee. The 2010 NASA Authorization Act (P.L. 111-267) is the most recent NASA authorization act. Its funding recommendations covered only through FY2013, but the policy provisions remain in effect until and unless they are repealed or replaced.

**House-Passed 2015 NASA Authorization Act (H.R. 810).** The House [passed](#) a one-year FY2015 NASA authorization (H.R. 810) on February 10, 2015 under suspension of the rules. It was virtually identical to the 2014 NASA Authorization Act that passed the House in 2014 other than substituting the amounts appropriated for NASA for FY2015 for those appropriated for FY2014. The Senate never acted on either the 2014 or 2015 bills.

**House Committee-Approved NASA Authorization Act for 2016 and 2017 (H.R. 2039).** The House Science, Space, and Technology Committee [approved](#) H.R. 2039 on April 30, 2015. Debate was highly partisan primarily because of substantial proposed cuts to NASA’s earth science program and the bill was approved on a party-line vote. No further action has taken place. It would have authorized funds for FY2016 and FY2017.

The policy provisions of H.R. 2039 were virtually identical to those in H.R. 810. The funding provisions were completely new, however. As shown in Table 3, they were complicated because the bill recommended two different levels depending on whether the budget caps in the 2011 Budget Control Act (BCA) remained.

- The first set of funding recommendations assumed the BCA caps were lifted. A press release from committee Republicans referred to those levels as “**aspirational.**”
- The second set assumed the BCA caps were not lifted; the press release called that set “**constrained.**”
- A third scenario was mentioned – where the funding fell somewhere in between – in which case any additional funds would be applied proportionately among all of NASA’s funding accounts.

The budget caps for FY2016 and FY2017 were, in fact, [lifted](#) in October 2015, so the “aspirational” levels would have applied if the bill became law. More information comparing the bill to the President’s FY2016 request is in [a previous version of this fact sheet](#).

The House did not pass the bill by the end of the 114<sup>th</sup> Congress, however. Instead, in the 115<sup>th</sup> Congress, it passed S. 442 as described below.

**Senate- and House-Passed FY2017 NASA Transition Authorization Act (S. 442).** The Senate Commerce, Science, and Transportation Committee approved S. 3346 on September 21, 2016 during the 114<sup>th</sup> Congress. House and Senate negotiations produced a compromise version of the bill that passed the Senate on December 9, 2016. Unfortunately, the House had already completed its legislative business for the year and left town, so the bill died.

A new version, S. 442, passed the Senate on February 17, 2017 and the House on March 7, 2017. It is very similar to last year’s S. 3346. The bill is intended to provide stability to NASA during the presidential transition. Committee members hope to avoid the type of disruption that occurred when President Obama took office and cancelled the Constellation program to send astronauts back to the Moon by 2020. Following are its major provisions. Significant changes in S. 442 from S. 3346 are **highlighted in bold**.

**Funding:** authorizes \$19.508 billion for NASA for FY2017 (future years are not addressed). That is the same amount as approved by the House Appropriations Committee in the

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FY2017 CJS bill, and \$202 million more than what the Senate Appropriations Committee approved (\$19.306 billion). Authorization bills do not actually provide any money. Only appropriations bills do that, although authorization bills provide guidance to appropriators on how the committees that oversee an agency, like NASA, think the money should be spent. In this case, the authorization bill allocates the money differently than either appropriations bill (neither of which has passed their respective chambers yet). Table 1 shows the authorized funding levels. Key policy provisions are summarized below, but are far from comprehensive (the bill is 146 pages long).

- **International Space Station (ISS), including commercial crew and cargo:** offers a sense of Congress that ISS should continue at least until 2024, with an evaluation of extending it to 2028. Amends the 2010 NASA authorization act to direct that NASA may not acquire human spaceflight transportation services to and from ISS from a foreign entity unless certain conditions exist. Requires that commercial crew systems meet NASA human rating requirements and **states that the “primary consideration in the acquisition strategy” of the commercial crew program is to carry U.S. government astronauts to and from the ISS “safely, reliably, and affordably” and serve as a crew rescue vehicle.** States that it is U.S. policy for NASA to procure commercial cargo services through fair and open competition in compliance with Federal Acquisition Regulations. Offers a sense of Congress that an orderly transition is needed to a future where NASA no longer is the primary supplier and consumer of low Earth orbit (LEO) human spaceflight capabilities and requires biennial reports from NASA on how to achieve that transition.
- **Space Communications:** requires a plan on how to meet NASA's LEO and deep space communications and navigation needs for the next 20 years.
- **Indemnification of NASA Launch and Reentry Services:** amends 51 U.S.C. 201subchapter III to say the United States will indemnify launch and reentry service providers from third-party claims, with conditions, for launches that are unusually hazardous or nuclear in nature.
- **Human Deep Space Exploration:** amends the 2010 NASA authorization act to state, among other things, that the long term objective is to expand permanent human presence beyond low Earth orbit and the potential for human exploration and extension of human presence throughout the solar system and enable a capability for a thriving space economy in the 21<sup>st</sup> century. A key objective is to achieve human exploration of "Mars and beyond" through a steppingstone approach. Directs the NASA Administrator to manage programs, including the Space Launch System (SLS) and Orion, to enable humans to explore "Mars and other destinations" by defining "a series of sustainable steps and conducting planning, research, and technology development on a timetable that is technically and fiscally possible" and the sustainable steps may include intermediate destinations. **[S. 3346 had listed intermediate destinations as “including the surface of the Moon, cis-lunar space, near-Earth asteroids, Lagrangian points, and Martian moons,” but that is omitted in S. 442. S. 442 refers in various places to “the Moon” and cis-lunar space, but not the surface of the Moon specifically.]** Directs the NASA Administrator to engage with international, academic and industry partners to maximize cost-effectiveness. States that the President may invite ISS partners "and other nations, as appropriate" to participate in a human mission to the surface of Mars "under the leadership of the United States."



- **SLS/Orion:** reaffirms congressional support for these programs and directs the NASA Administrator to develop an SLS upper stage to enable human exploration of deep space. Directs NASA to conduct an uncrewed exploration mission to demonstrate SLS/Orion by 2018, a crewed mission to demonstrate SLS including a core stage and Exploration Upper Stage by 2021 "subject to applicable human rating processes and requirements," and to conduct future missions at a rate to ensure safety and operational readiness (and assess other uses for SLS); and to develop a deep space habitat as a key element of the deep space human exploration program. **Directs the NASA Administrator to submit a report on how Orion can fulfill the provision in the 2010 NASA Authorization Act that it serve as a backup to commercial crew for transporting astronauts to ISS, including by using a launch vehicle other than SLS.**
- **Human Exploration Roadmap:** requires NASA to submit a human exploration roadmap, with extensive language about what it must include, beginning December 1, 2017 with biennial updates. It shall include a critical decision plan to "expand human presence beyond low Earth orbit to the surface of Mars and beyond, considering potential interim destinations such as cis-lunar space and the moons of Mars."
- **Advanced Space Suits:** requires the NASA Administrator to submit a plan for achieving a new space suit capability for future deep space missions that might also be used on ISS.
- **Asteroid Redirect Robotic Mission (ARRM):** requires an evaluation of alternatives to ARRM for demonstrating technologies and capabilities needed for the Journey to Mars and **states that Congress is not convinced that the cost of the mission is justified by the benefits it will produce. [S. 3346 stated only that the goals "may not be commensurate with the cost."]**
- **Mars 2033:** requires a study by an independent, non-governmental systems engineering and technical assistance organization to study a human mission to Mars to be launched in 2033 (it does not specify whether it is to orbit or land).
- **Health Care for Former Astronauts:** incorporates the TREAT Act (H.R. 6076 from the 114<sup>th</sup> Congress), which passed the House (amended) on December 7, 2016. It allows NASA to provide health care to former astronauts and government payload specialists for conditions resulting from their spaceflights.
- **Science:** reaffirms congressional intent that NASA have a balanced and adequately funded science portfolio including small, medium and large space missions, suborbital missions, research and analysis grants, and technology development, with science priorities guided by Decadal Surveys from the National Academies of Sciences, Engineering and Medicine. Expresses support specifically for planetary science, especially the Mars 2020 rover and a mission to Europa; the James Webb Space Telescope; and the Wide-Field Infrared Survey Telescope. Amends the list of U.S. objectives for aeronautical and space activities (51 U.S.C. 20102(d)) to add a 10th item -- "the search for life's origins, evolution, distribution, and future in the universe." Directs the NASA Administrator to contract with the National Academies to develop a science strategy for the study and exploration of exoplanets, to develop a science strategy for astrobiology, and make an assessment of the architecture of the robotic Mars exploration program. Requires the Administrator to submit reports on how to utilize public private partnerships to study astrobiology and Near Earth Objects (NEOs). Requires the Director of the White House Office of Science and Technology Policy (OSTP) and the NASA Administrator to submit reports on carrying out a NEO survey program, an analysis of options to divert an object on a collision course with Earth, and a description of efforts to coordinate and cooperate with other countries on discovering and mitigating hazardous

asteroids and comets. Allows NASA to conduct its senior reviews of science mission extensions on a triennial (rather than biennial) basis. Prohibits NASA from terminating the SOFIA program. Directs OSTP to conduct an analysis of needs for radioisotope power system material for solar system exploration missions. (The bill does not mention Earth science.)

- **Aeronautics:** expresses support for a robust aeronautics program. Requires the NASA Administrator to submit roadmaps for research and development of hypersonic and supersonic aircraft and rotorcraft and other runway-independent air vehicles.
- **Space Technology:** establishes as policy that NASA shall develop technologies to support NASA's core missions. Sets as a goal development of propulsion technologies to shorten the human travel time to Mars. Requires a report from NASA comparing the agency's space technology investments to the high priority areas identified by the National Academies report on NASA's Space Technology Roadmaps.

The bill also has extensive language on "maximizing efficiency" at NASA that includes a host of issues. Among them are direction regarding NASA's information technology and cybersecurity activities and the leveraging of commercial satellite servicing capabilities across mission directorates, and requirements for an OSTP report on issues relating to protecting the Apollo landing sites on the Moon, a National Academy of Public Administration review of the effectiveness of the NASA Advisory Council, and a NASA report on concepts and options for removing orbital debris. The bill also would extend by one year (to December 31, 2018) NASA's Extended Use Leasing (EUL) authority (51 U.S.C. 20145(g)), which currently sunsets on December 31, 2017.

**Table 1: NASA's FY2017 Budget Request and Congressional Action  
(in \$ millions, see notes below)**

Account	2016 Approps	FY 2017 Request (see table 2)		Authorization			Appropriations		
		With Mandatory	Without Mandatory	House Cmte (114 <sup>th</sup> Congress)	Senate passed (note 6)	Final (enacted)	House Cmte	Senate Cmte	Final (note 5)
<b>Science</b>	<b>5,589.4</b>	<b>5,600.5</b>	<b>5,302.5</b>	<b>note 2</b>	<b>5,500.0</b>	<b>5,500.0</b>	<b>5,597.0</b>	<b>5,395.0</b>	<b>5,764.9</b>
<i>Earth Science</i>	1,921.0	<sup>note 3</sup> 2,032.2	1,972.2		N/A	N/A	1,690.0	1,984.0	1,921.0
<i>Planetary Science</i>	1,631.0	1,518.7	1,390.7		N/A	N/A	1,846.0	1,355.9	1,846.0
<i>Astrophysics</i>	730.6	<sup>note 3</sup> 781.5	696.5		N/A	N/A	792.9	<sup>note 3</sup> 807.0	750.0
<i>JWST</i>	620.0	569.4	569.4		N/A	N/A	569.4	569.4	569.4
<i>Heliophysics</i>	649.8	698.7	673.7		N/A	N/A	698.7	678.7	678.5
<i>Education</i>	<sup>note 3</sup> 37.0	<i>note 3</i>	N/A		N/A	N/A	N/A	<i>note 3</i>	<i>note 3</i>
<b>Aeronautics</b>	<b>640.0</b>	<b>790.4</b>	<b>634.5</b>	<b>note 2</b>	<b>640.0</b>	<b>640.0</b>	<b>712.0</b>	<b>601.0</b>	<b>660.0</b>
<b>Space Technology</b>	<b>686.5</b>	<b>826.7</b>	<b>690.6</b>	<b>note 2</b>	<b>686.0</b>	<b>686.0</b>	<b>739.2</b>	<b>686.5</b>	<b>686.5</b>
<b>Exploration</b>	<b>4,030.0</b>	<b>3,336.9</b>	<b>3,163.9</b>	<b>note 2</b>	<b>4,330.0</b>	<b>4,330.0</b>	<b>4,183.0</b>	<b>4,330.0</b>	<b>4,324.0</b>
<i>Expl Sys Dev</i>	3,680.0	2,859.5	2,686.5		N/A	N/A	3,779.0	3,934.0	3,929.0
<i>(Orion)</i>	(1,270.0)	(1,119.8)	N/A		N/A	N/A	(1,350.0)	(1,300.0)	(1,350.0)
<i>(SLS)</i>	(2,000.0)	(1,310.3)	N/A		N/A	N/A	(2,000.0)	(2,150.0)	(2,150.0)
<i>(Expl Ground Sys)</i>	(410.0)	(429.4)	N/A		N/A	N/A	(429.0)	(484.0)	(429.0)
<i>Expl R&amp;D</i>	350.0	477.4	477.4		N/A	N/A	404.0	396.0	395.0
<b>Space Operations</b>	<b>5,029.2</b>	<b>5,075.8</b>	<b>5,075.8</b>	<b>note 2</b>	<b>5,023.0</b>	<b>5,023.0</b>	<b>4,890.3</b>	<b>4,950.7</b>	<b>4,950.7</b>
<i>ISS</i>	N/A	1,430.7	N/A		N/A	N/A	N/A	N/A	N/A
<i>Space Trans</i>	N/A	2,757.1	N/A		N/A	N/A	N/A	N/A	N/A
<i>(Cmrcl Crew)</i>	(1,243.9)	(1,184.8)	N/A		N/A	N/A	N/A	(1,184.8)	1,184.8
<i>(Crew and Cargo)<sup>note 4</sup></i>	N/A	(1,572.8)	N/A		N/A	N/A	N/A	<sup>note 4</sup> (1,028.0)	1,028.0
<i>Space &amp; Flt Sprt</i>	N/A	887.4	N/A		N/A	N/A	N/A	N/A	N/A
<b>Education</b>	<b>115.0</b>	<b>100.1</b>	<b>100.1</b>	<b>note 2</b>	<b>115.0</b>	<b>115.0</b>	<b>115.0</b>	<b>108.0</b>	<b>100.0</b>
<b>Safety/Security/MS</b>	<b>2,768.6</b>	<b>2,836.8</b>	<b>2,836.8</b>	<b>note 2</b>	<b>2,788.6</b>	<b>2,788.6</b>	<b>2,835.4</b>	<b>2,796.7</b>	<b>2,768.6</b>
<b>CECR</b>	<b>388.9</b>	<b>419.8</b>	<b>419.8</b>	<b>note 2</b>	<b>388.0</b>	<b>388.0</b>	<b>398.0</b>	<b>400.0</b>	<b>360.7</b>
<b>Inspector General</b>	<b>37.4</b>	<b>38.1</b>	<b>38.1</b>	<b>note 2</b>	<b>37.4</b>	<b>37.4</b>	<b>38.1</b>	<b>38.1</b>	<b>37.9</b>
<b>TOTAL</b>	<b>19,285.0</b>	<b>19,025.1</b>	<b>18,262.1</b>	<b>note 2</b>	<b>19,508.0</b>	<b>19,508.0</b>	<b>19,508.0</b>	<b>19,306.0</b>	<b>19,653.3</b>

- Notes: (1) Columns may not add due to rounding. Text and numbers in *italics* are subtotals. Text and numbers in (*italics in parentheses*) are sub-subtotals. N/A = not applicable or not available. Figures for FY2016 are from the Consolidated Appropriations Act. Figures for FY2017 request are from NASA budget documents at [www.nasa.gov/budget](http://www.nasa.gov/budget). Figures for Senate and House Appropriations Committees' actions and the final figures in the omnibus bill are from the reports ("explanatory statements") on the respective bills.
- (2) The House Science, Space and Technology Committee approved a FY2016-FY2017 NASA authorization bill in 2015. No further legislative action occurred on this bill. Table 3 shows what the authorization amounts were in the House committee-approved bill.
- (3) For FY2017, NASA incorporates funding for education-related activities in SMD within the astrophysics budget (\$25 million) and the earth science budget (\$6 million). Congress routinely breaks SMD education funding out into a separate line item, as shown here for FY2016. However, for FY2017, the Senate Appropriations Committee followed NASA's lead and allocated \$42 million for education as part of the astrophysics budget. The omnibus appropriations bill calls out the total in the text of the report, \$37 million, but not in the accompanying table. The report states the money is to come equally from planetary science and astrophysics and managed for all of the Science Mission Directorate by the Astrophysics Division.
- (4) The NASA request in this line is labeled "crew and cargo" and pays not only for commercial cargo flights to ISS, but payments to Russia for taking U.S., European, Japanese and Canadian crews to and from ISS on Soyuz spacecraft. The language in the Senate report refers only to \$1.028 billion provided for cargo. No mention is made of the Soyuz payments. Since the report does not specify the amounts for line items such as ISS or Space and Flight Support, it may be that it allocated more for this line than shown in the report, or it is providing NASA flexibility on how to spend the other funds in this account. The final omnibus agreement does not call out the amount in the table. The text has a paragraph labeled "commercial cargo" rather than "crew and cargo." That paragraph says "up to the requested amount of \$1,028,000,000" is for "domestic cargo resupply flights." It therefore does not clarify the matter since "up to" is vague.
- (5) These figures are from the omnibus appropriations bill released on April 30, 2017, which is expected to clear Congress and be signed into law before May 5, 2017 when the current Continuing Resolution expires.
- (6) The figures are from the 115<sup>th</sup> Congress bill, S. 442, which passed the Senate on February 17, 2017 and the House on March 7, 2017. It was signed into law on March 22, 2017 (P.L. 115-10).

**Table 2: NASA’s FY2017 Budget Request: Discretionary versus Mandatory**  
(see text for more information, in \$ millions)

Account	FY2016 approps	2017 Request		
		Total (incl Mandatory)	Mandatory	Total (without Mandatory)
<b>Science</b>	<b>5,589.4</b>	<b>5,600.5</b>	<b>298.0</b>	<b>5,302.5</b>
<i>Earth Science</i>	<i>1,921.0</i>	<i>2,032.2</i>	<i>60.0</i>	<i>1,972.2</i>
<i>Planetary Science</i>	<i>1,631.0</i>	<i>1,518.7</i>	<i>128.0</i>	<i>1,390.7</i>
<i>Astrophysics</i>	<i>730.6</i>	<i>781.5</i>	<i>85.0</i>	<i>696.5</i>
<i>JWST</i>	<i>620.0</i>	<i>569.4</i>	--	<i>569.4</i>
<i>Heliophysics</i>	<i>649.8</i>	<i>698.7</i>	<i>25.0</i>	<i>673.7</i>
<i>Education</i>	<i>37.0</i>	--	--	--
<b>Aeronautics</b>	<b>640.0</b>	<b>790.4</b>	<b>155.9</b>	<b>634.5</b>
<b>Space Technology</b>	<b>686.5</b>	<b>826.7</b>	<b>136.1</b>	<b>690.6</b>
<b>Exploration</b>	<b>4,030.0</b>	<b>3,336.9</b>	<b>173.0</b>	<b>3,163.9</b>
<i>Expl Sys Dev</i>	<i>3,680.0</i>	<i>2,859.6</i>	<i>173.0</i>	<i>2,686.5</i>
<i>Expl R&amp;D</i>	<i>350.0</i>	<i>477.3</i>	--	<i>477.4</i>
<b>Space Operations</b>	<b>5,029.2</b>	<b>5,075.8</b>	--	<b>5,075.8</b>
<b>Education</b>	<b>115.0</b>	<b>100.1</b>	--	<b>100.1</b>
<b>Safety/Security/MS</b>	<b>2,768.6</b>	<b>2,836.8</b>	--	<b>2,836.8</b>
<b>CECR</b>	<b>388.9</b>	<b>419.8</b>	--	<b>419.8</b>
<b>Inspector General</b>	<b>37.4</b>	<b>38.1</b>	--	<b>38.1</b>
<b>TOTAL</b>	<b>19,285.0</b>	<b>19,025.1</b>	<b>763.0</b>	<b>18,262.1</b>

Source: Total (including Mandatory) and Mandatory columns are from NASA’s budget documentation. Total (without Mandatory) calculated by SpacePolicyOnline.com. Note that “mandatory” includes funding intended to come from the mandatory part of the budget (\$663 million) as well as from President Obama’s proposed tax on oil companies (\$100 million). See text for more information.

Note: Text and figures *in italics* are subsets.

**Table 3: House and Senate NASA Authorization Bills for FY2016 and/or FY2017 in the 114<sup>th</sup> Congress  
H.R. 2039 and S. 3346 (in \$ millions)**

Account	2016 Request	2017 Request (without mandatory, see Table 1)	House Cmte 2016 (note 2)		House Cmte 2017 (note 2)		Senate-Passed FY2017 Auth notes 4, 5
			Aspirational	Constrained	Aspirational	Constrained	
<b>Science</b>	<b>5,288.6</b>	<b>5,302.5</b>	<b>4,951.7</b>	<b>4,678.6</b>	<b>4,935.3</b>	<b>4,678.6</b>	<b>5,500.0</b>
<i>Earth Science</i>	1,947.3	1,972.2	1,450.0	1,198.5	1,450.0	1,198.5	N/A
<i>Planetary Science</i>	1,361.2	1,390.7	1,500.0	1,500.0	1,500.0	1,500.0	N/A
<i>Astrophysics</i>	709.1	696.5	730.7	709.1	730.7	709.1	N/A
<i>JWST</i>	620.0	569.4	620.0	620.0	569.4	620.0	N/A
<i>Heliophysics</i>	651.0	673.7	651.0	651.0	685.2	651.0	N/A
<i>Education</i>	note 3	N/A	N/A	N/A	N/A	N/A	N/A
<b>Aeronautics</b>	<b>571.4</b>	<b>634.5</b>	<b>571.4</b>	<b>571.4</b>	<b>580.0</b>	<b>571.4</b>	<b>640.0</b>
<b>Space Technology</b>	<b>724.8</b>	<b>690.6</b>	<b>596.0</b>	<b>500.0</b>	<b>596.0</b>	<b>500.0</b>	<b>686.0</b>
<b>Exploration</b>	<b>4,505.9</b>	<b>3,163.9</b>	<b>4,953.1</b>	<b>4,845.4</b>	<b>5,268.0</b>	<b>4,845.4</b>	<b>4,330.0</b>
<i>Expl Sys Dev</i>	2,862.9	2,686.5	3,310.0	3,310.0	3,681.5	3,310.0	N/A
<i>(Orion)</i>	(1,096.3)	N/A	(1,200.0)	(1,200.0)	(1,349.6)	(1,200.0)	N/A
<i>(SLS)</i>	(1,356.5)	N/A	(1,700.0)	(1,700.0)	(1,899.6)	(1,700.0)	N/A
<i>(Expl Ground Sys)</i>	(410.1)	N/A	(410.0)	(410.0)	(432.3)	(410.0)	N/A
<i>Commercial Spflt</i>	1,243.8	<i>moved to Space Ops</i>	1,243.8	1,136.1	1,184.8	1,136.1	N/A
<i>Expl R&amp;D</i>	399.2	477.4	399.2	399.2	401.7	399.2	N/A
<b>Space Operations</b>	<b>4,003.7</b>	<b>5,075.8</b>	<b>3,992.5</b>	<b>3,950.4</b>	<b>3,992.5</b>	<b>3,950.4</b>	<b>5,023.0</b>
<i>ISS</i>	3,105.6	N/A	N/A	N/A	N/A	N/A	N/A
<i>Space &amp; Flt Sprt</i>	898.1	N/A	N/A	N/A	N/A	N/A	N/A
<b>Education</b>	<b>88.9</b>	<b>100.1</b>	<b>119.0</b>	<b>119.0</b>	<b>119.0</b>	<b>119.0</b>	<b>115.0</b>
<b>Safety/Security/MS</b>	<b>2,843.1</b>	<b>2,836.8</b>	<b>2,843.1</b>	<b>2,843.1</b>	<b>2,843.1</b>	<b>2,843.1</b>	<b>2,788.6</b>
<b>CECR</b>	<b>465.3</b>	<b>419.8</b>	<b>465.3</b>	<b>465.3</b>	<b>436.1</b>	<b>465.3</b>	<b>388.0</b>
<b>Inspector General</b>	<b>37.4</b>	<b>38.1</b>	<b>37.0</b>	<b>37.0</b>	<b>37.0</b>	<b>37.0</b>	<b>37.4</b>
<b>TOTAL</b>	<b>18,529.1</b>	<b>18,262.1</b>	<b>18,529.1</b>	<b>18,010.2</b>	<b>18,807.0</b>	<b>18,010.2</b>	<b>19,508.0</b>



Note 1: Columns may not add due to rounding. Numbers in *italics* are subsets. Numbers in (*italics enclosed in parentheses*) are sub-subsets. N/A means not available or not specified. Neither of these bills became law. The 114<sup>th</sup> Congress did not complete action on a NASA authorization bill. A new bill, S. 442, was introduced and passed in the 115<sup>th</sup> Congress.

Note 2: The bill (H.R. 2039) was approved by the House Science, Space, and Technology Committee on a party-line vote and never brought to the floor for debate. It authorized amounts for FY2016 and FY2017 under two scenarios that the committee described as “aspirational” and “constrained.” The higher “aspirational” levels assume that the budget caps in the 2011 Budget Control Act (BCA) are removed by Congress. The lower “constrained” levels assume the BCA caps remain in place.

Note 3: In the FY2015 appropriations bills, Congress broke out funding for education within the Science Mission Directorate (SMD) as a separate line item. The FY2016 and FY2017 requests included funding in the Astrophysics line item for education and outreach for the entire directorate.

Note 4: The Senate passed S. 3346 on December 9, 2016, blending the Senate Commerce, Science, and Transportation Committee-approved bill with portions of H.R. 2039 and an earlier bill (H.R. 810) for FY2015 that had passed the House. The House already had completed its work for the 114<sup>th</sup> Congress and left by the time S. 3346 passed the Senate, however, so the bill died. It could serve as the basis for new legislation in the 115<sup>th</sup> Congress.

Note 5: The House committee was dealing with H.R. 2039 in the spring of 2015, a year and a half before the Senate committee drafted S. 3346. Much changed during that period of time. The funding figures in the Senate-passed S. 3346 were built on what the House and Senate Appropriations Committees had approved in their FY2017 bills, not H.R. 2039. Thus it is more useful to compare the funding figures in this column to those in Table 1 for the appropriations committees. Note that those appropriations bills also did not pass Congress. NASA is operating under a Continuing Resolution through April 28, 2017.

**Table 4: Funding for the Asteroid Initiative, Including the Asteroid Redirect Mission (ARM)  
(in \$ millions)**

Purpose	FY2014 Enacted	FY2015 Request	FY2016 Request	FY2017 Request
<b>“Direct” Funding (see notes)</b>				
ARM Formulation (HEOMD)	0	0	38	67.8
Asteroid Grand Challenge and related activities (Office of Chief Technologist)	7	7	7	~1
<b>“Leveraged” Funding (see notes)</b>				
Asteroid Detection (SMD)	40.5	40	50	50
Solar Electric Propulsion (STMD)	39	93	69	66.7
EVA Suits, In-Space Robotic Servicing (HEOMD and STMD)	40	40	56	~32
<b>TOTAL</b>	<b>126.5</b>	<b>180</b>	<b>220</b>	<b>217</b>

**Notes: (1)** Figures in this table for FY2014- 2016 are from a chart provided to SpacePolicyOnline.com by NASA on February 2, 2015. Data for FY2017 were provided in a NASA budget media teleconference on February 9, 2016. Some of the numbers were described as approximations and are designated here as ~, but the total of \$217 million was stated definitively. Congress does not specify funding for ARM in its reports on appropriations bills so appropriated levels after FY2014 are not included.

(2) In FY2016, NASA distinguished between “direct” and “leveraged” funding for ARM, where direct funding is specifically related to the Asteroid Initiative (which includes ARM) while “leveraged” funding is for NASA activities that would be undertaken even if the Asteroid Initiative did not proceed.

(3) HEOMD = Human Exploration and Operations Mission Directorate. SMD = Science Mission Directorate. STMD = Space Technology Mission Directorate

**Table 5: Funding for the Space Launch System: NASA Request versus Congressional Appropriations  
(in \$ millions)**

Account: Subaccount	FY2014	FY2015		FY2016		FY2017
	Enacted	Request	Final	Request	Final	Request (incl mandatory)
Exploration: Exploration Systems Development/ SLS	1,600.0	1,380.3	1,700.0	1,356.5	2,000.0 (incl \$85 M for EUS)	1,310.5
Exploration: Exploration Systems Development/ Exploration Ground Systems	318.2	351.3	351.3	410.1	410.0	429.4
CECR: Exploration Construction of Facilities	*139.3	52.3	*67.9	10.0	*10.0	8.8
<b>TOTAL</b>	<b>2,057.5</b>	<b>1,783.9</b>	<b>2,119.2</b>	<b>1,776.6</b>	<b>2,410.0</b>	<b>1,748.7</b>

Notes: CECR = Construction, Environmental Compliance and Restoration. EUS is the Exploration Upper Stage, which is needed for certain SLS missions. NASA did not request EUS funding in FY2016.

\* The \$139.3 figure for FY2014 CECR is from NASA's FY2016 budget request . CECR funding figures for FY2015, FY2016 and FY2017 are from NASA's FY2017 budget book, p. EXP-19.