

## **NASA Response to the 2014 Senior Review for Astrophysics Operating Missions**

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### **Background**

The Senior Review for Astrophysics Operating Missions has been conducted biennially since the early 1990s.

The NASA Science Mission Directorate (SMD) conducts comparative reviews of operating missions within each division to maximize the scientific return from these missions within finite resources. The Senior Review, held every two years, assists NASA in maximizing the scientific productivity from its Operating Missions within a constrained budget. NASA uses the findings from the Senior Review to define an implementation strategy and give programmatic direction to the missions and projects concerned through the next four fiscal years. NASA uses the findings from the Senior Review to:

- Prioritize continued funding of the operating missions and projects;
- Define an implementation approach to achieve astrophysics strategic objectives;
- Provide programmatic and budgetary direction to missions and projects for Fiscal Year (FY) 2015 and FY 2016; and
- Issue initial funding guidelines for FY 2017 and FY 2018 (to be revisited in the 2016 Senior Review).

This established practice was codified in the NASA Authorization Act of 2005 (Public Law 109-155), Section 304(a): “The Administrator shall carry out biennial reviews within each of the Science divisions to assess the cost and benefits of extending the date of the termination of data collection for those missions that have exceeded their planned mission life time.”

Missions in the 2014 Senior Review for Astrophysics include strategic missions, Principal Investigator-led Explorer missions, and foreign-led missions in which the U.S. is a minor partner (the NASA Senior Review assesses only U.S. funding for foreign-led missions). The 2014 Senior Review included the following astrophysics missions (in alphabetical order):

- Chandra X-ray Observatory
- Fermi Gamma-ray Space telescope
- Hubble Space Telescope
- Kepler Space Telescope
- Nuclear Spectroscopic Telescope Array (NuSTAR)
- Planck (ESA mission)
- Spitzer Space Telescope
- Suzaku/Astro-E2 (JAXA mission)
- Swift Gamma-ray Burst Explorer
- Widefield Infrared Survey Explorer (WISE)
- X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission)

The 2014 Senior Review was conducted March 10-April 3, 2014. For the first time this year, there were individualized panels for Hubble and Chandra separate from the main comparative panel.

The charter for the main comparative panel was to:

- Perform an assessment of the missions under review that includes
  - scientific merit and expected science return (primary criterion),
  - cost efficiency, any ongoing technology development, data collection, archiving, distribution, mission and data usability, and the vitality of the mission's science team (secondary criterion), and
  - current costs (secondary criterion).
- Perform an assessment of the overall MO&DA portfolio that includes
  - scientific tradeoffs and opportunity costs of extending missions and
  - strength and ability of the portfolio.
- Rank the projects, reviewed during the period (FY 2015 and FY 2016) and the extended period (FY 2017 and FY 2018)
- Provide findings to assist with an implementation strategy for Astrophysics Division MO&DA for FY 2015 through FY 2018
- Provide any relevant recommendations that would
  - enhance the science return of ranked missions within available resources and/or
  - reduce the operation cost of ranked missions with acceptable impact on the science return.
- Make a recommendation on whether or not to extend each mission under review.

The charter for the Hubble and Chandra panels was to:

- Perform an assessment that includes
  - scientific merit and expected science return,
  - how the science addresses the strategic objectives,
  - effectiveness of the observatory and science center in enabling new science, archival research, and theory,
  - any obvious technical obstacles in the next two to four years, and
  - overall quality of observatory stewardship.
- Provide any relevant recommendations that would enhance the science return of the mission within its available resources.
- Provide any relevant recommendations that would reduce the operation cost with acceptable impact on the science return; identify aspects of operation and stewardship that do not provide good return on investment
- Identify prioritized mission objectives and other proposed activities/goals that would be appropriate metrics at the next review.
- Make a recommendation on whether or not to extend the mission.

The review compared expected scientific returns and contributions to the system observatory relative to program costs under the pressure of reduced resources for astrophysics operating missions. A set of findings consistent with the 2010 Astrophysics Decadal Survey was developed by the review panel, to help prioritize the resources for astrophysics operating missions for FY 2015 and FY 2016 along with forward looking findings through FY 2018.

The members of the Senior Review panels worked very hard to carry out their charge. NASA is appreciative of the time and effort that they invested in the Senior Review.

All three Senior Review reports are available at <http://science.nasa.gov/astrophysics/documents>.

Based on the findings and recommendations in these three reports, NASA has made decisions for each of the 11 missions and projects as described below.

## **NASA Response**

The report of the Senior Review panel makes clear that all of the projects proposing within the 2014 Senior Review are scientifically meritorious and deserving of continued funding and continued operations. The panel ranked the missions and recommended that additional funding be found to preserve the portfolio of operating missions. However, the current constrained budget conditions prevent NASA from being able to increase funding for operating missions without unacceptable impacts on other parts of the astrophysics program.

NASA used the prioritized rankings and individual recommendations of the Senior Review to make the following decisions for each of the projects in the Senior Review. The missions are presented in alphabetical order.

### Summary of NASA decisions:

- Chandra X-ray Observatory: extension approved
- Fermi Gamma-ray Space telescope: extension approved
- Hubble Space Telescope: extension approved
- Kepler Space Telescope: extension approved
- Nuclear Spectroscopic Telescope Array (NuSTAR): extension approved
- Planck (ESA mission): augmentation approved
- Spitzer Space Telescope: mission not extended
- Suzaku/Astro-E2 (JAXA mission): extension approved
- Swift Gamma-ray Burst Explorer: extension approved
- Widefield Infrared Survey Explorer (WISE): augmentation not approved
- X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission): extension approved

### Detailed NASA decisions for each mission:

#### **Chandra X-ray Observatory**

The Chandra mission is approved to continue planning against the current budget guidelines. Any changes to the guidelines will be handled through the budget formulation process. The Chandra mission will be invited to the 2016 Astrophysics Senior Review. Current planning is that the 2016 Senior Review for Chandra will be an incremental review, not a full review.

### **Fermi Gamma-ray Space telescope**

The Fermi mission extension is approved for FY 2015-FY 2016 with reduced funding requiring further operation efficiencies. The Astrophysics Division is providing the Case II recommendation in the Senior Review report. The Fermi mission will be invited to the 2016 Astrophysics Senior Review; additional reduced operation costs will be expected.

### **Hubble Space Telescope**

The Hubble mission is approved to continue planning against the current budget guidelines. Any changes to the guidelines will be handled through the budget formulation process. The Hubble mission will be invited to the 2016 Astrophysics Senior Review. Current planning is that the 2016 Senior Review for Hubble will be an incremental review, not a full review.

### **Kepler Space Telescope**

The Kepler mission extension is approved for FY 2015-FY 2016 for K2 operations at a 10-percent reduction from the requested level; the full request cannot be accommodated within the constrained budget conditions. Additional funding will be provided for closeout of prime mission at a level to be determined through the budget formulation process supplemented by the closeout proposal review. Guidelines provided for FY 2017-FY 2018, including completion of both K2 and closeout in FY 2017, will be revisited in Senior Review 2016. The Astrophysics Division is providing the Case II recommendation in the Senior Review report; the full recommendation cannot be accommodated within the constrained budget conditions. The Kepler mission will be invited to the 2016 Astrophysics Senior Review for consideration of the third year of the K2 extension.

### **Nuclear Spectroscopic Telescope Array (NuSTAR)**

The NuSTAR mission extension is approved near the requested level in FY 2015-FY 2016. The Project should begin implementing a Guest Observer (GO) program immediately. The Project must reduce operating costs during extended mission below prime mission costs starting in FY 2015. Guidelines provided for FY 2017-FY 2018 assume further efficiencies will be found in operations without reducing GO funding, to be revisited in Senior Review 2016. The Astrophysics Division is providing the Case II recommendation in the Senior Review report. The NuSTAR mission will be invited to the 2016 Astrophysics Senior Review.

### **Planck (ESA mission)**

The Planck mission extension is approved for FY 2016. No additional funds are available in FY 2015 due to the constrained budget conditions. Additional funding for the extension is provided in FY 2016. The Astrophysics Division is providing the Case II recommendation in the Senior Review report reduced due to the constrained budget conditions. The Planck mission will not be invited to the 2016 Astrophysics Senior Review.

### **Spitzer Space Telescope**

The Spitzer mission extension for FY 2015 is not approved due to the constrained budget conditions and based on the findings and recommendations of the Senior Review report. The baseline plan to complete Spitzer operations after the end of FY 2014 and complete the closeout of the mission by the end of FY 2015, consistent with the President's FY 2015 budget request, is confirmed. The Spitzer project is invited to respond with a request for a budget augmentation to conduct continued operations with reduced operations costs. The response requesting a budget augmentation, if submitted, will be considered during the FY 2016 budget formulation process. If the Administration proposes additional funding for Spitzer in the FY16 Budget, the project will be able to seamlessly continue operations in FY15, while awaiting final appropriations from the Congress for FY16. The Astrophysics Division is providing the Case II recommendation of the Senior Review report.

### **Suzaku/Astro-E2 (JAXA mission)**

The Suzaku mission extension is approved for FY 2015-FY 2016 including augmentations to operations to allow for a one year overlap in U.S. funded observations with ASTRO-H. No GO funding is provided. Project should plan for closeout of U.S. Suzaku operations after one year of ASTRO-H operations. The Astrophysics Division is providing the Case II recommendation in the Senior Review report without GO funding. The Suzaku mission will not be invited to the 2016 Astrophysics Senior Review.

### **Swift Gamma-ray Burst Explorer**

The Swift mission extension is approved for FY 2015-FY 2016 with the current budget guidelines. The augmentation requested cannot be accommodated within the constrained budget conditions. Guidelines provided for FY 2017-FY 2018 are to be revisited in Senior Review 2016. Senior Review 2014 recommended approving the overguide request but budget constraints prevent that recommendation from being approved. The Astrophysics Division is providing the Case II recommendation in the Senior Review report. The Swift mission will be invited to the 2016 Astrophysics Senior Review.

### **Widefield Infrared Survey Explorer (WISE)**

The MaxWISE proposal was recommended for selection by the Senior Review. However, the only source of funding would be to displace funding from higher rated operating missions in the Senior Review. Due to constrained budget conditions, the MaxWISE proposal is declined.

### **X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission)**

The XMM-Newton mission extension is approved for FY 2015-FY 2016 with an augmented GO program. The full augmentation requested by the project cannot be accommodated within the constrained budget conditions. Guidelines provided for FY 2017-FY 2018 will be revisited in Senior Review 2016. The Astrophysics Division is providing the Case II recommendation in the Senior Review report. The XMM-Newton mission will be invited to the 2016 Astrophysics Senior Review.

### **Acknowledgement**

NASA accepts the findings of the Senior Review Panel. NASA has made decisions and has implemented a plan based on their recommendations. NASA is grateful that these members of the community stepped forward to provide findings regarding the astrophysics operating missions and their proposed plans for the next two years.

NASA would like to formally thank the members of the Senior Review Panels for their hard work, their dedication, and their willingness to commit to the full scope of the task before them. The process of reconciling the breadth of exemplary science made possible by the suite of current astrophysics operating missions, with the fiscal reality of the constrained budget conditions, made this an incredibly difficult task. Given the hard decisions that confronted them, the Senior Review Panel rose to the task to recommend the best forward plan possible to ensure the health of the individual supported missions, the entire NASA astrophysics portfolio, and the NASA astrophysics community.