

September 25, 2015

Revision 1: Typographical issues corrected 12/8/2015



**To:** MSFC/W. Weisskopf, Project Scientist, CXO  
GSFC/J. McEnery, Project Scientist, Fermi  
GSFC/J. Wiseman, Project Scientist, HST  
ARC/S. Howell, Project Scientist, K2  
CIT/F. Harrison, PI, NuSTAR  
GSFC/C. Markwardt, Mission Scientist, NuSTAR  
JPL/M. Werner, Project Scientist, Spitzer  
GSFC/N. Gehrels, PI, Swift  
GSFC/S. Snowden, US Project Scientist, XMM-Newton

**From:** NASA HQ/Jeffrey J.E. Hayes, Program Executive, Operating Missions,  
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**Subject:** Call for Proposals – Senior Review 2016 of the Astrophysics Division  
operating missions

## **1. Senior Review Background:**

NASA's Science Mission Directorate (SMD) periodically conducts independent, comparative reviews of its operating missions. NASA uses the findings from these reviews to define an implementation strategy and give programmatic direction to the missions and projects concerned for the next four fiscal years. This is consistent with Section 304(a) of the NASA Authorization Act of 2005 (Public Law 109-155), which states that:

“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 lifetime.”

The NASA Astrophysics Division (APD) will host its next Senior Review (SR) of operating missions in 2016. The Senior Review assesses proposals for funding, usually

involving additional resources in upcoming years, to continue operations of missions in the extended operations phase. The purpose of the review is to assist NASA in maximizing the scientific productivity and operating efficiency of the Astrophysics Division mission portfolio within the available funding. NASA will use the findings from the Senior Review to:

- Prioritize the operating missions and projects;
- Define an implementation approach to achieve astrophysics strategic objectives;
- Provide programmatic direction to the missions and projects concerned for 2017 and 2018; and
- Issue initial funding guidelines for 2019 and 2020 (to be revisited in the 2018 Senior Review).

NASA actions resulting from the Senior Review could include authorizing a mission to pass from its prime phase to extended; maintaining the status quo; significantly restructuring the project; or deciding to terminate an ongoing science mission.

This Call for Proposals describes the objectives and process for the review and contains instructions for the submission of proposals and in-person presentations to the review panels.

## 2. Execution of the 2016 Senior Review:

The execution of the 2016 Senior Review follows the assessment, prioritization, and NASA response to the 2014 Senior Review (<http://science.nasa.gov/astrophysics/2014-senior-review-operating-missions/>). All operating missions that are currently in extended phase with the intent of remaining in operation or receiving funding past 2016 are subject to this review.

Consistent with the 2014 Senior Review, all missions will be comparatively assessed by a single panel, with the exception of those missions whose budgets are already recognized in the notional run-out of the President's FY 2016 budget request. Accordingly, the panels will be structured as follows:

1. The Main panel. This comparative review will assess the merits and performance of the following six missions (in alphabetical order): Fermi, K2, NuSTAR, Spitzer, Swift, and XMM-Newton.
2. The Chandra X-ray Observatory (CXO) panel. Chandra has been operating since 1999, and there have been no major changes to the observatory since the time of the last Senior Review. Given the strong endorsement of Chandra by the 2014 Senior Review, and Chandra's position as a Great Observatory, NASA intends to extend the mission. Consistent with NASA's response to the 2014 Senior Review, the 2016 SR will be an incremental or "delta" review that will focus on changes since the 2014 SR with an emphasis on the efficiency of the mission.

3. The Hubble Space Telescope (HST) panel. Hubble has been operating since 1990, and there have been no major changes to the observatory since the time of the last Senior Review. Given the strong endorsement of Hubble by the 2014 Senior Review, and Hubble's position as a Great Observatory, NASA intends to extend the mission. Consistent with NASA's response to the 2014 Senior Review, the 2016 SR will be an incremental or "delta" review that will focus on changes since the 2014 SR with an emphasis on the efficiency of the mission.

Each mission that is invited to the Senior Review will submit a proposal outlining how its science investigations will benefit the Astrophysics Division's research objectives. These objectives and focus areas are described in the 2014 Science Plan for NASA's Science Mission Directorate (the SMD Science Plan) and the 2010 Astrophysics Decadal Survey ([New Worlds, New Horizons in Astronomy and Astrophysics](#)). Performance factors to be assessed will include mission science productivity, present and future scientific potential, data quality and accessibility, technical status, budget efficiency, and operating efficiency.

Proposals should outline descriptions of the project's scientific merit and most recent accomplishments, the prospect of future scientific impact and productivity, the productivity and vitality of the scientific team, the current and future plans of data dissemination, the technical status of the instruments' health and safety, the level and quality of observatory stewardship, and a detailed budget for the proposed investigations. Projects that were included in the 2014 Senior Review should report their progress and accomplishments relative to their 2014 SR submission goals. Those projects should also summarize any prior Senior Review Panel findings and discuss any actions or changes implemented in response to those findings.

For this review, projects are requested to submit plans that have a set of Prioritized Mission Objectives (PMOs) for the next 2 years, with a possible extension for an additional two years. These objectives should elucidate the scientific, technical, and/or budgetary priorities for the upcoming two to four-year planning cycle and allow the Senior Review Panel to make a comparative analysis amongst divergent mission needs and priorities for allocating available funding. This will allow NASA flexibility in planning within a dynamic budgetary environment (e.g., reaction to a flat budget without inflation; reaction to a 5% budget reduction; reaction to a 10% budget reduction; or reaction to a 15% budget reduction). These prioritized objectives will also allow subsequent senior reviews to assess and measure the success of each mission in achieving its stated goals, as well as provide reporting inputs for the Agency.

### **3. Mission Extension Paradigm:**

Under this call, the budgets for mission extensions beyond the prime mission lifetime (in NPR 7120.5 parlance, Prime Phase E) will support, at a lower level, the activities required to maintain operations and continue to produce meaningful and significant science data, which is adequately described and accessible to the researcher. When a

mission has completed its Prime Phase E, NASA APD will accept higher operational risk, lower data collection efficiency, and instrument/mission degradation due to aging. Priority is given to maintain understanding of the instrument performance, to monitor progress toward accomplishing the objectives of science observations, and to involve the science community in formulating the mission observing program to make the best scientific use of NASA's Astrophysics missions; however, limited funding will be available in this "minimal-science data analysis mode" for detailed analysis, data fitting, modeling, and interpretation. Those missions currently in extended phase, which have a Guest Observer / General Observer / Guest Investigator (hereafter, GO/GI) program, are expected to offer lower funding and services to users who are assumed to have gained knowledge and familiarity during the mission's prime phase.

It is assumed that, along with this reduced funding profile and greater risk, the cost to implement will be lower than that of Prime Phase E. The Astrophysics Division sponsors several competitive programs that support basic research, theory, and data analysis. We have found that these programs provide an alternative source of support to those investigators who encounter reduced mission-funding support as a result of general reductions to mission budgets.

#### **4. Schedule for the 2016 Senior Review:**

*Draft Call for Proposals issued:* August 20, 2015  
*Deadline to send comments on draft to NASA:* September 10, 2015  
*Final Call for Proposals issued:* November 2, 2015  
*Senior Review Proposals due:* January 22, 2016  
*Main panel meets in Washington, DC:* February 22-25, 2016  
*HST review and site visit in Baltimore, MD:* March 8-10, 2016  
*CXO review and site visit in Cambridge, MA:* March 22-24, 2016  
*Delivery of panel reports to NASA HQ:* April 2016 (no later than)  
*NASA Response/Direction to projects:* May-June 2016

## 5. Instructions to Proposers (all missions, with the exception of CXO and HST):

### 5.1. Proposal Preparation Instructions:

There are three overarching Astrophysics imperatives identified in the 2014 SMD Science Plan: “discover how the universe works, explore how it began and evolved, and search for life on planets around other stars.” These objectives are derived from the 2010 Astrophysics Decadal survey, [New Worlds, New Horizons in Astronomy and Astrophysics](#). Each project within the Astrophysics portfolio is chosen for its ability to shed insight into these areas. Each project should demonstrate, in the context of the review, how its science can contribute to the vision of the Astrophysics Division as outlined within the SMD Science Plan, the Decadal Survey, and the Astrophysics Roadmap, which presents a 30-year vision for astrophysics at NASA.

Proposals need to discuss the project’s potential for advancing NASA’s science objectives during the FY17 to FY20 timeframe, in accordance with the instructions to the Senior Review Panels. The proposal should address the following areas specifically and in conjunction with identified PMOs for the next 2-4 year planning cycle:

1. Scientific merit, including that of the project itself, and its unique capabilities and relevance to the stated Astrophysics research objectives and focus areas as part of the overall Astrophysics mission portfolio. Missions having a comprehensive and extensive GO/GI program should be prepared to discuss the relative merits and scientific productivity of these programs compared to alternate sources of research funding within the Astrophysics Division Research & Analysis portfolio;
2. Promise of future impact and productivity (due to uniqueness of capabilities, wavelength coverage, etc.) during the current-year planning cycle (again, missions with GO/GI programs should be prepared to discuss the promise of those programs);
3. Progress made toward achieving the PMOs identified in the 2014 Senior Review proposal (for missions that were subject to the 2014 SR);
4. Impact of past scientific results as evidenced by publications, citations, press releases, etc. and how that ties into future promise;
5. Broad accessibility, usability, and utility of the data, both as a unique mission and as a member of the Astrophysics mission portfolio, focusing on the cost efficiency, technology development, data collection, archiving, and distribution;
6. Spacecraft and instrument health and safety;
7. Productivity and vitality of the science team (e.g., continuity and expertise in the

calibration, validation, and archiving of instrumental data, scientific research, training younger scientists, etc.). This may also include training of younger scientists from GO/GI programs, if known;

8. Level and quality of observatory stewardship (e.g., maximizing the scientific return while minimizing the ongoing costs); and,
9. Effectiveness of communications and communications plans, including communication with the science community and the general public.

Education is no longer a part of the operating missions' budgets, and any education activities funded by SMD outside of the operating missions' budgets will not be reviewed as part of the Senior Review.

## **5.2. Required Sections:**

The proposal shall contain the following sections:

- Science and Science Implementation
- Technical and Budget (including Health & Safety)
- Appendices (see Section 5.3):
  - Standard Budget Spreadsheet
  - Acronym List
  - Link to online bibliography

The scientific and the technical/budget sections combined should not exceed 30 pages (including figures, figure captions, tables, and other graphics). Not included in the page limit are the appendices (see Section 5.3). Letters of endorsement are not needed for the Senior Review, and should not be included.

All pages are to be formatted on 8.5 x 11-inch paper, single-spaced, with 0.75 inch margins using a minimum of 11 point Arial font style. The entire proposal, except budget spreadsheets, must be submitted electronically in PDF format; the budget must be submitted using the provided Excel format (which may be expanded upon as needed).

Should the home institution require signatures, please prepare these as a cover letter to the proposal. Copies of this submittal letter will not be used in the review but will be retained within the Astrophysics Division. Sufficient proposal identifiers include the project name and names of key writers or presenters placed at the top of the first page.

### **5.2.1. Instructions for the Science and Science Implementation Section:**

The science and science implementation section of the proposal should describe the science merits of the proposed continued program and the specific contributions of the instruments to the mission and to the astrophysics portfolio. This section should focus on how the proposed science objectives will contribute to the state of knowledge of the

discipline, and their relevance to the research objectives and focus areas as stated in the SMD Science Plan, the 2010 Astrophysics Decadal Survey and long-term vision of the Astrophysics Division as outlined in the Roadmap. The science proposal should include an explicit summary of what has been accomplished to date (focusing principally on advances accomplished since the last Senior Review), a self-assessment of performance against the prior Senior Review Proposal's objectives, and a synopsis of how the findings of the 2014 Senior Review were addressed.

For missions that were assessed in the 2014 Senior Review, proposals must state the 2014 Prioritized Mission Objectives (PMOs), together with a detailed description of the progress toward meeting these goals over the past two years. Note that the 2014 Senior Review proposals will be made available to the panel. In order to assist the reviewers, the 2016 proposal may explicitly address sections in the 2014 proposal, but it should remain a self-contained document.

Proposals must also include a set of PMOs for the next four years, and a detailed description of how the PMOs will be accomplished. For missions currently in extended phase, it is not necessary to cite the mission's original science objectives. Each team is expected to conduct extended phase scientific investigations of the highest scientific merit with a clear implementation plan. These investigations should be distinct from the task of archiving data. The reporting of results to the scientific community via refereed journal articles and other means should be summarized in a way that makes it possible to assess the productivity over the last two years (if currently in extended Phase E). Proposers should specifically address how future achievements will build upon past results. The scientific merit of the program is a major criterion used to determine the ranking of the mission.

### **5.2.2. Instructions for the Technical/Budget Section:**

The section should begin with a discussion of the overall technical status of the components of the mission. These should include the spacecraft, instruments, and ground system including spacecraft control center and science center(s). The discussion should summarize the health of the components and point out limitations as a result of degradation, aging, use of consumables, obsolescence, etc. Any funding to Instrument Teams or other groups should be described and justified in detail. Projects are also instructed to show, in an appropriate summary manner, the anticipated 'in kind' support from NASA-funded sources other than the project's in-guide budget. These 'in kind' sources include tracking support from the NASA tracking networks and support from the multi-mission infrastructure projects at AFRC, ARC, GSFC, MSFC, JPL, and elsewhere. Representations of direct or in-kind funding from international partners, from other US Government agencies, or non-Government institutions should be provided separately, for informational purposes.

A second part of this section should discuss the proposed budgets. Labor, major equipment, and other expenses for the in-guideline budget must be explained in sufficient detail to determine the merit and incremental cost of each proposed task.

Labor costs should be explicitly sub-categorized as Civil Servant or Contractor. The proposed cost must represent the entire value of the project, including project expenditure, expenses paid by the Center, tracking networks (DSN, TDRSS, etc.), tail circuits, and multi-mission infrastructure projects such as the Advanced Multi-mission Operations System (AMMOS) at JPL and the Space Science Mission Operations (SSMO) Project at GSFC. Missions are asked to separate the costs of obtaining, validating, calibrating, and archiving data from costs of completing scientific investigations with the data obtained.

### *Budget Scenarios:*

Each project should provide a plan for at least the first, and optionally one or two more, of the following three budget scenarios:

#### **(1) An “in-guide” plan (required)**

Projects must present a plan for a budget consistent with the funding levels set in the April, 2015 NASA Astrophysics Planning, Programming, Budgeting, and Execution (PPBE) process. Each project must propose an in-guide plan, which follows the NASA Astrophysics budget guideline for the period under review. Where an out-year guideline is zero, projects must propose to their last Astrophysics PPBE submission.

#### **(2) An “under-guide” plan (optional)**

Projects may present a plan and budget that would allow for continued operations at a level below their in-guide budgets. By identifying such a minimum acceptable funding level, the project is indicating that any further reduction is untenable, and that the project should be terminated rather than be funded at a level lower than the under-guide level. The science/technical/budget description of this scenario should address the reduced scope compared to the in-guideline scenario. The difference in return (science, technical, spacecraft health and safety, etc.) compared to the in-guideline plan should also be clearly identified. If a project assesses the in-guide budget to already be the minimum level for continued operations, then this must be explicitly stated in the proposal.

#### **(3) An “over-guide mission” plan (optional)**

Projects may present an over-guide plan and budget if the proposed in-guide budget poses a significant (self-assessed) risk to the continued operations of the mission. The proposed over-guide budget should be included with full cognizance of the very tight fiscal constraints that NASA faces. In other words, this over-guide request should be a carefully considered request, not a maximal request. The science/technical/budget description of this scenario should address the added scope and expected benefits compared to the in-guideline scenario. The added return (science, technical, spacecraft health and safety, etc.) from the over-guide versus the in-guideline plan should be clearly identified. The budget section should explicitly detail the use of the additional requested funds. The added return should be clearly connected to the additional budget required (over the current NASA Astrophysics budget guideline) so that the Senior

Review Panel can evaluate none, some, or all of the added return and estimate the budget required for partially funding any proposed increases.

*Additional budget requirements:*

The included spreadsheet contains instructions and the mandatory form for the budget portion of the proposal. This form serves as a standard budget spreadsheet for all proposals, and allows the panel to make the appropriate comparisons. Projects are required to submit a budget spreadsheet for each of the “in-guide,” “under-guide,” and “over-guide” mission scenarios they propose.

For the period under consideration in this Senior Review, the budget should be itemized, as required in the spreadsheet, and described and justified in full detail in the technical and budget section. For each of the in-guide,” “under-guide,” and “over-guide” mission scenarios proposed, the project is required to submit Technical and Budgetary Prioritized Mission Objectives (PMOs) to facilitate the SR Panel’s ability to assess planned operating efficiencies and budgetary plans in accordance with the Extended Mission paradigm.

Appendix A provides the mandatory budget summary form with instructions and definitions. The budget spreadsheet provides tables for NASA-provided ‘in kind’ support and instrument team budgets; each proposal may include additional details in a format determined by each project.

### **5.3. Required Appendices:**

The following appendices are required and do not count against the page limit:

- A list of references.
- Standard budget(s) in the mandatory format. The spreadsheet template in Appendix A provides the mandatory summary format for the budget and supplies a spreadsheet template.
- A full list of all acronyms used with their designations spelled out.
- An online bibliography of recent publications. The proposal should contain the URL to this bibliography. The Astrophysics Division recommends that the bibliography should be listed in sequence with the most recent refereed publications first. The bibliography should contain, as a minimum, the most recent (2-3 years) papers, although it may list all papers for the lifetime of the mission. It is appropriate to list papers to American Astronomical Society (AAS) meetings, conferences, workshops, PhD theses, etc., but these should be listed separately from the listing of the refereed papers.

### **5.4. Proposal Submission Deadline:**

The proposals will be uploaded electronically in PDF format to the NASA NSPIRES website and must be received by January 22, 2016, at 5 pm EST.

**5.5. Further Information Required for the Senior Review Deliberations:**

After submission of proposals, members of the Senior Review panels may have further questions or requests for clarification. NASA will moderate these questions and requests, and expects to send them to the proposing teams at least one week before the start of the review.

## 6. Instructions to Proposers (CXO and HST):

### 6.1. Required Elements:

Consistent with NASA's response to the 2014 Senior Review, the 2016 SR for Chandra and Hubble will be an incremental or "delta" review that will focus on changes to the mission since the 2014 SR. Each proposal must contain the following:

- An update on scientific accomplishments since the 2014 Senior Review proposal.
- A description of the expected science return over the requested funding period.
- A set of Prioritized Mission Objectives (PMOs) for the next four years (if different to those articulated in the 2014 Senior Review proposal).
- A detailed description of how the PMOs will be accomplished (if different to those articulated in the 2014 Senior Review proposal).
- A description of the progress made toward achieving the PMOs identified in the 2014 Senior Review.
- A discussion of how the mission implemented the findings of the 2014 Senior Review.
- A synopsis of any internal reviews undertaken by the mission since the 2014 Senior Review, as well as any actions that have, or will be, implemented as a result.
- A description of any additional changes to observatory operations since 2014.
- A discussion of planned changes, if any, to observatory operations over the next four years.
- An update on changes to the health of the spacecraft and instruments since 2014.
- Budget (see Section 6.2).
- Appendices (see Section 6.3).

Please note that copies of the 2014 Senior Review proposal will be made available to the panel. In order to assist the reviewers, the 2016 proposal may explicitly address sections in the 2014 proposal, but it should remain a self-contained document.

Each proposal should not exceed 20 pages (including figures, figure captions, tables, and other graphics). Not included in the page limit are the appendices (see Section 6.2). Letters of endorsement are not needed for the Senior Review, and should not be included.

All pages are to be formatted on 8.5 x 11-inch paper, single-spaced, with 0.75 inch margins using a minimum of 11 point Arial font style.

Should the home institution require signatures, please prepare these as a cover letter to the proposal. Copies of this submittal letter will not be used in the review but will be retained within the Astrophysics Division. Sufficient proposal identifiers include the project name and names of key writers or presenters placed at the top of the first page.

## 6.2. Budget:

**Each project must propose an in-guide plan, which follows the NASA Astrophysics budget guideline for the period under review. An over-guide will not be considered in this Senior Review because the project currently has a budget for all of the fiscal years under consideration.**

Labor, major equipment, and other expenses for the in-guideline budget must be explained in sufficient detail to determine the merit and incremental cost of each proposed task. Labor costs should be explicitly sub-categorized as Civil Servant or Contractor. The proposed cost must represent the entire value of the project, including project expenditure, expenses paid by the Center, tracking networks (DSN, TDRSS, etc.), tail circuits, and multi-mission infrastructure projects such as the Advanced Multi-mission Operations System (AMMOS) at JPL and the Space Science Mission Operations (SSMO) Project at GSFC. The project is asked to separate the costs of obtaining, validating, calibrating, and archiving data from costs of completing scientific investigations with the data obtained.

The budget plan must follow the NASA budget guideline for the period under review. The attached spreadsheet contains instructions and the mandatory form for the budget portion of the proposal. For the period under consideration in this Senior Review, the budget should be itemized, as required in the spreadsheet, and described and justified in full detail in the technical and budget section. The budget spreadsheet provides tables for NASA-provided ‘in kind’ support and instrument team budgets. This form will serve as a standard budget summary; however, the proposal may include additional details in a format determined by each project.

## 6.3. Required Appendices:

The following appendices are required and do not count against the page limit:

- A list of references.
- A full list of all acronyms used with their designations spelled out.
- An online bibliography of recent publications. The proposal should contain the URL to this bibliography. The Astrophysics Division recommends that the bibliography should be listed in sequence with the most recent refereed publications first. The bibliography should contain, as a minimum, the most recent (2-3 years) papers, although it may list all papers for the lifetime of the mission. It is appropriate to list papers to American Astronomical Society (AAS) meetings, conferences, workshops, PhD theses, etc., but these should be listed separately from the listing of the refereed papers.
- Standard Budget spreadsheet. The spreadsheet template in Appendix A provides the mandatory summary format for the budget and supplies a spreadsheet template.

#### **6.4. Proposal Submission Deadline:**

The proposals will be uploaded electronically in PDF format to the NASA NSPIRES website and must be received by January 22, 2016, at 5 pm EST.

#### **6.5. Further Information Required for the Senior Review Deliberations:**

After submission of proposals, members of the Senior Review panels may have further questions or requests for clarification. NASA will moderate these questions and requests, and expects to send them to the proposing teams at least one week before the start of the review.

## 7. Main Panel Instructions:

### 7.1 Review Criteria:

All proposals will be assessed against the following criteria:

#### Criterion A: Scientific Merit (40% weighting)

- Factor A-1:** Overall scientific strength and impact of the mission.
- Factor A-2:** Expected scientific output and “return on investment” over the requested funding period.
- Factor A-3:** Incremental and synergistic benefit to the Astrophysics Division Mission Portfolio.
- Factor A-4:** Quality of data collection, archiving, distribution, and usability.

#### Criterion B: Relevance and Responsiveness (30% weighting)

- Factor B-1:** Relevance to the research objectives and focus areas described in the SMD Science Plan. Relevance to the scientific goals of the Astrophysics Division as defined in the Division’s Strategic Objectives and the 2010 Astrophysics Decadal Survey.
- Factor B-2:** Progress made toward achieving PMOs in the 2014 Senior Review proposal (for missions included in the 2014 SR).
- Factor B-3:** Performance of addressing any findings in the 2014 Senior Review.

#### Criterion C: Technical Capability and Cost Reasonableness (30% weighting)

- Factor C-1:** Cost efficiency of the mission’s operating model in terms of meeting the proposed scientific goals.
- Factor C-2:** Health of the spacecraft and instruments, and suitability of the mission’s operating model and science team to maximizing its scientific return.
- Factor C-3:** Current operating costs.

The following scale will be used to map the number and significance of the strengths and weaknesses to an adjectival description for **each** of the three criteria above:

Adjectival description	Basis
Excellent	A thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the CfP as documented by numerous or significant strengths and with no major weaknesses.
Very Good	A competent proposal of high merit that fully responds to the objectives of the CfP, whose strengths fully out-balance any weaknesses and none of those weaknesses

	constitute fatal flaws.
Good	A competent proposal that represents a credible response to the CfP, whose strengths and weaknesses essentially balance each other.
Fair	A proposal that provides a nominal response to the CfP but whose weaknesses outweigh any strengths.
Poor	A seriously flawed proposal having one or more major weaknesses that constitute fatal flaws.

An overall ranking will be produced for the missions that uses the panel's adjectival ratings for each criterion and their relative weightings. The adjectival ratings will be converted into a numerical scale that facilitates this purpose.

## 7.2 Panel Charge:

1. Use the above criteria to individually **assess** each project over the period (FY17 and FY18) and the extended period (FY19 and FY20).
2. Use the above criteria to **rank** the projects over the period (FY17 and FY18) and the extended period (FY19 and FY20).
3. Provide findings to assist with an implementation strategy for the Astrophysics Division portfolio of operating missions for FY17 through FY20, including an appropriate mix of:
  - a. Continuation of projects at their "in-guide" level (see Section 5.2);
  - b. Continuation of projects with either enhancements or reductions to their in-guide budgets, the boundaries of which are defined by the "over-guide" and "under-guide" levels (see Section 5.2);
  - c. Mission extensions beyond the prime mission phase, subject to the "Mission Extension Paradigm"; and/or,
  - d. Termination of projects.

The findings must take into account the following factors:

- a. The Main Review Panel's assessments and relative rankings of the missions under consideration.
- b. The overall strength and ability of the resulting mission portfolio, including both the missions under consideration, as well as new missions expected to be launched, to fulfill the Astrophysics Division priorities from FY17 through FY20, as represented in the 2014 SMD Science Plan and in the context of the 2010 Astrophysics Decadal Survey.
- c. The projected science returns of the missions under review with the potential advances to be gained from an alternative strategy of increased funding for other Division priorities.
- d. The scientific tradeoffs and opportunity costs involved in extending

existing projects versus reducing or terminating them and using that funding for future flight opportunities, most especially in light of new Astrophysics missions expected to be launched.

### **7.3 Meeting Agenda:**

The Main Senior Review panel will meet for four days and follow this agenda:

- Day 1: Morning: Instructions, program background, logistics (writing assignments, etc.), and a discussion of conflicts of interest and the procedures to minimize their impacts. Rest of the day: Begin assessments of missions.
- Day 2: Project presentations, plus questions and answers;
- Day 3: Complete project presentations. Continue assessments and write draft summary of findings;
- Day 4: Finalize draft, and present preliminary findings to the Division Director and staff.

### **7.4 Presentations to the Review Panel:**

Each mission will be allotted 90 minutes for an oral presentation to the panel. During each presentation, the project representatives should plan on using one hour of the allocated time for their prepared presentation, and reserving 30 minutes for questions and answers. To minimize the burden on projects, while also allowing for adequate expertise and support to be present, no more than three people may represent any one of the projects. These people must be direct representatives of the project itself, and not external affiliates. The project presentations should accomplish several objectives, in decreasing priority order:

- To provide a forum for questions from panelists and answers from the projects.
- To provide any significant updates; e.g., science results obtained since proposal submission.
- To re-emphasize the highlights of the proposals, bearing in mind that the proposals have been read in detail by all panelists.

### **7.5. Panel Deliverables**

The panel is required to produce a first draft of the report before the end of the meeting. At the end of the last day, the panel will out-brief their report to the Astrophysics Division Director and staff. The panel may then take an additional 2-3 weeks to finalize and submit its report.

## 8. CXO and HST Panel Instructions:

### 8.1. Panel Charge:

Both the Chandra X-ray Observatory and Hubble Space Telescope have been operating since the 1990s, and there have been no major changes to either observatory since the time of the last Senior Review. Given the strong endorsement of both Chandra and Hubble by the 2014 Senior Review, and their continued effectiveness as Great Observatories, NASA intends to extend both missions. Consistent with NASA's response to the 2014 Senior Review, the 2016 SR will be an incremental or "delta" review that will focus on changes since the 2014 SR with an emphasis on the efficiencies of both missions. Accordingly, the panel will:

1. *Consider the PMOs described in the 2016 Senior Review proposal, and assess the scientific merit and expected science return of the observatory over the next 2 to 4 years.*
2. *Assess the observatory's progress made toward achieving the PMOs described in the 2014 Senior Review proposal. A copy of the proposal will be made available to reviewers.*

The panel will also consider (a) the response of the observatory to any findings made of the 2014 Senior Review, (b) any additional operational changes implemented by the observatory since 2014, (c) any further operational changes planned over the next 2 to 4 years, and (d) the observatory's identification of risks to the science program over the next 2 to 4 years. Focusing principally on these areas, and using the 2014 Senior Review report as a baseline, the panel will provide updates on:

3. *The efficiency of the observatory, and its associated operations center and infrastructure in enabling new science, archival research, and theory.*
4. *The efficiency of the science and mission operations processes, and identify any obvious technical obstacles to achieving the observatory's science objectives in the next two to four years.*
5. *The overall quality of observatory stewardship, and the usage of the allocated funds, in light of overall limited financial resources, to maximize science quality, observational efficiency, and return on investment.*
6. *Relevant findings that would enhance the science return of the mission within its available resources.*

### 8.2. Meeting Agenda:

The CXO and HST Senior Review panels will meet for approximately 2.5 days and follow this agenda:

- Day 1: Morning: Instructions and logistics (writing assignments, etc.), and a discussion of conflicts of interest and the procedures to minimize their

impacts. Discussion of initial impressions and findings. Rest of the day: a formal oral presentation from the project (not to exceed 2.5 hours), plus questions and answers;

Day 2: Follow-up Q&A session as needed. Continue with panel assessments;

Day 3: Draft panel report, and present preliminary findings to the Division Director and staff.

### **8.3. Site Visits:**

The purpose of the site visits is to allow the panels to gain insight into the overall operations of these major observatories, as well as the required infrastructure for their maintenance. The visits will assess the scientific productivity, spacecraft robustness, and operating efficiency of the observatory. It is the intent of the site visit to allow the projects to have key personnel on-hand, should questions from the panel arise from with the submitted proposal, or the oral presentation. It is not meant to require the projects to host a tour of the facilities for the panel (i.e. mission operations centers, etc.), due to this being a “delta” review.

### **8.4. Panel Deliverables:**

The panel is required to produce a first draft of the report before the end of the meeting. At the end of the last day, the panel will out-brief their report to the Astrophysics Division Director and staff. The panel may then take an additional 2-3 weeks to finalize and submit its report.

## 9. NASA Response:

In May-June 2016, NASA HQ will contact each of the proposing missions/projects and relay direction resulting from the Senior Review. This direction may include new budget guidelines and other specific instructions resulting from the Senior Review process, possibly including notices of intent to terminate. At this time, NASA HQ will post the report of the Senior Review panel and the APD response to a public NASA HQ website. Each of the projects will then submit back to NASA HQ their plan for complying with the new guidance and instructions. The NASA HQ program scientists will ensure that key officials in participating international space agencies or other U.S. government agencies that are partners in a proposing mission are contacted and apprised of NASA's decisions resulting from the Senior Review.

The next Senior Review will be held 2 years hence. Biennial Senior Reviews allow NASA the ability to rebalance its astrophysics mission portfolio as needed.

## 10. Further Information:

For further information, please contact:

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## Appendix A:

One attachment:

MS Excel spreadsheet: Astro\_SR\_2016\_Std\_Budget\_Spreadsheet\_FINAL.xlsx

**Useful Links:**

**Strategic/Policy Documents and other inputs:**

2014 SMD Science Plan:

[http://science.nasa.gov/media/medialibrary/2014/05/02/2014\\_Science\\_Plan-0501\\_tagged.pdf](http://science.nasa.gov/media/medialibrary/2014/05/02/2014_Science_Plan-0501_tagged.pdf)

Enduring Quests, Daring Visions: NASA Astrophysics in the Next Three Decades:

<http://science.nasa.gov/science-committee/subcommittees/nac-astrophysics-subcommittee/astrophysics-roadmap/>

2010 Astrophysics Decadal Survey:

[http://www.nap.edu/catalog.php?record\\_id=12951](http://www.nap.edu/catalog.php?record_id=12951)

**Mission Archive Plans:**

NASA Data Policy:

<http://www.nasa.gov/open/plan/science-data-access.html>