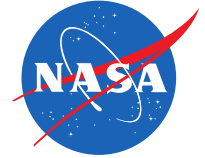


October 17, 2018



**To:** MSFC/M.C. Weisskopf, Project Scientist, Chandra X-ray Observatory  
GSFC/J. McEnery, Project Scientist, Fermi Gamma-ray Space Telescope  
GSFC/J. Wiseman, Project Scientist, Hubble Space Telescope  
GSFC/K. Gendreau, PI and Project Scientist, NICER  
CIT/F. Harrison, PI, NuSTAR  
GSFC/B. Cenko, PI, Neil Gehrels Swift Observatory  
MIT/G. Ricker, PI, TESS  
GSFC/K. Weaver, US Project Scientist, XMM-Newton

**From:** NASA HQ/Daniel A. Evans, Program Scientist, Astrophysics Division, SMD  
  
NASA HQ/Jeffrey J.E. Hayes, Program Executive, Operating Missions,  
Astrophysics Division, SMD

**Subject:** Call for Proposals – 2019 Senior Review of 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 five fiscal years. This is consistent with Section 304(a) of the NASA Authorization Act of 2005 (P.L. 109-155), and the NASA Transition Authorization Act of 2017 (P.L. 115-10), which modifies Section 51 U.S.C. §30504 to read:

(a) Assessments. —

(1) In general. —

The Administrator shall carry out triennial 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 exceed their planned missions' lifetime.

(2) Considerations. —

In conducting an assessment under paragraph (1), the Administrator shall consider whether and how extending missions impacts the start of future missions.

(b) Consultation and Consideration of Potential Benefits of Instruments on Missions. —

When deciding whether to extend a mission that has an operational component, the Administrator shall—

(1) consult with any affected Federal agency; and

(2) take into account the potential benefits of instruments on missions that are beyond their planned mission lifetime.

(c) Reports. —

The Administrator shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives, at the same time as the submission to Congress of the Administration's annual budget request for each fiscal year, a report detailing any assessment under subsection (a) that was carried out during the previous year.

These reviews of operating missions are NASA's highest form of peer review, as the subject is not a single science investigation, or even a single space mission, but rather a portfolio of operating missions. The reviews of operating missions are referred to as Senior Reviews, in recognition of the high level of the peer review.

The NASA Astrophysics Division (APD) will host its next Senior Review (SR) of operating missions in 2019. 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 FY20, FY21 and FY22; and
- Issue initial funding guidelines for FY23 and FY24 (to be revisited in the 2022 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.

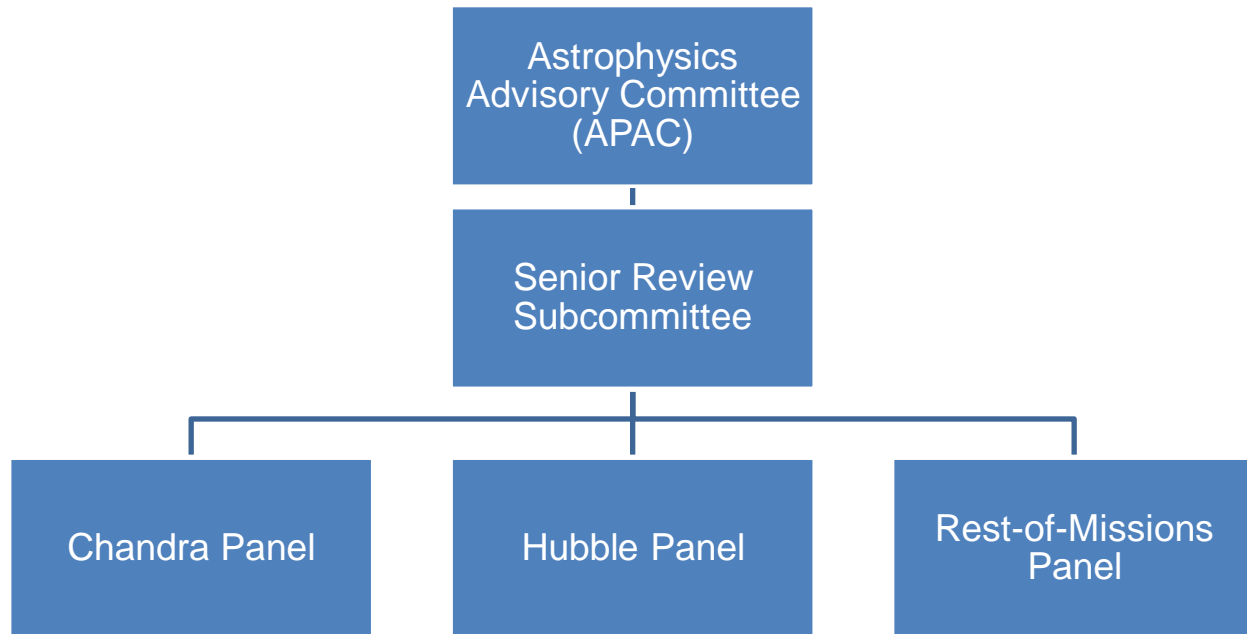
## **2. Execution of the 2019 Senior Review:**

The execution of the 2019 Senior Review follows the assessment, prioritization, and NASA response to the 2016 Senior Review (<http://science.nasa.gov/astrophysics/2016-senior-review-operating-missions/>). The following missions will be included in the 2019 Senior Review:

- Chandra X-ray Observatory (CXO)
- Fermi Gamma-ray Space Telescope (Fermi)
- Hubble Space Telescope (HST)
- Neutron Star Interior Composition Explorer (NICER)
- Nuclear Spectroscopic Telescope Array (NuSTAR)
- Neil Gehrels Swift Observatory (Swift)
- Transiting Exoplanet Survey Satellite (TESS)
- X-ray Multi-Mirror Mission-Newton (XMM-Newton)

### **2.1 Review Composition and Structure**

The 2019 Astrophysics Senior Review will adopt a multi-level review structure (see figure below), in which three panels report to a Senior Review Subcommittee, which has been established as a subordinate group to the Astrophysics Advisory Committee, consistent with the Charter of the Astrophysics Advisory Committee and compliant with the Federal Advisory Committee Act (FACA) of 1972 (P.L. 92-463).



## 2.2 The Chandra and Hubble Panels

Consistent with the 2014 and 2016 Senior Reviews, there will be separate panels for Chandra and Hubble. This recognizes their status as astrophysics community facilities, as well as the scope and complexity of their operations. Given that the Senior Review Subcommittee will rank Chandra and Hubble alongside all the other missions (Section 2.4), the 2019 Senior Review for these two missions will be a ‘full’ review, rather than a ‘delta’ review that was conducted in 2016. As a result, not only will the panels assess the scientific merit, relevance and responsiveness to the division’s strategic goals, and technical capability and cost reasonableness of Chandra and Hubble, but they will place additional emphasis on their operations and efficiency.

## 2.3 The Rest-of-Missions Panel

The remaining missions (Fermi, NICER, NuSTAR, Swift, TESS, XMM-Newton) will be reviewed by a single panel that will be charged with assessing their scientific merit, relevance and responsiveness to the division’s strategic goals, and technical capability and cost reasonableness.

## 2.4 The Senior Review Subcommittee

The Senior Review Subcommittee is a subordinate group under the APAC, and will operate in compliance with its Terms of Reference. Its principal role is to merge the findings from the Chandra, Hubble, and Rest-of-Missions Panels and to rank **all** missions

on the basis of their scientific merit, their relevance and responsiveness to the division's strategic goals, and their technical capability and cost reasonableness.

The Senior Review Subcommittee will write a report that includes a series of findings to assist with the Astrophysics implementation strategy for FY20-FY24, including an appropriate mix of:

- Continuation of projects at their in-guide level;
- Continuation of projects with either enhancements or reductions to their in-guide budgets;
- Mission extensions beyond the prime mission phase; and/or,
- Termination of projects.

The membership of the Senior Review Subcommittee will be drawn from the Chandra, Hubble, and Rest-of-Missions panels. It will report to the APAC, and will not provide advice or work products directly to NASA. The Subcommittee Chair will report on the Subcommittee's recommendations and findings, as well as its work products, for public deliberation by the APAC. The final report of the Senior Review Subcommittee is a deliverable to the APAC.

The APAC approved the Terms of Reference (TOR) for the Senior Review Subcommittee on April 12, 2018, and the Terms of Reference were signed on August 10, 2018, thereby establishing the Senior Review Subcommittee. The TOR can be found at: <https://science.nasa.gov/astrophysics/2019-senior-review-operating-missions/>

## **2.5 The NASA Astrophysics Advisory Committee (APAC)**

The APAC is responsible for approving the Terms of Reference (TOR) for the Senior Review Subcommittee. After public deliberation of the Senior Review Report delivered to it by the Senior Review Subcommittee, the APAC will deliver a final report to NASA reflecting its formal recommendations to NASA, as well as append an unedited copy of the Senior Review Subcommittee's report.

## **3. Overview of the Scope of Senior Review Proposals:**

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*). As described in this Call for Proposals, the three principal criteria are: (1) scientific merit, (2) relevance and responsiveness to the Astrophysics Division's strategic goals, and (3) technical capability and cost reasonableness.

As discussed in Section 6.1, proposals should provide descriptions of the project's

scientific merit; promise of future impact and productivity; impact of scientific results; accessibility and usability of data; spacecraft and instrument health and safety; observatory stewardship; training, mentoring, and leadership opportunities; and communications.

For this review, projects are required to submit plans that have a set of Prioritized Mission Objectives (PMOs) for FY20-FY22, with a possible extension to FY23-FY24. These PMOs should elucidate the scientific, technical, and/or budgetary priorities for the upcoming three to five-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. 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. For missions that are primarily driven by GO/GI-type investigations, the PMOs should primarily focus on stewardship and efficiency. Even for these GO/GI-driven missions, however, a project may opt to state as a PMO the expected science return of one or more current or future 'key projects,' and/or the expected science return from other discretionary allocations of observing time.

#### **4. 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, the NASA Astrophysics Division may 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, more limited funding may be available in this "minimal-science data analysis mode" for detailed analysis, data fitting, modeling, and interpretation. This paradigm, however, applies to the first mission extension only: it is not a requirement that a subsequent mission extension has a reduced operating cost over that which preceded it.

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.

#### **5. Schedule for the 2019 Senior Review:**

*Draft Call for Proposals issued: September 18, 2018*

*Deadline to send comments on draft to NASA: October 1, 2018*

*Final Call for Proposals issued: November 2, 2018*

*Proposals due: February 1, 2019*

*Chandra panel meeting and site visit in Cambridge, MA: February 25-27, 2019*

*Hubble panel meeting and site visit in Baltimore, MD: February 25-27, 2019*

*Rest-of-Missions panel meets in Washington, DC: March 11-14, 2019*

*Panel reports delivered to Senior Review Subcommittee: April 2, 2019*

*Senior Review Subcommittee meets: April 10-11, 2019*

*Senior Review Subcommittee report delivered to APAC: April 25, 2019*

*Special APAC meeting: May 8-9, 2019*

*NASA Response/Direction to projects: May-June 2019*

## 6. Instructions to Proposers (all missions – additional instructions for CXO and HST are in Section 7):

### 6.1. 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 Senior Review, therefore, 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 FY20 to FY24 timeframe, in accordance with the instructions to the Senior Review Panels. The proposal should address the following areas specifically and in conjunction with the PMOs identified for the next 3-5 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.) (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 2016 Senior Review proposal (for missions that were subject to the 2016 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. Level and quality of observatory stewardship (e.g., maximizing the scientific return while minimizing the ongoing costs);



8. In the context of the expected lifetime of the mission, the project's plans to prepare for the future by providing the training, mentoring and leadership opportunities that will expand the skills of its staff, as well as foster the next generation of mission leaders; 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.

## **6.2. Required Sections:**

The proposal shall contain the following sections:

- Science and Science Implementation
- Technical/Management/Budget (including Health & Safety)
- Appendices (see Section 6.3):
  - Standard Budget Spreadsheet
  - Acronym List
  - Link to online bibliography

The scientific and the technical/management/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 6.3). 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.

### **6.2.1. 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 2016 Senior Review were addressed.

For missions that were assessed in the 2016 Senior Review, proposals must state the 2016 Prioritized Mission Objectives (PMOs), together with a detailed description of the progress toward meeting these goals over the past three years. Note that the 2016 Senior Review proposals will be made available to the panel as appropriate. In order to assist the reviewers, the 2019 proposal may explicitly address sections in the 2016 proposal, but it should remain a self-contained document.

Proposals must also include a set of PMOs for FY20-FY24, 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. For missions that are primarily driven by GO/GI-type investigations, the PMOs should primarily focus on stewardship and efficiency. Even for these GO/GI-driven missions, however, a project may opt to state as a PMO the expected science return of one or more current or future 'key projects' and/or the expected science return from other discretionary allocations of observing time. 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 three 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.

#### **6.2.2. Instructions for the Technical/Management/Budget Section:**

The section should begin with a discussion of the overall technical status of the components of the mission. This description 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.

The second part of this section should address the suitability of the mission's operating model (e.g., governance, science team, instrument team) to meet the proposed scientific goals, provide a narrative self-assessment of the level and quality of observatory stewardship, and discuss the project's plans to prepare for the future by providing the

training, mentoring and leadership opportunities that will expand the skills of its staff, as well as foster the next generation of mission leaders.

The third 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 (required)**

Projects must 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 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 reviewers 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/management/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.

### **6.3. 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.

**6.4. Proposal Submission Deadline:**

The proposals will be uploaded electronically in PDF format to the NASA NSPIRES website and must be received by February 1, 2019, at 5 pm EST.

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

After the 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 panel meetings and/or Senior Review subcommittee meetings.

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

### 7.1. Scope:

As stated in Section 2.4, given that the Senior Review Subcommittee will rank Chandra and Hubble alongside all the other missions, the 2019 Senior Review for these two missions will be a ‘full’ review, rather than a ‘delta’ review that was conducted in 2016. The review panels will fully assess the scientific merit and productivity of Chandra and Hubble, but will also place additional emphasis on the operations and efficiency of these two missions.

### 7.2 Required Elements:

Proposers should **fully** follow all aspects of Section 6 when preparing their proposals, taking note of the following adjustments:

1. An additional section, entitled “Project’s Perspective on Operations and Efficiency” must be included. This section shall include:
  - a. An assessment of the current efficiency of science and mission operations, to include metrics where appropriate.
  - b. A discussion of any plans to further improve the efficiency of science and mission operations over the next three to five years.
  - c. A discussion of how funds are presently used, to include FTE counts in each key functional area.
  - d. A description and justification of the management and decision processes that the project uses to apply the funding it receives to maximize science quality, observational efficiency, and return on investment.
2. The scientific and the technical/management/budget sections combined should not exceed 40 pages (including figures, figure captions, tables, and other graphics). Not included in the page limit are the appendices (see Section 6.3).

## 8. Rest-of-Missions Panel Instructions:

### 8.1 Review Criteria:

All proposals will be assessed against the following criteria:

#### Criterion A: Scientific Merit (50% 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 (25% 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 2016 Senior Review proposal (for missions included in the 2016 SR).
- Factor B-3:** Performance of addressing any findings in the 2016 Senior Review (for missions included in the 2016 SR).

#### Criterion C: Technical Capability and Cost Reasonableness (25% 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 (e.g., governance, science team, instrument team) to maximizing its scientific return.
- Factor C-3:** In the context of the expected lifetime of the mission, the project’s plans to prepare for the future by providing the training, mentoring and leadership opportunities that will expand the skills of its staff, as well as foster the next generation of mission leaders.
- Factor C-4:** 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.

## 8.2 Panel Charge:

1. Use the above criteria to individually **assess** each project over the period (FY20, FY21 and FY22) and the extended period (FY23 and FY24).
2. Prepare a report, which will be used by the Senior Review Subcommittee to prepare findings to assist with an implementation strategy for the Astrophysics Division portfolio of operating missions for FY20 through FY24.

## 8.3 Meeting Agenda:

The Rest-of-Missions 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 report;
- Day 4: Finalize draft report.

## 8.4 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 individuals 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.

### **8.5. Panel Deliverables**

The panel is required to produce a first draft of its report before the end of the meeting. The panel may then take an additional 2 weeks to finalize and submit its report to the Senior Review Subcommittee.

## 9. CXO and HST Panel Instructions:

### 9.1. Panel Scope:

The 2019 Senior Review for Chandra and Hubble will be a ‘full’ review, rather than a ‘delta’ review that was conducted in 2016. The review panels will fully assess the scientific merit and productivity of Chandra and Hubble, but will also place additional emphasis on the operations and efficiency of these two missions.

### 9.2 Review Criteria:

The Chandra and Hubble proposals will be assessed against the following criteria:

#### Criterion A: Scientific Merit (50% 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 (25% 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 2016 Senior Review proposal (for missions included in the 2016 SR).
- Factor B-3:** Performance of addressing any findings in the 2016 Senior Review (for missions included in the 2016 SR).

#### Criterion C: Technical Capability and Cost Reasonableness (25% 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 (e.g., governance, science team, instrument team) to maximizing its scientific return.
- Factor C-3:** In the context of the expected lifetime of the mission, the project’s plans to prepare for the future by providing the training, mentoring and leadership opportunities that will expand the skills of its staff, as well as foster the next generation of mission leaders.
- Factor C-4:** 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.

### 9.3 Additional Requested Findings

The CXO and HST panels are additionally requested to **specifically** provide findings that address the following areas:

- 1. The effectiveness of the observatory, and its associated operations center and infrastructure in enabling new science, archival research, and theoretical studies.*
- 2. 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 three to five years.*
- 3. 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.*
- 4. Notable aspects that would enhance the science return of the mission within its available resources.*

### 9.4 Panel Charge:

1. Use the criteria delineated in Section 9.2 to **assess** the project over the period (FY20, FY21 and FY22) and the extended period (FY23 and FY24).
2. Provide additional findings as described in Section 9.3.
3. Prepare a report, which will be used by the Senior Review Subcommittee to

prepare findings to assist with an implementation strategy for the Astrophysics Division portfolio of operating missions for FY20 through FY24.

### **9.5. Meeting Agenda:**

The CXO and HST 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), an optional site visit, plus questions and answers;

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

Day 3: Write and finalize draft report.

### **9.6. Presentations and Site Visits:**

The purpose of the oral presentation and optional site visit is to allow the panel to gain insight into the overall operations of these major observatories, as well as the required infrastructure for their maintenance. The presentation and optional site visit will allow the panel to assess the scientific productivity, spacecraft robustness, and operating efficiency of the observatory. It is preferable to have key personnel on-hand, should questions from the panel arise from the submitted proposal, the oral presentation, or the optional site visit.

### **9.7. Panel Deliverables:**

The panel is required to produce a first draft of its report before the end of the meeting. The panel may then take an additional 2 weeks to finalize and submit its report to the Senior Review Subcommittee.

## 10. Senior Review Subcommittee Instructions:

The membership of the Senior Review Subcommittee will be drawn from the Chandra, Hubble, and Rest-of-Missions panels. The Terms of Reference (TOR) for the Senior Review Subcommittee provides additional details.

### 10.1. Products Available to the Senior Review Subcommittee

The following input products will be made available to the Senior Review Subcommittee:

- All 2019 Senior Review proposals.
- 2016 Senior Review proposals (for those projects included in the 2016 SR)
- Copies of presentations and Q&A responses from each mission to the Rest-of-Missions, Chandra, and Hubble panels.
- Final reports from the Rest-of-Missions, Chandra, and Hubble panels, which contain detailed assessments of each mission, together with adjectival assessments (Excellent through Poor) for each review criterion.

### 10.2 Subcommittee Charge

Consistent with the Terms of Reference for the Senior Review Subcommittee: principally using the input products described in Section 10.1, and in the context of the research objectives and focus areas described in the SMD Science Plan, the Subcommittee shall:

1. Provide an overall narrative assessment of the scientific merits of the expected returns from the projects reviewed during the period FY20 through FY24 (individual mission assessments are not, per se, required, given the detailed reports provided to the Senior Review Subcommittee by the Rest-of-Missions, Chandra, and Hubble). The scientific merits include relevance to the research objectives and focus areas, scientific impact, and promise of future scientific impact, as well as contributing to NASA's overall science objectives in astrophysics.
2. Provide an overall narrative assessment of the cost efficiency, data availability and usability, and the vitality of the projects (individual mission assessments are not, per se, required, given the detailed reports provided to the Senior Review Subcommittee by the Rest-of-Missions, Chandra, and Hubble).
3. Rank the missions on the basis of their scientific merit, their relevance and responsiveness to the division's strategic goals, and their technical capability and cost reasonableness.
4. From the assessments above, provide findings on an implementation strategy for the operating mission portfolio for FY20 through FY24, which could be a combination of:

- a. Continuation of projects at their in-guide level;
  - b. Continuation of projects with either enhancements or reductions to their in-guide budgets;
  - c. Mission extensions beyond the prime mission phase; and/or,
  - d. Termination of projects.
5. Provide an overall assessment of the strength and ability of the operating mission portfolio to meet the expectations of the total science to be obtained from FY20 through FY24, as represented in the 2014 SMD Science Plan and in the context of the 2010 Astrophysics Decadal Survey (New Worlds, New Horizons in Astronomy and Astrophysics).

### **10.3. Meeting Agenda:**

The Senior Review Subcommittee will meet for approximately 2 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: assessments and rankings;

Day 2: Write and finalize draft report.

### **10.4. Panel Deliverables:**

The panel is required to produce a first draft of its report before the end of the meeting. The panel may then take an additional 2 weeks to finalize and submit its report (containing the Rest-of-Missions, Chandra, and Hubble panel reports as appendices) to the APAC.

## 11. NASA Response:

In May-June 2019, following formal recommendations from the APAC and after consultation with stakeholders as appropriate, 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 Subcommittee, the Rest-of-Missions panel, the Chandra panel, and the Hubble panel to a public NASA HQ website. NASA HQ will also post the formal recommendation from the APAC and its response. Each of the projects will then submit back to NASA HQ their plan for complying with the new guidance and instructions. NASA HQ 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.

## 12. Further Information:

For further information, please contact:

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## Appendix A:

One attachment:

MS Excel spreadsheet: Astro\_SR\_2019\_Std\_Budget\_Spreadsheet.xlsx

## **Useful Links:**

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

2019 Senior Review Website:

<https://science.nasa.gov/astrophysics/2019-senior-review-operating-missions/>

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>