

**The *Chandra* X-ray
Observatory (CXO)
Research Program**

Call for Proposals

Cycle 21

Due Date: 14 March 2019, 6 p.m. EDT

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The *Chandra* X-ray Center is operated for NASA by the Smithsonian Astrophysical
Observatory

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1 - General Information

1.1 The Chandra Program: Call for Proposals (CfP)

We invite scientists to participate in Cycle 21 of the *Chandra* X-ray Observatory's (CXO) science program. The *Chandra* program is sponsored by NASA's Science Mission Directorate (SMD) and managed by the NASA Marshall Space Flight Center (MSFC). The *Chandra* X-ray Center (CXC), which is funded by NASA via a contract to the Smithsonian Astrophysical Observatory (SAO) in Cambridge, MA, has the responsibility for managing the *Chandra* science program, carrying out the *Chandra* Communication and Public Engagement (CPE) program, conducting the peer review that recommends the allocation of observing time and funds to the user community, selecting the proposals, and operating the *Chandra* spacecraft. The *Chandra* X-ray Observatory is described in [Chapter 2](#).

The funding of awards associated with this Call for Proposals (*CfP*) generally flows from NASA through SAO and the CXC to the Awardees. The CXC is the organizational unit within SAO that carries out SAO's contractual obligation to operate the *Chandra* X-ray Observatory and solicit proposals and when used in this document will encompass the NASA/SAO/CXC interrelationship.

1.2 Proposal Review Process: Deadlines and Schedule

Science proposal submission and review will be conducted in two stages to minimize the burden of proposal preparation ([Chapter 7](#))

- **Stage 1:** Involves the scientific and technical merits of the proposed investigation. Evaluation criteria include overall scientific merit, relevance to the *Chandra* program and the competence of the proposers ([Section 9.1](#)).
- **Stage 2:** The PIs of those proposals selected in Stage 1 will be invited to submit a cost proposal for the Stage 2 review ([Chapter 10](#)).

Table 1 Schedule and Deadlines for the *CfP* Cycle

| EVENT | DATE |
|-------------------------------------|-------------------------------|
| <i>CfP</i> Release | 13 December 2018 |
| Science Proposal Deadline (Stage 1) | 6 p.m. EDT, 14 March 2019 |
| Peer Review | 25-28 June 2019 |
| Selected Proposals Announced | 22 July 2019 |
| Stage 2 Budget Allocations emailed | Mid August 2019 |
| Budget Deadline (Stage 2) | 6 p.m. EDT, 26 September 2018 |
| Cost Review | October 2019 |
| Stage 2 Final Selection | November 2019 |
| Cycle 21 Starts | About January 2020 |

Late Proposals will not be considered. We recommend submission well before the deadline.

1.3 Summary of the CfP

This *CfP* solicits basic research proposals for the conduct of space science observations and subsequent analysis of the resultant scientific data from the *Chandra* X-ray Observatory (CXO). The *CfP* also solicits proposals for research that makes use of publicly available archived *Chandra* data and for theoretical and modeling studies related to the *Chandra* mission. The primary goal of the *Chandra* mission is the investigation of the nature and physics of astronomical objects as revealed through their X-ray emission.

1.3.1 Types of Science Research Proposals

- **General Observing Projects (GO):** new *Chandra* observations, generally (but not limited to) requiring less than 400 ksec of observing time (regardless of the number of objects observed)
- **Large and Very Large Projects (LPs and VLPs):** new *Chandra* observations requiring 400-1000 ksec (LP) or > 1 Msec (VLP) of observing time and designated as LP/VLP by the PI. The Big Project Panel can allocate a maximum of 1.5Msec to targets situated above 60 deg or below -60 deg ecliptic latitude (see [Section 4.2.](#)) There are no other limits to the requested exposure time of an LP/VLP or to the number of targets.
- **Target of Opportunity (TOO):** projects that are triggered by the occurrence of an anticipated transient astrophysical phenomenon (e.g., a supernova).
- **Joint Observing Projects:** projects that require multi-wavelength data taken by *Chandra* and one or more other facilities ([Chapter 5](#)).
- **Archival Research Projects** that use data from the *Chandra* archives, or the *Chandra* Source Catalog.
- **Theory/Modeling Projects** that seek to better understand and interpret the data that have been taken with *Chandra*, or that seek to determine what new observations might be taken to test a hypothesis.

1.3.2 Timeline and Observing Time Allocations

The observations selected as a result of this *CfP* will be generally implemented during a one-year period beginning about January 2020 with any multi-cycle observations extending at most into the following two cycles. The observing time is allocated as follows: 1 Msec of the on-target observing time available during this cycle to calibration observations, 1 Msec is allocated to Director's Discretionary Time (DDT), 2450 ksec to Guaranteed Time Observations (GTO), and the remaining time available is allocated for

General Observations (GO). The time available for General Observers under this *CfP* is estimated at about 14 Msec. This total includes up to 2 Msec that is available to Joint Partner Observatories to allocate as part of our Joint time agreements. We anticipate that 5 Msec will be available to the Big Project Panel (BPP) to allocate to LPs and VLPs. At least 1 Msec will be allocated by the BPP to VLPs. In addition, the BPP may allocate up to 2 Msec of Cycle 22 time to VLPs. LP and VLP programs together will be allocated a maximum of 1.5 Msec of observing time on targets situated above 60 deg or below -60 deg ecliptic latitude. Approximately 9 Msec will be available to the topical panels for review of regular GO proposals (typically less than 400 ksec). These allocations are updated before the peer review to account for the actual observing efficiency during the current observing cycle. The unlikely event of an adjustment >5% will be announced to the community.

It is anticipated that further opportunities for participation in the *Chandra* Research Program will be announced annually, including the analysis of the increasing body of archival data.

1.4 Cancellation of the CfP

The CXC reserves the right to make no awards under this *CfP* and to cancel this *CfP*. The CXC, the Smithsonian Institution, and NASA assume no liability should the *CfP* be cancelled or for anyone's failure to receive notification of a cancellation.

1.5 What's New in Cycle 21

- Proposers are required to use the new *Chandra* Proposal Software (CPS) for all GO proposal submissions in Cycle 21. CPS replaces the Remote Proposal Submission (RPS) used in previous cycles. *Chandra* proposers are strongly advised to sign up for a CPS account well in advance of the Cycle 21 deadline. Proposers for Director's Discretionary Time (DDT) should continue to use RPS until a DDT version of CPS is available.
- There are significant restrictions on the duration of *Chandra* observations at many solar pitch angles (see [Section 3.3](#) of the POG). In October 2018 the CXC issued a white paper call for lists of astrophysical objects (Cool Attitude Targets, CATs) that can be included in the schedule to provide spacecraft cooling. The mission planning team started using CATs for spacecraft cooling in December 2018. CAT data does not have associated proprietary time. There are no restrictions on GTO and GO proposers applying for accepted CAT targets. CATs are described in more detail in [Section 2.7.5](#) of the POG and [Section 3.11](#) of this document.
- Observing preferences (e.g. time windows, roll angles etc) may be requested to

enhance the science return of proposed observations (see [Section 4.4](#) for details). Going forward into Cycle 21, the increasing complexity of keeping the spacecraft within acceptable thermal limits will likely result in a drop in the number of preferences that are met. *Proposers should explicitly demonstrate that the science goals used to justify the observation will be attainable even if preferences are not met*

- A maximum of 1.5 Ms of observing time on targets situated above 60 deg or below -60 deg ecliptic latitude will be available to the BPP for allocation to LPs and VLPs.

1.6 Proposal Submission

Science proposals must be submitted electronically via *Chandra* Proposal Software tool. (<http://cxc.cfa.harvard.edu/proposer/CPS.html>). Cost proposals must also be submitted electronically using forms available from the CXC website, see [Chapter 10](#) for more details.

1.7 How to Get Help

Questions concerning the *Chandra* mission and requests for assistance in Stage 1 proposal submission may be addressed to the *Chandra* Director’s Office (CDO) via the HelpDesk at: <http://cxc.harvard.edu/helpdesk> or by email to cxchelp@cfa.harvard.edu. The full contact information for the CDO is:

Chandra Director’s Office

Chandra X-ray Center

Smithsonian Astrophysical Observatory

Garden Street, Mail Stop 6

Cambridge, MA 02138-1516

Telephone: (617) 496-7576

FAX: (617) 495-7356

Email: cxchelp@cfa.harvard.edu

For questions concerning Stage 2 Cost Proposals, please refer to the information in [Chapter 10](#).

1.8 Relevant Documents and Web Addresses

Table 2. Useful Documents

| | |
|----------------------------------------------------|------------------------------------------------------------------------------------|
| Proposers’ Observatory Guide (POG) | Technical Description of the <i>Chandra</i> X-ray Observatory and its Instruments. |
| MARX Manual | Manual describing the installation and use of the MARX simulation software. |

Table 3. Web Addresses

| | |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| http://cxc.harvard.edu | CXC Website. |
| http://cxc.harvard.edu/proposer | Page providing access to relevant web-based information and documentation necessary to prepare a <i>Chandra</i> proposal. |
| http://cxc.cfa.harvard.edu/proposer/CPS.html | <i>Chandra</i> Proposal Software (CPS) |
| http://cxc.harvard.edu/toolkit/pimms.jsp | Proposal Planning Toolkit: including count rate determination (PIMMS), column density estimates (Colden), coordinates (Precess), and date conversions (Dates). |
| http://cxc.harvard.edu/soft/provis | PRoVis: Pitch, Roll and Visibility Tool. |
| http://cxc.harvard.edu/obsvis | Observation Visualizer (ObsVis): for displaying and examining a <i>Chandra</i> target field of view. |
| http://cxc.harvard.edu/proposer/orbits.html | Table of begin and end times of <i>Chandra</i> orbits when observations are possible above the Earth's radiation zones. |
| http://cxc.harvard.edu/ciao/download | Command Line Versions versions of the Proposal Planning Toolkit (without PIMMS) and ObsVis. |
| http://cxc.harvard.edu/ciao | CIAO: Data reduction and analysis software and information. |
| http://www.cfa.harvard.edu/spp/sp/policies/CPSR.html | Funding information web pages providing information on <i>Chandra</i> grants. |
| http://cxc.harvard.edu/soft/propsearch/prop_search.html | Accepted Proposal Search: Webtool for searching approved proposal database by PI Name, <i>Chandra</i> cycle, proposal number, etc. |

Table 4. Observation Catalog

| | |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------|
| http://cda.harvard.edu/chaser | <i>ChaSeR</i> : Web interface to catalog search and archive data access. |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------|

| | |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| http://cxc.harvard.edu/csc | <i>Chandra</i> Source Catalog |
| https://cxefps.cfa.harvard.edu/cda/footprint/cdaview.html | <u>F</u> ootprint Service: A visual web interface to all public <i>Chandra</i> observations and to the observational data used for the <i>Chandra</i> Source Catalog . |
| http://cxc.harvard.edu/cgi-gen/cda/bibliography | Bibliography: Web interface that allows simultaneous browsing of the archive and papers published about <i>Chandra</i> observations. |
| http://cxc.harvard.edu/proposer/Chandra_RfO.html | Information on the DDT program and listing of DDT observations to date. |

2 - Overview of Chandra Mission

2.1 Overview

The *Chandra* X-ray Observatory (CXO) was launched on the Space Shuttle Columbia on July 23, 1999. The *Chandra* program is sponsored by NASA's Science Mission Directorate (SMD) and managed by the NASA Marshall Space Flight Center (MSFC). The prime contractor responsible for developing the spacecraft and integrating the CXO was TRW. The science instruments were developed as follows:

- The Advanced CCD Imaging Spectrometer (ACIS), built by the Pennsylvania State University in collaboration with the Massachusetts Institute of Technology (MIT);
- The High Resolution Camera (HRC) built by the Smithsonian Astrophysical Observatory (SAO);
- The Low Energy Transmission Grating (LETG) built by the Scientific Research Organization of the Netherlands (SRON) in collaboration with the Max-Planck-Institut für Extraterrestrische Physik (MPE); and
- The High Energy Transmission Grating (HETG) built by MIT.

Chandra has as its primary mission the study of the structure and emission properties of astrophysical sources of high-energy radiation. The scientific objectives of the *Chandra* Mission are to utilize the Observatory to:

- Determine the nature of celestial objects from normal stars to quasars;
- Understand the nature of physical processes that take place in and between astronomical objects; and
- Understand the history and evolution of the universe.

2.2 Science Payload

Chandra is comprised of the spacecraft, the X-ray telescope, and the Science Instrument Module (SIM). The spacecraft provides the power, attitude control, communications, etc. for the telescope and instruments. The X-ray telescope consists of an optical bench, the High Resolution Mirror Assembly (HRMA), an aspect camera system, and two objective transmission gratings: the High Energy Transmission Grating (HETG) and the Low Energy Transmission Grating (LETG). The HRMA is a Wolter Type I, 1.2-m diameter, 10-m focal length, iridium-coated X-ray telescope consisting of 4 nested pairs of cylindrical hyperboloid and paraboloid mirrors. At 1.5 keV, >85% of the on-axis, imaged and aspect-corrected X-rays are contained in a circle of diameter ~ 1.0 arc second.

Chandra carries two focal-plane scientific instruments mounted in the SIM: the ACIS, and the HRC. The SIM provides three functions: launch lock, translation (to interchange focal plane instruments), and focus. Only one of the two focal plane instruments can be placed

at the telescope's focus at any time; therefore, simultaneous observations with both focal-plane instruments cannot be accommodated.

The ACIS has two arrays of CCDs, one (ACIS-I) optimized for imaging wide fields (16x16 arc minutes) and the other (ACIS-S) optimized as a readout for the HETG transmission grating. One chip of the ACIS-S (S3) can also be used for on-axis (8x8 arc minutes) imaging and offers the best energy resolution of the ACIS system.

The HRC is comprised of two micro-channel plate imaging detectors, and offers the highest spatial (<0.5 arc second) and temporal (16 μ sec) resolutions. The HRC-I is a single micro-channel plate and has a field-of-view of 31x31 arc minutes. The HRC-S consists of three contiguous segments, tilted slightly in order to conform to the Rowland circle of the LETG. The background rate is quite different in the two devices, being larger in the HRC-S.

The HETG is optimized for high-resolution spectroscopy over the energy band 0.4-10 keV. Two types of gratings are mounted in the HETG: medium-energy gratings (MEGs) covering the 0.4–5 keV band and high-energy gratings (HEGs) covering the 0.9–10 keV band. The MEGs are mounted behind the annular aperture of the outer two mirror pairs while the HEGs are mounted behind the apertures of the inner two mirror pairs. The two sets of gratings operate simultaneously so that the dispersed axes of the spectra cross at a shallow angle in the focal plane. The ACIS-S is the readout of choice for use with the HETG. The resolving power (E/DE) varies from \sim 800 at 1.5 keV to \sim 200 at 6 keV.

The LETG is optimized for high-resolution spectroscopy over the energy bandwidth \sim 0.09–4 keV. The LETG provides resolving power \sim 1000 at 0.1 keV and \sim 200 at 1.5 keV. The HRC-S is the only detector aboard the Observatory that can fully accommodate the LETG-dispersed spectrum.

Detailed descriptions of all of the instruments are contained in the [Proposers' Observatory Guide](#). Proposers should refer to that document for additional details before preparing a proposal.

2.3 Operation

After launch into low earth orbit by the shuttle Columbia, the initial *Chandra* operational orbit was achieved by use of Boeing's Inertial Upper Stage and *Chandra*'s own propulsion system. There are sufficient expendables (control gas for momentum unloading) for well over 20 years of operation. The orbital period of about 63.5 hours can allow long, uninterrupted observations (up to \sim 180 ksec, but is limited in practice by thermal requirements of various *Chandra* systems) before the instruments have to be powered down as the satellite dips into the radiation belts. Approved longer observations are segmented into several orbit-sized observations on ingestion into the observation

catalog. Information on the start and end times of the portions of *Chandra* orbits useful for observing is available at <http://cxc.harvard.edu/proposer/orbits.html>.

The Observatory's solar panels can rotate about an axis perpendicular to the optical axis so that at any time the Observatory can be pointed to any position in the sky except for avoidance regions around the Sun (46 degrees), Moon (6 degrees), Earth (10 degrees), and anti-sun direction (10 degrees). Both the Moon and Earth may be viewed if specially requested as long as an accurate aspect solution is not required. In order to avoid overheating the spacecraft components on the sunward side, or excessive cooling of the propellant lines, the maximum length of an exposure depends on the pitch angle at which the target is observed. Some pitch angles are excluded. Observations with exposure times longer than the maximum allowed at a given pitch angle will be segmented.

The high elliptical orbit and the radiation belts that prevent the conduct of observations at low altitudes imply that most of observations are made nearer apogee, where the Earth, as seen from *Chandra*, appears to move only slowly through the sky. As a result, the Earth and its surrounding avoidance region constitute a portion of the sky that will be partially blocked from view, and long, continuous observations in this region (>30 ksec at the center of the region) will be difficult, although shorter observations are possible. The proposer is urged to read Chapter 3 of the [Proposers' Observatory Guide \(POG\)](#) to become familiar with *Chandra* observing constraints and to make use of the [Observation Visualizer \(ObsVis\)](#) and [PROMIS](#) to see how these constraints might impact their observations. For highly constrained observations, we recommend that the proposer contact the [CXC Help Desk](#).

2.4 The Chandra X-ray Center (CXC)

The *Chandra* X-ray Center (CXC), funded by NASA via a contract to the Smithsonian Astrophysical Observatory (SAO) in Cambridge, MA, is responsible for planning and conducting all aspects of *Chandra* operations. The CXC's main activities include:

- Proposal Solicitation and Review: Soliciting proposals for observing time and research funding, conducting peer reviews, and selecting proposals.
- Mission Planning: Based upon approved proposals, creating a timeline of science observations and detailed schedules of spacecraft activities.
- Instrument Calibration: By means of special observations and advanced data analysis, determining parameters and data products that characterize the science instruments.
- Mission Operations: Commanding the spacecraft, monitoring and assessing spacecraft and science instrument health and safety, and receiving science and engineering data from the spacecraft.
- Data Processing and Archiving: Processing spacecraft telemetry to produce science data products for users, and storing products in a permanent archive. Data in the archive are typically available to the public after the one-year proprietary period expires, while calibration data are available immediately.
- Supporting Data Analysis: Defining and producing software for use in analyzing *Chandra* data

- User Support: Assisting users to derive maximum benefit from the *Chandra* X-ray Observatory; maintaining and conducting the *Chandra* Users' Committee; and producing documents and other materials on the use of the *Chandra* X-ray Observatory.
- Public Outreach: Conducting a program of public outreach using *Chandra* data and results.

SAO, through its management of the CXC, is responsible for scientific research of the highest technical merit utilizing the *Chandra* X-ray Observatory. In order to carry out this responsibility, NASA has directed SAO to engage the participation of the broader science community and has determined that this function will be accomplished by SAO allotting observing time and research

funding to users in accordance with the following process conducted at appropriate intervals:

- Prepare and issue Calls for Proposals for observations with the CXO and for funding of activities including data analysis by General Observers; Archival and Theoretical Research.
- Prepare and conduct independent peer evaluations of proposals, and select proposals for observation and funding as recommended by the peer review panels.
- Allocate funding to selected investigations as recommended by the peer review panels, determine the period of performance of each award, issue funding instruments on behalf of NASA in the form of grants, and administer the awards through closeout.

SAO is not responsible for transferring funds to NASA Centers and other federal agencies whose proposals are selected for awards. NASA will be responsible for direct funding of research at NASA Centers and for executing appropriate inter-agency agreements with other federal agencies. However, the CXC provides the results of the CXO observations, as selected, to all investigators, including those at federal agencies.

3 - Observing Policies

3.1 Who May Propose

Participation in this program is open to the following categories of institutions and organizations:

- **Educational Institutions** – Universities or two- and four-year colleges accredited to confer degrees beyond that of the K-12 grade levels.
- **Nonprofit, Nonacademic Organizations** – Private or Government supported research laboratories, universities consortia, museums, observatories, professional societies, educational organizations, or similar institutions that directly support advanced research activities but whose principal charter is not for the training of students for academic degrees.
- **NASA Centers** – Any NASA Field Center and the Jet Propulsion Laboratory.
- **Other Federal Agencies** – Any non-NASA, U.S. Federal Executive agency or Federally Funded Research and Development Center (FFRDC) sponsored by a Federal agency.
- **Commercial Organizations** – Organizations of any size that operate for profit or fee and that have appropriate capabilities, facilities, and interests to conduct the proposed effort.
- **Non-U.S. Organizations**– Institutions outside the United States that propose on the basis of a policy of no-exchange-of-funds. See [Section 3.1.2](#) for additional information.

Each proposal must have one, and only one, Principal Investigator (PI). The PI is responsible for the scientific and administrative conduct of the project. Any other individuals who are actively involved in the program should be listed as Co-Investigators (Co-Is). A CoI may be designated as the "Observer" if he/she is primarily responsible for carrying out the observations (see [Section 3.3](#)).

3.1.1 Bilateral Collaboration Between the US and the People's Republic of China

Investigators worldwide, as noted above, are eligible to submit a proposal in response to the *Chandra* Call for Proposals. However, proposals involving only investigators based in the People's Republic of China (PRC), or only PRC-based and U.S. investigators are subject to the restriction on bilateral activity with China (PL-113-235 Section 532). Note that multilateral collaborations are generally permitted. For purposes of this provision, Taiwan is not considered part of the People's Republic of China; however, Hong Kong is considered part of the People's Republic of China.

3.1.2 Non-U.S. Participation

Science proposals from outside the United States are welcome. However, research conducted by non-U.S. institutions cannot be funded by NASA; therefore, researchers

who propose investigations requiring new *Chandra* observations, but whose primary institution is not in the U.S., must seek support through their own national funding agencies. Proposals by non-U.S. PIs that have one or more U.S. Co-Is who require funding *must* designate one of the U.S. Co-Is as the "Administrative PI". This person will have general oversight and responsibility for the budget submissions by the U.S. Co-Is in Stage 2.

The *Chandra* data archive is open to the public. For archive/theory proposals, the PI's primary institution must be U.S.-based. Non-U.S. researchers should not propose to this CfP for funding unless their proposal includes U.S. Co-Investigators who are eligible for funding.

3.2 Proposal Confidentiality

Proposals submitted to the CXC will be kept confidential to the extent allowed by the review process. For accepted proposals, the scientific justification section of the proposal remains confidential but other sections become publicly accessible, including PI names, project titles, abstracts, and all observational details. The remainder of the approved proposals, and the entirety of proposals not selected, will remain confidential.

All CXC and visiting personnel who will be handling or reviewing the proposals as part of the review process will be fully informed of the confidential nature of the proposals. They will be required to sign a non-disclosure agreement, agreeing to treat information in the proposals as confidential and not to disclose it or use it in any way beyond that needed for the review process itself. All copies (electronic and hardcopy) of the proposals distributed as part of the review process will be destroyed once the process is complete.

3.3 Communication with PI/Observer

All communication for each approved proposal will be conducted with the proposal PI or, for questions concerning observational constraints or parameters (See [Section 9.3](#)), the Observing Investigator, if any. It is the responsibility of the PI and/or the Observing Investigator to respond to any questions in a timely manner.

3.4 Proprietary Time

With certain exceptions, all General Observing data awarded either to GTOs or to GOs will be proprietary for one year beginning when the data are made available to the observer. For segmented "Long Duration" observations, the one-year period for each target begins when 90% of the data have been made available to the observer. For series of discrete observations (e.g., monitoring sequences, grids) the proprietary period is established separately for each of the observations.

Data from unanticipated Targets Of Opportunity (TOOs) and other use of Director’s Discretionary Time may be proprietary for limited periods – no more than three months – before they are placed in the public archive. Calibration data scheduled and obtained by the *Chandra* X-ray Center will not be proprietary and will be placed directly into the public archive.

3.5 Policies Regarding Plagiarism

As defined by the American Astronomical Society (AAS), plagiarism is "the act of reproducing text or other materials from other papers without properly crediting the source. Such material is regarded as being plagiarized regardless of whether it is cited literally or has been modified or paraphrased" (for details see <http://journals.aas.org/policy/ethics.html>). It is not acceptable to use plagiarised text in a *Chandra* proposal. Any material reproduced from another source must be contained within quotes and complete references given.

The text of all submitted Science Justifications will be screened using commercial plagiarism software. Text that is "recycled" from papers authored by the PI or CoIs is acceptable in the context of a *Chandra* proposal. Proposals found to contain plagiarised or incompletely cited text will be rejected and the PI and CoIs notified. The decision to reject a proposal on the grounds of plagiarism will be made by the CXC Director in consultation with the appropriate panel chair.

3.6 The Guaranteed Time Observer (GTO) Program

In Cycle 21, the GTOs comprise the following: Four Instrument Principal Investigators (IPIs) for the Advanced CCD Imaging Spectrometer (ACIS), for the High-Resolution Camera (HRC), for the Low-Energy Transmission Grating (LETG), and for the High-Energy Transmission Grating (HETG). Their observing time is based on a distribution of 3.5 "shares" as follows:

| | | |
|--------------------------|----------------|------------------|
| LETG IPI | 0.5 share | 0.5 share total |
| HETG, ACIS, and HRC IPIs | 1.0 share each | 3.0 shares total |

GTOs are guaranteed to receive their observing time but cannot reserve targets in advance of the *CfP*. GTOs submit a list of top priority (primary) targets at the time of the GO deadline. The CXC checks for target conflicts between GO and GTO targets. The GTOs write proposals for any primary targets in conflict with proposed GO targets. These GTO proposals are sent to the GO peer review. The reviewers are instructed to determine whether the GTO-GO conflict constitutes a genuine duplicate observation (i.e. whether the

instrument and observing modes in the two proposals overlap to the extent that only one observation is necessary to achieve the science goals of both proposals). In the case of a genuine duplication the peer review will resolve the conflict based on science merit. If there is no real conflict, the GTO proposal is approved.

GTOs submit the bulk of their targets after the approved GO targets have been announced. They can request time on any target that is not in an approved GO proposal. They can also add time to GO targets won by members of the GTO instrument teams. GTOs can request an observation of an approved GO target if the science mode is significantly different. Requests for duplicates will be reviewed by the CXC Director.

3.7 Criteria for Completeness

In general an observation, for completeness purposes now defined as corresponding to a unique sequence number as assigned in the Observation Catalog (OBSCAT), will be considered complete when 90% or more of the approved exposure time has been observed, as determined by the Good Time Interval (GTI) in the processed data relative to the approved time.

The following 4 exceptions are identified:

- 1) TOO and DDT observations with GTI less than 90% of the approved time may be declared complete by the CXC Director or designated representative when constraints due to competing targets and/or observatory restrictions do not allow the full time (or 90% of it) to be achieved and when a subsequent observation would no longer meet the objectives. Such cases will be tracked and closed by adjusting the approved exposure time in the Observing Catalog (OBSCAT) after final scheduling is completed.
- 2) For observations (unique sequence number) greater than 200 ksec, any remaining time exceeding 20 ksec will be scheduled even if the GTI to approved time ratio exceeds 90%, provided constraints allow.
- 3) For observations less than 5 ksec, targets will be observed only once and the observation will be considered complete regardless of the GTI achieved unless a spacecraft anomaly causes the entire observation to be missed.
- 4) For observations with less than 2 ksec remaining, no additional time will be scheduled even if the 90% GTI to approved time ratio has not been achieved.

Items 3 and 4 are intended to avoid additional short exposures with their relatively high fractional overhead (inefficient use of *Chandra*). Item 4 assures that observations between 5 and 20 ksec get at least 60% of their approved time (for 5 ksec approved) with a sliding scale assuring that at least 90% is achieved at 20 ksec approved time.

Note: The proprietary time begins when the observation is "complete" according to the above rules.

3.8 Data Quality

3.8.1 High Background

Good science data can be lost (or overwhelmed) because of occasional episodes of very high background. If the principal target was a point source and the background is ≥ 10 times nominal for $\geq 50\%$ of the observation, the target may be observed again for the amount of time lost due to the high background. If the target is extended and the background increase is ≥ 5 times nominal for $\geq 50\%$ of the observation, then another observation may be scheduled to replace the amount of time lost due to the high background. We realize that the precise application of these limits is somewhat arbitrary. The intent is to only schedule additional observations if the scientific objectives were not achieved due to the high background. If "space weather" only causes some deterioration in data quality, the observation is considered complete.

Although the CXC monitors space weather, there is no real-time contact with the *Chandra* X-ray Observatory so high background periods cannot be avoided. Ultimately, it is the observer's responsibility to determine if the data require another observation according to the criteria above. An application for an additional amount of time on target should be made to the CXC Director. Providing a plot of the background counting rate vs. time and a short table with the integration time at different background levels is required.

3.8.2 Telemetry Saturation Due to X-ray Sources

Telemetry saturation produced by the target and/or other sources in the field-of-view are the responsibility of the observer. The rare case of a previously unknown transient appearing in the field-of-view will be handled case-by-case.

3.9 Duplicate Targets

Proposals for new observations that duplicate existing *Chandra* observations will not be accepted unless scientifically justified. It is the proposer's responsibility to ensure that he or she does not propose for observations of the same target with the same instrument and comparable observing time to one already in the *Chandra* Observing Catalog or that such a request is explicitly justified. For targets previously observed in the X-ray band, particularly those observed by *XMM-Newton*, the proposal should address the specific need for the addition of *Chandra* data to accomplish the proposed scientific investigation. Previous observations may be checked using, for example, HEASARC W3Browse: http://heasarc.gsfc.nasa.gov/docs/HHP_heasarc_info.html.

Previous observations may also be checked using the CDA Footprint Service (<https://cxcfps.cfa.harvard.edu/cda/footprint/cdaview.html>). Note, though, that this

interface only provides information on observations that have been released to the public. Observations that are still proprietary or scheduled in the future may be searched for in *ChaSeR* (<http://cda.cfa.harvard.edu/chaser>). The review panels will be provided with a list of previous *Chandra/XMM-Newton/Suzaku* X-ray observations of proposed targets. Information on the various ways to access the *Chandra* Observation Catalog may be found in [Section 8.1.3](#).

3.10 Supporting Ground-Based Observations

As part of the proposal and corresponding budget for a *Chandra* investigation, proposers may request funding support for correlative observations at other wavelengths beyond the joint observations described in this solicitation ([Chapter 5](#)). Funding for such correlative studies will be considered only when they directly support a specific investigation using *Chandra*. Unless there are exceptional circumstances, such as a CXO/NOAO or CXO/NRAO joint proposal or some archive or survey proposals, funding for ground-based supporting observations should not exceed 10% of the total request.

3.11 Cool Attitude Targets (CATs)

There are significant restrictions on the duration of *Chandra* observations at many solar pitch angles (see [Section 3.3](#) of the POG). In October 2018 the CXC issued a white paper call for lists of astrophysical objects (Cool Attitude Targets, CATs) that can be included in the schedule to provide spacecraft cooling. The mission planning team will start to use CATs in early 2019.

The following policies apply to CAT observations:

- A CAT will be scheduled only if there is no GO/GTO target at the appropriate pitch angle.
- There is no guarantee that a specific CAT or a minimum number of CATs will be observed.
- If a list is approved as a source of CATs, potential targets that are already in the *Chandra* archive or in the ObsCAT will be removed from the CAT database, unless there is scientific justification for repeated observations (e.g., a variability study).
- Scientists proposing through *Chandra* GO/GTO programs can include observations of CATs. Approved GO/GTO targets will then be removed from the CAT database of available targets.
- CAT observations will become public immediately.
- Funding to analyze CAT data may be sought through a *Chandra* Archival Research proposal ([Section 4.7](#)).

4 - The General Observer Program

Observations to be carried out with *Chandra* during the 12 months of Cycle 21 science operations will be selected from proposals submitted in response to this *CfP*. Up to 2 Msec of Cycle 22 and 1 Msec of Cycle 23 observing time may be allocated to time-constrained, multi-cycle observing proposals requesting time that extends beyond Cycle 21. The CXC reserves the right to reject any approved observation that is in conflict with safety or mission assurance priorities or schedule constraints, or is otherwise deemed to be non-feasible.

4.1 General Observing (GO) Projects

There are no restrictions regarding the amount of observing time or the number of targets that may be requested in this category. Proposals may be submitted for single targets with a relatively short observation time, or for larger programs involving multiple targets and/or significant amounts of observing time. All proposals will be reviewed, and a mix of large and small programs will be selected. Proposals requesting observations whose science requires constraints distributed over multiple (up to three) proposal cycles will be considered ([Section 4.6](#)). Observations allocated time in this category will have one year of proprietary time unless a shorter proprietary time interval is requested by the PI.

4.2 Large and Very Large Observing Projects

Submissions of Large Projects (LPs) and Very Large Projects (VLPs) are encouraged. LPs are for proposals that require between 400 ks and 1 Msec of observing time and VLPs are for projects that require > 1 Msec of observing time. Both LPs and VLPs can include long-duration observations of single targets or shorter duration observations of many targets (see [Section 9.1.1](#) for a discussion of Slew Tax). LPs and VLPs must be designated as such by the PI. LP and VLP programs together will be allocated a maximum of 1.5Msec of observing time on targets situated above 60 deg or below -60 deg ecliptic latitude. There are no further restrictions to the length of LPs/VLPs. The observations proposed for LPs/VLPs may span up to 3 cycles when required to achieve the scientific goals.

Duplicate targets ([Section 3.9](#)) are not allowed. If a target is approved both as part of a GO proposal and an LP/VLP, it will be awarded to one program. In general, the target will be awarded to the GO program unless the peer review recommends otherwise. In the case that the target is awarded to the GO program, the proposer of the LP/VLP may always make use of data taken for the other project once they are made public.

LPs/VLPs are evaluated differently from other proposals. LPs/VLPs are first evaluated and graded along with the other observing proposals by two independent "Topical Science" panels. The graded LPs/VLPs are then passed to the "Big Project" panel which allocates time to LPs/VLPs and makes the final recommendations for an integrated observing plan involving all top-rated proposals to the Selection Official. Although the Big Project panel may recommend shortening LPs/VLPs under exceptional circumstances, it is intended that LPs/VLPs be an all-or-nothing proposition. Observations approved in this category will be allocated one year of proprietary time unless a shorter time is requested by the PI.

4.3 Target of Opportunity Projects

Proposals are also solicited for Pre-Approved Targets of Opportunity (TOOs). These are defined to be observations of unanticipated astronomical events, such as a supernova or a gamma-ray burst that must take place to trigger the observation. The number of times the Observatory can be used to respond to a TOO is limited by operational considerations with difficulty increasing with rapidity of response. The minimum expected response time for a TOO is 24 hours. The estimated number of TOOs available to the GO Program in Cycle 21 is shown in [Table 5](#) below.

Table 5: TOO Response Category

| Number of observations ¹ | Category | Minimum response time (days) |
|-------------------------------------|-----------|------------------------------|
| 8 | Very Fast | 0 - 5 |
| 20 | Fast | 5 - 15 |
| 26 | Medium | 15 - 30 |
| 26 | Slow | >= 30 |

(1) Follow-up observations that require a rapid response to the initial trigger also count against this allocation. Follow-ups with a slower response count as time-constrained observations.

Proposals may not contain a mixture of TOO and non-TOO targets. Once a TOO has been selected, the observing time is awarded, but not scheduled until the triggering event takes place. It is the responsibility of the PI to alert the CXC to the occurrence of the triggering event. Response time requests for TOO triggers must be within, or longer than, the approved response time window.

Given the high operational impact of TOOs, no constraints or follow-up observations over

and above those included in the proposal CPS forms and recommended by the peer review will be accepted. All follow-up *Chandra* observations need to be included in the original proposal forms. Follow-ups to TOOs will count as Time Constrained observations. All trigger criteria must be specified in the appropriate fields on the CPS form ([Chapter 7](#)).

Those proposing for a Pre-Approved TOO should be aware that any such observations awarded for a given observing Cycle, but not accomplished, cannot be carried over to the next Cycle, although they may be re-proposed. Follow-ups to successfully triggered TOOs may extend into future cycles. Since the *CfP* is being released prior to the end of this Cycle, there may be a set of selected and Pre-Approved TOOs for this Cycle that have not been triggered. Proposers may choose to assume that these will not have been triggered by the time the next Cycle starts. The PI/Observer should indicate on the CPS form of the new cycle proposal whether or not a trigger of the previous cycle's TOO would cancel the TOO observation proposed/accepted for the new cycle.

Requests to initiate a Pre-Approved TOO are made to the CXC Director or a designated representative, who decides whether to interrupt the timeline and conduct the observation. The investigator is required to submit the TOO trigger form (http://cxc.harvard.edu/proposer/Chandra_RfO.html).

The response to a TOO will be classified according to the minimum time delay between trigger and observation. Short time delays between trigger and first observation are difficult to accommodate and therefore are limited in number. TOO follow-up observations (observations following a TOO within a few weeks) will either count as TOOs (for rapid response) or time-constrained observations ([Section 4.4](#)).

4.4 Time Constraints and Preferences

The proposer may desire to place constraints (e.g., monitoring, coordination with observations at other wavelengths, uninterrupted observing periods, roll angle, etc.) on the proposed observations. A constraint should be applied to achieve core science goals. A preference may be applied to enhance the science return of an observation (see below for a more detailed description).

Constraints are discussed in [Chapter 3](#) of the POG. Constraints limit the flexibility of scheduling and, therefore, reduce the overall observing efficiency. They may also cause an observation to be unfeasible if, for example, they require violation of the pitch angle restrictions. Thus, proposers should carefully consider the impact of a request for a constrained observation and provide scientific and technical justification. An observation with very restricted time or roll constraints may, if bumped or otherwise rescheduled, be delayed six months or more to allow these constraints to be met.

Observers with science goals that could be enhanced by having observations carried out in

particular time windows, roll ranges, phase ranges, or monitoring intervals, are permitted to request these as preferences rather than requiring hard constraints. Preferences are not counted against the limited amount of constrained time, but should be requested by formal specification on the CPS forms. Preferences are met on a best-effort basis. Specifically, when the *Chandra* long-term schedule is generated, attempts will be made to meet all preferences that do not conflict with approved constrained observations and do not violate spacecraft constraints or guidelines. Preferences that force targets to be observed at unfavorable pitch angles are unlikely to be met. Proposers should use the [PProVis](#) tool, available on the CXC website, to confirm that a constraint (or monitoring sequence) which they are considering does not require observations at pitch angles and with durations that are not feasible. Once placed in the LTS, attempts will be made to accomplish the preferences, but this is not guaranteed; changes required to meet TOOs or to balance spacecraft considerations may result in changes to the observing plan leaving preferences unmet. *Proposers should explicitly demonstrate that the science goals used to justify the observation will be attainable even if preferences are not met.*

4.5 Constraint Classifications

No more than 15% of *Chandra* observations in this Cycle will be allocated to constrained observations (see below). All constraints must be specified in the CPS forms or, if not possible, in the "Remarks" field with the "Constraints in the Remarks" flag set. Any constraints not so specified will need special handling and will be implemented only on a best-effort basis. Additional constraints, beyond those proposed and recommended by the peer review, will be considered only in extreme circumstances and must be approved by the CXC Director (request via email to the [CXC HelpDesk](#)). Proposers should use the [PProVis](#) tool, available on the CXC website, to confirm that a constraint (or monitoring sequence) which they are considering does not require observations at times, pitch angles and/or durations that are not feasible (as directed in [Section 2.3](#)). Information on the periods of time when *Chandra* observations are allowed due to its passage beyond the Earth's radiation zone is provided at <http://cxc.harvard.edu/proposer/orbits.html>. Please note that an observation is defined as a single approved exposure of a target ([Section 3.7](#)). Monitoring observations are counted based on the number of repeat visits. Long observations (>90 ksec) will be divided into several 90 ksec-long observations for the purpose of counting constraints.

The grading scheme for constrained observations is shown in [Table 6](#). Cycle quotas are also listed; ~80% of these will be allocated to the *Chandra* Peer Review.

Note that a constrained observation that has more than one constraint grade according to [Table 6](#) will be given the most restrictive grade. Specifically:

- If multiple observations of the same target are proposed (e.g., a sequence of

coordinated observations, or a monitoring series), then each observation contributes separately to the allowed quota of observations in that difficulty class. If the first observation (<90 ksec) has no constraints, only the subsequent observations will be counted.

- In the case of long observations (>90 ksec), each 90 ksec increment or fraction thereof will count as a separate observation against the quotas allowed for the relevant category of difficulty.
- Constrained grid observations will also be counted in 90 ksec units for the purpose of counting constraints ([Section 9.1.2](#)).

Constraints should be specified to achieve the science not the constraint grade. It is noteworthy that, over the past several cycles, the Easy category had the highest oversubscription factor while the Average category had the lowest.

CPS generates an estimate of the constraint class of each target and the "slew tax" (pointing overhead) which will be charged at the peer review. Final constraint classifications will be determined by the CXC after the proposal deadline, taking into account all declared constraints, including those that are specified in the remarks.

Observers wishing to assess the classification of their observations in complex, ambiguous or highly constrained cases should contact the [CXC HelpDesk](#), allowing adequate time before the proposal deadline for a response to be made.

Table 6 Grading Scheme for Constrained Observations

| Constraint | Parameter | Easy | Average | Difficult |
|--------------------------|------------------|-------------|----------------|------------------|
| Uninterrupted (ksec) | Duration | <30 | 30-40 | >40 |
| Coordinated (days) | Window | - | >3 | <3 |
| Roll (days) ¹ | Window | >21 | 3-21 | <3 |
| Time Window (days) | Window | >21 | 3-21 | <3 |
| Phase Interval | Period | <20 | 20-60 | >60 |

| | | | | |
|------------------|--------------------------------|-----------|-----------|-----------|
| (days) | | | | |
| Monitor Interval | Note (2) | >5 | 2-5 | <2 |
| Group | Note (3) | >10 | 4-10 | <4 |
| | Cycle Quota⁴ | 48 | 25 | 17 |

(1) The constraint refers to the number of days a target can remain within the declared roll angle constraint. This can be estimated using the PRoVis tool available on the Proposer Webpage.

(2) The dimensionless parameter for the monitoring interval constraint will be determined as follows:

- determine the smallest specified I_{max} of all the proposed monitoring intervals, $\min(I_{max})$
- for that interval, compute the fractional tolerance $fractol = (I_{max} - I_{min}) / (I_{max} + I_{min})$
- compute the metric: $\min(I_{max}) * fractol / \max(T)$

Where I_{min} and I_{max} are the minimum and maximum proposed intervals, $\min(I_{max})$ is the smallest specified I_{max} of all proposed intervals and $\max(T)$ is the largest exposure time of any proposed observation.

(3) The dimensionless parameter for Group Observations is: $(\text{TIME INTERVAL FOR THE GROUP}) / (\text{TOTAL DURATION OF OBSERVATIONS IN GROUP})$.

(4) Should a level quota be unfilled at the peer review it may be combined with a quota at a lower difficulty level.

4.6 Multicycle Proposals

Proposals for time-constrained observations that span more than one cycle may request time in up to 3 cycles. A maximum of 2 Msec of Cycle 22 and 1 Msec of Cycle 23 observing time may be allocated to such proposals in Cycle 21. All targets must be proposed for Cycle 21, and proposals must justify the allocation of time across the multiple cycles. The peer review reserves the right to recommend only those observations proposed for the current cycle.

4.7 Theory/Modeling Projects

Research that is primarily Theoretical/Modeling in nature can have a lasting benefit for current or future observational programs with *Chandra*, and it is appropriate to propose such programs with relevance to the *Chandra* mission. Theoretical/Modeling research should be the primary or sole emphasis of such a proposal. Analysis of archival data should not be the goal of the project. Archived data may be used only to show how *Chandra* observations may be better understood through the results of the proposed Theory/Modeling research. Theory/Modeling proposals must be submitted using the same proposal format as observing proposals, and the proposal type "Theory" should be checked on the electronic submission.

A Theory/Modeling proposal should address a topic that is of direct relevance to *Chandra* observing programs, and this relevance must be explained in the proposal. Research that is appropriate for a general theory program should be submitted to the Science Mission Directorate's Astrophysics Theory Program, solicited in the annual Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement and/or other appropriate funding sources. The primary criterion for a Theory/Modeling proposal is that the results must enhance the value of *Chandra* observational programs through their broad interpretation (in the context of new models or theories) or by refining the knowledge needed to interpret specific observational results (for example, a calculation of cross sections). As with all investigations supported through this *CfP*, the results of the Theoretical/Modeling investigation should be made available to the community in a timely fashion.

A Theory/Modeling proposal must include an estimated amount of funding in the Stage 1 submission and must provide a narrative within the science justification section that describes the proposed use of the funds. Detailed budgets are not requested in Stage 1, however, and are due only in Stage 2.

The scientific justification section of the proposal must describe the proposed theoretical/modeling investigation and also the anticipated impact on observational investigations with *Chandra*. Review panels will consist of observational and theoretical astronomers with a broad range of scientific expertise. However, the reviewers will not necessarily be specialists in all areas of astrophysics, particularly theory, so the proposals must be written for general audiences of scientists. The proposal should discuss the types of *Chandra* data that would benefit from the proposed investigation, and references to specific data sets in the *Chandra* data archive should be given where appropriate. The proposal should also describe how the results of the theoretical/modeling investigation will be made available to the astronomical community, and on what time scale the results are expected.

4.8 Archival Research Projects

This *CfP* also includes the opportunity to propose investigations based on data in the *Chandra* public archive for part or all of the study. Proposals for which archival data is the major focus of the investigation should select the "Archive" category on the CPS form. A PI may link an archival research proposal with an observing proposal to extend an existing sample or to perform the same science analysis. There is no restriction on the amount of existing *Chandra* data that may be proposed for analysis. The *Chandra* website (<http://cxc.harvard.edu>) contains information on the data that are available in the archive. The data currently available from the *Chandra* Data Archive may be browsed and visualized through the CDA Footprint service (<https://cxcfps.cfa.harvard.edu/cda/footprint/cdaview.html>). Data becoming publicly

available in the future may be browsed through *ChaSeR* (<http://cda.cfa.harvard.edu/chaser>). The data may also be accessed through this website. All on-orbit calibration data are placed directly in the archive. Data from Director's Discretionary Time (DDT) observations ([Chapter 6](#)) are placed in the archive no later than three months after receipt by the PI, while other proprietary observations are archived no later than one year after receipt by the PI. Data from CAT observations ([Section 3.11](#)) are publically available right away and may be included in archive proposals. A bibliographic interface allows simultaneous browsing of the *Chandra* Data Archive and the literature (<http://cxc.harvard.edu/cgi-gen/cda/bibliography>).

Archival Research proposals must include an estimated amount of funding in the Stage 1 submission and must provide a brief narrative within the science justification section that describes the proposed use of the funds. Detailed budgets are not requested in Stage 1 and are due in Stage 2.

4.8.1 Archive Proposals and the Chandra Source Catalog (CSC)

We will accept archival proposals that make use of the Chandra Source Catalog as all or part of the proposed science program. Release 2.0 of the catalog includes information about sources extracted from 10,382 Chandra ACIS and HRC-I imaging observations released publicly through the end of 2014, and contains ~315,000 unique sources in several energy bands.

CSC2 represents a major improvement over the previous version of the catalog CSC1.1, in terms of both data quantity and data processing, resulting in fainter source thresholds and better defined source properties. In particular, CSC2 achieves significant improvement to the depth of the catalog by the stacking (co-adding) of multiple observations of the same field whose aimpoints are within 60'', prior to source detection. Additionally, an improved approach to source detection allows point sources to be detected reliably down to roughly 5 net counts on-axis for exposures shorter than ~15ks.

The extraction of all sources properties available in the catalog, including aperture photometry, variability analysis and spectral properties, is performed at the stack level and for each individual observation. As in the previous version of the catalog, users can also retrieve all data products used to estimate the source properties.

Prospective users of the catalog should be aware of the selection effects that restrict the source content of the catalog and which may limit scientific studies that require an unbiased source sample. Users are urged to review the catalog Caveats and Limitations (<http://cxc.harvard.edu/csc2/caveats.html>) prior to using the CSC2 for their scientific investigations.

For more information on the Chandra Source Catalog, please refer to the public catalog web pages at <http://cxc.cfa.harvard.edu/csc2/>. The observations used for the CSC2 and its sky coverage can be visualized with the custom CSC2 World Wide Telescope (WWT) interface available at <http://cxc.harvard.edu/csc2/wwt.html>.

5 - Joint Observing Projects

In addition to time on *Chandra*, time may be requested and awarded via this *CfP* on other observing facilities, where such time (not necessarily simultaneous) is required to meet the scientific objectives of the proposal.

Submitting a single joint proposal in response to this *Chandra CfP* avoids the risk of having to submit proposals to two separate competitive reviews, where each might recommend first obtaining time on the other. Time on a participating Joint Partner Observatory (JPO) is only awarded to highly-ranked *Chandra* proposals, and requested JPO time will be subject to approval by the relevant JPO Director.

5.1 Requirements and Conditions Common to All Joint Proposals

This introduction section describes policies and recommendations applicable to all Joint proposals, while important policy details, links, technical and other information specific to each JPO are described in individual sections below.

For a Joint Observing Project to be successful, the project must be fundamentally of a multi-wavelength nature and must require all proposed observations to meet the science goals. Proposers should take special care to justify both the scientific and technical reasons for requesting observing time on all observatories included in their *Chandra* proposal.

Each JPO will carry out a detailed technical review and reserves the right to cancel any approved observation which is determined to be infeasible, or which may jeopardize the *Chandra* (and other JPO) observations for the target.

Proposers must always check whether appropriate archival data may exist, and provide clear scientific and technical justification for any new observations of previously observed targets. Observations awarded time on our JPOs through this *CfP* that duplicate observations already approved by the JPO for the same time period may be canceled, or data sharing and cooperation among different groups may be necessary, as determined by the JPO. This includes TOOs with similar trigger criteria, with or without previously known coordinates.

A request for simultaneous or otherwise time-constrained observations must be scientifically justified, specified on the *Chandra* CPS forms, and fully described within

the proposal. The technical justification must include consideration of the relative visibility of the target by all requested facilities. Coordination with ground-based observatories other than the AUI Observatories (VLA, VLBA, GBT) is only available as a preference, and if approved, will be carried out on a best-effort basis. No time on the joint facilities will be allocated without accompanying *Chandra* time except where noted for NOAO. For Cycle N, up to 10% and 5% of the available joint time in Cycles N+1 and N+2 respectively may be allocated to multi-cycle observing proposals, if scientifically justified and subject to the continued availability of that time. If proposing joint time for future cycles, include in the Cover Form the total joint observing time request across all cycles.

If approved for JPO time, successful PIs will be required to contact the JPO(s) and submit detailed observing information appropriate to the telescope and instrument combination(s) awarded. Any major requested change to the approved JPO portion of a *Chandra* program such as a change of instrument, wavelength settings, etc. requires strong scientific justification, is not normally approved, and may also jeopardize the awarded *Chandra* program.

Except where explicitly described otherwise in individual JPO sections below, generally: (1) funding from JPOs for analysis of JPO data is not available; (2) JPO time is only awarded together with *Chandra* observing time; and (3) proprietary time for all JPO observations awarded through the *Chandra* peer review will be those standard for each JPO.

5.2 Chandra/Hubble Space Telescope (HST) Observations

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with HST.

A total of 250 orbits of HST observing time are available for this opportunity. Of those, 100 HST orbits are reserved for regular *Chandra* GO programs, and 150 HST orbits for *Chandra* LPs or VLPs. Conversely, a total of 1Msec of *Chandra* observing time is available for award as part of the annual HST Call for Proposals, with up to 400 ksec available to HST Regular, and 600 ksec for HST Large programs (>75 HST orbits). However, the *Chandra* project can award no more than one HST Target of Opportunity (TOO) observation with a turn-around time shorter than three weeks.

Proposers wishing to take advantage of the *Chandra*-HST arrangements are encouraged to submit their proposal only to the observatory announcement that represents the primary science. The expertise required to best appreciate and evaluate the proposals will be weighted toward the wavelength band of the primary observatory.

Information on HST observing and science policies, as well as details on the proposal submission process are available at <https://hst-docs.stsci.edu/> along with links to other relevant technical descriptions. In particular, standard duplication policies described in [Section 3.9](#) apply to HST observations requested as part of *Chandra*-HST proposals. Known duplications should be justified scientifically. The Space Telescope Science Institute is prepared to assist observers proposing in response to this opportunity. Questions should be addressed to help@stsci.edu.

HST will contact successful PIs of joint programs. The same funding rules apply to joint HST programs as to regular HST programs; a separate budget has to be submitted for the HST portion of the program.

5.3 Chandra/XMM-Newton Observations

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with XMM.

The *Chandra* Project may award up to 1 Msec of *XMM-Newton* time. Of that time, 600 ksec is reserved exclusively for *Chandra* LP or VLP programs. Up to 400 ksec is allocated to regular *Chandra* GO programs, and any such unused time may be allocated to V/LP as needed. By agreement with the *Chandra* Project, the *XMM-Newton* Project may award up to 1 Msec of *Chandra* observing time, of which 600 ksec is reserved for *XMM-Newton* Large (or when offered, Multi-Year Heritage) programs, through an exactly reciprocal policy.

No Target of Opportunity (TOO) observations with a turn-around time of less than 5 working days from an unknown triggering date will be considered for this cooperative program.

Establishing technical feasibility is the responsibility of the observer, who should review the *Chandra* and *XMM-Newton* (<http://heasarc.gsfc.nasa.gov/docs/xmm/xmmgof.html>) documentation or consult with the CXC HelpDesk (<http://cxc.harvard.edu/helpdesk>).

Note that simultaneous longer-duration observations with *XMM-Newton* that require *Chandra* satellite pitch angles violating the conditions discussed in [Section 4.4](#) may not be feasible.

XMM-Newton will contact successful PIs after the *Chandra* peer review results have been announced.

5.4 Chandra/National Optical Astronomy Observatory (NOAO) Observations

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with NOAO.

Chandra proposers can request the use of observing facilities available through NOAO (including Gemini, CTIO, KPNO, SOAR, but not facilities made available through the TSIP or NNEXPLORE programs).

Both *Chandra* observing *and archival* research proposals are eligible. The highest priority for the award of NOAO time will be given to programs that plan to publicly release the optical data in a timely manner (i.e., shorter than the usual 18-month proprietary period) and that create databases likely to have broad application.

NOAO plans to make up to 5% of the public time each semester on each telescope available for this opportunity. Time on the Gemini telescopes will be restricted to no more than 40 hours per year per telescope, and will be scheduled as queue observations. The Gemini queue time is distributed across three priority bands (see <http://www.gemini.edu> for an explanation of the bands) as follows: NOAO will schedule no more than 15 hours of the *Chandra*/NOAO time as Band 1, 15 hours as Band 2, and 10 hours as Band 3. The available observing time is divided roughly equally between the A and B semesters covered by the *Chandra* cycle, for a maximum of 20 hours per semester on each telescope.

Detailed technical information concerning NOAO facilities may be found at <http://ast.noao.edu/observing>.

Proposers wishing to make use of this opportunity must provide the following additional NOAO-related information as part of their *Chandra* proposal, the:

- choice of NOAO telescope(s) and instrument(s). Dates of availability for the various telescopes and instruments can be found at: <http://www.noao.edu/gateway/nasa>
- total estimated observing time for each telescope/instrument combination and provide a quantitative breakdown of that total. For Gemini requests, please include the conditions needed – see <http://www.gemini.edu/node/10781>. For hours of Gemini queue time, you may enter fractional nights in the Cover Form, assuming 10 hours per night.
- number of nights for each semester during which time will be required and any observing constraints (dates, moon phase, synchronous or synoptic observations, etc.)
- plan for public release of the NOAO data within one year of the observation date.

For NOAO time on Gemini (only), successful PIs will be required to submit a full scientific justification to NOAO using Gemini's Phase-I Tool (PIT). NOAO will review the proposal to determine the Gemini queue band into which the observations will be placed. Note that the band awarded may restrict the conditions available for the observations.

If NOAO time is approved through this *CfP*, successful PIs should contact the NOAO TAC Chair Verne Smith (vsmith@noao.edu), with copy to Mia Hartman (mhartman@noao.edu).

5.5 Chandra/AUI Observatories (VLA, VLBA, GBT)

On 1 October 2016 the Robert C. Byrd Green Bank Telescope (GBT) was separated from the National Radio Astronomy Observatory (NRAO). The NRAO continues to operate the Very Large Array (VLA) and the Very Long Baseline Array (VLBA) but the GBT is now operated by the Green Bank Observatory (GBO). Nevertheless, all three observatories continue to participate in the Joint proposal program with Chandra, under the aegis of Associated Universities, Inc. (AUI).

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with NRAO and GBO. □Proposers interested in making use of the VLA, GBT or VLBA facilities as part of their *Chandra* science must follow all policies and recommendations for Joint proposals described in the introductory section, as well as those specific to NRAO and GBO below.

NRAO and GBO plan to make up to 3% of VLA, VLBA and GBT observing time available for this opportunity with a maximum of 5% in any configuration/time period and including an 18-month period close to the *Chandra* Cycle 21 such that all VLA configurations are available. A VLA configuration schedule is published at <https://science.nrao.edu/facilities/vla/proposing/configpropdeadlines>.

Up to 120 ksec of *Chandra* time will be made available to NRAO and GBO proposers annually. See the section on Joint Observations with Chandra in the latest NRAO and GBO Calls for Proposals.

Detailed technical information concerning the AUI telescopes can be found at:

- o <http://science.nrao.edu/facilities/vla> ,
- o <http://greenbankobservatory.org/gbt-observers/> and
- o <https://science.lbo.us/facilities/vlba>

Technical information required for a proposal can be found at:

- o <https://science.nrao.edu/facilities/vla/docs/manuals/oss> (VLA),
- o <http://greenbankobservatory.org/gbt-observers> (GBT) and
- o <https://science.lbo.us/facilities/vla/docs/manuals/oss> (VLBA).

For the VLA, Joint proposals may only use capabilities defined as "general observing" in the NRAO Call for Proposals.

The semester 2019B calls can be found (after 3 January 2019) at:

- o <https://science.nrao.edu/observing/call-for-proposals/2019b/>
- o <http://greenbankobservatory.org/gbt-observers/proposals/2019b-call-for-proposals/>

and calls for future semesters will be posted at equivalent URLs.

Technical questions about proposing or observing for NRAO and GBO telescopes (whose answers are not found in the above links) should be posted to <https://help.nrao.edu>.

Proposers must provide as part of their *Chandra* proposal the:

- choice of NRAO and GBO telescope(s) (VLA, GBT, and/or VLBA), and
- total estimated NRAO and GBO observing time in hours.

Be aware that some *Chandra* targets might not require new NRAO and GBO observations because the joint science goals can be met using non-proprietary archival data from the VLA, GBT or VLBA available at <https://archive.nrao.edu/archive/advquery.jsp> and/or VLA continuum images from sky surveys at a wavelength of 20cm and at a FWHM resolution of 45 arc seconds (see <http://www.cv.nrao.edu/nvss>) or 5 arc seconds (see <http://sundog.stsci.edu/top.html>).

If approved for NRAO and/or GBO time, successful PIs will be contacted by the NRAO or GBO Scheduling Officers (schedsoc@nrao.edu for the VLA and VLBA, and gvertime@nrao.edu for the GBT). The successful PIs for GBT projects will be responsible for organizing the project's information in the GBT Dynamic Scheduling Software and for carrying out their GBT observations. For the VLA and VLBA, the PIs will be responsible for submitting scheduling blocks to the telescopes' dynamic queues. For projects requiring simultaneous NRAO/GBO-*Chandra* observations, the appropriate Scheduling Officers in conjunction with *Chandra* Mission Planning will allocate time on an appropriate date ("Fixed Date" in NRAO/GBO parlance, as opposed to the more common Dynamic Scheduling). The PI will be informed, and will be responsible for submitting scheduling blocks for that, two weeks prior to the observations.

All scientific data from NRAO and GBO telescopes have a proprietary period where the data are reserved for the exclusive use of the observing team. The data archive policy and proprietary periods are given at <https://science.nrao.edu/observing/proposal-types/datapolicies>. This policy also applies to NRAO and GBO data taken during time awarded through the *Chandra* Joint program.

5.6 Chandra/Swift Observations

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with Swift.

The Swift Project is making up to 500 ksec of Swift observing time available to such joint science proposals. Coordinated observations are allowed, if judged feasible. *Chandra* Cycle 21 is expected to overlap with Swift Cycles 15 (April 2019 through March 2020) and 16 (April 2020 through March 2021). The awarded Swift time will be valid for a 12 month period from the start of *Chandra* Cycle 21.

Proposed Swift time may be time-constrained, including coordinated and monitoring observations, and Targets of Opportunity (excluding TOO observations of new GRBs). Note that proposed Swift observing time can include monitoring that precedes, follows and/or (for TOOs) triggers *Chandra* observing time.

Detailed technical information concerning Swift may be found at <http://swift.gsfc.nasa.gov/proposals>. PIs are expected to determine if a target can be viewed by Swift (<http://heasarc.gsfc.nasa.gov/Tools/Viewing.html>) and whether bright stars prohibit the use of the Swift UVOT:

http://swift.gsfc.nasa.gov/proposals/bright_stars/bright_star_checker.html.

Proposers must clearly describe how their proposal capitalizes on the unique capabilities of Swift, and provide the following additional Swift-related information as part of their *Chandra* proposal the:

- total requested Swift observing time in the relevant *Chandra* CPS box,
- expected count rates (from simulations or previous Swift observations), and
- desired observing modes for the Swift instruments.

PIs need to provide a strong justification for the choice of the filters if UVOT filters other than "filter of the day" are requested. If no strong justification is provided, observations will be performed in "filter of the day" mode.

If Swift time is approved through this *CfP*, successful PIs will be contacted by Swift, and then be required to submit the standard Swift cover and target forms to the Swift Guest Observer Facility via ARK/RPS (<https://heasarc.gsfc.nasa.gov/ark/swiftrps/joint>) to provide the required information about observing strategy and instrument configurations.

Swift data sets obtained under this agreement will not be proprietary to the PI and will be immediately released publicly via the HEASARC data archive.

5.7 Chandra/NuSTAR Observations

Policies and recommendations for Joint proposals described in the introductory section apply to all *Chandra* proposals joint with *NuSTAR*.

The *NuSTAR* project is making available up to 1 Msec of *NuSTAR* observing time to joint science proposals. Of that time, 500 ksec is reserved for regular *Chandra* GO programs, and 500 ksec for *Chandra* LP or VLP programs. Coordinated observations are allowed if justified and feasible.

The minimum response time for *NuSTAR* ToO observations is 48 hours. However, a more rapid response time (still subject to *Chandra*'s minimum response time of 24 hours) may be requested by the PI; such requests will be accommodated on a best-effort basis. The minimum exposure that can be requested for any *NuSTAR* observation is 20 ksec.

A technical description of *NuSTAR*, and considerations important for proposers can be found at http://heasarc.gsfc.nasa.gov/docs/nustar/nustar_prop.html.

Proposers must provide the following additional *NuSTAR*-related information as part of their *Chandra* proposal:

- the total requested *NuSTAR* observing time in the relevant *Chandra* CPS box,
- the expected *NuSTAR* count rates based on simulations
- an evaluation of possible stray light contamination obtained by using the *NuSTAR* target constraint check available on the *NuSTAR* SOC website
http://www.srl.caltech.edu/NuStar_Public/NuStarOperationSite/Home.php.

If the latter target stray light evaluation indicates "Potential Issues" then proposers may submit a request for a feasibility analysis to the *NuStar* SOC at NuStar-help@srl.caltech.edu. The request should include the target name and/or J2000 RA Dec coordinates for the observation.

If the *NuSTAR* time is approved, the observer will be contacted by the *NuSTAR* Science Operations Center for further details, including observing strategy and other relevant constraints. Proposals deemed infeasible at this stage will be dropped.

There is no direct NASA funding available for supporting *NuSTAR* observations at the current time. US-based observers desiring support should submit a proposal through the NASA Astrophysics Data Analysis Program (ADAP).

6 - Director's Discretionary Time (DDT)

Up to 1 Msec of time is reserved for Director's Discretionary Time. Proposals that were rejected by the peer review will not generally be considered for DDT. DDT proposals fall into one of two categories:

6.1 Transient Science (DDT Targets of Opportunity)

DDT proposals may be submitted at any time for transient phenomena such as supernovae, gamma ray bursts or accreting binaries. Proposers must demonstrate why the science return from the proposed observation is important and cannot be submitted to the peer review during the next cycle. Proposers should also note that TOO programs approved by the peer review take priority over DDT requests if the object in question fulfills the trigger criteria of a pre-approved TOO ([Section 4.3](#)). The long orbit and broad sky coverage of *Chandra* offer considerable flexibility in the treatment of TOOs. The minimum expected response time for a TOO is approximately 24 hours. The total number of TOOs performed is limited by operational and manpower constraints.

Given the limited availability and high operational impact of TOOs, proposers are asked to carefully consider whether *Chandra* is the optimal observatory for their particular target(s) and to justify this choice in their proposal. Other X-ray missions, e.g., SWIFT, are more flexible for performing TOO observations on medium/bright targets. SWIFT TOO application information either pre-approved (by peer review) or unanticipated, can be found on the SWIFT website at: <http://www.swift.psu.edu/too.html>.

If the proposed observation is accepted, the CXC will create a new short term schedule as soon as possible. Some negotiation between the observer and the CXC may be necessary to achieve the optimum blend of response time and minimum impact on the rest of the schedule. Requests for fast DDT requests will be assessed and approved by the CXC Director and the *Chandra* Project Scientist and/or their designees.

6.2 Non-Transient Science

Proposals for non-transient science benefitting from a short-turn around are allowed as part of the DDT program. These proposals must clearly explain the benefits of an observation in the current cycle as opposed to waiting for the next *CfP*. DDT proposals for non-transient science will be assessed by the CXC Director, the *Chandra* Project Scientist, designated CXC scientists and at least one outside expert.

6.3 The DDT Process

Proposals for DDT must be submitted electronically through the Remote Proposal Software (RPS). The DDT form may be found on the [CXC website](#) by selecting the "Proposer" button and then "Director's Discretionary Time" (http://cxc.harvard.edu/proposer/Chandra_RfO.html). A one-page Science Justification is required and should be uploaded via RPS. Proposers should check that the requested target(s) are visible to *Chandra* (e.g. using [PRoVis](#)), give estimates for the count rates and justify the instrument configuration.

The proposer may apply for a short period of time (at most 3 months) during which the data are considered proprietary. No proprietary time will be allocated to the accepted proposal(s) when multiple teams have submitted DDT proposals, or otherwise expressed interest in doing so, for similar observations of a particular target during the same time period or event. A limited amount of funding is available to support US-based PIs/Co-Is of DDT observations. Once a proposal is approved, funding may be requested using the standard cost proposal form as described on the [CXC Cost Proposal Help](#) page.

7 - Proposal Preparation and Submission

7.1 Overview

Chandra proposal submission and review will be conducted in two stages to minimize the burden of proposal preparation.

- **Stage 1:** During the first stage, the scientific and technical merits of the proposed investigation (Archival Research and Theory/Modeling as well as new observations) will be reviewed, including the appropriateness of using *Chandra* to address the scientific objectives and the relevance of the investigation to furthering our understanding of high-energy astrophysical processes. Based upon the recommendation of the Stage 1 peer review (scientific and technical), the Selection Official (the CXC Director) will select a set of proposals for award of observing time (proposals for new observations) or award of support for analysis and/or interpretation of existing data (Archival Research and Theory/Modeling proposals).
- **Stage 2:** The PIs of those proposals selected in Stage 1 which include US-based PIs or Co-Is will then be invited to submit a cost proposal for the Stage 2 review ([Chapter 10](#)).

Once the targets are identified, the *Chandra* X-ray Center (CXC) is responsible for generating the schedule of observations or science timeline. The timeline is determined for the most part by satellite and observing constraints, as specified in the proposal and as recommended by the peer review. These constraints are described in detail in the *Chandra* Proposers Observing Guide (<http://cxc.harvard.edu/proposer/POG/index.html>). Proposers may also specify additional constraints such as a particular time or time interval during which an observation must take place. Proposers should note that time-constrained observations are difficult to accomplish efficiently and will be limited to ~15% of the total number of observations selected. Details of constraint classification and quotas are described in [Section 4.4](#)

All Stage 1 proposals are required to be submitted electronically via CPS (<http://cxc.cfa.harvard.edu/proposer/CPS.html>). All files must be in PDF format. Proposal preparation and simulation tools are available on the World Wide Web as listed in [Table 3](#). The proposer is urged to make use of these tools well before the deadline for proposal submission.

7.2 Proposal Content

The Stage 1 proposal includes:

- Cover Page Form;
- General Form;
- Target Summary Form, if the proposal requires new observations;
- Scientific Justification and Technical Feasibility (as described below);
- Previous *Chandra* PI Programs listing (one page, described below); and
- CV/Bibliography for the PI (one-page, optional).

The page limits are listed in [Table 7](#). The proposal must be submitted electronically. The information will be entered into a database that will be used in cataloging and evaluating proposals and, for those observing programs selected for implementation, will be transferred to the Observation Catalog. The forms must be completed in the requested format. Cost sections should not be submitted for the Stage 1 scientific review. However, proposals for the Archival Research or Theory/Modeling projects must include a preliminary cost estimate and a brief narrative describing the proposed use of these funds within the science justification section of the Stage 1 proposals. Formal cost proposals will be considered as part of the Stage 2 process.

7.3 Cover Pages

To be eligible for funding for either PI or Co-Is, a U.S. Institution MUST be specified on the CPS form, and must be the primary institution of the investigator seeking funds.

Institutional endorsement information (name of administrator, administrative authority, and administrative institution) are optional for the Stage 1 proposal, but may be provided by separate hardcopy (to the address in [Section 1.7](#)) in those cases where the proposing institution requires them. In all cases, institutional endorsements are required for the hardcopy submission of a Stage 2 cost proposal.

The abstract on the Cover Page Form is limited to 800 characters, including spaces between words. If the abstract exceeds this length, it will automatically be truncated at 800 characters when entered into the database.

The CPS proposal Cover Page Form requires four or more keywords describing proposal science. Selected keywords may be used to facilitate preliminary matching of proposals to reviewers, as well as archive searches.

7.4 Target Forms

The CPS target forms must include full specification of the observing parameters for every

target and for every observation of that target. In complex cases that cannot be entered on the forms, please enter a detailed description in the Remarks section of the target form and/or contact the [CXC HelpDesk](#) for advice. If any additional constraints or preferences are included in the Remarks, you must set the corresponding flag (pull-down menu above the Remarks window) to ensure that they are implemented. Incorrect information will jeopardize the acceptance of a proposal. **The information in the CPS forms will take precedence over any contradictory/different information described in the proposal science justification.** Any observing parameter information included in the science justification and not in the CPS forms will not be accepted. Additional constraints or changes to observing parameters requested after the proposal deadline will only be considered in very unusual circumstances and will require approval by the CXC Director.

For proposals involving observations, the proposer is urged to be as accurate as possible when entering the position of the target, since even small errors can seriously reduce the quality of the data. Positions must be given in equinox J2000.0 at the current epoch. Upon proposal submission, the CPS will run a crosscheck of coordinates and object names entered with the SIMBAD catalog and will notify PIs should any errors be found in this cross-check. If after such notification there is time before the deadline, the PI should re-check the target(s) in question and, if necessary, re-submit his or her proposal (both target form and science justification) with corrected target name and coordinates. If the deadline has passed, the PI should contact the CXC, via the [HelpDesk](#), as soon as possible, to make any necessary corrections.

Multiple observations of a large target/sky area where all pointings are within 1 degree of their nearest neighbor may be classified as a grid and should be allocated a unique grid name in CPS. For a large number of pointings, proposers may elect to enter grid specifications rather than the full list of targets. If the proposal is approved, the PI must send the full target list to the CDO as a tab-delimited ASCII file with three columns: ObsId, RA, Dec, where RA and Dec are in decimal degrees.

7.5 Science Objectives

The proposal must state clearly the scientific objectives, with relevant background and reference to previous work. The reviewers will not necessarily be specialists in your particular science area, so include all relevant information in your proposal. Show how the proposed investigation may be used to advance our knowledge and understanding of the field. Justify the use of *Chandra* or its archival data to accomplish the objectives, in contrast to using other available observatories or archives. If X-ray data from *Chandra*, *XMM-Newton*, or any other facility exists, justify the need for additional *Chandra* data to achieve the scientific objectives. To search for other data, see e.g., HEASARC Browse web page (<http://heasarc.gsfc.nasa.gov/db-perl/W3Browse/w3browse.pl>). Any constraint

on the observations must be clearly stated and justified. Discuss the data analysis program required to attain the science goals including the scope of the effort.

7.6 Technical Feasibility

For all observing proposals, the proposer needs to justify the use of the *Chandra* X-ray Observatory. The proposal should show how the particular details (observing time, instrument, instrument mode, etc.) of the proposed observations allow one to achieve the stated scientific objectives. State how targets or pointing directions were selected. List assumptions about source intensity, surface brightness, and spectrum. Estimates of both counting rates and total counts needed to accomplish the investigation must be provided. It is in the proposer's best interest to allow a reviewer to understand the assumptions and to be able to easily reproduce the estimates of the counting rate(s). The proposer should also demonstrate that the estimated counts are sufficient to extract the desired science results from the observation. The impacts of pileup on the observed energy spectrum should be addressed for observations with ACIS, HETG/ACIS, or LETG/ACIS of even moderately bright sources. Proposals for observations that might encounter pileup must explicitly discuss the plans for dealing with such data in order to demonstrate a thorough understanding of the implications for their proposed research.

Observers can require a maximum of 4 CCDs to be ON. A total of 6 chips may be selected, but at least 2 must be optional. This is required for thermal management of the Observatory. Please see the Proposers' Observatory Guide.

7.7 Archival Research and Theory/Modeling

Proposals that request funding for Archival Research must include a discussion of any publications that already have resulted from the observations and an indication as to how and why the proposed research will significantly extend these results. Proposals for Theory/Modeling must discuss how the proposed research will further the understanding of *Chandra* data.

Proposers interested in Archival Research should also discuss how and why the specific archival data are sufficient to meet their objective(s). Furthermore, such proposals must address the analysis tools to be used, their suitability for accomplishing the investigation, and the proposer's ability to apply such tools to the project. Archival Research and Theory/Modeling proposals should include a brief budget narrative within the science justification section.

7.8 Joint Proposals

Proposers wishing to apply for joint time also need to include a section entitled "Technical Justification of Joint Facilities" in which they address the technical feasibility of the observations using the relevant observatory(ies) in their proposals. This must include the visibility of the target by the observatory(ies) in question (particularly in the case of a

request for simultaneous observations).

7.9 Other Observing Facilities Being Used for the Research

The proposer should include in his or her scientific justification a list of all other observing facilities being used for the proposed research, in addition to those being requested in this proposal. These facilities should be discussed whether or not their use results in a time constraint on the *Chandra* observations. Note that, apart from NRAO, coordination with ground-based observations may only be listed as a preference.

7.10 Previous Chandra Programs (Required)

The PI must provide a list of all previous approved *Chandra* Observing, Archival Research or Theory/Modeling programs for which they were PI, along with a brief status of selected relevant program(s) and resulting publications (1 page maximum, uploaded separately, see [Table 6](#)). Omit this page if there are no such programs. A webtool for searching the CXC approved proposal database by PI Name, *Chandra* cycle, proposal number, etc. is available at http://cxc.harvard.edu/soft/propsearch/prop_search.html.

The CXC seeks to track *Chandra*-related publications for the benefit of users of the *Chandra* Data Archive, for proposal reviewers, and for maintaining general *Chandra* bibliographic metrics. We encourage all users to provide material within their publications to facilitate this tracking. Authors should include wherever relevant (1) a DataSet Identifier for each ObsId; (2) *Chandra* grant number(s); and (3) the *Chandra* facility keyword ("CXO"). Details are described at <http://cxc.harvard.edu/cdo/scipubs.html>.

7.11 PI/CV Bibliography (Optional)

The PI has the option to include a one page CV and bibliography.

7.12 Proposal Formats and Page Limits

All proposal text must be in English. Because of the large number of proposals anticipated in response to this *CfP*, there will be strict page limits as shown in [Table 7](#). All information required to evaluate the proposal must be included within the proposal page limits. Reference to published papers or web-based material may be used for supporting material only. The section including the scientific justification and technical feasibility is limited to six pages for observing proposals that are classified as Large, Very Large or as Joint Projects, and to four pages in all other cases including proposals for a TOO, Archival Research, and Theoretical/Modeling Research. For purposes of judging the length of the electronic proposal, the following two guidelines apply:

- Each printed side of a paper sheet containing text or illustration will count as one page;
- Each page must have at least 1-inch margins on all sides of a standard 8.5 x 11 inches (US-letter sized) sheet.

Proposals that violate formatting rules (exceed the page limit or violate the margins rule) will be red-flagged for reviewers. Proposers who repeat violations over multiple cycles will have their proposals rejected.

Proposers are strongly encouraged to write proposals using an easily-read font family with no more than 15 characters per inch (horizontally) and 6 lines per inch (vertically). In most cases this is achieved with 11 or 12 point font in single-spaced paragraphs. Using smaller fonts or narrower line spacing hampers the readability of proposals and generally has a negative impact on the judging of the proposal by the reviewer.

Proposers are encouraged to use the LaTeX template provided at the CXC website, (<http://cxc.harvard.edu/proposer> "Observing Proposal Preparation and Submission") that conforms to the guidelines. Please ensure also that the LaTeX is properly converted to PDF (see <http://cxc.harvard.edu/proposer/generatePDF.html>).

Submitted science justification PDF files may not exceed 10 Mbytes in size, or they will be automatically rejected by the software with an error message.

Table 7. Proposal Content and Page Limit

| SECTION (Note 1) | PAGE LIMIT | COMMENTS |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------|
| Cover Page Form | 1 | No other cover needed. |
| General Form | 1 | No other cover needed. |
| Scientific Justification and Technical Feasibility: <ul style="list-style-type: none"> • General, TOO, Archival Research, or Theory/Modeling • Large, VLP, Joint | 4 6 | Including text, figures, charts, tables, references, and budget narrative (for archival research and theory). |
| Target Forms | As needed | Not required for Archival Research or Theory/Modeling proposals. |
| Previous <i>Chandra</i> Programs | 1 | Information on previous programs of PI, including proposal number, PI, title and related publications. (Note 2) |
| PI's CV/Bibliography (optional) | 1 | Emphasis should be on relevant experience and publications. |

Notes:

1. The proposal forms may be accessed via CPS at <http://cxc.cfa.harvard.edu/proposer/CPS.html>.

2. Those with a large number of prior programs may include minimal information for each program.

7.13 Help After Submitting: When You Discover A Mistake

If a mistake is discovered before the deadline, please go through the submit process as if you had not submitted before, resubmitting both the form and science justification, and entering the number of the proposal being replaced. The proposal is scanned to confirm that it is a resubmission. Proposals for which resubmission cannot be confirmed are flagged for the attention of a CXC staff member. The proposal with the most recent date and time is considered as the "final" proposal.

It is possible to correct minor errors in forms after the proposal deadline, especially if the item is critical to the success of the potential observation (e.g., incorrect coordinates). Please inform the CXC (via the HelpDesk, <http://cxc.harvard.edu/helpdesk>) as soon as possible after the mistake is discovered.

Late changes in the Science Justification are not allowed. However, some typographical or numerical errors can be misleading, and corrections of such can be emailed to the CXC. If appropriate, this email will be included in material sent to the peer review. Note that a long list of corrections to a careless submission cannot be accepted as this would be considered *de facto* as a late proposal submission.

8 - Resources for Proposers and Proposal Submission

The CXC has extensive on-line resources for *Chandra* proposers and a suite of software tools for common proposal-related tasks. All proposal-related material can be found at <http://cxc.harvard.edu/proposer>.

8.1 On-line Resources

8.1.1 *The Proposers' Observatory Guide (POG)*

The main reference document for *Chandra* operation and instrumentation is the *Chandra* Proposers' Observatory Guide. The POG is available from the CXC website (<http://cxc.harvard.edu/proposer/POG>). Additional information on instruments and calibration can be found at <http://cxc.harvard.edu/cal>. A hardcopy version of the POG is available upon request to <http://cxc.harvard.edu/helpdesk>.

8.1.2 *The HelpDesk*

The CXC uses commercial Helpdesk software to track users' requests and problems. Click on [Log into the CXC HelpDesk](#), and the HelpDesk login box will appear. First time users should use the sign up above the login form. All users then need to enter a user name (we suggest first and middle initial followed by last name, but any unique string will be okay) and password and press enter/return to log in. More detailed information is given on the interface or users can email the CXC HelpDesk: cxchelp@cfa.harvard.edu for assistance.

8.1.3 *Searching the Chandra Archives and Downloading Data*

ChaSeR (Search and Retrieval from the *Chandra* Data Archive) at <http://cda.harvard.edu/chaser> allows a user to check what observations have been made, the status of the observations (observed, publicly released, etc.), and to select data products and retrieve them.

The *Chandra* Data Archive Footprint Service provides a visual web interface to all **public** *Chandra* observations as well as the observational data used for the *Chandra* Source Catalog. The instrumental sky coverage is superimposed on an image from the Digital Sky Survey. This tool also provides access to *Chandra* images and a seamless interface to *ChaSeR* for downloading data. The CDA Footprint service is available from: <https://cxcfps.cfa.harvard.edu/cda/footprint/cdaview.html>

The Bibliography web interface allows simultaneous searching of the archive and of the published papers related to *Chandra* observations. It is available from

<http://cxc.harvard.edu/cgi-gen/cda/bibliography>. *ChaSeR* also provides links to related publications.

Detailed target lists by cycle and a complete list of approved Large and Very Large and X-ray Visionary Projects can be found at http://cxc.harvard.edu/target_lists/index.html.

A webtool for searching the CXC approved proposal database by PI Name, *Chandra* cycle, proposal number, etc. is available at http://cxc.harvard.edu/soft/propsearch/prop_search.html. An additional tool of interest is the processing status tool, which provides comprehensive information about the processing of each observation. The processing status tool can be accessed via *ChaSer*, but it can also be accessed directly from http://cxc.harvard.edu/soft/op/op_pst.html.

8.1.4 Instrument Response Functions

Instrument response functions (RMFs and ARFs) for simulating spectra within *Sherpa* and *XSPEC* can be found on the proposer page (<http://cxc.harvard.edu/proposer>) and the Calibration_Database_(CALDB)_page (http://cxc.harvard.edu/caldb/prop_plan/index.html). These responses should be used for proposal preparation only; they should NOT be used for data analysis because they are not accurate for the date of a specific observation.

8.2 Proposal Preparation Software

The CXC provides several software_tools to aid in proposal preparation. All these tools are available from the main CXC proposer page (<http://cxc.harvard.edu/proposer>).

8.2.1 Precess, Colden, Dates, ObsVis, PProVis, PIMMS, and Effective Area and PSF Viewers

These tools perform the following functions:

- Effective Area Viewer is a web-based tool that displays *Chandra*'s on-axis Effective Area as a function of energy for proposal planning and allows comparison with versions from previous cycles.
- PSF Viewer is a web-based tool that displays the PSF (Point Spread Function). Precess is an interactive astronomical coordinate conversion program. It allows precession of equatorial coordinates and conversion between equatorial, ecliptic, galactic, and supergalactic coordinates.
- Colden is an interactive program to evaluate the Galactic neutral hydrogen column density at a given direction on the sky. Colden accesses two databases: the Bell survey (Stark et al 1992 ApJS 79, 77) and the Dickey & Lockman 1990 (ARA&A, 28, p.215) compilation of Bell and other surveys for all-sky coverage.
- Dates is an interactive calendar and time conversion tool.
- ObsVis is a tool to aid observation planning, allowing inspection of instrument

fields-of-view (FOVs). It will display instrument FOVs on a Digital Sky Survey or user-loaded image, mark the locations of sources from various X-ray catalogs and provides other functionality such as manipulation of multiple fields-of-view for planning of grids of observations.

- P_{Ro}Vis is a web-based tool which allows interactive plotting of observatory roll angle, pitch angle and target visibility for use in checking observation feasibility. This software includes dynamic interaction with the display.
- PIMMS (Portable Interactive Multi-Mission Simulator) was developed at NASA-GSFC by Dr. K. Mukai. [We thank Dr. Mukai for making some changes to the code for *Chandra*.] PIMMS allows the user to convert between source fluxes and count rates for different mission/instrument combinations.

All of these tools have web interfaces linked into the Proposer pages. Command-line (non-web) versions that have additional features are also available for several tools. For example, command line versions of *Precess*, *Colden*, *Dates* allow for a list of input parameters in a text file. The command-line versions of these tools are distributed with *CIAO* (<http://cxc.harvard.edu/ciao/>). *Chandra* users with *CIAO* installed can run these routines in the same way as all other *CIAO* tools (CLI tool names: prop_colden, prop_dates, prop_precess, and obsvis). Standard *CIAO* helpfiles are available.

8.2.2 MARX

MARX is a suite of programs created by the MIT/CXC group and designed to enable the user to simulate the on-orbit performance of the *Chandra* X-ray Observatory. *MARX* provides a detailed ray-trace simulation of how *Chandra* responds to a variety of astrophysical sources and can generate standard FITS events files and images as output. It contains detailed models for the HRMA mirror system as well as the HETG and LETG gratings and all focal plane detectors. More detailed information, including the source code and documentation, is available from the MIT *MARX* Web Page (<http://space.mit.edu/CXC/MARX>). *MARX* should be used to demonstrate the feasibility of challenging observations, for example resolving multiple or overlapping sources with unique spectra, HETG observations of extremely bright objects, or grating observations of extended sources. *Chandra* users with *CIAO* installed can install the latest version of *MARX* by running the script [*install_marx*](#).

8.2.3 CIAO

The *Chandra* Interactive Analysis of Observations (*CIAO*) package is an extensive suite of tools designed for *Chandra* data reduction. Although not designed specifically for proposal preparation, *CIAO* can be used to analyze simulated *Chandra* data (e.g. from *MARX*) and create simulated spectra. Full details can be found at <http://cxc.harvard.edu/ciao>. Sherpa is the *CIAO* interactive spatial/spectral fitting package. It can also be used for simulations of *Chandra* spectra.

8.2.4 XSPEC

XSPEC is the spectral analysis portion of the Xanadu X-ray data analysis package, developed and maintained at NASA-GSFC. *XSPEC* can be obtained from:

<http://heasarc.gsfc.nasa.gov/docs/xanadu/xspec/index.html>.

The spectral simulation portion of *XSPEC* can also be run on-line. *WEBSPEC* can be accessed from: <http://heasarc.gsfc.nasa.gov/webspec/webspec.html>.

9 - Stage 1: Scientific and Technical Proposal Evaluation, Selection and Implementation

9.1 Evaluation of Research Objectives

The criteria used in the Stage 1 evaluation are listed below in order of importance.

- 1) The overall scientific merit of the investigation and its relevance to the *Chandra* science program and capabilities. This includes addressing the scientific objectives of the *Chandra* mission which are aligned with the NASA strategic plans. For observing proposals, the degree to which the objectives have been satisfied by one or more previous observations will be evaluated.
- 2) For observing proposals, the suitability of using the *Chandra* X-ray Observatory and data products for the proposed investigation and the need for new X-ray data beyond any already obtained; the feasibility of accomplishing the objectives of the investigation within the time, telemetry, and scheduling constraints; and the feasibility of the analysis techniques. For programs incurring a large expenditure of observatory time relative to exposure time (multiple short exposure or grid pointings), the total observatory time required will be considered. For Archival Research and Theory/Modeling proposals, the relevance to the *Chandra* scientific program will be considered. For Archival Research proposals, the value of any additional analysis beyond the original use of the data will also be considered.
- 3) The competence and relevant experience of the Principal Investigator and any collaborators as an indication of their ability to carry the investigation to a successful conclusion. Past performance in scientific research, as evidenced by the timely publication of refereed scientific papers including those on previous *Chandra* programs, will be considered.
- 4) To aid in the Stage 2 cost review, the data analysis and interpretation effort required to achieve the proposed science goals will also be evaluated by the Stage 1 peer review panels.

The peer review will be conducted using a number of panels, each responsible for proposals directed at particular scientific topics. Large Projects will be initially evaluated by the appropriate topical panel, but the final recommendation for award of time will be made by the Big Project Panel. The final evaluation stages of Large Project proposals demand that reviewers efficiently consider a significant number of proposals that may be outside their area of expertise. LP proposers are advised to bear this in mind when preparing their proposals.

9.1.1 Observing Efficiency/Slew Tax

An observing efficiency including slew and settle time is used to determine the amount of time actually necessary to accomplish a proposal. Thus, in addition to the time on target, this "slew tax" is added when accounting the observing time at the peer review. Due to orbital or thermal constraints, longer exposures are candidates for segmenting into multiple observations by Mission Planning. The slew tax is 1.5 ksec for each target that requires less than 90 ksec of observing time. Observations requiring more than 90 ksec will be charged an additional 1.5 ksec tax per 90 ksec or fraction thereof. Thus, a proposal requesting a 210 ksec observation of one target is charged a slew tax of 4.5 ksec for the purpose of the peer review. For a large set of short exposures of different targets, this slew tax can substantially increase the "cost" in terms of time needed for a project. CPS generates an estimate of the constraint class of each target and the "slew tax" (pointing overhead) which will be added to the observing time at the peer review.

9.1.2 Grid Surveys and Slew Tax

- For a series of contiguous or nearly contiguous pointings (maneuver from one observation to the next of less than or equal to 1 degree), with no change in instrument set-up or observing mode, the slew tax for the first observation will remain 1.5 ksec, while for observations 2 through n (where "n" is explained below) slew tax will be assessed at 0.5 ksec.
- A grid of pointings will be assembled into one or more groups comprising a set of closely spaced pointings with a maximum exposure time per group of 90 ksec, including the slew tax.
- The value of "n" is the number of observations that can be done including the slew tax without exceeding 90 ksec. Proposals requesting more than 90 ksec (including slew tax) will be assessed slew tax in several groups, the first observation of each group will be charged the 1.5 ksec slew tax.
- Proposers should set the CPS flag *"Is this observation part of a grid survey?"* to be "Y" (yes).

Please note that observations taken as part of a grid survey are not constrained and therefore are not guaranteed to have the same (or similar) roll angle. Proposers must also include a group or roll constraint if they wish to ensure that the individual observations have roll angles within particular tolerances. The number of constrained observations, should a grid be constrained, will be determined similarly to the slew tax calculation. Grid observations will be grouped into sets with total exposure time, including slew tax, of no more than 90 ksec and each group will be charged as 1 constrained observation, classified according to the scheme in [Section 4.5](#).

9.2 Selection

The final selection of proposals is made by the Selecting Official (the CXC Director), who

notifies the PIs and the *Chandra* Project Office at MSFC of the results. The list of selected targets is posted on the CXC website (http://cxc.harvard.edu/target_lists) and entered into the Observation Catalog.

Although some investigations may begin immediately (Archival Research, Theory/Modeling, and Joint Observing Projects), no funding will be provided until the Stage 2 Cost review is complete and the final award has been issued. As a general rule, PIs of proposals requiring new observations will not be funded until the first *Chandra* observation has been successfully performed and the data provided to them.

9.3 Implementation of Observing Programs

Once an observing program is approved, the targets are transferred to the *Chandra* Observation Catalog (OBSCAT) and assigned a unique observation identifier (OBSID) for scheduling. Below we describe the process of observation parameter confirmation and scheduling the observations (see the [Proposers' Observatory Guide](#) for more information). The PI is considered the primary point of contact for all matters pertaining to the science program. If a separate "Observer" is identified in the CPS form, they will be the primary point of contact for observation planning. The PI (and Observer if there is one) will be notified when program data are available for download.

Once the approved observations are in the OBSCAT, the CDO contacts all PIs and observers to confirm those parameters most critical for scheduling the observations. This process, known as the Initial Proposal Parameters Signoff (IPPS), includes confirmation of time constraints and preferences, target coordinates and instrument selection. Once these responses have been received and any updates completed, the *Chandra* Mission Planning team begin their generation of the Long-term Schedule (LTS), which covers the full observing cycle (see below). A second, detailed review of observation parameters is initiated by the Uplink Support Interface team (USINT) if requested by the observer.

The *Chandra* Mission Planning and Operations teams at the CXC produce a mission timeline using a two-part process. First, for the entire period covered by this *CfP*, a long-term schedule (LTS) is generated with a precision of about a week. The LTS is published on the CXC web page: <http://cxc.harvard.edu/longsched.html>. Updated LTSs are generated regularly, as needed, in response to TOOs and other timeline changes. Targets are scheduled in the LTS to achieve maximum efficiency in the observing program within the operational constraints of *Chandra*. Unconstrained observations are scheduled to produce the highest observing efficiency. Unconstrained targets with relatively short exposure times, totaling a substantial fraction of the observing time, are held in a pool from which they can be selected for use in short-term scheduling. Second, about three weeks prior to the anticipated execution of the observations, a short-term schedule (STS) is produced. The STS is used for the automatic generation of the required

spacecraft commands. The STS, including slew times, pointing direction, guide stars, roll angles, etc., is reviewed and finalized approximately one week in advance of execution, at which time it is published on the CXC web page: http://cxc.harvard.edu/target_lists/stscheds.

The CXC will make its best effort to schedule all approved observations. All approved non-TOO observations that are not scheduled, or that were scheduled but not successfully executed, will automatically be rescheduled within the current observing cycle or carried over into the next observing cycle. However, approved TOO observations that are not triggered will not be carried into the next cycle; they must be proposed for again. The official changeover date between cycles will be published on the [CXC website](#).

If observations have to be cut short because of unforeseen circumstances, the following criteria will determine whether the target will be scheduled for additional observing time. For observations of 5 ksec or greater, the observation will be considered complete if 90% or more of the approved exposure time was obtained. For observations less than 5 ksec, only one best-effort pointing will normally be attempted. (see [Section 3.7](#) for more details).

For information on proprietary data rights, see [Section 3.4](#). A PI may waive or shorten the proprietary period, and this is customary for observations intended to benefit the general community. The CXC will ensure that the proprietary rights of other PIs are not violated by such an early data release.

9.3.1 Possible Early Observation of Targets

Efficient and safe operation of the Observatory requires substantial flexibility in target selection. A result of this requirement near the end of a cycle may be the need to advance some observations selected by peer review before the normal beginning of the next cycle. In such cases the relevant observers will be contacted by the CXC to request an early detailed check of observing parameters, possibly at short notice.

10 - Stage 2: Cost Proposal Submission, Evaluation and Allocation

10.1 Overview

Subject to the availability of funds from NASA, funding will be provided to support eligible investigators of approved proposals. It is anticipated that approximately 200 awards will be issued for an estimated total amount of \$10M. In the case of Co-Is seeking funding, awards will be issued directly to the Co-I's institution in order to avoid double charging of institutional overheads.

Based on Stage 1 ratings, the Selecting Official (the CXC Director) will invite eligible investigators whose investigations were recommended by the peer review to submit a Stage 2 Cost Proposal. Proposers not recommended to proceed to Stage 2 are not prohibited from preparing a Stage 2 proposal, but they should be aware that their proposed investigation is unlikely to be selected.

10.2 Eligibility for Grant Funds

Proposals for funding will be accepted from institutions/organizations described in [Section 3.1](#). Funding for these programs may be requested by scientists who are:

- U.S. Citizens residing in the United States;
- U.S. Citizens residing abroad if salary/stipend and support are being paid primarily by a U.S. institution; and
- U.S. permanent residents and foreign national scientists working in the United States if salary/stipend and support are being paid primarily by U.S. institutions.

These definitions include U.S. Co-Is on observing projects with PIs at a non-US institutions.

Proposals involving only investigators based in the People's Republic of China (PRC), or only PRC-based and U.S. investigators are subject to the restriction on bilateral activity with China (PL-113-235 Section 532). Note that multilateral collaborations are generally permitted. It should be noted that for purposes of this provision, Taiwan is not considered part of the People's Republic of China; however, Hong Kong is considered part of the People's Republic of China.

Proposals by non-U.S. PIs that have one or more U.S. Co-Is who require funding *must* designate one of the U.S. Co-Is as the "Administrative PI." This person will have general oversight and responsibility for the budget submissions by the U.S. Co-Is in Stage 2 and should indicate they are the 'US Cost PI for Non-US Science PI' on their Chandra Cost Proposal Cover Page..

When a U.S. investigator obtains grant funds for a project that involves non-U.S. investigators, no funding may flow through the U.S. investigator to the non-U.S. investigators. This prohibition includes funding for travel.

10.2.1 Switching Institutions

Investigators who are switching institutions during a grant award period and whose current institution agrees to a transfer should contact the CXC and/or the SAO Subawards Section as soon as possible to arrange for their award to be transferred to the new institution with a minimum of delay. Please see Section XIX, "Transferring the Award" of the SAO Terms and Conditions for details of this process.

Investigators, whose primary affiliation changes from a US to a non-U.S. institution, cannot retain their NASA funding. However, if as a result of the PI's move, other US-based Co-Is of the original proposal have taken on a larger share of the work, it may be possible for that funding to be officially transferred to the relevant US-based Co-I. The PI should contact the CXC Helpdesk to discuss this matter.

Investigators who move from a non-US institution to a US-based institution within a year of the original science proposal submission may be eligible for funding and should contact the CXC Helpdesk for more information.

10.3 Content and Submission of Cost Proposals

Cost proposals shall include:

- 1) The *Chandra* Cost Proposal Cover Page Form with institutional signature. Note that the Institution Administrative Contact information and Investigator information must be complete. This includes the email addresses for both the Administrative Contact and the Investigator.
- 2) A budget using the *Chandra* Cost Proposal Budget Form (see <http://cxc.harvard.edu/proposer/>). The PI's Budget Form must include the Co-I name, institution and total amount to be awarded to each CoI as line items.
- 3) A succinct one or two page Budget Justification. The Budget Justification should include a breakdown of the work assignments for all funded investigators taking part in the investigation. The Budget Justification must describe the basis of estimate and rationale for each proposed component of cost, including direct labor, consultants, travel, other direct costs, and facilities and equipment. The Proposer must provide adequate budget detail to support estimates. The Proposer must state the source of cost estimates (e.g., based on quote, on previous purchases for same or similar item(s), cost data obtained from internet research, etc.). The Proposer must describe in detail the purpose of any proposed travel in relation to the grant and provide the basis of estimate, including information or assumptions on destination, number of travelers, number of days, conference fees, air fare, lodging, meals and incidentals, etc. If

destinations are not known, the Proposer should, for estimating purposes, make reasonable assumptions about the potential destination and use historical cost data based on previous trips taken or conferences attended. Funding for observing proposals is normally issued after the data from the first successful observation are released to the PI. For Target of Opportunity proposals, the budget justification must show the breakdown of funding for each approved target. If there is more than one approved target, the award may be incrementally funded as each target is successfully observed and the data are released to the PI.

- 4) A written certification for any workstation, personal computer or any general-purpose equipment costing \$5,000 or more. The certification form can be found at http://www.cfa.harvard.edu/spp/sp/forms/GO_forms.html
- 5) A List of Current and Pending Support Information must be provided for all ongoing and pending projects and proposals that involve the proposing PI and any Co-Is who are requesting funding. This information must be provided for each such individual for each of the following two categories of awards that may exist at the time of the proposal submission deadline:
 - Current Awards (for any of the period that overlaps with the submitted proposal), and
 - Pending Awards (including the proposal being submitted to CXC).

For each of these two categories, using a format of the proposers choosing, the following information is required: name of the investigator, project title, sponsoring agency, period-of-performance, amount of award or total proposed budget, and commitment by PI (or Co-I) in terms of a fraction of a full-time equivalent (FTE) work year. If the PI and each funded Co-I have no Current or Pending Support, then a statement to that effect is required.

- 6) A copy of the applicant's institution's federally-approved Indirect Cost (IDC) Rate Agreement (required for PI institution and any Co-I institutions).
- 7) Certifications and Assurances Required by U.S. Code: The signature of the Institutional Representative on the Budget Form verifies that the proposing organization complies with the required certifications and assurances (see Appendix A for full text); therefore, they do not need to be independently signed and submitted.

The Budget Form and Justification must contain estimated costs for the following potential expenditures:

- **SALARIES AND WAGES:** List personnel, individual person-months, and total cost for each individual.
- **OTHER DIRECT LABOR:** Costs and/or stipends for Individuals providing research assistance, such as graduate students, post-doctoral research associates or science data aides.
- **FRINGE BENEFITS**
- **COMPUTING DEVICES:** Computing devices means machines that cost less than \$5,000 and are used to acquire, store, analyze, process and publish data and other information electronically, including accessories (or "peripherals") for printing, transmitting and receiving, or storing electronic information. The purchase of computing devices is

allowable as a direct cost providing the purchase is justified and essential to the performance of the award and allocable to the project, even if not solely dedicated to the performance of the award. The budget justification must state how the computing device will be used in the conduct of the research.

- **EQUIPMENT:** SAO permits acquisition of special purpose and general purpose equipment specifically required for use exclusively for research activities. The budget justification must contain the description, purpose and acquisition value of the equipment, and include a written certification that the equipment will be used exclusively for research activities. The purchase must meet the criteria of the cost principles as set forth in 2 CFR Part 200 Subpart E – Cost Principles. Equipment means tangible personal property (including information technology systems) having a useful life of more than one year and a per-unit acquisition cost of \$5,000 or more unless a lower threshold has been established by the Recipient Institution. "Special purpose equipment" means equipment which is used only for research, medical, scientific, or other technical activities. "General purpose equipment" means equipment, which is not limited to research, medical, scientific or other technical activities. Special purpose or general purpose equipment acquired by the recipient with award funds, valued under \$5,000 (unless a lower threshold is established by the recipient) are classified as "supplies," do not require the prior approval of the SAO Grant Officer. See "computing devices" above.
- **TRAVEL:** Describe the purpose of the proposed travel, specifically who will be traveling, the departure location and destination, estimated airfare, lodging, meals and incidentals etc., number of days on travel, the relationship of the travel to the grant, and the basis of cost estimate.
- **SUPPLIES:** Provide general categories of needed supplies and the estimated cost.
- **PUBLICATION COSTS:** Provide number of papers, total pages, and total cost.
- **COMPUTER SERVICES:** Provide type of service and total cost.
- **OTHER DIRECT COSTS:** Enter the total of direct costs not covered above. Provide an itemized list explaining the need for each item and the basis for the estimate.
- **INDIRECT COSTS:** Provide the name of the cognizant Federal agency, date of negotiation agreement, rate(s), base, and total. Attach a copy of the rate agreement per [Section 10.3](#), Item 6 above.
- **SUBTOTAL:** Enter the sum of items above.
- **CO-I AWARDS:** Provide name, primary institution, and total dollar amount for each Co-I requesting funds. If there are more than three separately funded Co-Is, the total of all Co-I requests should be provided and the breakdown for each separately funded CoI must be provided in the Budget Justification.
- **PROJECT TOTAL:** Total cost of support being requested for the project.

The allowability of the above costs is dependent upon conformance with the Terms and Conditions for CXC Observing Program Awards (see the Terms and Conditions currently being used for Cycle 20 <http://www.cfa.harvard.edu/spp/sp/policies/grants.html> and 2 CFR Part 200, Subpart E - Cost Principles; the Terms and Conditions for Cycle 21 will

be posted at a later date).

While proposals from investigators working at for-profit organizations are eligible for funding, profit and/or fee is unallowable. Proposals involving NASA employees as either a PI or as a Co-I should use the full cost accounting method authorized at their Centers at the time proposals are due for the entire proposed period-of-performance.

To assure compatibility with NASA's data systems, requested workstation/computer systems must be capable of establishing one of the existing portable data analysis environments supported by the CXC. Information on the minimum computer system and platforms on which the software is available can be found on the CXC web page (<http://cxc.harvard.edu>) (click on "Data Analysis" and then "Download") or by direct link at <http://cxc.harvard.edu/ciao>.

Further information and instructions can be found on the SAO website: <http://www.cfa.harvard.edu/spp/sp/policies/CPSR.html>.

10.3.1 Cost Proposal Submission:

Each proposing PI should submit, through their primary institution, a single Stage 2 cost proposal, for each approved project, containing his/her own budget requests and include the budget requests of any Co-Is seeking funding in the Budget Form. Co-Is shall provide the PI with the necessary budget information to be included in Section J of the PI's budget form. Co-Is shall submit their cost proposal through their primary institution following the same procedures as the PI, but indicating they are a Co-I on the budget form. The budget form can be found at:

https://www.cfa.harvard.edu/spp/sp/forms/GO_forms.html

A signed hard copy of your cost proposal must be sent to the SAO Grant Subawards Section. Note that Co-Is Institutions will submit the hard copy of their cost proposal directly to the SAO Subawards Section (Grant Awards). Hard copies shall be signed by the institution's authorized signatory and include **all** cost proposal documents.

Hardcopy submission of the Stage 2 Cost Proposal to the SAO Subawards Section may be done using one of two methods.

- The signed cost proposal must be scanned into a single Adobe PDF file. The signed and scanned Adobe PDF copies of the cost proposal shall be submitted by e-mail to: chandracp@cfa.harvard.edu. **For PIs, the e-mail subject line must state "Chandra Cost Proposal #XXXXXXXX PI". (Replace Xs with assigned Chandra Science Proposal number.) If the submission is for a Co-I, the e-mail subject line must state "Chandra Cost Proposal #XXXXXXXX Co-I". (Replace Xs with assigned**

Chandra Science Proposal number.) Do not use any other e-mail address for submission of the cost proposal.

- Cost proposals may also be submitted using a courier service or the U.S. Mail. In this case each proposing institution shall submit an original and 1 copy of the Stage 2 cost proposal information as described above. All original cost proposals must have the original signature of the institution's authorized signatory.

Hard copy cost proposals using U.S. Mail or courier service shall be sent to:

Mailing Address:

Subawards Section
Smithsonian Astrophysical
Observatory
60 Garden Street, Mail Stop 22
Cambridge, MA 02138-1516

Courier Delivery (e.g. FedEx):

Subawards Section
Smithsonian Astrophysical
Observatory
100 Acorn Park Drive, Mail Stop
22
Cambridge, MA 02140-2302
617-495-7421

Detailed instructions for preparation of the Cover Page can be found at:

http://www.cfa.harvard.edu/spp/sp/forms/CP_Cover_Instruct.html

Detailed instructions for preparation of the Budget Form and PDF files of the Budget Justification can be found at:

http://www.cfa.harvard.edu/spp/sp/forms/Budget_Instruct.html

Note that changes to the science proposal will not be allowed or considered in Stage 2.

For Joint Proposals, each organization will separately fund the observations performed with the respective satellite depending on the availability of funds. The PI will need to submit both their observation specifications and a cost proposal to the relevant organization, following their schedule and using their forms. Cost proposals for all approved *Chandra* programs, including those awarded time as part of the joint proposal process will be due in accordance with the deadline listed in [Table 1](#). *XMM-Newton*-approved projects may be requested to submit their *Chandra* cost proposals early due to the earlier allocation dates. See [Chapter 5](#), Joint Observing Projects, for additional information.

10.4 Evaluation of Cost Proposals

The PIs of approved science proposals with US-based PIs and/or Co-Is will receive written notification of the allocated budget amount. The allocated budget is based on the

amount of approved *Chandra* time, the number of targets approved and an evaluation of the level of effort required to complete the data analysis and interpretation phase of the project, the funding eligibility of the Science PI and, in the case of joint proposals, whether or not *Chandra* is the primary facility. For a joint proposal where *Chandra* is not the primary facility, the budget allocation will be reduced. In the case of an Archival Research or Theory/Modeling proposal, the allocation is based upon the budget proposed by the PI, the scientific/technical rating and the availability of funds. The relative value of any highly rated proposals for Archival or Theory/Modeling Research will be considered against the perceived value of proposals for new observations, taking into account the critical resources of available funds and the amount of *Chandra* observing time. The Stage 2 proposals will be reviewed for: the total cost of the investigation, including cost realism and reasonableness in the context of the anticipated level of effort required to carry out the investigation successfully, and the total proposed cost in relation to available funds. Awards will be made at the allocated budget amount or the amount requested in the cost proposal, whichever is less. Cost proposals exceeding the allocated budget amount will not be considered and the award will be made at the allocated budget amount.

10.5 Selection

After receipt and review of Stage 2 proposals, selection will be made based on the Stage 1 evaluation of scientific merit and technical feasibility and the Stage 2 evaluation of proposed costs. Based on the totality of these evaluations, a recommended set of cost proposals will be delivered to the Selecting Official for final selection and award. Given the submission of proposals of sufficient merit, it is anticipated that approximately 200 investigations, including those for Archival Research and Theory/Modeling Research, will be recommended for selection. The CXC reserves the right to offer selections at a reduced level of cost and/or observing time from that proposed in order to fit within the program constraints. Proposers to this program should further understand that the lack of either monetary or observing time resources are sufficient grounds for not selecting a proposal even though it may have been judged to be of high intrinsic scientific merit.

10.6 Grant Award

The Smithsonian Astrophysical Observatory (SAO) is under contract to NASA to operate the CXC, and therefore CXC grants will be issued and administered by the SAO Subawards Section, with the exception of awards issued to NASA Centers (including JPL) and Other Federal Agencies. For the latter, the NASA Marshall Space Flight Center will be responsible for the transfer of funds as well as the administration of these awards.

It is important to note:

- until an award is made and fully funded, there is no guarantee that the recommended financial resources will be available,
- awards are made to the proposing institution and not directly to the PI.

Those proposers selected for award by the CXC will be notified of the allocated budget amount for their investigation. Revised budgets will not be required to be submitted when the amount approved for funding is within twenty percent (20%) of the proposed amount. However, if there are separately funded Co-Is on the project, the PI must provide the Subawards Section, in writing, the revised information on how funds are to be allocated. In cases where the reallocation of funds will result in a difference exceeding 20% of the original budget submitted by the PI or any individual Co-I, a revised budget will be required to be submitted by that investigator. Awards to winning proposers will be implemented through the issuance of grants. No awards will be funded by the contract mechanism.

Following selection and notification, the CXC and the SAO Subawards Section will communicate formally only with the cost-PI for matters concerning grant awards.

Grants awarded for programs that do not include new *Chandra* observations (e.g., Archival Research and Theory/Modeling projects) will be issued at the beginning of the Cycle, defined as 1 January of the new Cycle. Those grantees that include new *Chandra* observations, including joint projects, will receive their awards when the data from their first observations have been successfully processed and delivered to the PI, or the start of the Cycle, whichever is later. Target of Opportunity awards with more than one approved target may be incrementally funded as each target is successfully observed and the data are released to the PI. Depending on the availability of funds, the award should be received by the recipient institution approximately one-month after the first processed data have been distributed to the PI. It should be noted, however, that, in general, the initial release of awards for a cycle will not take place until January (but see [Section 10.7](#) below).

In unusual cases where the PI requires work to be accomplished prior to the observation, up to 25% of the approved funds can be awarded before the first observation has been taken. If preparatory funds are required, the PI shall submit a written justification to the SAO Subawards Section after the investigator's institution has received notification that it will be receiving funding. Requests for preparatory funding should not be included in the cost proposal.

Awards will be issued with a two-year period-of-performance when requested in the submitted budget. Multi-Cycle Observing Proposals will be issued with a three-year period-of-performance when requested in the submitted budget. Please note that the Code of Federal Regulations, 2 CFR 200.328, Monitoring and Reporting Program Performance, requires that a Program Performance Report be submitted at least annually for all multi-year awards. This Annual Report must be submitted thirty (30) days prior to the end of each twelve-month period as stated in the Report Filing Guide of the Award documents. The eligibility of individual Investigators to receive future multi-year awards will depend

upon recipients' compliance with the Annual Report requirement.

All grants will be administered in accordance with the Terms and Conditions for CXC Observing Program Awards posted at http://www.cfa.harvard.edu/spp/sp/policies/GO_TermsConds.html (see the Terms and Conditions for Cycle 20; the Terms and Conditions for Cycle 21 will be posted at a later date).

10.7 Processing of Cost Proposals

Observations of some new cycle targets may begin in July-August of the previous cycle rather than the typical December timeframe expected for the start of the new cycle's observations. This has resulted in an offset between the availability of new data and the issuing of awards to fund the work on that data for a subset of proposals. Our processing procedures have been modified in order to facilitate funding of the early-observation proposals as soon as possible after the observations are taken, subject to the availability of funds to cover those awards. PIs of science proposals for which observations take place before December 1st may request early award of their funding by contacting the SAO Subawards Section, once their cost proposal has been fully and successfully submitted.

10.8 Contact Information for Cost Proposals

QUESTIONS CONCERNING THE STAGE 2 COST PROPOSALS MAY BE ADDRESSED TO:

Subawards Section
Smithsonian Astrophysical Observatory
60 Garden Street, Mail Stop 22
Cambridge, MA 02138-1516
Email: grants@cfa.harvard.edu
Telephone: 617-496-7705
Fax: 617-495-4224

11 - Appendix: Certifications and Assurances

The following pages contain copies of the two Certifications and one Assurance currently required by U.S. Code from every institution, except from U.S. Federal institutions, submitting a Stage 2 proposal. Note that these individual Certifications and Assurance are included for reference and should not be signed and returned; language is included on the Web-based Cover Page that confirms that these Certification and Assurance requirements are met once the printed copy of the Cover page is signed by the Authorizing Institutional Representative and submitted with the Stage 2 proposal.

11.1 Certification Regarding Debarment, Suspension, and Other Responsibility Matters

Pursuant to Executive Order 12549, Debarment and Suspension, and implemented at 2 CFR Parts 180 and 1880.

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

- a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
- d) Have not within the three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

11.2 Certification Regarding Lobbying for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure

11.3 Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The (institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant") HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) , Title IX of the Education Amendments of 1962 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter call "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and HEREBY GIVE ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognized and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees , and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

11.4 Assurance: Restrictions on Funding Activities with China: Section 532 of PL 113-235

The prospective recipient will not make funds available to develop, design, plan, promulgate, implement, or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company unless such activities are specifically authorized by a law enacted after the date of enactment of this Act or used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by NASA

11.5 Representation: Restrictions on Reporting Waste, Fraud, and Abuse: Section 743 of PL 113-235

The prospective recipient represents that it does not and will not require employees or contractors - who seek to report fraud, waste, or abuse - to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contractors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

11.6 Representation: Regarding Unpaid Corporate Tax Liabilities: Section 744 of PL 113-235

If a corporation, the prospective recipient represents that it has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; unless an agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government.

11.7 Representation: Regarding Corporation Felony Convictions: Section 745 of PL 113-235

If a corporation, the prospective recipient represents that it has not been convicted, or had an officer or agent acting on behalf of the corporation convicted, of a felony criminal violation under any Federal law within the preceding 24 months.