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

Call for Proposals

Cycle 11

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

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Chapter 1 - General Information

1.1 The *Chandra* Program: Call for Proposals

We invite scientists to participate in Cycle 11 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* Education and Public Outreach (EPO) 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 all awards associated with this Call for Proposals (*CfP*) 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. For details, please refer to Chapter 5:

- **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 7.1).
- **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 8) and will also be given an opportunity to submit an Education/Public Outreach (EPO) proposal (Chapter 9).

Table 1.1 Schedule and Deadlines for the *CfP* Cycle

EVENT	DATE
CfP Release	15 December 2008
Science Proposal Deadline (Stage 1)	**6 p.m. EDT, 17 March 2009**
Peer Review	22-26 June 2009
Selected Proposals Announced	Mid July 2009
Budget Deadline (Stage 2)	**6 p.m. EDT, 17 September 2009**
Cost Review	October 2009
Stage 2 Final Selection	November 2009
EPO Electronic Deadline	**5 p.m. EDT, 23 October2009**
EPO Hardcopy Deadline	**4 p.m. EDT, 28 October 2009**
EPO Review	December 2009
Cycle 11 Starts	About December 2009

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 participation in the program 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. A separate supplementary *CfP* will be issued following the Stage 1 review to solicit EPO proposals from eligible PIs whose *Chandra* proposals have been selected in Stage 1. 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.

This *CfP* offers the opportunity for the submission of seven different types of proposals (Chapter 4) and two types of EPO proposals.

Types of Science Research Proposals:

1. **General Observing Projects (GO)** involving new *Chandra* observations, generally (but not limited to) requiring less than 300 ksec of observing time (regardless of the number of objects observed);
2. **Large Observing Projects (LP)** involving new *Chandra* observations that require 300 ksec or more (regardless of the number of objects observed) and designated as LPs by the PI;
3. **Very Large Observing Projects (VLP)** involving new *Chandra* observations that require 1 Msec or more (regardless of the number of objects observed) and designated as VLPs by the PI;
4. **Target of Opportunity (TOO) Projects** that are triggered by the occurrence of an unanticipated astrophysical phenomenon (e.g., a supernova);
5. **Joint Observing Projects** that require multi-wavelength sets of data taken by *Chandra* and one or more of the facilities described in Section 4.5;
6. **Archival Research Projects** that use data from the *Chandra* archives or the *Chandra* Source Catalog; and
7. **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.

The observations selected as a result of this *CfP* will be implemented during a one-year period beginning about December 2009. Based on guidelines set by the *Chandra* Observing Policy (Chapter 3), 3.5% (700 ksec) of the on-target observing time available during this cycle is allocated to calibration observations, and 700 ksec is allocated to Director's Discretionary Time (DDT). Following this allocation, 85% of the remaining time is available for General Observations (GO), and 15% is allocated to Guaranteed Time Observations (GTO). The time available for General Observers (including Large and Very Large Projects) under this *CfP* is estimated at about 17 Msec. 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 11

- **Effective Area Files**

  We plan to release updates within about a month of this CfP which will impact the effective areas of all instruments. At that time, we will provide an updated CALDB and Proposers' Observatory Guide (POG).
  The updates will affect PIMMS, Effective Area Viewer and proposal threads which use this software, as well as all CIAO software which accesses instrument effective areas in the CALDB. Information on the status of this update and about the updated effective area files will be posted prominently on the Proposer Webpages and on the Cycle 11 Effective Area download webpages as well as described in the POG. In most cases proposal and observation planning will not be impacted, so that proposers may start by using the tools released with this Cycle 11 CfP. However we recommend that proposers revisit count rate and other estimates or simulations after we have issued the updates and before they submit their proposals.
  The updates involve two issues. The first adjusts the time dependence of the contamination buildup on the ACIS Optical Blocking Filters (OBF) and the second better takes into account a small level of contaminant on the Chandra Telescope (HRMA) that appears to have been present prior to launch.

  1. Contaminant Build up on the ACIS Optical Blocking Filter (OBF): The primary impact of the change in ACIS filter modeling is to allow for more accurate extrapolation of throughput to future times, bringing it in-line with current measurements using the ACIS External Calibration Souce (ECS). However, this change will not remove a current uncertainty in the filter throughput below ~500 eV. At the Carbon K-edge, (284 eV) the uncertainty would lead to systematically high, derived column densities at a level ~1e20 cm^{-2}. For proposers, the lack of an accounting for the additional optical depth results in over-estimated count rates at low energies. We will provide information and guidance to proposers as to the possible effects the remaining uncertainty in the <500 eV absorption will have on predicted feasibility determinations for Chandra proposals with the January release.
  2. HRMA Effective Area: The primary impact of the change in the telescope effective area is a lower effective area at low energies which will result in lower continuum-derived temperatures for high-temperature thermal sources such as clusters of galaxies, steeper derived power law slopes (~0.1) and a few percent higher derived fluxes. In terms of estimates for proposals, those made with the current release (i.e. before the January update) will over-estimate the low energy (<2 keV) count rate.

- **Updates to Joint Time Program**

    - **Spitzer:** With the transition to Spitzer's warm mission, the Chandra review will once again allocate Spitzer time to highly ranked projects whose science requires data from both satellites. The available time is 100 hours. Please see Section 4.5.3 for details.
    - **RXTE:** There will be no joint program with RXTE.
    - **Suzaku:** Starting this cycle, the Chandra review will allocate up to 500 ksecs of Suzaku time to highly ranked projects whose science requires data from both satellites. Please see Section 4.5.6 for details.
    - **HST:** Due to the uncertainty concerning which instruments will be available, proposers are asked to include discussion of alternative(s) in the event that their preferred instrument is not available.

- **RPS updates:**

    - **Constraint/Slew time tool:** Since the number of time-constrained targets is limited at Peer Review by class (Easy, Average and Difficult), RPS now provides a tool which, given the entered target parameters, 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 must be specified in the remarks.
    - **Monitoring Observations:** the specifications for monitoring observations have been simplified to request the observing time, time interval and the maximum and minimum possible time interval for each target.

- **Pitch, Roll, and Visibility Tool (PRoVis):** This target visibility interface has undergone a major upgrade and is no longer packaged with the observation field-of-view visualizer (ObsVis). The new PRoVis adds indicators for the current restricted pitch angle ranges and allows for interactive plot manipulation, parameter updates and cursor readout. PRoVis is provided to assist in planning your proposed observation, in particular to ensure that any requested time constraints are feasible. However, as always, the detailed Mission Planning will be done by the CXC.

- **Maximum Exposure Web Page:** For time-constrained targets which must be uninterrupted, a new web page available (http://cxc.harvard.edu/proposer/maxexpo.html) on the CXC website provides tables allowing estimation of the maximum uninterrupted exposure time for a target observed at a given pitch angle and season.

- **Chandra Source Catalog:** The Catalog is in production and has been publicly accessible since 8 Oct 2008. Archive proposals (Section 4.7.1) making use of the catalog are welcomed.

1.6 Proposal Submission

Science proposals must be submitted electronically via the Remote Proposal System (RPS) software (cxc.harvard.edu/cgi-bin/RPS/Chandra/RPS.pl), available on the CXC website; see Section 5.3 for more details. Cost proposals will also be submitted electronically using forms

available from the CXC website; see Chapter 8 for more details. EPO proposal submission is discussed separately in Chapter 9.

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) 495-7268
FAX: (617) 495-7356
Email: cxchelp@cfa.harvard.edu

For questions concerning the Stage 2 Cost Proposals or EPO proposals, please refer to the information in Chapters 8 and 9.

1.8 Relevant Documents and Web Addresses

Documents recommended to proposers for additional information are listed in Table 1.2. Web addresses, which may be useful in preparing scientific, cost, and EPO proposals in response to this *CfP,* may be found in Table 1.3.

Table 1.2. Useful Documents

DOCUMENT	DESCRIPTION
Proposers' Observatory Guide (POG)	Technical Description of the *Chandra* X-ray Observatory and its Instruments.
MARX Manual	Manual describing the installation and use of the MARX simulation software.
EPO Proposal Guidelines	Guidelines for preparation of EPO proposals.

Table 1.3. Web Addresses

WEB LINK	DESCRIPTION
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 *Chandra* proposal.
http://cxc.harvard.edu/cgi-bin/RPS/Chandra/RPS.pl	Remote Proposal Submission (RPS) Software.
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 Chandra target field of view.
http://cxc.harvard.edu/proposer/maxexpo.html/	MaxExpo: Table and plots allow estimation of the maximum uninterrupted Chandra exposure time
http://cxc.harvard.edu/ciao/download.html	CLI versions of the Proposal Planning Toolkit and ObsVis.
http://cxc.harvard.edu/ciao/	CIAO: Data reduction and analysis software and information
http://cxc.harvard.edu/funding.html	Funding information web pages providing information on *Chandra* grants

OBSERVATION CATALOG:	
WEB LINK	**DESCRIPTION**
http://cda.harvard.edu/chaser/	WebChaSeR: Web interface to catalog search and archive data access.
http://cxc.harvard.edu/targets/	Target Search Page: Non-java search engine.
http://cxc.harvard.edu/DDT/DD_program.html	Information on DDT program and listing of DDT observations to date.

Chapter 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 Mission Science 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-Institüt für Extraterrestriche 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) 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 μsec) 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 ($E/\Delta E$) varies from ~800 at 1.5 keV to ~200 at 6 keV.

The LETG is optimized for high-resolution spectroscopy over the energy bandwidth ~0.09–4 keV. The LETG provides resolving power ~1000 at 0.1 keV and ~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

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 10 years of operation. The orbital period of about 63.5 hours allows for reasonably long, uninterrupted observations of up to ~160 ksec before the instruments have to be powered down as the satellite dips into the radiation belts. Approved longer observations are split into several orbit-sized observations on ingestion into the observation catalog.

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), and Earth (10 degrees). Both the Moon and Earth may be viewed if specially requested and as long as an accurate aspect solution is not required. In order to avoid over-heating the EPHIN charged particle detector or excessive cooling of the propellant lines, the maximum length of an exposure is dependent 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. Current details of these restrictions are given in the Proposers' Observatory Guide (http://cxc.harvard.edu/proposer/POG/index.html). However, pitch angle restrictions are evolving with time and proposers are urged to check the CXC website for current information.

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 the appropriate chapter of the Proposers' Observatory Guide (POG) to become familiar with all *Chandra* observing constraints and to make use of the Observation Visualizer (ObsVis) and PRoVis to see how these constraints might impact their observations.

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.
- Education and Public Outreach: Conducting a program of formal and informal education and 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 Research; Postdoctoral Fellowships; Education and Public Outreach; and other research.
- Prepare and conduct independent peer evaluations of proposals, and select proposals for observation and funding as recommended by the peer reviews.
- 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.

Chapter 3 - Proposal Submission 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 3.3 for additional information.

Each proposal must have one, and only one, Principal Investigator (PI). Any other individuals who are actively involved in the program should be listed as Co-Investigators (Co-Is). The PI is responsible for the scientific and administrative conduct of the project and is the formal contact for all communications with the CXC.

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". (Note: U.S. is defined as the 50 states and the District of Columbia.) This person will have general oversight and responsibility for the budget submissions by the U.S. Co-Is in Stage 2.

3.2 Observing Policy

3.2.1 Chandra Observing Policy

3.2.1.1 Introduction and Scope

This section establishes the observing policy for *Chandra*. This policy reviews and confirms the distribution of observing time among the Guaranteed Time Observers (GTOs) and General Observers (GOs), establishes guidelines for the resolution of conflicts between and within these groups, and sets guidelines for the distribution of observing time.

3.2.1.2 Distribution of Data

Proprietary Data

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 fragmented "Long Duration" observations, the one-year period for each target begins when 90% of the data have been made available to the observer.

Data from unanticipated Targets Of Opportunity (TOO) 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.

Data from Very Large Projects (VLP) will not be proprietary.

3.2.1.3 Distribution of Observing Time

Distribution between GO and GTO - Scientific observations commenced approximately 2 months after launch. X-ray data obtained during these first two months were considered calibration data and were placed directly into the public archive. Subsequent to 22 months after launch, and exclusive of Calibration Time and Director's Discretionary Times, 85% of observing time is provided to GOs and 15% to GTOs.

Distribution among GTOs - In Cycle 11, the GTOs comprise the following: Four Instrument Principal Investigators (IPIs) for the Advanced 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

3.2.1.4 Target Selection and Phasing

Target selection will be carried out in a sequence phased with the timing of the CXC Call for Proposals. Target selection begins with the GTOs specifying targets that over-subscribe the GTO time available. Any GTO-GTO conflict at this point shall be resolved by the GTOs. In the event that a resolution is not achieved, the GTOs shall write proposals in accordance with the *CfP*. After the GO proposals are received, GO-GTO conflicts are identified. In response, GTOs may either (i) replace a conflicted target with an unconflicted backup target or (ii) write a proposal and let the peer review decide the conflict. Targets resulting from peer review of the responses to the *CfP* will be added to the set of unconflicted GTO targets to form the complete approved target list

3.2.1.5 GTO Proposals

GTOs must submit proposals for observing time if there are GO or other GTO proposals for the same target. GTOs are guaranteed to receive their observing time in accordance with Section 3.2.1.3 but cannot reserve targets in advance of the *CfP*.

3.2.1.6 Conflict Resolution

All conflicts (GO-GO, GO-GTO, or GTO-GTO) are decided as part of the peer review process with selection based on scientific merit.

3.2.1.7 Large Projects

Large Projects (see Section 4.2) are those that are designated as such by the proposer and that require more than 300 ksec observing time, whether long-duration observations of single targets or shorter duration observations of multiple targets. Large Projects are encouraged. Up to 6 Msec of observing time will be allocated for Large Projects and Very Large Projects in this cycle. The allocation of time to each type will be determined through peer review.

Large Projects must be proposed to be completed within the time span covered by the *CfP* and cannot reserve targets beyond that time.

3.2.1.8 Very Large Projects

Very Large Projects (see Section 4.3) are those that are designated as such by the proposer and that require 1 Msec or more of observing time. Very Large Projects are encouraged. Up to 6 Msec of observing time will be allocated for Large Projects and Very Large Projects in this cycle. The allocation of time to each type will be determined through peer review. Apart from the minimum amount of observing time and the restriction that data obtained under a Very Large Project enter the public data archive immediately, the approach to, and selection procedures for Large Projects are applicable (Section 3.2.1.6).

3.2.1.9 Targets of Opportunity (TOOs)

There are two categories of Targets of Opportunity: Those that are proposed and selected through peer review (Pre-Approved); and those that simply occur and have been brought to the attention of the Director of the CXC, who may reschedule *Chandra* to obtain the appropriate observations in the best interest of the scientific community.

Pre-Approved TOOs

A proposed TOO may be reserved for a single proposal cycle. The proposer may propose to renew the opportunity in subsequent cycles.

Unanticipated TOOs

Data obtained from an unanticipated TOO are considered Director's Discretionary Time. These data may be kept proprietary for a period not to exceed three months.

3.2.1.9 GO Time Allocation

All GO time allocations will be subject to peer review.

3.2.1.10 GTO Time Allocation

All GTO targets with conflicts will be subject to peer review, consistent with the provisions of Sections 3.2.1.3 and 3.2.1.4.

3.2.1.11 Director's Discretionary Time (DDT)

For this Cycle, 700 ksec of observing time is reserved for Director's Discretionary Time. This allocation includes unanticipated TOOs.

3.2.1.12 Time-Critical Targets

The number of time-constrained observations accepted in any Cycle will be limited to 15% of the total with quotas for the various classes of constraints (section 5.2.8). New or additional constraints may not be imposed by the observer after the proposal deadline. Please note that an observation is defined as a single observation of a target. Monitoring observations are counted based on the number of repeat visits. Long observations (>80 ksec) will be divided into several 80 ksec-long observations for the purpose of counting constraints.

3.2.2 Procedures Concerning TOOs and DDTs

The deep orbit of *Chandra* permits reasonable access to any TOO. The minimum planned response time for a TOO is approximately 24 hours. The total number of TOOs performed is limited by operational and manpower constraints.

Requests either to initiate a Pre-Approved TOO or to propose a new one are made to the CXC Director, who decides whether to interrupt the timeline and conduct the observation. The investigator is required to submit the appropriate web-based form. The form, a Request for Observation (RfO), can be found at the CXC home page (http://cxc.harvard.edu/) and submitted via the WWW.

The response to a TOO will be classified according to the time delay between trigger and observation. The faster the *Chandra* response, the more difficult and the more limited the number of TOOs allowed. TOO follow-up observations (observations following a TOO within a few weeks) will either count as TOOs (for rapid response) or time critical observations (Section 4.4).

3.2.2.1 Pre-Approved TOOs

TOOs generated by a peer review-approved proposal are similar in spirit to the *IUE* or *RXTE* in that time is allocated to the proposal, but the time is unscheduled. To initiate the scheduling process, the investigator is required to specify in the RfO how the trigger condition has been met.

TOOs disrupt the timeline, and it is possible that the TOO conflicts with a time-critical observation or with another TOO. In such situations, the CXC Director will determine priorities. Any disrupted preplanned observation will, however, ultimately be accomplished if feasible.

3.2.2.2 Unanticipated TOOs

A request for an unanticipated TOO observation is made directly to the CXC Director as part of the DDT program. A RfO must be submitted. The procedure is as follows:

- The proposer must determine whether the target falls within the portion of the sky visible to *Chandra*. The PRoVis tool can generate such information.
- The proposer must establish whether the target can be detected using *Chandra*. The proposal planning tools can be used for this purpose.

- The proposer must address the following questions:
  - Why is the science from the observation important, and why not simply propose during the next *Chandra CfP*?
  - Is there an impending, previously approved, *Chandra* observation that can accomplish the objectives?
  - How urgent is the TOO? Must the observation be done immediately?
  - If relevant, what is the likelihood of additional transient behavior (i.e., does the phenomenon recur?)? If recurrence is likely, what is the consequence if the target is not observed until the next occurrence?
  - If data already exist in the archive, why is another observation with *Chandra* necessary?
  - What is the proposed or suggested detector configuration?

If the proposed observation is accepted, the CXC will create a new timeline 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.

3.2.2.3 Director's Discretionary Time (DDT)

General requests for DDT must follow the same procedure as required for an unanticipated TOO. The procedure is described in Section 3.2.2.2.

- The proposer may apply for a short period of time (at most 3 months) during which the data are considered proprietary.
- A limited amount of funding is available to support US-based PIs/Co-Is of DDT observations. This funding may be requested using the standard cost proposal form on the CXC website (http://cxc.harvard.edu/).

3.2.3 Criteria for Completeness and Data Quality

3.2.3.1 Completeness

In general, an observation, defined as corresponding to a unique sequence number, will be considered complete when 90% or more of the requested time has been observed, as determined by the Good Time Interval (GTI) in the processed data relative to the approved time. (Previous policy set this threshold at 80%).

The following 4 exceptions are identified:

1. TOO and DDT observations with GTI less than 90% of the requested time may be declared complete by the CXC Director or his 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 observing 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 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 ks remaining, no additional time will be scheduled even

if the 90% GTI to requested time 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 ks 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.

3.2.3.2 Data Quality Due to High Background

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 ≥ 50% of the observation, the target may be observed again for a period of time equal to the amount of time lost due to the high background. If the target is extended and the background increase is ≥ 5 times nominal for ≥ 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 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" causes only 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.

3.2.3.3 Data Quality - 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 unique case of a previously unknown transient appearing in the field-of-view will be handled case-by-case.

3.3 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, non-U.S. researchers who propose investigations requiring new *Chandra* observations must seek support through their own national funding agencies.

The *Chandra* data archive is open to the public; to obtain data of interest to his/her project, an interested researcher need only access the CXC website (http://cxc.harvard.edu) or contact the *Chandra* X-ray Center for assistance. U.S. researchers who wish to analyze archival data or undertake theoretical investigations may apply for funding for their research through this *CfP*. The PI of an archive/theory proposal must be affiliated with a U.S.-based Institution. 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.

Non-U.S. Principal Investigators are not eligible to submit an EPO supplementary proposal.

3.4 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.

3.5 *Chandra* Observation Catalog: Checking for 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 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).

The review panels will be provided with a list of previous X-ray observations of proposed targets. Information on the various ways to access the *Chandra* Observation Catalog may be found in Chapter 6.

3.6 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 (Section 4.5). 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 joint proposal or some archive or survey proposals, funding for ground-based supporting observations should not exceed 10% of the total request.

Chapter 4 - Proposal Types

Observations to be carried out with *Chandra* during the 12 months of Cycle 11 science operations will be selected from proposals submitted to the CXC in response to this *CfP*.

There are seven types of proposals that may be submitted in response to this *CfP*; they are detailed in the following sections. In addition, Director's Discretionary Time (DDT) proposals for observations that cannot be completed in, or cannot wait for, the usual proposal cycle may be submitted at any time, see Section 4.8.

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 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 distributed over multiple proposal cycles will not be considered. 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 Observing Projects

Large Projects are defined as requiring 300 ksec of observing time or more, regardless of whether they include long-duration observations of single targets or shorter duration observations of many targets. Large Projects must be designated as such by the PI and are encouraged. Up to 6 Msec of the observing time in this Cycle is reserved for Large and Very Large Projects, subject to the submission of proposals of high scientific merit.

The observations proposed for Large Projects must be completed within the 12-month period covered by this *CfP*. In the case of target conflicts with a small proposal, the Selecting Official, based on the recommendation of the peer review, may award the target in question to the smaller proposal. In this case, the proposer of the Large Project may always make use of data taken for another project once they are made public.

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

4.3 Very Large Observing Projects

Very Large Observing Projects are defined as requiring 1 Msec of observing time or more, regardless of whether they include long-duration observations of single targets or shorter duration observations of many targets. This category is open to all science topics and must be

designated as such by the PI. Up to 6 Msec of the observing time in this cycle is reserved for Large and Very Large Projects, subject to the submission of proposals of high scientific merit.

The observations proposed for Very Large Projects must be completed within the period covered by this *CfP*. Very Large Projects will be evaluated as described for Large Projects in Section 4.2. Target conflicts will also be treated similarly.

Observations approved as part of a Very Large Project will have no proprietary time associated with them, and the data will be made public immediately.

Projects that plan to deliver products, such as source catalogs, high fidelity data products, or software to the community are encouraged to outline these plans in the proposal. A modest funding allocation may be requested in the Stage 2 Cost proposal to facilitate the delivery of such products.

4.4 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 in order 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. 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, have comparable capabilities and at times 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.

For this Cycle's GO programs (including Large and Very Large Projects), it is estimated that the Observatory can support a maximum of:

# OBSVNS (Note a)	RESPONSE TIME (days)
8	<1-4
20	4-12
26	12-30
26	>30

Note: Follow-up observations count against this allocation if they have a rapid response. If they have a slower response, they count as time-constrained observations.

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. Proposals may ***not*** contain a mixture of TOO and non-TOO targets.

Given the high operational impact of TOOs, no constraints or follow-up observations over and above those included in the proposal RPS forms and recommended by the peer review will be accepted. All follow-up observations whose timing depends on events close to the trigger need to be included in the original proposal forms and will be counted as separate TOOs with category determined by the requested time delay between the event and the observation. All trigger criteria must be specified in the appropriate fields on the RPS form. Follow-up observations that have a longer lead time (> 12 days) are classified as constrained observations.

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. 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 (about December 2009). If the current cycle TOO is triggered, the PI/observer should indicate on the trigger form (RfO) whether or not the observation should cancel the TOO observation proposed/accepted for the new Cycle.

4.5 Joint Observing Projects

Joint Observing Projects may be proposed as follows with the intent to address those situations where data (not necessarily simultaneous) from more than one facility are required to meet the scientific objectives of the proposal. In addition to time on *Chandra*, time may be requested and awarded via this *CfP* on one or more of the five facilities described below. It is the proposer's responsibility to provide a technical justification for all observing facilities included in the proposal. A request for simultaneous or otherwise time-constrained observations must be scientifically justified, and the technical justification must include consideration of the relative visibility of the target by all requested facilities. Please note that coordination with ground-based observatories other than NRAO is only available as a preference and will be carried out on a best-effort basis. No time on other facilities will be allocated without accompanying *Chandra* time on the same target, except where noted.

4.5.1 Chandra/Hubble Space Telescope (HST) Observations

This *CfP* solicits proposals to allow observers interested in using both the Hubble Space Telescope (HST) and the CXO to achieve their scientific objectives to submit a single proposal in response to either HST or *Chandra CfP*s. The only criteria above and beyond the usual review criteria are that the project must be fundamentally of a multi-wavelength nature and that both sets of data are required to meet the science goals. Simultaneous *Chandra* and HST observations should be requested only if necessary to achieve the scientific goals. Proposers responding to this *CfP* may request, and be awarded, HST observing time in conjunction with their *Chandra* observations. One hundred orbits of HST observing time are available for this opportunity. Conversely, up to 400 ksec of *Chandra* observing time are available for award as part of the response to HST research opportunities. However, the *Chandra* project can award no more than one HST Target of Opportunity (TOO) observation with a turn-around time shorter than two weeks.

Proposers wishing to take advantage of the CXO-HST arrangements are encouraged to submit their proposal to the Observatory announcement that represents the prime science. The expertise required to best appreciate and evaluate the proposals will be weighted toward the wavelength band of the primary observatory. Demonstration of the technical feasibility for both observatories to produce the necessary data is required, including consideration of the relative visibility of the target(s) to both facilities for the case of time-constrained observations. Technical information about HST is available at http://www.stsci.edu/. General policies for HST observations are described in the latest HST Call for Proposals, available at http://www.stsci.edu/hst/proposing/documents/cp/cp_cover.html. The Space Telescope Science Institute is prepared to assist observers proposing in response to this opportunity. Questions should be addressed to help@stsci.edu.

Proposers should carefully consult the status of HST observing capabilities at http://www.stsci.edu/hst/. In the event that the proposed HST instruments are not available, in their science justification, proposers should explain backup plans and/or the impact on their science program.

4.5.2 Chandra/XMM-Newton Observations

If a science project requires observations with both XMM-Newton, sponsored by the European Space Agency, and the *Chandra* X-ray Observatory, then a single proposal may be submitted to request time on both Observatories to either the most recent XMM-Newton Announcement of Opportunity or to this Chandra *CfP* so that it is unnecessary to submit proposals to two separate reviews.

By agreement with the *Chandra* Project, the XMM-Newton Project may award up to 400 ksec of *Chandra* observing time. Similarly, the *Chandra* Project may award up to 400 ksec of XMM-Newton time. The time will be awarded only for highly ranked proposals that require use of both observatories and shall not apply to usage of archival data. The only criterion above and beyond the usual review criteria is that both sets of data are required to meet the primary science goals. Proposers should take special care in justifying both the scientific and technical reasons for requesting observing time on both missions. Simultaneous *Chandra* and XMM-Newton observations should be requested only if necessary to achieve the scientific goals. No Targets of Opportunity, either pre-Approved or unanticipated, will be considered for this cooperative program. For this *CfP*, no XMM-Newton time will be allocated without the need for *Chandra* time to complete the proposed investigation.

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/) for proposals that are approved, both projects will perform detailed feasibility checks. Both projects reserve 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. Note that simultaneous longer-duration observations with XMM-Newton that require *Chandra* satellite pitch angles violating the conditions discussed in Section 2.3 may not be feasible. Any observation(s) deemed to be not performable as indicated above would cause revocation of observations on both facilities.

4.5.3 Chandra-Spitzer Observations

If your science project requires observations from both the Spitzer Space Telescope and the Chandra X-ray Observatory, you can submit a single proposal to request time on both observatories to the Chandra Cycle-11 review. This avoids the "double jeopardy" of having to submit proposals to two separate reviews.

NASA has directed the Spitzer project to plan for approximately two years of 'warm' Spitzer observations using the 3.6 and 4.5 micron channels of the IRAC instrument after Spitzer's cryogen runs out in spring 2009. For Chandra Cycle 11, the CXC will be able to award up to 100 hours of Spitzer time to highly rated proposals. The only criteria above and beyond the usual review criteria are that the project is fundamentally of a multi-wavelength nature and that both sets of data are required to meet the science goals. Simultaneous Chandra and Spitzer observations should be requested only if necessary to achieve the scientific goals. Spitzer General Observer time will only be awarded in conjunction with Chandra observations and

should not be proposed for in conjunction with an Archival Research or Theory/Modeling Proposal.

In the Chandra Cycle 11 review, no more than 50 hours of the 100 hours of Spitzer observing time available will be awarded to an individual proposal. No TOOs will be approved. Evaluation of the technical feasibility is the responsibility of the observer, who should review the Spitzer documentation (http://ssc.spitzer.caltech.edu/propkit) or consult with the Spitzer Science Center (SSC) HelpDesk (help@spitzer.caltech.edu). For proposals that are approved, the SSC will perform detailed feasibility checks. The SSC reserves the right to reject any previously approved observation that proves to be non-feasible, impossible to schedule, and/or dangerous to the Spitzer instruments. Any Spitzer observations that prove infeasible or impossible could jeopardize the overall science program and may cause revocation of the corresponding CXO observations. Duplicate Spitzer observations may also be rejected by the SSC.

Proposers requesting joint Chandra-Spitzer observations must provide a full and comprehensive technical justification for the Spitzer portion of their program. This justification must include:

- The requested IRAC observing time, justification for the requested time, target fluxes, required sensitivity, and assumptions made in the derivation of these quantities.
- Information on whether the observations are time-critical; indicate whether the observations must be coordinated in a way that affects scheduling of either Chandra or Spitzer observations.

Technical documentation about the Spitzer Space Telescope is available from the Spitzer Science Center (SSC) website, which also provides access to the Spitzer HelpDesk (email: help@spitzer.caltech.edu). The primary document is the Spitzer Observer's Manual, available, together with other relevant documents, from the Proposal Kit Web Page. Spitzer strongly recommends that observers proposing Spitzer observations estimate the required observing time using Spot, the Spitzer proposal planning software, also available from the online proposal kit (http://ssc.spitzer.caltech.edu/propkit).

Proposers requesting joint CXO-Spitzer observations must specify whether they were awarded Spitzer time in a previous cycle for similar or related observations.

4.5.4 Chandra/National Optical Astronomy Observatory (NOAO) Observations

By agreement with NOAO, proposers interested in making use of observing facilities available through NOAO (except Keck and Magellan) as part of their *Chandra* science may submit a single observing or archival research proposal in response to this *CfP*. The award of NOAO time will be made to highly ranked *Chandra* proposals and will be subject to approval by the NOAO Director.

The primary criterion for the award of NOAO time is that both *Chandra* and NOAO data are required to meet the scientific objectives of the proposal. Both 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 (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 time available for this opportunity. NOAO observing time will be divided roughly equally between the Fall and Spring semesters covered by the *Chandra* cycle.

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

- Indicate the choice of NOAO telescope(s) and instrument(s) (dates of availability for the various telescopes and instruments can be found on the web at: http://www.noao.edu/gateway/nasa/
- Enter the total estimated observing time for each telescope/instrument combination
- Specify the number of nights for each semester during which time will be required and include any observing constraints (dates, moon phase, synchronous or synoptic observations, etc.)
- Include a full and comprehensive scientific and technical justification for the requested NOAO observing time; and
- Provide a plan for the public release of the NOAO data within one year of the observation date.

Demonstration of the technical feasibility of the proposed NOAO observations is the responsibility of the proposer. Detailed technical information concerning NOAO facilities may be found at http://www.noao.edu.

If approved for NOAO time, successful PIs will be required to submit the standard NOAO forms providing detailed observing information appropriate to the telescope and instrument combination(s) awarded. NOAO will perform feasibility checks on the proposed observations and reserves the right to reject any observation determined to be unfeasible for any reason. Such a rejection could jeopardize the entire proposed science program and impact the award of the *Chandra* observing time as well.

In addition, for NOAO time on Gemini (only), successful PIs will be required to submit a full scientific justification to NOAO on the standard NOAO proposal form. This justification will be reviewed by the regular NOAO Time Allocation Committee in order to determine into which Gemini queue band the observations will be placed.

4.5.5 Chandra/National Radio Astronomy Observatory (NRAO) Observations

By agreement with NRAO, proposers interested in making use of the NRAO Very Large Array (VLA), Very Long Baseline Array (VLBA) and Green Bank Telescope (GBT) facilities as part of their *Chandra* science may submit a single proposal in response to this *CfP*. The award of NRAO time will be made to highly ranked *Chandra* proposals and will be subject to approval by the NRAO Director.

The primary criterion for the award of NRAO time is that both *Chandra* and NRAO datasets are essential to meet the scientific objectives of the proposal. No NRAO time will be allocated without *Chandra* time.

NRAO plans 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 11 such that all VLA configurations are available. A VLA configuration schedule is published at http://www.vla.nrao.edu/genpub/configs/.

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

- Enter the total estimated NRAO observing time in hours
- Indicate the choice of NRAO telescope(s) (VLA, VLBA and/or GBT);

- Include in your scientific justification a full and comprehensive scientific and technical justification for the requested NRAO configuration(s) and observing time.

Be aware that some *Chandra* targets might not require new NRAO observations because the joint science goals can be met using:

- Non-proprietary archival data from the VLA or VLBA available at http://archive.nrao.edu/archive/e2earchive.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).

Detailed technical information concerning the NRAO telescopes can be found at http://www.vla.nrao.edu/astro/ (VLA), http://www.vlba.nrao.edu/astro/ (VLBA), and http://www.gb.nrao.edu/ (GBT). In particular, technical information required for a proposal can be found at http://www.vla.nrao.edu/astro/guides/vlas/current/ (VLA), http://www.vlba.nrao.edu/astro/obstatus/current/obssum.html (VLBA), and http://www.gb.nrao.edu/gbtprops/man/GBTpg/GBTpg_tf.html (GBT).

If approved for NRAO time, successful PIs will be contacted by the NRAO Scheduling Officers. The successful PIs will then be responsible for submitting observing scripts to NRAO. The deadline for the receipt of these scripts will be communicated by the Scheduling Officers. NRAO will perform final feasibility checks on these scripts and reserves the right to reject any observation determined to be infeasible for any reason. Such a rejection could jeopardize the success of the joint science program.

4.5.6 Chandra/Suzaku Observations

By agreement with the Suzaku Project, proposers interested in making use of Suzaku time as part of their Chandra science investigation may submit a single proposal in response to this Chandra CfP. The award of Suzaku time will be made to highly ranked Chandra proposals and will be subject to approval by the Suzaku Project.

The primary criterion for the award of Suzaku time is that both Chandra and Suzaku data are required to meet the scientific objectives of the proposal. Suzaku time will not be awarded without accompanying Chandra observing time.

The Suzaku Project is making available up to 500 ksec of Suzaku observing time available to such joint science proposals. Coordinated observations are allowed, if judged feasible. Chandra Cycle 11 is expected to overlap with Suzaku Cycle 5, a 1-year observing program which begins in 2010 April.

A maximum of 75ksec on Suzaku can be time-constrained for science reasons, including coordinated observations, roll, phase or window constraints, or Targets of Opportunity. No TOO requiring less than 4 days response time will be considered.

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

1. Enter the total requested Suzaku observing time in the relevant Chandra RPS box; and
2. Include a full and comprehensive scientific and technical justification for the requested Suzaku observing time, including the expected count rates (from simulations or previous Suzaku observations), and the desired observing modes.

It is the responsibility of the proposer to demonstrate the feasibility of the proposed Suzaku observation. Detailed technical information concerning Suzaku may be found at http://www.astro.isas.jaxa.jp/suzaku/. The Suzaku Guest Observer Facility and Project Scientist will make feasibility assessments of the proposed observations independently of the Chandra review. Proposed Suzaku observations determined to be infeasible will be rejected. Such a rejection could jeopardize the entire proposed science program and impact the award of the Chandra observing time as well.

If Suzaku time is approved, successful PIs will then be required to submit the standard Suzaku cover and target forms to the Suzaku Guest Observer Facility via RPS to provide the required information about observing strategy and instrument configurations in a form amenable to the Suzaku scheduling software.

Limited funds are available to US-based researchers to support Suzaku analysis through the Suzaku Stage 2 (budget) proposals process. Suzaku datasets obtained under this agreement will be proprietary to the PI for one year after the performance of the observation, and will subsequently be released publicly via the HEASARC.

4.6 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 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. 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 investigation will be made available to the astronomical community, and on what time scale the results are expected.

4.7 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 RPS form. A PI may link an archival research proposal with an observing proposal to extend an existing sample to perform the same science. 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 may also be accessed through this website (see Section 3.5). All on-orbit calibration data are placed directly in the archive. Data from Director's Discretionary Time (DDT) observations (see Section 4.8) 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. VLP data have no proprietary period and are placed in the archive coincident with receipt by the PI.

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.

4.7.1 Archive Proposals and the Chandra Source Catalog

The Chandra Source Catalog is currently in production, and the first official release of the catalog is expected to take place in January 2009. We will accept archival proposals which make use of the catalog as all/part of the planned science program.The first release of the catalog includes information about sources detected in public ACIS imaging observations from roughly the first eight years of the Chandra mission. Sources detected in public HRC-I imaging observations are also expected to be included.

The catalog includes sources detected with a minimum 3 sigma significance level above the background (typically corresponding to about 10 net source counts on-axis and roughly 20-30 net source counts off-axis). In the first release of the catalog, if multiple observations of the same field exist, those observations are not co-added prior to performing source detection. Instead, source detection is performed on each observation individually, so that the 3 sigma threshold applies to detections from each observation separately.

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. The catalog is constructed from pointed observations obtained using Chandra; it is not an all-sky catalog, and does not include sources detected to a uniform depth. The first release of the catalog includes only point and compact sources, with observed spatial extents < ~30 arcsec. Sources larger than this will not be detected with the current catalog algorithms. Observations of fields containing extended sources have been excluded from the catalog, or in some cases only a part of the field has been included.

For each detected source and observation, the catalog includes the following properties:

- Source position and errors,

- Aperture photometry fluxes and errors in several energy bands,
- Spectral hardness ratios,
- Power-law and thermal black-body spectral fits for bright (> 250 counts) sources,
- Source variability measures (Gregory-Loredo and K-S tests),
- Estimate of source extent compared to the local point spread function.

In addition, a number of file-based data products will be produced for each observation and source individually. These include full field images, an exposure map, and a limiting sensitivity map; source region and PSF images, source-region exposure map, source light curve, a source-region photon event list; and for ACIS a source spectrum, ARF, and RMF.

These files will be in formats suitable for further analysis in CIAO.

For more information on the Chandra Source Catalog, please refer to the public catalog web pages, which are available at http://cxc.cfa.harvard.edu/csc/index.html

4.8 Proposals for Director's Discretionary Time

Unanticipated Targets of Opportunity or those that cannot wait for the next proposal cycle may be proposed for observation using Director's Discretionary Time (DDT) at any time. Proposals for DDT must be submitted electronically through RPS as described in Section 5.3. Note that the RPS form for DDT is different from that for ordinary proposals. The DDT form may be found on the CXC website by selecting the "Proposer" button and then "Targets of Opportunity" and "Director's Discretionary Time" (http://cxc.harvard.edu/soft/RPS/Chandra_RfO.html). More information is available in Section 3.2.

Chapter 5 - Proposal Preparation and Submission Instructions

5.1 Overview and Schedule of Process

Science 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 will then be invited to submit a cost proposal for the Stage 2 review (Chapter 8) and will also be given an opportunity to submit an Education and Public Outreach (EPO) proposal (Chapter 9). A subset of the Stage 1 science peer review panel will evaluate those cost proposals requesting more than a fair share budget and provide a list of those recommended for selection to the Selection Official. A separate peer review panel will be convened to review the EPO proposals.

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' Observatory Guide (POG) (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 5.2.8

5.2 Stage 1 Research Proposal Details

5.2.1 Proposal Content

The Stage 1 proposal must include:

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

- CV/Bibliography for the PI (one-page, optional).

The page limits are listed in Table 5.2. The proposal must be submitted electronically (see Section 5.3 for proposal submission instructions). The information will be entered into a database that will be used in cataloging and evaluating proposals, as well as for scheduling those observations that are selected for implementation. The forms must be completed in the requested format. Cost sections and EPO proposals 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 and EPO proposals will be considered as part of the Stage 2 process.

5.2.2 Cover Pages

Although a signature block is included on the General Form, institutional endorsements 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 list of selected targets and corresponding abstracts will be made public once the results have been announced.

5.2.3 Target Forms

The RPS 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 (above the Remarks) to ensure that they are implemented. **The information in the RPS forms will take precedence over any contradictory/different information described in the proposal science justification.** Information included in the science justification and not in the RPS 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.

PIs should ensure that information on target forms is correct. Incorrect information will jeopardize the acceptance of a proposal.

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/epoch J2000. Upon proposal submission, the RPS 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 crosscheck. If 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, (http://cxc.harvard.edu/helpdesk/) as soon as possible, to confirm the coordinates or make any necessary corrections. Proposers requesting more than one target, or multiple pointings at a single target, should assign a Target Number that indicates the order of priority. Prioritization will aid the Selecting Official in the

event that a reduction in observing time is recommended. In such cases, every attempt will be made to honor the highest priority targets. If a large number of targets are requested (more than 5), the email version of the RPS is the recommended method of preparing the forms.

5.2.4 Science Objectives

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. 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.

5.2.5 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 of 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. To maximize the scientific utility of the Chandra archive, proposers are encouraged to select for imaging the maximum number of ACIS CCDs that their core science allows. Please see the Proposers' Observatory Guide (POG, Section 6.20.2) concerning optional ACIS chips.

5.2.6 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.

5.2.7 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 on the relevant observatory(ries) in their proposals, this must include the visibility of the target by the observatory(ries) in question (particularly in the case of a request for simultaneous observations).

5.2.8 Constrained Observations

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. Such constraints are discussed in section 3.4.2 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 (see Section 2.3). Thus, proposers should carefully consider the impact of a request for a constrained observation and provide scientific justification. Proposers should note the potential impact on time-constrained observations produced by interruption by a TOO or other unanticipated events. 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. 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 RPS 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 PRoVis 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 (as directed in section 2.3). The maximum uninterrupted exposure time for a target observed at a given pitch angle can be estimated from the MaxExpo page (http://cxc.harvard.edu.proposer/maxexpo.html).

The grading scheme for constrained observations is shown in Table 5.1 Cycle quotas are also listed; ~80% of these will be available to the Chandra peer review.

Note that a constrained observation that has different grades according to Table 5.1 will be given the most restrictive grade. However, an observation that has many constraints will only be counted once towards the appropriate quota. Specifically:

1. 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.
2. An observation constrained in multiple ways is counted in the highest (i.e. most difficult) category resulting from considering each constraint type separately.
3. In the case of long observations (>80 ksec), each 80 ksec increment or fraction thereof will count as a separate observation against the quotas allowed for the relevant category of difficulty.
4. Constrained grid observations will also be accounted in 80 ksec units for the purpose of counting constraints (Section 7.1).

Constraints should be specified to fit the science not the classification. It is noteworthy that the Easy category had the highest oversubscription ratio in Cycle 10 (7:1) while the Average category was undersubscribed.

If observers wish to assess the classification of their observations in complex or ambiguous cases, please contact the CXC HelpDesk (section 6.1.2 of the *CfP*), allowing adequate time before the proposal deadline for a response to be made.

Table 5.1. Grading Scheme for Constrained Observations

Constrain	**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 (days)	Period	<20	20-60	>60
Monitor Interval	(2)	>5	2-5	<2
Group	(3)	>10	4-10	<4
	Annual Quota (4)	**45**	**35**	**20**

(1) The constraint refers to the number of days at which a target can remain within the declared roll angle constraint. This can be estimated using the PRoVis tool available on the Proposer Webpage. Only nominal roll values should be used since off-nominal rolls have very brief dwell times.

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

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

Where Imin and Imax are the minimum and maximum proposed intervals, min(Imax) is the smallest specified Imax of all proposed intervals and max(T) is the largest exposure time of any proposed observation

(3) The dimensionless parameter for Group Observations is: (TIME INTERVAL FOR THE GROUP) / (TOTAL DURATION OF OBSERVATIONS IN GROUP)

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

5.2.9 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.

5.2.10 Previous Chandra Programs

The PI and Observing Investigator (if any) must provide a list of all previous *Chandra* Observing, Archival Research, Theory/Modeling, or GTO programs in which they were involved along with the status of the program(s) and any resulting publications (1 page maximum, see Table 5.2). Additional Co-Is that cannot be listed in the scientific justification may be included in this page.

5.2.11 PI/CV Bibliography

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

5.2.12 Observation Preferences

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 can only be requested by formal specification on RPS forms, not through requests after a proposal is accepted. 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 request observations that force targets to be observed at unfavorable pitch angles will not be met. Proposers should use the PRoVis 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 (as described in Section 2.3). 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.

5.2.13 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 5.2. Excess pages will be removed from proposals before the peer review. Proposals that violate the font or margin regulations will be rejected. All information required to complete and understand 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 or Very Large Projects (designated as such by the PI and requesting at least 300 ksec or at least 1 Msec, respectively) or as Joint Projects (CXO/HST, CXO/NOAO, CXO/XMM, CXO/NRAO and CXO/RXTE), 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 guidelines apply:

- Each side of a printed paper sheet containing text or illustration will count as one page;
- Text may be either single or double-spaced, but must use an easily read font having no more than 15 characters per inch (minimum 11 pt); and
- Each page must have at least 1-inch margins on all sides of a standard 8.5 x 11 inches (US-letter sized) sheet.

Proposers are encouraged to use the LaTex template provided at the CXC website, (http://cxc.harvard.edu/proposer/) that conforms to these requirements.

Proposal format violations: Proposals that exceed the page limit will have all excess pages removed. Proposals that violate the font size will be rejected and returned to the PI.

Table 5.2. Proposal Content and Page Limit

SECTION (Note a)	PAGE LIMIT	COMMENTS
Cover Page Form	1	No other cover needed
General Form	1	No other cover needed
Scientific Justification and Technical Feasibility: • General, TOO, Archival Research, or Theory/Modeling • Large, Very Large, or 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 *Chandra* Programs	1	List of previous programs of PI and Observing Investigator (if any) including publications (see notes)
PI's CV/Bibliography (optional)	1	Emphasis should be on relevant experience and publications

Notes:

a. The proposal forms may be accessed via the Remote Proposal System (RPS) software at http://cxc.harvard.edu/.

b. Those with a large number of prior programs may include minimal information but should include proposal number, PI, Observers, references (one per line).

5.2.14 Proposal Preparation Tools

Proposal preparation and simulation tools are available on the World Wide Web as listed in Table 1.3. The proposer is urged to make use of these tools well before the deadline for proposal submission.

5.3 Proposal Submission Instructions

5.3.1 Electronic Submission Required

All Stage 1 proposals are required to be submitted electronically according to the instructions given below and on the CXC website (http://cxc.harvard.edu/cgi-bin/RPS/Chandra/RPS.pl). The file including the science justification and previous *Chandra* program list (and, optionally, a CV) must be in PDF format. Electronic submission facilitates efficient proposal processing and reduces the likelihood of transcription error in the various databases. Proposers who do not have access to electronic communications should call the *Chandra* Director's Office, (617) 495-7268.

5.3.2 Remote Proposal System (RPS)

Stage 1 proposals must be submitted electronically by either of two methods, both of which make use of the Remote Proposal System (RPS) software. More detailed information concerning the *Chandra* RPS system may be found on the CXC website (http://cxc.harvard.edu/cgi-bin/RPS/Chandra/RPS.pl).

The proposer may access this system either through the World Wide Web (WWW) or by email as follows:

- **The WWW version of the *Chandra* RPS** provides a form-based interface. Access is linked to the *Chandra* home page at http://cxc.harvard.edu/ (select "Proposer" link http://cxc.harvard.edu/proposer/. Help files for each form and each input parameter are available as hypertext links, and the user has complete control over the entries.
- **The interface to the email version of the *Chandra* RPS** needs to be initiated by the proposer. Instructions may be obtained by sending an email message to: rps@head.cfa.harvard.edu with:
  - <BEGIN>
  - <OPTION=HELP>
  - <END>

  in the body. In this case, the science justification PDF file should be submitted using ftp to cxc.harvard.edu following the instructions provided by RPS.
- The email interface is recommended for proposals including more than a few targets.
- Independent of interface, the process will, at a minimum, involve the following steps for all proposals:
- Preparing the Scientific Justification and Technical Feasibility, preparing the list of previous *Chandra* programs and (optionally) the PI CV/bibliography, including any figures, and converting the document to a single PDF file. Please be sure to print out the PDF file to ensure it is readable before submitting it;
- Providing the information for, and completing, the Cover Page and General Form. For proposals requiring new observations, the Target Form(s), including constraints and remarks where needed;
- Verifying that the information on the Cover Page Form, the General Form, and (as appropriate) the Target Form(s) is correct;
- Submitting the Cover Page Form, the General Form, and (as appropriate) the Target Form(s), following which RPS assigns a proposal number;
- Submitting the PDF file of the Science Justification and Technical Feasibility, list of previous programs (and optional CV), etc.; and
- Receiving an email acknowledging receipt of your proposal and notification of the proposal number and of any errors found via crosscheck of the target information with the SIMBAD and/or RASS catalog and with the *Chandra* Observation Catalog. For gratings observations this check will confirm/not the presence of an RASS source close to the target position. Under the assumption that most gratings targets are RASS sources, this minimizes the chance of incorrect coordinates.
- Should an error in your coordinates or target list be found by the above check, your proposal should be corrected and re-submitted.

5.3.3 Help After Submitting: When You Have Discovered A Mistake

If the 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 member of the CXC. 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 sent to the CXC in a letter or email of explanation. If appropriate, this letter 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.

5.3.4 Color Figures

The default distribution of proposals to the peer reviewers will be electronic in PDF format. Black and white hardcopies will be provided only at the specific request of individual reviewers. It is therefore no longer necessary to submit multiple hardcopies that include color figures. However, since color figures do not always reproduce well in black and white, 10 color hardcopies may be submitted to the CXC, by the proposal deadline, for distribution to reviewers who request hardcopies if the PI so wishes.

5.3.5 EPO Proposals

Specific instructions for electronic submission of supplementary EPO proposals will be described in a separate *CfP* and will be posted on the CXC website.

Chapter 6 - 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/.

6.1 On-line Resources

6.1.1 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 can be found at the "Instruments and Calibration" (http://cxc.harvard.edu/cal/) link on the CXC web page.

A hardcopy version of the POG is available upon request to the CXC HelpDesk (http://cxc.harvard.edu/helpdesk/).

6.1.2 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. 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. Once you have logged in, you can send a query (or "ticket") by clicking on the "Open a New Ticket". New users will be asked to enter more information (this only needs to be done once). HelpDesk also allows you to search previous tickets that are not private. More detailed information is given on the interface. Users can also email the CXC HelpDesk: cxchelp@head.cfa.harvard.edu.

In the last few days before and after the proposal deadline, we activate a dedicated email address for problems with proposal submission. This address should be used for proposal submission purposes only and is not active for most of the year. This dedicated email address helps the CDO to deal more efficiently with the very large volume of correspondence we receive around the proposal deadline. Dates for which the address is switched on will be posted on the proposer page at the CXC website. The proposal help email address is: prophelp@head.cfa.harvard.edu.

Proposal queries submitted via the HelpDesk interface and cxchelp email alias will always be answered.

6.1.3 *Searching the Chandra Archives and Downloading Data*

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

There is also a downloadable version of *ChaSeR* that has somewhat more sophisticated search capabilities than the web version. *ChaSeR* is available from the *Chandra* Data Archive (http://cxc.harvard.edu/cda/).

ChaSeR includes a precession tool and provides quick access to images. *ChaSeR* is extensively documented on the archive pages of the CXC website. In particular, there are detailed instructions for installation on many systems and a useful FAQ page. The user is referred to these sources for installation instructions as well as usage tips, updates, and more complete documentation.

The Target Pages (http://cxc.harvard.edu/targets/) is another tool that can be used to search the *Chandra* Data Archive (but not to download archival data). Detailed target lists can be found at http://cxc.harvard.edu/target_lists/index.html.

An additional tool of interest is the processing status tool, which provides detailed and comprehensive information about the processing of each observation. The processing status tool can be accessed via the Target Search Pages (click on the ObsID on the search results page). The tool can also be accessed from http://cxc.harvard.edu/soft/op/op_pst.html.

6.1.4 *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/). These responses should be used for proposal preparation only; they should NOT be used for data analysis!

6.2 Proposal Preparation Software

The CXC provides several software tools to aid in proposal preparation.

6.2.1 *Precess, Colden, Dates, ObVis, PRoVis, PIMMS, and Effective Area and PSF Viewers*

These tools perform the following functions:

- 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 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 and mark the locations of sources from various X-ray catalogs. This tool has been substantially rewritten for Cycle 11 and includes additional functionality, for example manipulation of multiple fields-of-view for planning of grids of observations.
- PRoVis 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 is a substantially updated version of WebVis, now including indication of ranges of pitch angle with restricted exposure times and 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 missions. PIMMS also uses simple spectral models (blackbody, bremsstrahlung, power, Raymond-Smith) to calculate count rates or fluxes.
- Effective Area Viewer is a web-based tool that displays the on-axis Effective Area provided 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); (see http://cxc.harvard.edu/cgi-bin/build_viewer.cgi?psf)

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 example, command line versions of *Precess*, *Colden*, *Dates,* and *PIMMS* allow for a list of input parameters in a text file.

The command-line versions of these tools are distributed with *CIAO*. *Chandra* users with *CIAO* installed can run these routines in the same way as all other *CIAO* tools (CLI tool names: prop_pimms, prop_colden, prop_dates, prop_precess, and obsvis). Standard *CIAO* helpfiles are available.

6.2.2 Software Helpfiles and Proposal Threads

Helpfiles for proposal-related software and proposal "Threads" are available from the CXC proposer site (http://cxc.harvard.edu/proposer/). Helpfiles are available over the web as HTML files, in PDF format, and as part of the *CIAO* "ahelp" system. Proposal Threads are modeled on *CIAO* threads and give step-by-step examples of how to perform feasibility calculations, fill in RPS forms, and submit a proposal. They are intended primarily (but not exclusively) for less experienced *Chandra* users.

6.2.3 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.

6.2.4 CIAO

CIAO 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 an interactive spatial/spectral fitting package that forms part of *CIAO*. It can also be used for simple simulations of *Chandra* spectra.

6.2.5 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.

Chapter 7 - Stage 1: Scientific and Technical Proposal Evaluation, Selection and Implementation

7.1 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 and achieving the goals of the most recent NASA strategic plans. For observing proposals, the degree to which the objectives have been satisfied by one or more previous observations will be evaluated. (Section 3.5 gives instructions for obtaining information on completed and planned observations).
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 that 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 scans), 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.

The peer review will be conducted using a number of panels, each responsible for proposals directed at particular scientific topics. Large and Very 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.

An observing efficiency including slew and settle time will be used to determine the amount of time for observations. To evaluate time required by a given proposal, a “slew tax” of 1.5 ksec will be added to each proposed target within the peer review process; this added time closely represents the average observatory slew and set-up time required for each observation. The Peer Review takes the slew tax into account along with the requested time when assessing the resources requested to accomplish a proposed research project. For a large set of short exposures this slew tax can substantially increase the “cost” in terms of time needed for a project. In addition:

- 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) will be assessed at 0.5 ksec.

- A grid of pointings will be assembled into one or more groups comprised of a set of closely spaced pointings with maximum exposure time per group of 80 ksec, including the slew tax.
- The value of "n" is the number of observations that can be done including the slew tax without exceeding 80 ksec. Proposals requesting more than 80 ksec (including slew tax) will be assessed slew tax in several groups, the first observation of each group will be charged 1.5ksec slew tax.
- Proposers should set the RPS flag "*Is this observation part of a grid survey?"* to be "Y" (yes). The formula for slew tax is included here to enable proposers to understand the total time that they are effectively requesting; however, the time on target is all that the proposers should include in their proposal.
- The CXC will compute the slew tax and provide the information to the Peer Review.

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 the individual observations have roll angles within particular tolerances. The number of constrained observations accounted 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 80 ksecs and each group will be charged as 1 constrained observation, classified according to the scheme in Section 5.2.8. Please refer to the thread Slew Tax and Constrained Observations for Grids (http://cxc.harvard.edu/proposer/threads/slewtax/) for examples.

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.

7.2 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 also 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 results of the Stage 2 Cost review are 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 observation has been successfully performed and the data provided to them by the CXC.

7.3 Implementation

Once the observing program is approved, the targets are transferred to the *Chandra* Observation Catalog 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). 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, initiated in Cycle 9 and 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) at the CXC and carried out by the observers. USINT contacts each observer to request a detailed check of all observing parameters. An observation can only be released for final scheduling in the Short-term Schedule (STS, see below) once this second check has been completed.

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 ~30% 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 3.2 for more details).

For information on proprietary data rights, see Section 3.2.1.2. 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.

Chapter 8 - Stage 2: Cost Proposal Submission, Evaluation and Allocation

8.1 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 $10.4M. In the case of Co-Is seeking funding, it is planned for awards to be issued directly to the Co-I's institution in order to avoid double charging of institutional overheads.

Any investigator whose proposal receives sufficiently high evaluations during the Stage 1 review and that requires financial support is invited to submit a Stage 2 Cost Proposal. See Section 8.3 for the eligibility requirements for funding.

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. Optional Education and Public Outreach (EPO) proposals will also be solicited from successful Stage 1 proposers (see Chapter 9). Stage 2 and EPO proposals will be due in accordance with the deadlines listed in Table 1.1.

8.2 Content and Submission of Cost Proposals

Each PI and Co-I shall submit, through their institution, their Stage 2 Cost Proposals both electronically, using the Remote Proposal System (RPS), and via hard copy.

- Electronic Submission:

  Each proposing PI shall submit, through their 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 Section J of 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 to SAO through their institution (one proposal per institution) using the RPS System.

  Budget Justification and Current and Pending Support files should be in PDF format preferably combined into a single file.

  Grants will be issued directly to the Co-I's institution to avoid double charging of institutional overheads.

- Hard Copy Submission:

  NOTE: There are changes in the procedures for the submission of hard copy Cost Proposals. Each proposing institution is required to submit an original and one (1) copy of the Stage 2 Cost Proposal to the SAO Subawards Section.

  The hard copy of your cost proposal may be obtained by following the instructions for RPS. In cases where the use of RPS is not possible, hardcopies may be generated using the PDF forms available at http://cfa.harvard.edu/spp/sp/forms/GO_forms.html.

  The original and one (1) copy of the Stage 2 Cost Proposal for each separately funded Co-I at a different institution shall be submitted by the Co-I Institution directly to the SAO Subawards Section. Cover pages must have the original signature of the institution's authorized signatory.

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 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, the *Chandra* X-ray Center, the Space Telescope Science Institute (http://www.stsci.edu/institute/) the XMM-Newton Guest Observer Facility (http://heasarc.gsfc.nasa.gov/docs/xmm/xmmgof.html), and the Spitzer Science Center (http://ssc.spitzer.caltech.edu/propkit) will separately fund the observations performed with the appropriate satellite. 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 HST or Spitzer proposal process will be due in accordance with the deadline listed in Table 1.1 XMM-Newton-approved projects may be requested to submit their cost proposals early due to the earlier allocation dates. Cost proposals must 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. Group email addresses, e.g., sponsoredprojects@institution.edu, are not acceptable.
2. A budget using the *Chandra* Cost Proposal Budget Form (see the item "Cost Proposal and Funding Information" at (http://cxc.harvard.edu/). A Cost Proposal for each funded Co-I must be included. The PI's Budget Form must include the totals of the Co-I's budgets as line items in Section J of the Budget Form.
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, justification for any funded line item including any major purchases such as workstations, and justification of foreign or domestic travel. Funding for observing proposals is normally issued after the data from the first successful observation is released to the PI. Funding for Archival Research, Theory/Modeling, and

Joint Observing Projects is issued at the beginning of the observing cycle. If the PI requires more than a one-year period-of-performance, he/she may request a longer period-of-performance (up to two years) in his/her proposal, with supporting justification. 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 is released to the PI.

4. A written certification for any workstation and general-purpose equipment costing $5,000 or more. The certification form can be found at http://www.cfa.harvard.edu/spp/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, provide the following information: 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 include a statement to that effect.
6. A copy of the applicant institution's federally-approved Indirect Cost (IDC) Rate Agreement (required for PI institution and any Co-I institutions). Note – If multiple proposals are being submitted by the same institution, then one copy of the IDC Rate Agreement per applicant institution is sufficient.
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**
- **EQUIPMENT:** Provide estimated costs for workstations and other equipment. List items separately. Explain the need for items costing more than $5,000. Describe the basis for estimated cost. General-purpose equipment is not allowable as a direct cost unless specifically approved by the SAO Grant Officer. **Any general-purpose equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the proposed research and a written certification that the equipment will be used exclusively for research activities.** The certification form can be found at http://www.cfa.harvard.edu/spp/forms/GO_forms.html

(See below for additional information on workstation requests.)

- **TRAVEL:** Describe the purpose of the proposed travel, specifically who will be traveling, the departure location and destination, estimated airfare and per diem rates, length of trip, the relationship of the travel to the grant, and the basis of cost estimate. [Note: For Nonprofit Nonacademic Organizations, foreign travel destinations listed on the proposal must be specific. If additional foreign travel is added or if the destination changes after the proposal has been approved, prior approval from the SAO Grant Subawards Section is required by the Code of Federal Regulations, 2 CFR Part 230.51.e, Foreign Travel (OMB Circular A-122).]
- **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 8.2, Item 6 above.
- **SUBTOTAL:** Enter the sum of items above.
- **CO-I AWARDS:** Provide name, institution, and total dollar amount for each Co-I requesting funds.
- **PROJECT TOTAL:** Total cost of support being requested for the project.

Allowability of the above costs is dependent upon conformance with the Terms and Conditions for CXC Observing Program Awards (see http://www.cfa.harvard.edu/spp/polices/grants.html for the Terms and Conditions currently being used for Cycle 10; the Terms and Conditions for Cycle 11 will be posted at a later date).

While proposals from investigators working at for-profit organizations are eligible for funding, profit is unallowable; however, management fees of up to 3% may be permitted on a case-by-case basis.

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.

Note that when a cost proposal requests funds for both PI and Co-Is at different institutions, each Co-I must also submit a complete cost proposal package (all six items described above) and these must be submitted with the PI cost proposal as one package. In the case of a non-U.S. PI (ineligible for funding) and U.S. Co-Is, the U.S. Co-Is can apply for funding but one Co-I must take the lead as "Administrative PI" for the cost proposal package. This person will have overall oversight and responsibility for the budget submissions of the U.S. Co-Is. The Cost Proposal Cover Page Form for both the PI and all Co-Is requesting funding must have the original signature of the institution's authorized signatory. Faxed or scanned signatures are not acceptable.

To assure compatibility with NASA's data systems, requested workstation 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/download.html.

Requests for workstations must be justified in the Budget Justification. Workstations are not allowable as a direct cost unless specifically justified. Any equipment purchase requested to be

made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed, why it cannot be purchased with indirect funds, and a statement certifying that the equipment will be used exclusively for research and not for general business or administrative purposes (http://www.cfa.harvard.edu/spp/forms/GO_forms.html). Regardless of whether the request is through direct or indirect costs, the justification must be provided and should briefly describe the computing capabilities that exist or are expected to exist at the proposers institution during the period in which the proposed research would be performed and then explain the impact to the proposed work if the request for the additional workstation is declined. The budget request for workstations must be clearly stated on the Budget Form as a line item.

Further information and instructions can be found on the CXC website: http://cxc.harvard.edu/funding.html.

8.3 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 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 by U.S. institutions.

(Note: U.S. is defined as the 50 states and the District of Columbia.) These definitions include U.S. Co-Is on observing projects with non-U.S. PIs.

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.

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.

8.3.1 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 Sections as soon as possible to arrange for their award to be transferred to the new institution with the minimum of delay. Please see Section XIX, "Transferring the Award" of the SAO terms and Conditions for details of this process.

Investigators whose affiliation changes from a US to a non-US 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 is should contact the CXC Helpdesk to discuss this matter.

Investigators who move from a foreign 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.

8.4 Evaluation of Budgets

Each approved science proposal with US-based PIs and/or Co-Is will be allocated a fair share budget. Starting with Cycle 11, Cost Proposals including a budget which is at or less than the fair share allocation will not be subject to an external review. Cost Proposals requesting a budget above the fair share allocation will be reviewed by a subset of the Stage 1 peer review panelists. PIs who request a budget higher than the fair share allocation should include a detailed justification for the requested funding level in their proposal. The fair share budget allocation is based on the scientific/technical rating of the proposed investigation by the peer review, the amount of allocated *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 project with a foreign science PI or for a joint proposal where Chandra is not the primary facility, the fair share will be reduced. In the case of an Archival Research or Theory/Modeling proposal, the fair share 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 CXO observing time. The criteria used in the Stage 2 evaluation of the proposals will be: 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.

The EPO proposals will undergo a separate review (see Chapter 9). The submission or not of an EPO proposal has no relevance or bearing on the budget for the research proposal.

8.5 Selection

After receipt and evaluation 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 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.

8.6 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 that until an award is made, there is no guarantee that the recommended financial resources will be available and that 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 recommended funding level 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 will communicate formally only with the PI, or, in the event that the PI is unavailable, the CXC will communicate with the person identified in the proposal as the Observing Investigator. It will be the PI's responsibility to respond to any questions concerning observational constraints or configurations.

Grants awarded for programs that do not include new *Chandra* observations (e.g., Archival Research and Theory/Modeling projects) as well as Joint Observing projects will be issued at the beginning of the Cycle, defined at 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 is released to the PI. Depending on the availability of funds, the Award should arrive approximately one-month after the first processed data has been distributed to the PI. A copy of the Award will go to the Investigator cited in the approved proposal, with the original Award documents sent via overnight courier to the Recipient Institution.

Funding for observing awards is normally issued after the data from the first successful observation is released to the PI. Funding for Archival Research, Theory/Modeling, and Joint Observing awards is issued at the beginning of the observing cycle. If the PI requires more than a one-year period-of-performance, he/she may request a longer period-of-performance (up to two years) in his/her proposal, with supporting justification. A one-year no-cost extension is available upon request should work not be completed during the initial award period. Second one-year extensions may also be granted when justified.

We will continue to issue awards with a two-year period-of-performance when requested in the submitted budget. Please note that the Code of Federal Regulations, 2 CFR Part 215 Section 215.51, 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. The eligibility of individual Investigators to receive future multi-year awards will depend upon recipients' compliance with the Annual Report requirement.

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.

All grants will be administered in accordance with the Terms and Conditions for CXC Observing Program Awards (see or the Terms and Conditions currently being used for Cycle 10; the Terms and Conditions for Cycle 11 will be posted at a later date).

8.7 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

Technical questions regarding the Remote Proposal System (RPS) should be directed to the CXC HelpDesk at http://cxc.harvard.edu/helpdesk/ or by email to "cxchelp@cfa.harvard.edu"

Address for courier (e.g., FedEx) delivery of hardcopies:

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

Chapter 9 – Education and Public Outreach

NASA's Education programs support NASA's mission and core values. NASA undertakes a leading role to inspire interest in science, technology, engineering, and mathematics (STEM) and to make significant impacts in engaging underserved and underrepresented communities in STEM. NASA is committed to fostering education efforts that inspire, engage, and educate this Nation's future workforce, the next generation of scientists, explorers, and innovators.

A separate CfP for supplemental Education and Public Outreach (EPO) proposals will be issued. EPO proposals will be solicited only from those US-based proposers whose research proposals have been recommended for an award in Chandra Cycle 11. We strongly encourage every successful US-based Stage 1 Chandra proposer to consider submitting an Education and Public Outreach (EPO) supplemental proposal.

The Chandra Cycle 11 EPO Grant Program's Call for Proposals will be released on the Chandra website http://cxc.harvard.edu/ about July 2009. Instructions and guidelines for preparing supplemental EPO proposals and the criteria for evaluating them will be posted, along with links to the relevant Science Mission Directorate Education sites and documents. The deadline for submitting an electronic copy of the Chandra EPO proposal will be 5 p.m. EDT on Friday, 23 October 2009 (with the hardcopy deadline being 4 p.m. EDT on Wednesday, 28 October 2009).

EPO Contact Information

All questions concerning EPO *CfP* should be addressed to the CXC EPO office:

Kathleen Lestition, EPO Coordinator
Chandra EPO Office
Smithsonian Astrophysical Observatory
60 Garden Street, Mail Stop 6
Cambridge, MA 02138-1516
Telephone: 617-495-7399
FAX: 617-495-7356
Email: klestition@cfa.harvard.edu

Appendix A - 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.

A.1 Certification Regarding Debarment, Suspension, and Other Responsibility Matters

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 2 CFR Part 1800.

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

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

2. 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 statues or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. 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

4. 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.

A.2 Certification Regarding Lobbying (Applicable to Awards Exceeding $100,000).

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.

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 this 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.

The undersigned shall require that the language of this certification be included in the award documents for all sub awards at all tiers (including subcontracts, sub grants, and contracts under grants, loans, and cooperative agreements) and that all sub recipients 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.

A.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 1972 (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 called "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 gives 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 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 recognizes 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.