

Announcement of Chandra Legacy Program Call for White Papers

In its nearly 25-year history, the Chandra X-ray Observatory has revolutionized X-ray astronomy. The sub-arcsecond angular resolution, combined with the ACIS and HRC instruments plus LETG and HETG spectrometers, have enabled observations that have broken new ground in studies of objects and phenomena ranging from planets in our own Solar System to extremely distant black holes. Each year brings exciting results along with highly oversubscribed requests for new observations. With Chandra's legacy secure, it is nonetheless necessary to ask this question:

Are there major initiatives (science challenges) for which the capabilities of Chandra — alone or in combination with other cutting-edge facilities — are absolutely required to address fundamental questions about our current understanding of the components and evolution of the Universe, and which would represent a crucial missed opportunity if they are not completed during Chandra's lifetime?

It is with this question in mind that we announce plans for a **Chandra Legacy Program (CLP)**. The goal of the program is to provide the community with crucial results that only Chandra can produce and that will break new scientific ground and/or complement new and far-reaching observations in other wavelength regimes. Development of the CLP will be a multi-stage process that begins with this Announcement/Call for White Papers to select the topics for the CLP. A subsequent, fully open, Call for Proposals will be used to select the actual targets for implementing the CLP. Programs that can be accomplished under existing Chandra Calls are not a focus of this program.

The nominal time available for this initiative is 6 Ms, which will come from a combination of the Director's Discretionary Time program, the Guaranteed Time Observer program, and the General Observer program. Requests for more than 6 Ms may be submitted along with a more compelling justification for consideration during the review process. Observational programs for up to 6 Ms will be completed within two years in order to maximize future opportunities as well as potential synergies with other observatories. Programs exceeding 6 Ms will likely require additional time to complete.

Essential considerations in defining the program include:

- Use of Chandra's unique capabilities (e.g., high angular resolution, high-resolution grating spectroscopy, faint point-source sensitivity).
- Science themes in support of the 2020 Decadal Survey (see below).
- Synergies with current observing facilities.
- Stage-setting for next-generation X-ray facilities and investigations.

Note that selection of programs and targets for the CLP is not a selection of a specific group to carry out each selected project nor a commitment of funding to any particular group. All interested parties will have the opportunity to submit proposals to relevant Archival Programs to fund analyses and studies based on the CLP data.

Chandra Legacy Program Science Themes

The report from the 2020 Decadal Survey — “Pathways to Discovery in Astronomy and Astrophysics for the 2020s” — identified three broad science themes that “promise to address some of the most fundamental and profound questions in our exploration of the cosmos.” Chandra has unique capabilities that can contribute to each of these themes:

- Worlds and Suns in Context – *“revolutionary advances in our observations of exoplanets and stars and aims to understand their formation, evolution, and interconnected nature, and to characterize other solar systems, including potentially habitable analogs to our own.”*
- New Messengers and New Physics – *“exploit the new observational tools of gravitational waves and particles, along with temporal monitoring of the sky across the electromagnetic spectrum and wide-area surveys from the ultraviolet and visible to microwave and radio to probe some of the most energetic processes in the universe and also address the nature of dark matter, dark energy, and cosmological inflation.”*
- Cosmic Ecosystems – *“observations and modeling of the stars, galaxies, and the gas and energetic processes that couple their formation, evolution, and destinies.”*

With this Announcement, the astronomy community is asked to assess Chandra’s unique capabilities in the context of these Decadal themes. The goal is to identify crucial Chandra observations that will provide essential contributions to the broad-reaching advancement of our understanding of current outstanding questions in the field, while also posing new questions for future observational and theoretical investigations.

Virtually all topics within the Decadal themes require multiwavelength studies. Key facilities in the astrophysics portfolio provide unique capabilities for these studies. Identifying CLP themes that leverage or complement the contributions from other facilities can help make the best use of existing tools to address the science questions. While programs for which Chandra is of overwhelming importance are of prime interest for the CLP, we also encourage identification of programs for which Chandra will contribute in fundamental and necessary ways to such multi-facility investigations.

Finally, Chandra’s unique observing capabilities represent a resource that may not be supplanted for a decade or longer. These capabilities will thus help lay the groundwork for next-generation studies. CLP themes that help establish this foundation, and provide guidance for the future of X-ray astrophysics, are of critical importance.

Chandra Legacy Program Process

Development of the CLP begins with this Announcement/Call for White Papers from the astronomy community to present observing programs aimed at addressing Chandra legacy science as defined above. Each white paper must describe a cohesive program comprised of up to 6 Ms of Chandra observing time (with programs requesting more than 6 Ms providing additional, compelling justification). The white papers should discuss the science objectives in detail, explain how they will address fundamental and profound questions about the cosmos, and explicitly demonstrate the utilization of unique Chandra capabilities for these purposes, while addressing why the annual Chandra Calls for Proposals are unable to accomplish the goals laid out in the white papers. The white papers may also provide a sample list of targets with observing modes and notional observing times to assist the Review Committee in assessing the feasibility of the program and rating the potential scientific impact. White papers include a cover page (not counted) and then are limited to 5 pages in length (see detailed instructions at: <https://cxc.harvard.edu/CLP/>), with an additional page for references, plus up to 2 optional, additional pages with notional target information such as target names, RA and Dec, instrument and spectrometer of choice, mode if applicable, and potential exposure times. The deadline for submission of white papers is Monday January 22, 2024 (details at link above). Authors of white papers must follow procedures laid out for Dual Anonymous Chandra Reviews (information available at link above).

Due to operational constraints, observations solicited for the CLP will primarily use the ACIS instrument (with or without an HETG or LETG spectrometer). “Enhancement” observations requiring the use of the High Resolution Camera may also be requested (for up to 10% of the time with a cap of 500 ks). In addition, observations may not require more than 1.2 Ms at ecliptic latitudes $|b| > 55^\circ$. CLP white papers may include requests for observing time on other facilities that have joint time agreements in place for the Chandra General Observer program. We anticipate that up to 14% of the Chandra Cycle 26 and 27 joint observing time on these other facilities will be available for CLP programs (more details at link above). To facilitate completion, CLP program(s) may request at most only limited and simple observing constraints (e.g., monitoring at regular intervals with reasonable tolerances). Target of Opportunity will not be considered for the CLP.

The programs presented in the white papers will undergo a brief technical review and then be assessed by a Review Committee of ~10-12 experts drawn from panel chairs and pundits from recent Chandra peer reviews, supplemented by additional reviewers from the community at-large as appropriate. The Review Committee will recommend a CLP composed of a set of 1-3 programs (in full or in part) from the submitted white papers. The report from the Review Committee will provide specific objectives for the recommended CLP along with the rationale connecting those objectives to overarching questions identified by the 2020 Decadal Survey. Final selection for the CLP is the responsibility of the Chandra X-ray Center Director. Should the Review Committee or

Director conclude that no submitted white papers meet the standards desired for the CLP, no programs will be selected.

Results from this stage of the CLP process will be announced around February 20, 2024, approximately 1 month before the due date for Cycle 26 Chandra proposals. Along with the announcement of the topic(s) comprising the CLP, additional guidelines will be provided in a call for proposals to enable all interested members of the astronomical community to generate and submit detailed CLP proposals with a nominal due date of April 15, 2024. Proposals will be required to explicitly demonstrate how they address the themes and scientific objectives recommended by the initial CLP Review Committee and specified in this call for proposals. An additional review (likely by a subset of the initial CLP Review Committee) will recommend a final set of targets, instruments, modes, and exposure times for selection by the CXC Director. Following selection, targets from the CLP will be folded into the Chandra long-term schedule with a goal of completion of the full program within two years. Data from the CLP will be made publicly available immediately upon completion of each observing segment (ObsID).

We repeat that selection of programs and targets for the CLP is not a selection of a specific group to carry out each selected project nor a commitment of funding to any particular group. All interested parties will have the opportunity to submit proposals to relevant Archival Programs to fund analyses and studies based on the CLP data.

Additional information and details for submitting questions and white papers provided at: <https://cxc.harvard.edu/CLP/>

Current Schedule:

CLP Announcement/Call for White Papers – Nov 21, 2023

White Papers Due – Jan 22, 2024

Announcement of White Paper Review Results & Call for CLP Proposals – Feb 20, 2024

Cycle 26 Chandra Proposal Due – Mar 14, 2024

Formal CLP Proposals Due – Apr 15, 2024

Announcement of Final CLP Selections and Targets – May 15, 2024

Sources for CLP observing time:

The 6 Ms of observing time for the CLP will be derived from a combination of time from the GO, GTO, and DDT programs, with the following specific contributions, spanning Cycles 26 and 27: GO - 4 Ms (~12%), GTO - 1 Ms (~19%), DDT - 1 Ms (~50%), where the percentages refer to the fractional contributions of total time available in those programs over the course of these two Cycles.