Request for Information (RFI)

Technologies for large-area sub-arcsecond X-ray telescopes

General Information

Solicitation Number:	TBD
Agency:	National Aeronautics and Space Administration
Office:	Marshall Space Flight Center
Location:	Office of Procurement
Posted Date:	December 15, 2016
Response Date:	March 31, 2017
Classification Code:	A – Research and Development
NAICS code:	333314 – Optical Instrument and Lens Manufacturing
Notice Type:	Sources Sought
Synopsis:	
Added:	

Synopsis

The NASA Marshall Space Flight Center (MSFC) solicits information from the Government, academic, and industrial communities pertaining to all technology needs for producing grazing-incidence X-ray telescopes with large (several square meter) effective areas and fine (sub-arc second) angular resolution. MSFC seeks this information to assist in assessing current technology capabilities, identifying promising development paths, and evaluating feasibility and schedule for maturing these technologies as part of the X-ray Surveyor (now Lynx) Mission Concept Study. It is anticipated that the 2020 NRC Decadal Survey Committee will use this and other Studies in formulating their recommendation for the priorities for large strategic missions to follow JWST and WFIRST [1]. The X-ray Surveyor Concept Study is being conducted by a MSFC-based Study Office [2] under the leadership of a community-selected Science and Technology Definition Team (STDT) chartered by NASA's Astrophysics Division [3].

The 2016 Physics of the Cosmos Program Annual Technology Report [4] highlights X-ray optics as a Priority 1 key area where significant technology advances are needed to achieve the observational capabilities required to address the major science objectives of X-ray Surveyor. The Report identifies performance goals and objectives for lightweight high-resolution X-ray optics that feature (1) angular resolution of 0.5 arcsecond or better, (2) effective area up to 3 square meters at 1 keV and significant area in the roughly 0.1 to 10 keV range, (3) light weight ($\sim$1 kg/m^2 areal density) mirrors, and (4) low cost ($\sim$1 M\$/m^2 mirror surface area).

Historically, X-ray focusing telescopes have relied on grazing-incidence optics using two re-

flections to bring X rays to a focus. Large effective collecting areas are achieved by nesting multiple co-aligned, co-axial grazing-incidence mirror pairs in order to optimize the available aperture. Consequently, large-effective-area X-ray telescopes will likely require thin (substrate thickness 0.1 mm up to a few mm), lightweight (e.g., glass, silicon or light-weight metal alloy subtrate material) mirrors to achieve a high degree of nesting and acceptably low mass. For such mirrors, angular resolution is affected by many factors. Individual mirrors or substrates may have internal stresses or residual, low- and medium-frequency spatial errors, commonly referred to as figure errors. High-spatial frequency errors (characterized by spatial scales of a few mm and smaller), commonly referred to as micro-roughness or finish, can also impact performance due to scattering or reduction in the reflectivity of applied coatings. Coating-induced stresses, mounting-induced distortions, and alignment errors can further degrade the angular resolution of mirror assemblies consisting of numerous individual mirror elements.

Therefore, in addition to requiring technology that can inexpensively fabricate large numbers of precisely figured thin shells or shell segments, future high-resolution mirror development must show capability to coat and to align and mount precisely formed mirrors, possibly with (static or active) post-fabrication figure correction. Several examples of technologies currently under development for producing precision figured thin x-ray mirrors are reviewed in O'Dell et al. (2014) [5] and are discussed in presentations specific to the X-ray Surveyor Concept Study [6].

These reveal that the large area high-resolution telescope needed to achieve the science goals of X-ray Surveyor will require bringing together several approaches and various disciplines. Specifically, X-ray Surveyor will require technologies including

- Inexpensively fabricating large numbers of precisely-figured thin mirrors consisting of either hundreds of integral shells or thousands of segemented substrates.
- Coating techniques to deposit uniform coatings to enhance X-ray reflectivity; these coatings will likely be of single films or depositions of alternating layers of material (i.e, multilayers) where the properties of the coatings must balance factors like x-ray reflectivity, stability and stress.
- Metrology techniques, including those that work at x-ray wavelengths, to accurately measure the figure of the (coated) substrates and to align individual mirrors into a final optics assembly.
- Methods to align and mount the precisely formed mirrors, possibly with (static or

active) post-fabrication figure correction.

MSFC solicits information pertaining to these and related technological challenges for timely and cost-effective production of lightweight, large-area sub-arcsecond grazing-incidence X-ray telescopes. The information obtained through this RFI will be compiled, summarized, and made available to the X-ray Surveyor STDT who will identify and assess technology gaps in order to inform NASA's programmatic funding priorities and will develop a detailed technology roadmap for delivery to the Decadal Survey.

Requested Information

Recognizing that robust development and maturation of technologies for X-ray telescopes is crucial to a compelling and executable X-ray Surveyor mission concept, this RFI seeks input that will help define (1) the current state of the art in terms of capability and readiness, (2) the feasibility and schedule for raising the corresponding Technology Readiness Level (TRL), and (3) new and emerging technologies and/or significant engineering alternatives.

This RFI seeks input on the following topics: high-resolution light-weight mirror fabrication processes, mirror coating processes and methods for stress mitigation; static and active post-fabrication figure correction techniques; mounting and assembly schemes; alignment; metrology; and mass production approaches to any of these topics.

Responses should provide, at a minimum, (1) a description of the technology, what technological challenge it addresses and how it confronts that challenge in the context of the desired sub-arcsecond, large-area X-ray optic (2) an estimate of the current Technology Readiness Level and a justification for that estimate (3) a plan and schedule, including cost, for advancing the technology to TRL 6.

This RFI is not a solicitation for the procurement of goods or services. The Government is under no obligation to issue any such solicitation in the future as a result of this RFI. The Government will not pay for any costs associated with responding to this RFI.

Instructions for Responding to this RFI

All responses to this RFI must be in the form of a PDF document submitted in electronic form via email to tyler.c.cochran@nasa.gov. The body of the email message should identify and provide the name, institutional or organizational affiliation, address, telephone number and email address of the primary point-of-contact for the response. Other key institutions, companies and individuals collaborating on the RFI response should also be identified. Responses must be received by the due date specified above, shall use 12-pt font or larger, and

should not exceed ten (10) pages in length.

Material suitable for full and open distribution is requested and submittals shall be considered approved by the providing organization to be suitable for full and open distribution. Responders should not submit proprietary information, export controlled information (including EAR and ITAR restricted information), nor confidential information in response to this RFI unless such information is clearly segregated and marked as Proprietary or Confidential. Information identified by a respondent as Proprietary or Confidential will be kept confidential to the full extent that it is protected by law and regulations and will not be publicly disclosed.

NASA Clause 1852.215-84, Ombudsman, is applicable. The Center Ombudsman for this acquisition can be found at https://prod.nais.nasa.gov/pub/pub_library/Omb.html.

No solicitation exists; therefore, do not request a copy of this solicitation. If a soliciation is released, it will be synopsized in the FedBizOpps and on the NASA Acquisition Internet Service (NAIS). The Internet site, or URL, for the NASA/MSFC Business Opportunities home page is http://prod.nais.nasa .gov/cgi-bin/eps/bizops.cgi?gr=D&pin=62 It is the offeror's responsibility to monitor the Internet site for the release of solicitations and amendments (if any). Potential offerors will be responsible for downloading their own copy of solicitations and amendments, if any.

References

[1] https://smd-prod.s3.amazonaws.com/science-green/s3fs-public/atoms/files/White_Paper-Planning_for_the_2020_Decadal_Survey-signed.pdf

[2] https://smd-prod.s3.amazonaws.com/science-green/s3fs-public/atoms/files/Establishment_of_Large_Astrophysics_Mission_Concept_Studies-2015-11-30.pdf

[3] https://smd-prod.s3.amazonaws.com/science-green/s3fs-public/atoms/files/Mission_Concept_Study_and_Definition_Team_Charter-V1_2015-12-28.pdf

[4] http://pcos.gsfc.nasa.gov/technology/documents/PCOS2016PATR.pdf

[5] O'Dell, S. L. et al. SPIE 9208, 05 (2014)

[6] http://wwwastro.msfc.nasa.gov/lynx/

Point of Contact(s): Tyler Cochran, Contracting Officer, Phone 256-961-7454, Email: tyler.c.cochran@nasa.

Contracting Office Address:
NASA/George C. Marshall Space Flight Center, Office of Procurement
Marshall Space Flight Center, Alabama 35812
United States

Place of Performance:
TBD
United States

Primary Point of Contact.:
Tyler Cochran,
Contracting Officer
tyler.c.cochran@nasa.gov
Phone: 256-961-7454