

ARCHIVED REPORT

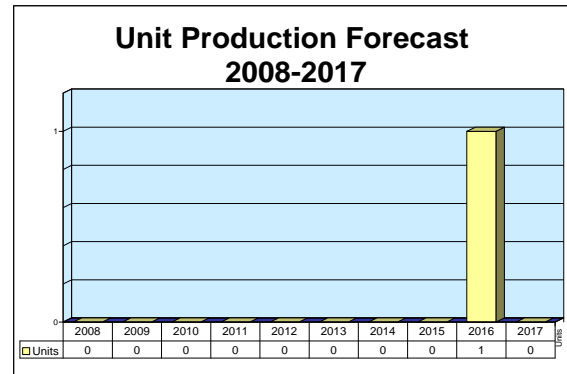
For data and forecasts on current programs please visit

www.forecastinternational.com or call +1 203.426.0800

International X-ray Observatory

Outlook

- Formerly Constellation-X, name changed to International X-ray Observatory in July 2008
- Chandra X-ray Observatory design life scheduled to expire by end of 2009
- Satellite platform expected to launch in 2017
- Program reduced to one satellite platform from original design of four individual satellite telescopes



Orientation

Description. The International X-ray Observatory (formerly Constellation-X) is the follow-on to the U.S. National Aeronautics and Space Administration's Chandra X-ray Observatory (space-based X-ray telescope). It is a planned combination of four X-ray telescopes bundled into one observatory satellite platform. The single platform design is a reduction from the original four-telescope satellite configuration.

Sponsor

U.S. National Aeronautics and Space Administration (NASA)

Office of Space Science and Applications

Mail Code S

NASA Headquarters

Washington, DC 20546-0001

USA

Tel: + 1 (202) 358-0000

Web site: <http://www.nasa.gov>

Web site: <http://ixo.gsfc.nasa.gov/>

(Overall program manager)

NASA/Goddard Space Flight Center (GSFC)

Mission Development Office

Code 740.2

800 Greenbelt Rd

Greenbelt, MD 20771

USA

Tel: + 1 (301) 286-2000

Web site:

<http://www.nasa.gov/centers/goddard/home/index.html> (International X-ray Observatory study effort)

Harvard-Smithsonian Center for Astrophysics
 60 Garden St
 Cambridge, MA 02138
 USA
 Tel: + 1 (617) 496-7941
 Fax: + 1 (617) 495-7356
 Web site: <http://chandra.harvard.edu>
 (Partner with GSFC for mission development)

Total Produced. None at this time. If the International X-ray Observatory proceeds with development, satellite/platform construction will likely begin in 2014, with first launch expected around 2017.

Application. Space exploration and surveillance through the use of X-ray imaging.

Price Range. The International X-ray Observatory production is currently estimated to be \$1.74 billion (in FY07 dollars).

Status. Phase A completed; Phase B commenced in FY07.

Contractors

Prime

Northrop Grumman Space Technology	http://www.st.northropgrumman.com , One Space Park, Redondo Beach, CA 90278 United States, Tel: + 1 (310) 812-4321, Fax: + 1 (310) 813-7548, Lead Contractor
--	--

Subcontractor

California Institute of Technology, Caltech	http://www.caltech.edu/ , 1200 E California Blvd, Pasadena, CA 91125 United States, Tel: + 1 (626) 395-6811 (Hard X-ray Telescope)
Goddard Space Flight Center, GSFC	http://www.nasa.gov/centers/goddard/home/index.html , NASA Bldg 03 Rm S22 M/S 6, Greenbelt, MD 20771-0001 United States, Tel: + 1 (301) 286-8955 (Calorimeter Spectrometer)
Lawrence Livermore Laboratory	http://www.llnl.gov/ , 7000 East Ave, Livermore, CA 94550-9234 United States (X-ray Micro-Calorimeters)
U.S. Naval Research Laboratory	http://www.nrl.navy.mil/ , Washington, DC United States (Silicon Strip Detectors for Hard X-ray Telescope)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Performance

Minimum effective area	15,000 cm ² at 1keV 6,000 cm ² at 6.4 keV 1,500 cm ² at 40 keV
Minimum telescope angular resolution	15 in HPD from 0.25 to 10 keV 1 ft HPD at about 10 keV
Minimum spectral resolving power E/-E	300 from 0.25 to 6.0 keV 3,000 at 6 keV 10 at 40 keV
Band pass	0.25 to 40 keV
Diameter field of view	2.5 ft < 10 keV 8 ft < 25 keV
Mission life	3 yr minimum; 5 yr goal
Redundancy/reliability	No one failure to result in loss of more than 33 percent of the mission science

Design Features. The NASA Goddard Space Flight Center is involved in pre-Phase A studies centered on a follow-on mission to the Chandra spacecraft. The

International X-ray Observatory was initially called the Constellation X-ray Mission or Constellation-X, which was originally a merger of two previous mission con-

International X-ray Observatory

cepts: the Next-Generation X-ray Observatory and the Large Area X-ray Spectroscopy Mission.

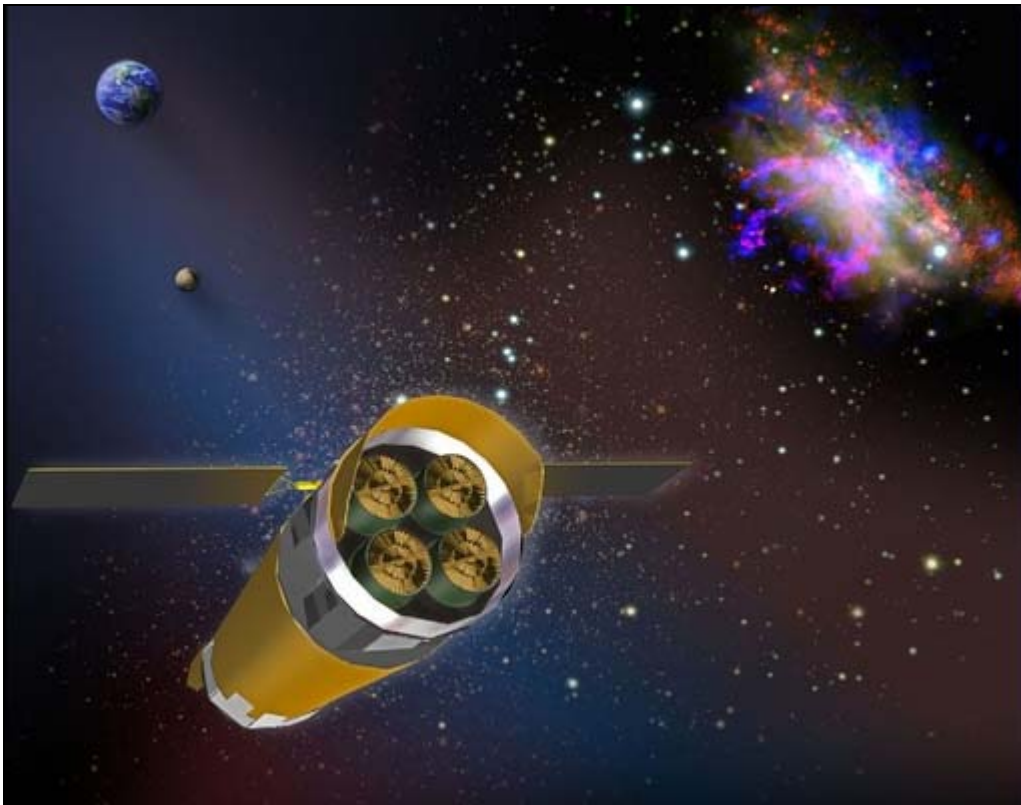
The International X-ray Observatory is intended to make observations at high spectral resolution that are about 100 times more sensitive than those made by Chandra. The mission would address many fundamental questions of astrophysics, such as those

involving the origin and distribution of the elements from carbon to zinc, the formation and evolution of clusters of galaxies, the validity of general relativity in the strong gravity limit, the evolution of super massive black holes in active galactic nuclei, the details of supernova explosions and their aftermath, and the mechanisms that heat stellar coronas and drive stellar winds.

Variants/Upgrades

The International X-ray Observatory is being modeled after the Keck Observatory (two optical telescopes positioned high atop Mauna Kea in Hawaii). Each Keck telescope is 10 meters wide and can be used in unison to observe the same light. Both Keck and the International

X-ray Observatory have superior collecting areas, or apertures, for analyzing the components of light. Both are complements to the Hubble Space Telescope and the Chandra X-ray Observatory.



NASA Artist's Rendition of the Single Platform International X-ray Observatory (formerly the Constellation-X Observatory)

Source: U.S. NASA

Program Review

Background. NASA's Goddard Space Flight Center awarded contracts to TRW and Ball Aerospace in 1998 to cooperatively conduct a five-month study of the International X-ray Observatory Mission. NASA con-

tributed about \$110,000 to each contractor to establish mission development teams to participate in defining the mission architecture for the International X-ray Observatory.

International X-ray Observatory

In June 1998, the space agency picked seven institutions to share \$20 million for technology development projects related to the International X-ray Observatory:

- Stanford University, Stanford, California – Tungsten transition-edge sensors for soft X-ray detector
- Naval Research Laboratory, Washington – Silicon strip detectors for the hard X-ray telescope
- Goddard Space Flight Center, Greenbelt, Maryland – A 2 keV calorimeter spectrometer for the International X-ray Observatory
- Columbia University, New York, New York – A reflection-grating spectrometer and camera for the International X-ray Observatory mission
- Lawrence Livermore National Laboratory, Livermore, California – Closely packed array of X-ray micro-calorimeters with multilayer absorbers
- Northwestern University, Chicago – Hard X-ray optics for Constellation-X
- California Institute of Technology, Pasadena – A comprehensive technology development program for the hard X-ray telescope

Space Observatory Adopts New Baseline Mission Objective

The team developing the International X-ray Observatory has defined a less expensive mission using a single Delta-IVH launch vehicle, as opposed to the baseline of two Atlas V vehicles (with two spacecraft per vehicle). Numerous configurations were considered, with focal lengths ranging from 10 meters (the current baseline) to 25 meters, and the number of telescopes varying between one and four. In November 2005, the then-Constellation-X team selected the most promising configuration, which turned out to be very similar to the original design. This configuration, the “10-4” (10-meter focal length, four telescopes), has now been designed in more detail (full thermal design, costing, etc.) and is in the process of being adopted as the new baseline mission.

Funding Issues. The International X-ray Observatory (formerly Constellation-X) program had been running slightly ahead of schedule until NASA shifted its focus back to human spaceflight and the moon. Along with this change came a change in funding, with the International X-ray Observatory taking a hit. With the renewed emphasis on human flight, the International X-ray Observatory will likely receive less funding than initially planned, at least through 2009. Development will thus be delayed. The International X-ray Observatory is expected to be launched in 2017.

Related News

Announcing the International X-ray Observatory (IXO) – In May 2008, ESA and NASA established a coordination group involving ESA, NASA, and JAXA, to explore establishing a joint mission merging the ongoing XEUS and Constellation-X efforts. The coordination group met twice, first in May 2008 at ESTEC, then in June 2008 at the Center for Astrophysics. As a result of these meetings, a joint understanding was reached by the coordination group on a proposal to proceed with developing an International X-ray Observatory (IXO). Under the proposal, the coordination group suggested the start of a joint study of IXO. A single merged set of top level science goals and derived key science measurement requirements were also established.

The starting configuration for the IXO study will be a mission featuring a single large X-ray mirror and an extensible optical bench with a 20-25-meter focal length, featuring an interchangeable focal plane. The instruments to be studied for the IXO concept will include an X-ray wide-field imaging spectrometer, a high spectral resolution non-dispersive X-ray spectrometer, an X-ray grating spectrometer, plus allocation for further payload elements with modest resource demands. The study will explore how to enhance the response to high-energy X-rays. This plan establishes an IXO study, which will be the input to the U.S. decadal process and to the ESA selection for the Cosmic Vision Plan. The IXO study supersedes the ongoing XEUS and Constellation-X activities.

At a bilateral ESA-NASA meeting on July 15 and 16, 2008, in Annapolis, this plan was endorsed by David Southwood, the ESA director for the Science and Robotic Exploration Program, and Ed Weiler, the NASA associate administrator of the Science Mission Directorate. A letter signed by Jon Morse (NASA HQ Astrophysics Division director) and Fabio Favata (ESA coordinator for Astronomy and Fundamental Physics Missions) features the details of the plan.

International X-ray Observatory

As part of this plan, the agencies will establish an IXO coordination group (IXO-CG) charged with defining the science requirements for the IXO study, supervising the IXO study activities, and providing input to the agencies. (NASA, 7/08)

Market Intelligence Service Subscribers: For additional news, go to the online E-Market Alert page located in the Intelligence Center at www.forecastinternational.com and click on the links to the products you subscribe to.

Funding

In FY06, NASA's budget was restructured. Consequently, the International X-ray Observatory (formerly Constellation-X) budget is no longer itemized. The program is now funded under the NASA program, Beyond Einstein, which falls under the larger NASA theme, The Universe.

U.S. FUNDING

	FY05 <u>QTY</u>	FY05 <u>AMT</u>	FY06 <u>QTY</u>	FY06 <u>AMT</u>	FY07 <u>QTY</u>	FY07 <u>AMT</u>	FY08 <u>QTY</u>	FY08 <u>AMT</u>
RDT&E (NASA)								
Beyond Einstein								
IXO	-	9.7	-	14.9	-	22.1	-	32.3
	FY09 <u>QTY</u>	FY09 <u>AMT</u>	FY10 <u>QTY</u>	FY10 <u>AMT</u>	FY11 <u>QTY</u>	FY11 <u>AMT</u>	FY12 <u>QTY</u>	FY12 <u>AMT</u>
Beyond Einstein								
IXO	-	51.5	-	147.6	-	170.6	-	N/A

All \$ are in millions.

N/A = Not Available

Source: NASA

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1998	Concept study contracts awarded to TRW and Ball Aerospace
July	2008	Named changed from Constellation-X Observatory to the International X-ray Observatory
	2009	Chandra X-ray Observatory design life expiration date
	2014-2015	Production to start on International X-ray Observatory satellites
	2017	Planned launch of International X-ray Observatory satellite

Worldwide Distribution/Inventories

The International X-ray Observatory is a **United States** NASA program.

Forecast Rationale

Newly renamed the International X-ray Observatory (IXO), the former Constellation-X is being promoted as a key element in NASA's Beyond Einstein initiative (formerly the Structure and Evolution of the Universe

theme), designed to help unlock the mysteries of how the universe started, and where it is going.

The International X-ray Observatory program has gone through several design studies, which have yielded

International X-ray Observatory

some fundamental program changes. The original design, which featured four individual satellite telescopes linked together, has evolved into a single observatory satellite platform that contains four telescopes. Unfortunately, all of the plan changes and budget reductions will delay the International X-ray

Observatory development by a few years. The contract award for IXO instrument production is expected in 2009. The contract award for the IXO platform itself is planned for 2010, with production completed in 2016. Launch is expected to take place around 2017.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	Thru 2007	High Confidence				Good Confidence			Speculative			Total
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Northrop Grumman Space Technology (Prime)												
IXO <> International X-ray Observatory <> United States												
Note: Formerly Constellation-X												
	0	0	0	0	0	0	0	0	0	1	0	1
Total	0	0	0	0	0	0	0	0	0	1	0	1