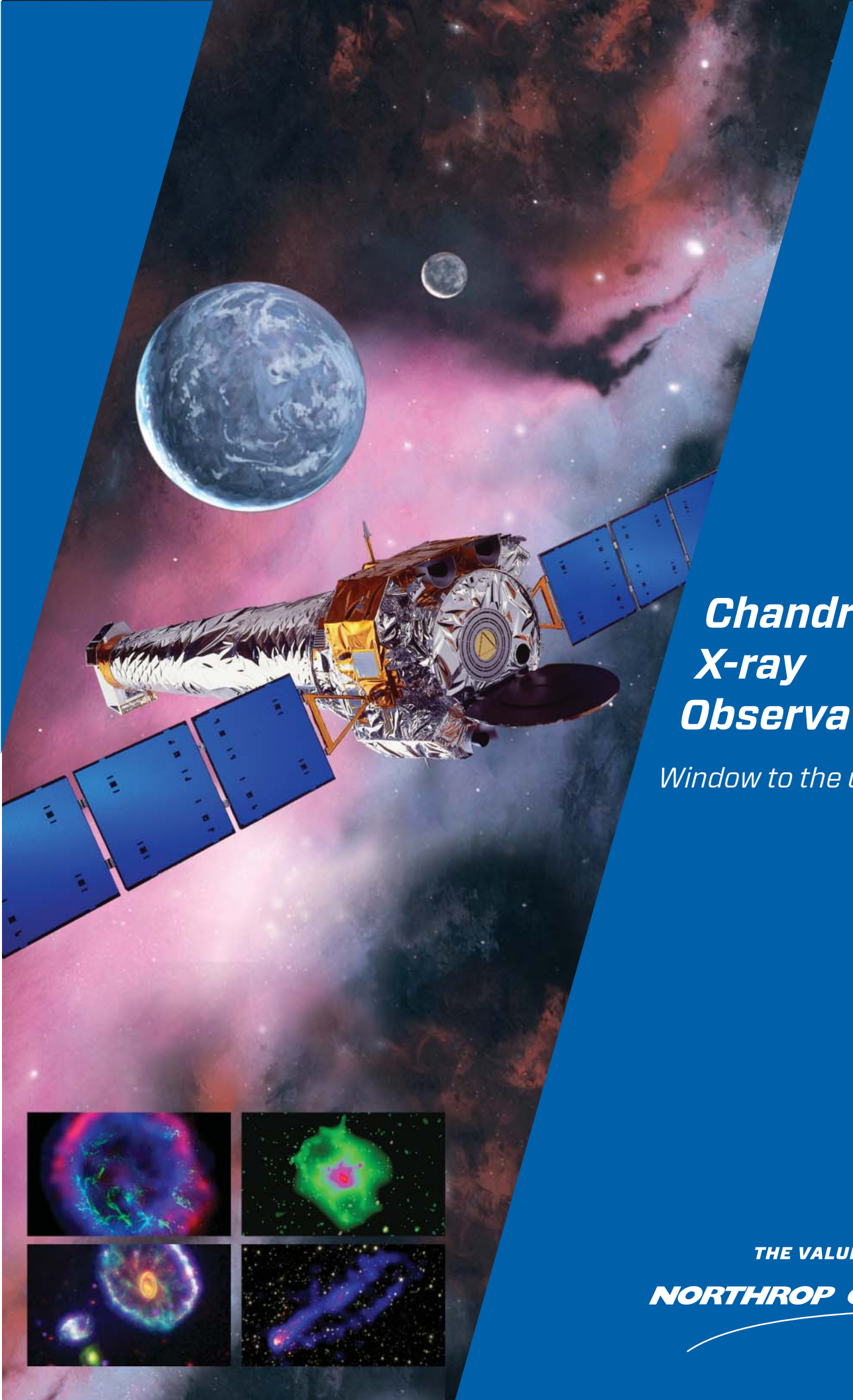

Chandra X-ray Observatory

Window to the universe

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

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Window to the universe

NASA's Chandra X-ray Observatory is giving astronomers a clearer view of the cosmos. The Northrop Grumman-built satellite consists of a highly sensitive X-ray telescope, imaging spectrometer, high resolution camera and associated detecting devices. Chandra offers scientists the opportunity to collect, observe, and analyze X-ray radiation, expanding our knowledge of the structure and evolution of the universe.

Black holes, intense gravitational fields resulting from the death of massive stars, produce some of the most intense X-ray sources in the heavens. As stars collapse upon themselves, they pull in everything around them—including light. The Chandra X-ray Observatory can measure the motion of particles near black holes, giving scientists a new understanding of the extreme gravitational forces at work.

Dark matter, a hypothetical source of gravity that holds superhot gases within clusters of galaxies, may be 3-10 times more prevalent than the clouds of hot gas and galaxies we can observe. But dark matter has never been seen. Chandra sheds light on this cosmic mystery by producing accurate measurements of the amount and distribution of the missing ingredient in galaxy clusters.

The Observatory's unique X-ray perspective is providing a new view of phenomena near and far—from comets within our solar system to quasars on the edge of the observable universe. It is studying the mechanisms of supernovas, dying stars that may give birth to new ones, and probing the secrets of distant galaxies, hubs of explosive activity. Because space offers a unique environment to test existing theories or discover new rules of physics, Chandra is expanding our knowledge of plasma physics, elementary particle physics and cosmology.

Significant advancement for X-ray astronomy

Chandra expands the world of high resolution X-ray astronomy pioneered by NASA in the late 1970s. That first X-ray imaging satellite, NASA's Einstein Observatory, was built by Northrop Grumman and flown from 1978-1981. Compared to the Einstein Observatory, Chandra resolves images 10 times more clearly and detects X-ray sources 100 times fainter.

Efficient science returns

Deployed from the space shuttle in 1999, the Chandra X-ray Observatory is operating in a highly elliptical, high altitude, 10,000 km by 140,000 km orbit that provides greater observing efficiency than a low-Earth orbit, and maximizes observation time above 60,000 km. From this orbital vantage point, Chandra has a clear view of distant X-ray phenomena, unobstructed by atmospheric distortion.

High resolution optics

Since X-rays would penetrate a normal dish-shaped mirror, the observatory mirrors are cylindrical, highly polished tubes. The X-rays are collected by four sets of these mirrors, nested one within the other, and funneled down the length of the 10m telescope to the imaging instruments. The mirrors are the largest of their kind and the smoothest ever created. They are accurate enough to detect deep space objects separated by one-half arc second, equivalent to identifying two dimes side by side from two miles away.

Orbital operations

The Chandra X-ray Observatory program is managed by NASA's Marshall Space Flight Center. Science and flight operations are managed by the Chandra X-ray Center, operated by the Smithsonian Astrophysical Observatory, Cambridge, Mass.

Specifications

Size:	13.8 m (45.3 ft) long x 19.5 m (64.0 ft)
Weight:	4,784 kg (10,560 lb)
Orbital Data:	Inclination - 28.5 deg Perigee - 10,000 km (6,200 mi) Apogee - 140,000 km (87,000 mi)
Power:	2,350 W (end of life)
Antennas:	Two low-gain, conical log spiral antennas provide spherical coverage
Frequencies:	Transmit - 2250 MHz; Receive - 2071.8 MHz
Telescope System:	
High Resolution:	4 sets of nested, grazing incidence
Mirror Assembly:	Paraboloid/hyperboloid mirror pairs; outer diameter 1.2 m (3.9 ft); 83.8 cm (2.75 ft) long; constructed of Zerodur, polished to better than 7 angstroms micro roughness; 10 m focal length; 1.0 deg field of view
Aspect Camera:	1.40 deg by 1.40 deg field of view, pointing stability to 0.25 arc-sec radius over 95% of all 10 sec periods; pointing accuracy to 30 arc-sec 99% of viewing time
Science Instruments:	
Charge Coupled Device Imaging Spectrometer:	Imaging resolution is 0.5 arc-sec over spectral range of 0.2 to 10 kev
High Resolution Camera:	Angular resolution is 0.5 arc-sec over the field of view; 31 by 31 arc-minutes over spectral range of 0.1 to 10 keV
High Energy Transmission Grating:	Provides spectral resolution of 60-1,000 over the energy range 0.4 to 10 keV
Low Energy Transmission Grating:	Provides spectral resolution of 40-20,000 over the energy range 0.09 to 3 keV

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