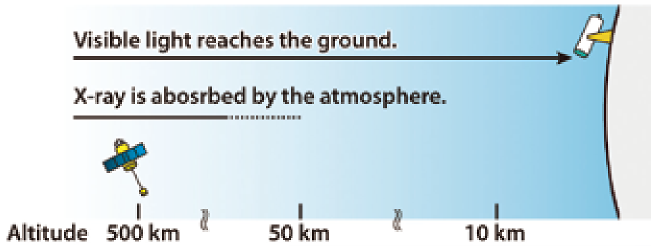
Reasons for launching an X-ray telescope

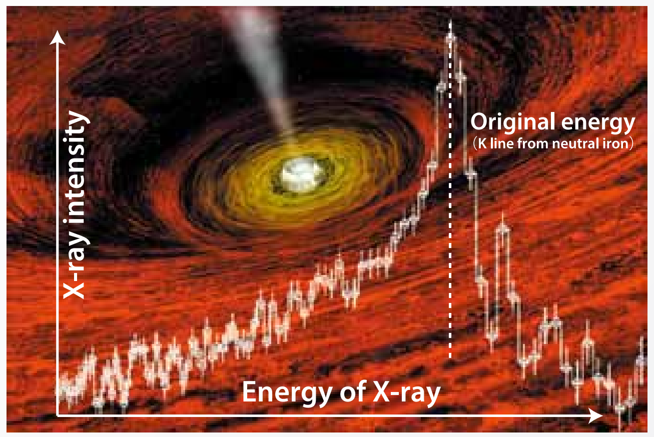
X-rays, which are what ASTRO-H will use for observations, are a type of electromagnetic wave, like the more familiar visible light or radio, infrared, and ultraviolet radiation. The difference between these is their wavelength. X-rays have wavelengths 1,000 to 100,000 times shorter (and are much more energetic) than visible light.
Although invisible to our eyes, various astronomical objects, such as black holes, neutron stars, and clusters of galaxies emit not only visible light but also X-rays, particularly from hot plasma and other high energy phenomena.

Although medical X-rays and luggage scanners at airports make use of the penetrating power of X-rays, the long distance through the Earth's atmosphere means that it effectively acts a wall, and blocks X-rays from space before they can reach the surface. For this reason, it is necessary to put X-ray telescopes on board a satellite and launch it into space, to detect X-rays from the universe. ASTRO-H will make observations while in a circular orbit 550 kilometers above the Earth.



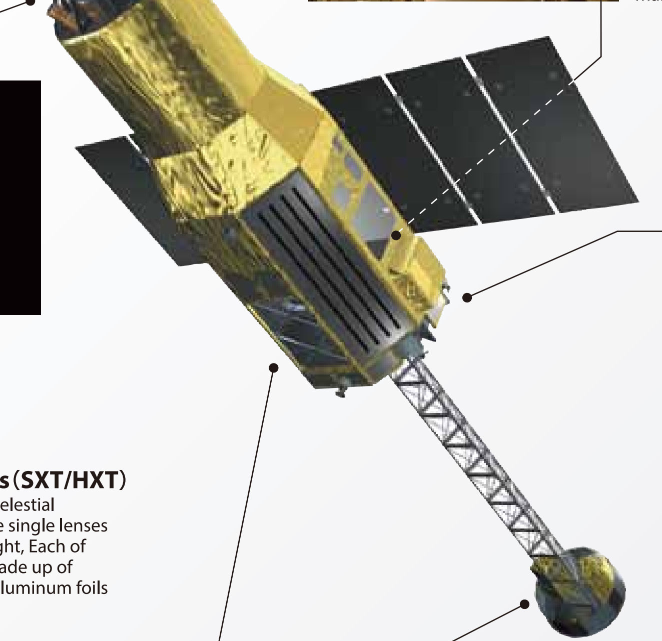
Do black holes emit X-rays?

While black holes cannot be seen with the naked eye, they are often associated with bright X-ray sources. Black holes are objects with such strong gravity that not even light cannot escape, so the X-rays are not from the black hole itself. Instead, they are produced by gas falling towards the black hole, perhaps from a Sun-like companion star. The matter heats up as it falls inwards, reaching temperatures as high as 10,000 to 1,000,000 degrees just before it enters the black hole. Such hot plasma emits more X-rays than visible light, and much of this radiation can escape as it is produced above the event horizon. However, because the black hole has very strong gravity, and because the plasma moves very fast, the energy of the light we observe will not be the same as originally emitted in the plasma, but instead will be distributed around its original, or "rest," energy, as predicted by Einstein's theories of Special and General Relativity. The instruments on ASTRO-H will enable us to measure the shape of this distribution very precisely, so we will be able to investigate the warping of space and time around black holes in detail.



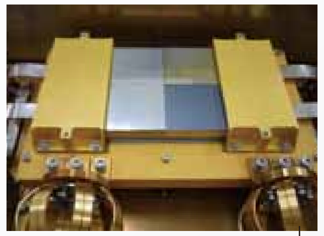
(C) Chandra X-ray Observatory

Cutting-edge Instruments



Soft X-ray Imager (SXI)

This is a wide field-of-view X-ray camera using an array of four large-format X-ray CCD chips. It provides simultaneous imaging and spectroscopic data in the energy range of 0.5 keV to 12 keV. The detector will be placed in the main body of the satellite.



Close-up view of the aperture.

Reflecting X-ray Telescopes (SXT/HXT)

This instrument focuses X-rays from celestial objects onto the detectors. Unlike the single lenses and mirrors usually used for visible light, Each of these X-ray reflecting telescopes is made up of over one thousand reflector-coated aluminum foils stacked into concentric circles.

Soft Gamma-ray Detector (SGD)

Many layers of semiconductor sensors are stacked to optimize the sensitivity of the gamma-ray spectrometer. Since gamma-rays have a higher penetrating power than X-rays, this instrument plays an important role investigating astronomical objects surrounded by dense gas.

Soft X-ray Spectrometer (SXS)

Specialized detector elements are cooled down to near absolute zero (−273 degrees Celsius) using a series of refrigeration units. When an X-ray hits a detector element, its temperature slightly rises. This increase in "heat" is measured, and from this the energy of the incident X-ray can be estimated to a higher degree of accuracy than any achieved to date. Researchers from around the world have great expectations for this instrument, so called X-ray micro-calorimeter, the centerpiece of ASTRO-H.

Close-up view of the main sensor part.

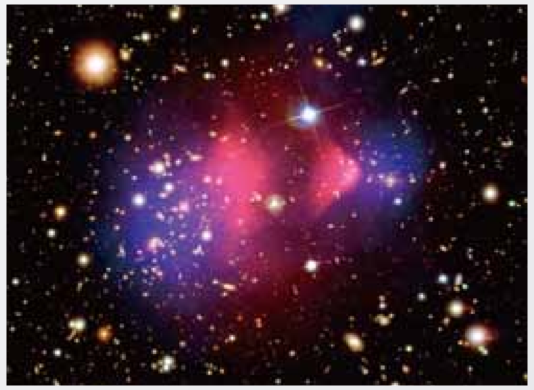
X-ray sensor and signal-processing electronics

Hard X-ray Imager (HXI)

This produces images of objects in the hard X-rays above 5 keV using a combination of silicon and cadmium telluride semi-conductors. Since a telescope for this imager has a 12-meter focal length, the sensor will be placed at the end of a boom which will be extended in orbit.

Learning the evolution of the universe through galaxy clusters

Clusters of galaxies are the largest objects in the universe, containing anywhere from tens to thousands of individual galaxies, and are permeated by hot gas shining brightly in X-rays. Observations with the X-ray micro-calorimeter (SXS) of ASTRO-H will produce precise measurements of the motion of the X-ray emitting gas. We will then be able to determine the energy distribution and the dynamics of individual galaxies and the hot gas. This will contribute to the ongoing effort to solve the puzzle of how such large structures formed and how they have evolved throughout the history of the universe.



(C) X-ray: NASA/CXC/CfA/M.Markevitch et al.; Optical: NASA/STScI; Magellan/U.Arizona/D.Clowe et al.; Lensing Map: NASA/STScI; ESO WFI; Magellan/U.Arizona/D.Clowe et al.

ASTRO-H Information

Name		ASTRO-H
Launch	Year	2015 JFY (planned)
	Place	Tanegashima Space Center
	Rocket	H-IIA rocket
Size		14 m in length (in orbit)
Weight		2.7 ton
Orbit	Altitude	550 km
	Inclination	31 degree

Collaboration with universities across Japan and international research institutes

ASTRO-H is not solely a JAXA mission, but includes participation from NASA, the European Space Agency (ESA) and universities/institutes around the world. The staff and graduate students at universities throughout Japan are also participating in the development of the ASTRO-H X-ray instruments (57 universities/institutes and over 270 individuals). Occasionally, this involves trips of several weeks to locations in the US and Europe for meetings and experiments. Status updates of the instrument development and on-going experiments are posted on the project web-site as "ASTRO-H Development Diary."

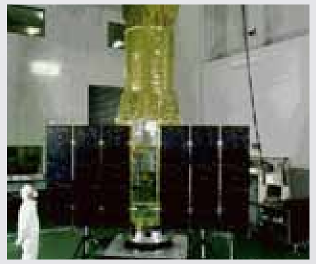
In preparation for the analysis of scientific data to be obtained after launch, joint research teams have been established by object types or research themes with researchers at the forefront of astrophysics, and these teams have started detailed discussions on how to select the targets for observations, and what scientific results are expected from ASTRO-H. As a part of this activity, over 100 researchers meet face to face in "science working group" meetings once every six months.

Picture of the preparations for a vibration test for the X-ray telescope to ensure they can withstand the vibrations that occur during launch. This test involved a collaboration of researchers from Nagoya University, Ehime University, and JAXA/ISAS.

ASTRO-H Member Agencies and Countries

The origin of the name "ASTRO-H"

"ASTRO" is shorthand for both "Astronomy" and "Astrophysics". ASTRO-H will mark the eighth JAXA satellite dedicated to astronomy/astrophysics, starting with the 1981 launch of the solar satellite, ASTRO-A (renamed "Hinotori" or "Phoenix" after launch). The letter "H" is because this is the 8th project in the series and it is the eighth letter of the alphabet. A new name for ASTRO-H will be announced soon after launch, as has been done for the previous seven ASTRO satellites. We look forward to finding out the new name for ASTRO-H.



ASTRO-D (ASCA)
The X-ray satellite, ASCA, launched in 1993, was the first X-ray satellite observatory to carry X-ray CCD spectrometers. ASCA's instruments were used to observe a variety of astronomical objects, resulting in an abundance of scientific results for researchers from around the world.

ASTRO-E2 (Suzaku)
The X-ray satellite Suzaku was launched in 2005. This has high sensitivity for faint X-ray sources and good spectral resolving power over a broad band of X-ray wavelengths. Suzaku is still going strong in 2015, carrying out numerous observations.

For more details, visit our website. http://astro-h.isas.jaxa.jp/