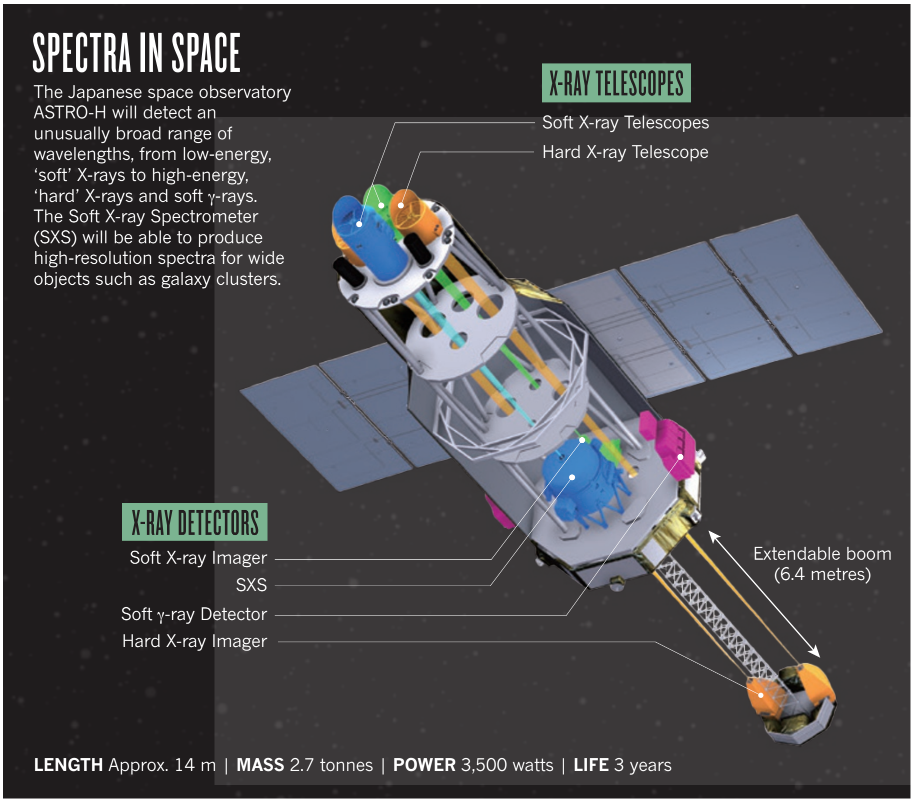


ASTRONOMY

High stakes for Japan's space probe

ASTRO-H will carry a technology that two earlier, ill-fated space telescopes failed to put into action.

BY DAVIDE CASTELVECCHI

Astronomers around the world are hoping that the third time will be the charm as Japan prepares to launch its largest space observatory ever. The telescope will use X-rays to study phenomena from black holes to dark matter and carries cryogenic imaging technology that flew on two previous missions — but met disaster both times.

Weather permitting, a Japanese-built H-IIA rocket is scheduled to launch the probe, provisionally named ASTRO-H, from Tanegashima Space Center at 17:45 local time on 12 February. Once in orbit, the 2.7-tonne probe will stretch out to its maximum length of 14 metres, including a 6.4-metre boom that will host an imager capable of collecting high-energy, or 'hard' X-ray photons (see 'Spectra in space'). The Japan Aerospace Exploration Agency (JAXA) leads the mission with an investment of ¥31 billion (US$265 million), but there is also major participation from NASA, as well as institutions in six other nations and the European Space Agency (ESA).

Studying X-ray emissions is the best way to observe a wide range of cosmic phenomena, from galaxy clusters to the super-heated accretion disks around black holes. But Earth's atmosphere is mostly opaque to radiation outside the visible spectrum, and particularly to X-rays and γ-rays, meaning that most X-ray astronomy requires a satellite.

The major existing X-ray satellites are NASA's Chandra X-ray Observatory and ESA's XMM-Newton, which both launched in 1999. These can analyse the constituent wavelengths of X-rays — the spectra — emitted by point-like objects such as stars. But ASTRO-H will be the first to provide high-resolution spectra for much more spread-out X-ray sources such as galaxy clusters, says Norbert Schartel, project scientist for XMM-Newton at ESA's European Space Astronomy Centre outside Madrid, who is also a member of ASTRO-H's ESA team.

Spectra carry information about the velocity and turbulence of the plasma that pervades galaxy clusters, which in turn can reveal whether, and how, a cluster resulted from a merger of two smaller ones, says Christine Forman, a high-energy astrophysicist at Harvard University in Cambridge, Massachusetts. X-ray pictures of clusters, when combined with visible-light images, have also previously provided striking — although indirect — evidence for the existence of dark matter. ASTRO-H should be able to help settle whether a 3.5-kiloelectronvolt X-ray signal seen in certain galaxies is a signature of dark matter decaying into photons — or something else, says Alexey Boyarsky, an astrophysicist at Leiden University in the Netherlands who co-discovered the signal (see *Nature* **517,** 422–423; 2015).

ASTRO-H will also cover a broader range of wavelengths than most other missions, from 'soft', low-energy photons starting at 300 eV, through hard X-rays and right up to soft γ-rays of 600 keV. But only the soft X-rays will have their spectra imaged to high resolution. At the heart of the instrument responsible for this — the Soft X-ray Spectrometer (SXS) — is an array of 36-pixel elements that must be kept at 0.05 degrees above absolute zero, well inside the main body of the craft. When a photon strikes one of the sensors, the temperature of the sensor rises slightly, causing its electrical conductivity to increase. The resulting change in voltage can be used to measure the energy of the original photon — and therefore its wavelength — with a precision of nearly one part in 1,000.

The technology first took shape in 1984, when Richard Kelley, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, started designing sensors for Chandra. After NASA scaled back its ambitions for the observatory and scrapped that plan, Kelley and his team provided the spectrometer for a Japanese X-ray telescope called ASTRO-E. But in 2000, the rocket that was supposed to put it into orbit crashed shortly after take-off.

JAXA prepared a replacement mission, Suzaku, which reached orbit in July 2005 — only for disaster to strike again. The liquid helium used to keep a spectrometer's sensors cold has to be slowly released, or outgassed. But in Suzaku, a tiny amount of that helium accumulated inside the craft. This was enough to ruin the vacuum that was supposed to insulate the helium tank from the rest of the craft. The tank heated up faster than expected, causing the helium to boil off and vent into space within four weeks of launch. Unable to stay superchilled, the spectrometer was crippled before it could start making observations, although Suzaku's other instruments continued to operate until the craft was decommissioned in 2015.

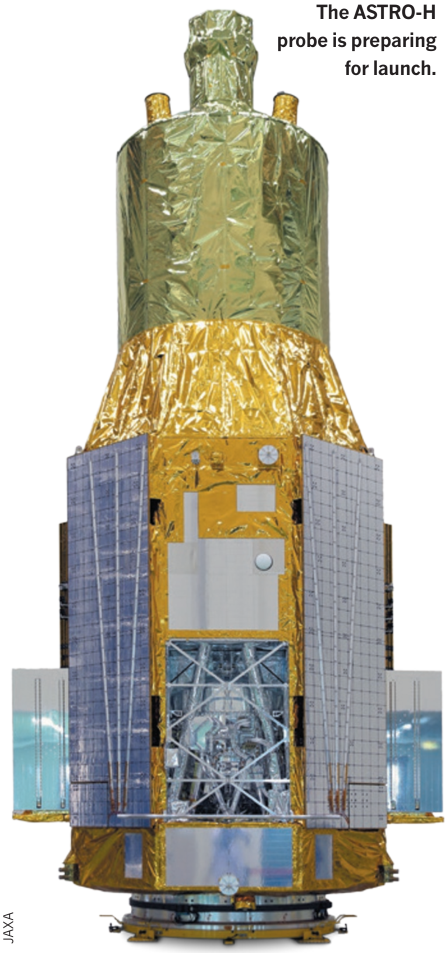
For ASTRO-H, JAXA redesigned the tank with plumbing to outgas the helium straight into space. And to further guard against glitches, ASTRO-H project manager Tadayuki Takahashi, an astrophysicist at the University of Tokyo and ASTRO-H's project manager, pushed his collaboration to work without borders. "Usually, international coalitions have clearly defined interfaces," with different laboratories providing isolated components of a spacecraft and its payload, says Takahashi. But ASTRO-H researchers regularly visited each other's labs, sometimes for months at a time.

Kelley says that Takahashi forged a very open collaboration. "Tad understands that if you want to maximize the chances of success, you have to have no barriers," he says. "Everybody has access to everything."

Astronomers around the world will be allowed to request observing time with ASTRO-H. Each team will have exclusive access to the resulting data for one year, after which JAXA will make them publicly available — a model long adopted by NASA. ASTRO-H will be renamed after launch, although what it will be called is yet to be determined.

A larger, higher-resolution version of the SXS is due to fly aboard Athena, an ESA-led X-ray astronomy mission planned for the late 2020s. ■

Additional reporting by **David Cyranoski**.



The ASTRO-H probe is preparing for launch.

JAXA

REPLICATION

Biotech giant posts negative results

Amgen papers seed channel for discussing reproducibility.

BY MONYA BAKER

A biotechnology firm is releasing data on three failed efforts to confirm findings published in high-profile scientific journals — details that the industry usually keeps secret.

Amgen, headquartered in Thousand Oaks, California, says that it hopes the move will encourage others to describe their own replication attempts, and thus help the scientific community to get to the bottom of work that other labs are having trouble verifying.

The data are posted online on a newly launched channel dedicated to quickly publishing researchers' efforts to confirm scientific findings (see go.nature.com/3zzea9), hosted by *F1000Research*, the publishing platform of London-based publishers Faculty of 1000 (F1000).

The idea emerged from discussions at a meeting in 2015 focused on improving scientific integrity. Sasha Kamb, who leads research discovery at Amgen, said that his company's scientists have many times failed to reproduce academic studies but that it takes too much effort to publish these accounts.

Bruce Alberts, a former editor-in-chief of *Science* who sits on *F1000Research*'s advisory board, suggested that Kamb try the faster F1000 route — an open-science publishing model in which submitted studies are posted online (for a fee that ranges from US$150 to $1,000) before undergoing open peer review; submissions are subject to checks by F1000 editors to ensure that data are freely available and that methods are adequately described. "The idea is to get the data out and get it critically looked at," Alberts says.

IRREPRODUCIBLE HISTORY

In 2012, Amgen researchers declared that they had been unable to reproduce the findings in 47 of 53 'landmark' cancer papers[1]. Those papers were never identified — partly because of confidentiality concerns — and there are no plans to release details now, says Kamb, who was not involved with that work.

The three latest studies that Amgen has posted deliberately do not make a detailed comparison of their results to previous papers, says Kamb. "We don't want to make strong conclusions that someone else's work is wrong with a capital W," he says.

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One study adds to existing criticism of a *Science* paper[2] that suggested a cancer drug might be a potential treatment for Alzheimer's disease; a second counters earlier findings (including some by Amgen researchers) connecting a gene to insulin sensitivity in mice[3,4]; and a third counters a *Nature* paper[5] reporting that inhibiting one particular protein could enhance the degradation of others associated with neurodegenerative diseases. Amgen researchers did not contact the original authors when they conducted their studies, Kamb says.

GAINING TRACTION

The main way that the scientific community spreads the word about irreproducible research is through insinuation, which is inefficient and unfair to the original researchers, says Ricardo Dolmetsch, global head of neuroscience at Novartis's Institutes for Biomedical Research in Cambridge, Massachusetts. "Anything we can do to improve the ratio of signal to noise in the literature is very welcome," he says.

The F1000 initiative is useful, but previous efforts have tried and failed to encourage the reporting of replications and negative results, cautions John Ioannidis, who studies scientific robustness at California's Stanford University. In general, the scientific community undervalues such work, he says.

But Kamb says that he has spoken with several industry leaders who have expressed support, and he hopes that they will contribute eventually. Morgan Sheng, a vice-president at biotechnology company Genentech in South San Francisco, says that he can forsee his company's scientists submitting data to the venture. "I believe the main risk of a publication venue like the F1000 channel is that it becomes a place for 'bashing' good science, because biological experiments are complex and beset by many variables that are hard to control. Non-replication does not necessarily mean 'not true'," Sheng adds. ■

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