

China's space science prepares for liftoff

In its latest five-year plan, China backs an ambitious selection of space-science projects and encourages international collaborations.

The Hard X-ray Modulated Telescope is to be China's first dedicated astronomy satellite. It is also the first Chinese mission to be selected through peer review.

In unveiling its five-year plan for 2006–10 this past March, the Chinese National Space Administration (CNSA) announced that the *HXMT* had won a competition for funding, beating out a proposal for the *Solar Space Telescope* (SST). A host of other astronomical projects are funded for various stages of R&D.

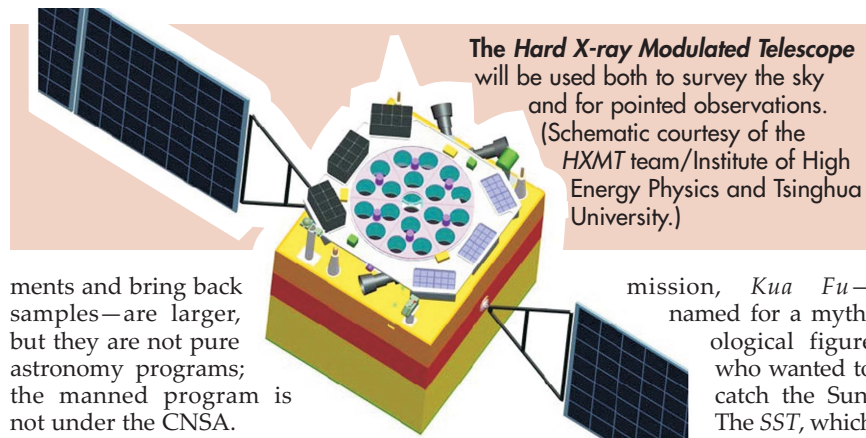
Scheduled for launch in 2010, the *HXMT* will survey the sky in the 20–250 keV range. "In this energy band, it should be the most sensitive instrument so far for a full-sky survey," says project coleader Shuang Nan Zhang, who splits his time between Tsinghua University and the Institute of High Energy Physics in Beijing. "It will take a year to scan the whole sky," he adds.

In addition to a hard x-ray survey instrument, the mission will carry two lower-energy detectors—capable of observing from 1 keV to 30 keV—for pointed observations. Possible targets for such observations include neutron-star-black-hole binaries, active galactic nuclei, supernova remnants, soft gamma-ray burst repeaters, and galaxy clusters. "With all the detectors pointed at the same source," Zhang says, "we can look at sources with broadband spectra and rapid variability—like a high-energy version of *RXTE* [NASA's *Rossi X-ray Timing Explorer*]."

China is providing the launcher, spacecraft, and hard and medium x-ray detectors, while a low-energy detector will be built jointly with scientists in the UK.

Unspecified budget

Zhang estimates the *HXMT* price tag at about \$100 million. "It's pretty cheap by international standards," he says. "But in China it's a megaproject. It's the [country's] largest astronomy project ever." The country's manned space program and lunar exploration plans—an orbiter will be launched this fall to map the Moon's surface, followed by landers and rovers that will carry out experi-



The *Hard X-ray Modulated Telescope* will be used both to survey the sky and for pointed observations. (Schematic courtesy of the *HXMT* team/Institute of High Energy Physics and Tsinghua University.)

ments and bring back samples—are larger, but they are not pure astronomy programs; the manned program is not under the CNSA.

The total budget for space science is unspecified, says Zhang, one of the architects of the CNSA five-year plan. "The government does not give us a budget. There is no cap. We tell them our needs. We say, 'It's been approved, please fund.'"

In the past, decisions about space missions in China have been made at top government levels. This time, with peer review, the people whose missions lost out were of course disappointed. But, says Zhang, the reaction from the community about using peer review has been positive. "Everyone is a winner because we have established the correct procedure."

Multiple missions

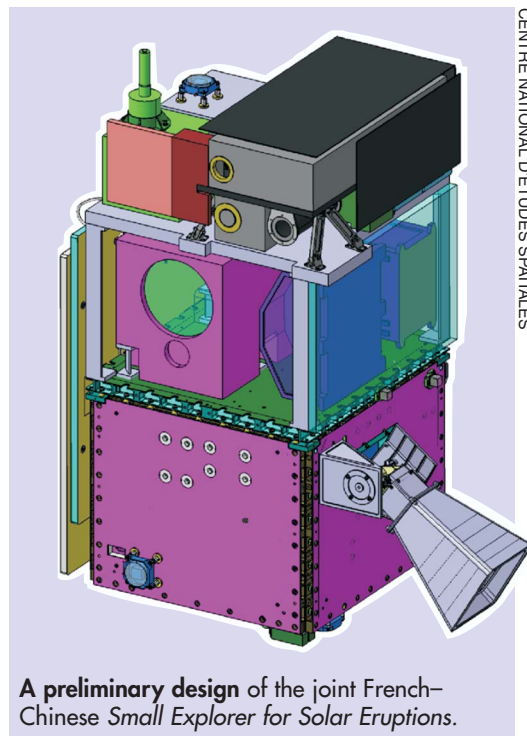
Besides the *HXMT*, two projects whose funding appears secure are the Long Slit Spectrograph, an instrument for the *World Space Observatory* (see the story on page 32), and a microsatellite that will piggyback on a Russian mission to Mars and gather information about the planet's atmosphere and magnetic field. For most other proposed missions, says LSS project manager Maohai Huang of China's National Astronomical Observatories in Beijing, "the status is in limbo. The fight for the actual level of funding for all projects is far from over."

As for the SST, the CNSA has now bundled evaluation of the telescope with another solar

mission, *Kua Fu*—named for a mythological figure who wanted to catch the Sun. The SST, which will have a 1-meter tele-

scope and five or more instruments, is intended to study solar flares and the Sun's magnetic field. *Kua Fu* is a mission consisting of three satellites equipped to monitor space weather, sample the solar wind, and study the Sun's corona and environment. The SST and *Kua Fu* "have very different scientific missions," says Zhang. "We hope [the government] will fund both."

China has two space collaborations



A preliminary design of the joint French-Chinese *Small Explorer for Solar Eruptions*.

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in the works with France. Originally scheduled for launch in time for the next solar maximum in 2011, the *Small Explorer for Solar Eruptions* is now expected to fly a year or so later. China is responsible for one *SMESE* instrument, a spectrograph for detecting x rays and gamma rays. The mission will also be able to image in the UV and IR. The main goal, says Cheng Fang, a solar physicist at Nanjing University and a principal investigator for China's contribution to *SMESE*, is to study solar flares and coronal mass eruptions. "China's contribution is roughly €5 million [\$6.7 million]. The French side is much more."

The other Franco-Sino mission is a gamma-ray burst mission that is not listed in the CNSA's five-year plan, but which will likely fly, according to a source who requested anonymity. It's scheduled for launch around 2012.

Further in the future, perhaps around 2015, astronomers in China hope to launch the *Solar Polar Orbit*

Radio Telescope, an array of interferometric low-frequency antennas rotating around a mother spacecraft and together forming a virtual dish about 150 meters in diameter. In solar polar orbit, *SPORT* would image coronal mass ejection plasma clouds to study and forecast space weather.

International partners

In the current five-year plan, says Zhang, China encourages international collaborations. "It means we should take every opportunity to participate in good, scientifically motivated programs if we believe the science interests match the interests of Chinese scientists. And it means the Chinese space program welcomes international collaboration." Through such collaborations, Zhang adds, "We can be part of the international community. That is what we want."

To date, China's collaborations in space science are with Russia, the European Space Agency, and several

European nations. The Alpha Magnetic Spectrometer is an isolated case of a US-China collaboration—but NASA has put it on hold (see *PHYSICS TODAY*, May 2007, page 30). Hopes in both countries' space science communities that collaborations might be established grew at the prospect of NASA administrator Michael Griffin's visit to China last year, but dimmed thanks to a narrowed itinerary and new US sanctions on China's space industry, according to Gregory Kulacki, a China specialist at the Union of Concerned Scientists.

The chill in space relations was exacerbated after China shot down one of its own satellites in January (see *PHYSICS TODAY*, March 2007, pages 29 and 100). Scientific collaborations between the two countries are in any case complicated by International Traffic in Arms Regulations, US laws that regulate the export and import of articles and services considered to be potentially militarily sensitive.

Toni Feder

Russia leads international team on revived UV space telescope

Thanks to an upswing in Russia's economy, a long-dormant plan for a UV space telescope is now taking shape.

A UV space telescope originally planned in the Soviet Union has regained traction as the Russian-led *World Space Observatory* and is set for launch in the first part of the next decade.

"It will be a multipurpose observatory," says *WSO* principal investigator Boris Shustov, director of the Russian Academy of Sciences' Institute of Astronomy in Moscow. Topics of study will include a search for missing baryonic matter in the intergalactic medium, the composition of atmospheres of exoplanets, and accretion physics in star formation and galaxy evolution. The *WSO*, he adds, "is the only large-scale facility planned in the UV in the next 15 years."

"The *WSO* is a follow-on to the *Hubble* [Space Telescope]," says the University of Leicester's Martin Barstow. "Whereas the *JWST* [James Webb Space Telescope, NASA's successor to the *HST*] doesn't deal with the optical and UV part of what the *Hubble* does, so the *WSO* observes in the UV, and doesn't do IR." Among the *WSO*'s strengths, adds Michel Dennefeld of Paris's Institute of Astrophysics, "are that its instruments will be entirely dedicated to



The World Space Observatory. (Artist's conception courtesy of the *WSO* team; the background is an image of the giant galactic nebula NGC 3603 taken by the *Hubble* Space Telescope, courtesy of NASA, ESA, Wolfgang Brandner [JPL/IPAC], Eva K. Grebel [University of Washington], and You-Hua Chu [University of Illinois at Urbana-Champaign].)