China forges ahead in space science

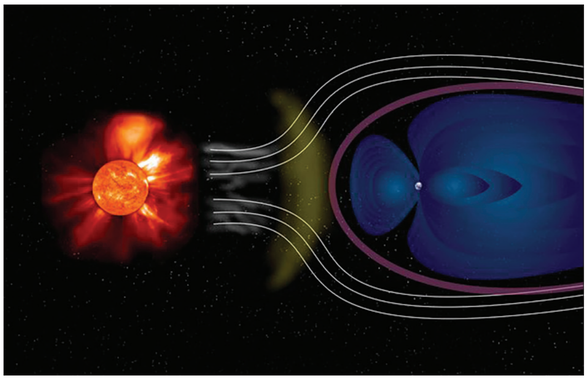
Scientists in China have drawn up a wishlist of next-generation space-science missions, but they will still need government backing to go ahead. **Ling Xin** reports

After years of detailed study and a highly competitive selection process, space scientists in China have officially told the government of the five space missions they want to launch between 2020 and 2022. From the observation of the Sun to the detection of black holes, the five proposed missions would require over 5 billion yuan ($725m) of government investment. Speaking at a press conference in Beijing in December 2016, Ji Wu, director-general of the National Space Science Center at the Chinese Academy of Sciences (NSSC-CAS), said that the projects have a high technical readiness. "We are already in the process of getting government approval and once given the green light, they will be entering the engineering development phase early [in 2017]," adds Wu.

The five missions, which were shortlisted from 21 proposals, include the Einstein Probe (EP) that will perform deep time-domain astronomy surveys to discover cosmic events and monitor variable sources in the soft X-ray-regime at around 0.4–5 keV. Weimin Yuan from the National Astronomical Observatories, who is chief scientist of the EP mission, says that the probe will search for X-ray signals associated with normally quiescent black holes and gravitational waves, which are both predictions of Einstein's theory of general relativity. Yuan told *Physics World* that the satellite will combine a wide-field X-ray monitor with a "follow-up" X-ray telescope to enhance its scientific capability for the discovery and characterization of X-ray transients. The team has been making steady progress in developing "challenging" key technologies such as the "micro-pore" optics, the large-format focal plane detector and onboard data analysis.

"The EP will provide new insights into the energetic processes occurring beyond the solar system," says astrophysicist Richard de Grijs at the Kavli Institute for Astronomy and Astrophysics at Peking University. "I have great faith in a successful outcome of this mission if it's given the go-ahead."

Another mission selected is the $100m Advanced Space-based Solar Observatory (ASO-S), which will study the connections between the solar magnetic field, solar flares and coronal mass ejections. ASO-S is planned to launch in 2021 or 2022 before the next solar maximum and would become China's first solar space observatory. According to Weiqun Gan, a researcher at Purple Mountain Observatory in Nanjing and ASO-S's chief scientist, the craft will be a "dream come true" for generations of solar physicists in the country. "We are eager to make fundamental contributions to the international solar physics community," he adds.


ESA

One for the future The Solar Wind Magnetosphere Ionosphere Link Explorer has been picked alongside four other probes to launch in the coming decade.

The other three missions given the go-ahead are the Water Cycle Observation Mission to understand how the Earth's water cycle is related to climate change; the Magnetosphere-Ionosphere-Thermosphere Coupling Exploration mission, which comprises four spacecraft to simultaneously traverse the Earth's polar regions at three different altitudes and investigate the interaction of the Earth's atmospheric layers; as well as the Solar Wind Magnetosphere Ionosphere Link Explorer – a CAS-European Space Agency (ESA) collaboration to explore the interactions between the Earth's magnetosphere and the solar wind, including space-weather science.

While China is a latecomer to launching dedicated space-science missions, it is quickly catching up thanks to generous government funding. That began in 2011 at the start of the nation's 12th five-year plan, which aimed to boost scientific and technological innovation at the national scale. Researchers received around $550m for the first batch of missions during 2011–2015 that resulted in CAS's strategic priority programme in space science. These missions included the Dark Matter Particle Explorer, which launched in late 2015; Shijian-10, a microgravity experiment platform that was sent into orbit in April 2016; and the Quantum Experiments at Space Scale that was launched in August 2016. The last of these – the Hard X-ray Modulation Telescope – is set to take off later this year.

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"In China, we used to be followers in many fields in science for way too long. This has to be changed," says Yuan. "The good sign is that innovation is now greatly encouraged by CAS as well as the government at an unprecedented level." Wu told *Physics World* that they are expecting a flat or slight increase in the budget over the next five years. "It is clear that space science, as an emerging area, has earned the recognition of the Chinese government," he adds. Yet Wu warns that the way such missions are funded needs to be improved, including the requirement of a more steady "annual government budget". Indeed, since there is no dedicated agency similar to NASA or ESA for space activities in China, projects tend to be approved in a case-by-case manner by the government.

China is already looking for international collaboration to compensate for the country's lack of experience. Maurizio Falanga, project manager at the International Space Science Institute (ISSI) in Bern and founding director of ISSI-Beijing, who has been strongly involved in the assessment of these candidate projects, says that the second batch of projects will be "more open for international collaboration or contribution". "Space science is one major area which engenders international cooperation," he adds. "We can avoid duplicate projects, share high costs and make common discoveries."

The need for partners is backed by de Grijs. "As a mature science nation, China would be well advised to act as a senior partner and consider inputs from a wide variety of stakeholders, partners and even competitors," he says. "This will ultimately benefit us all, anywhere in the world."