

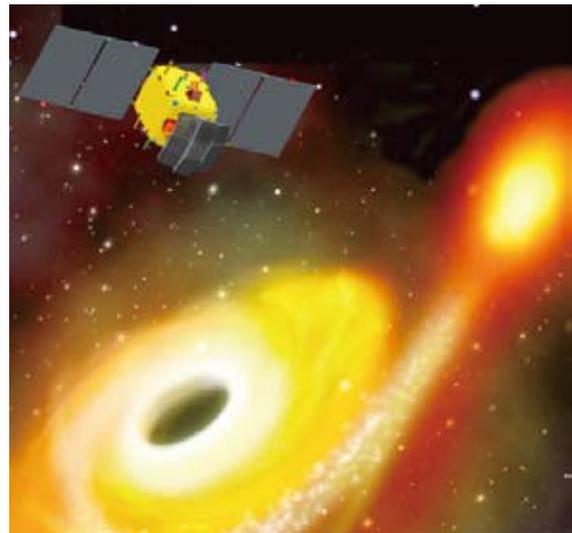
# Scientists Propose New Space Missions

By XIN Ling (Staff Reporter)

After years of background study and competitive selection, space scientists in China have officially submitted to the government their to-do list for five years to come. From the observation of solar activities to the detection of black holes, a total of five new missions are expected to be launched between 2020 and 2022, which would add up to over 5 billion yuan (\$725 million) worth of government investment, seen as a continuation of support for the emerging community.

Speaking at a press conference in Beijing on December 1, 2016, WU Ji, director general of the National Space Science Center, Chinese Academy of Sciences (NSSC-CAS) said the plan includes the Einstein Probe (EP), which will perform deep time-domain astronomy surveys to discover cosmic transients in soft X-ray; the Advanced Space-based Solar Observatory (ASO-S) to study the connections between the solar magnetic field, solar flares and coronal mass ejections; the Water Cycle Observation Mission (WCOM) that aims at synergetic observations of the Earth's water cycle and how it is related to global change; the Magnetosphere-Ionosphere-Thermosphere Coupling Exploration (MIT), comprised of four spacecraft to simultaneously traverse the Earth's polar regions at three different altitudes and investigate the coupling of the spheres; and the Solar Wind Magnetosphere Ionosphere Link Explorer (SMILE), a CAS-ESA joint effort to explore the interactions between the Earth's magnetosphere and the solar wind, including space weather science.

"These candidate projects have relatively high technical readiness," WU told *BCAS*. "We are already in the process of getting government approval. Once given the green light, they will be entering the engineering development phase early next year."



The Einstein Probe will perform time-domain astronomy surveys to discover cosmic transients in soft X-ray.



The Advanced Space-based Solar Observatory studies the connections between the solar magnetic field, solar flares and coronal mass ejections.



The Water Cycle Observation Mission is aimed at synergetic observation of the Earth's water cycle and how it is related to global change.



The Magnetosphere-Ionosphere-Thermosphere Coupling Exploration comprises four spacecraft, which will simultaneously traverse the Earth's Polar Regions at different altitudes and investigate coupling of the spheres.

YUAN Weimin, chief scientist of the EP mission from the National Astronomical Observatories, said that the probe was named after its key scientific goals – searching for X-ray signals associated with normally quiescent black holes and gravitational waves, which are both predictions of Einstein's General Theory of Relativity.

The satellite will “combine a wide-field X-ray

monitor with a follow-up X-ray telescope” to greatly enhance its scientific capability for the discovery and characterization of X-ray transients, YUAN explained. They have been making steady progress in developing key technologies like the micro-pore optics, the large-format focal plane detector and onboard data analysis on the fly, which are all “challenging at the international level”.

“Great scientific returns always come with big challenges,” he argued. “In China, we have been used to being followers in many fields in science for way too long. This has to be changed. The good sign is that innovation is now greatly encouraged by CAS as well as the government at an unprecedented level.”

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

ASO-S, which could hopefully become China's first solar space observatory in 2021 or 2022 before the next solar maximum, will be “a dream come true” for generations of solar physicists in the country. “The budget of ASO-S is approximately 100 million US dollars”, revealed GAN Weiqun, a researcher at the CAS Purple Mountain Observatory in Nanjing and chief scientist of ASO-S. “By developing our own satellite, we are eager to make fundamental contributions to the international solar physics community”.

Under the “Strategic Priority Program in Space Science” of CAS, in December 2015, China sent the Dark Matter Particle Explorer (DAMPE) – the first of the series – into space. A second and third lifted off a few months later: Shijian-10, a two-week microgravity experiment platform in orbit, and the Quantum Experiment at Space Scale (QUESS), the world's first space-based experiment for quantum key distribution, entanglement and communication. The last of the batch, the Hard X-ray Modulation Telescope, is ready for launch in the second half of 2017.

According to WU, so far, 17 out of the entire 19 experiments onboard Shijian-10 have yielded very good scientific results. Quantum key distribution by QUESS has been a success, too.

A latecomer in the space science arena, China is picking up quickly thanks to generous government input starting around 2011, which is the beginning of the nation's 12<sup>th</sup> Five-Year Plan, to boost scientific and

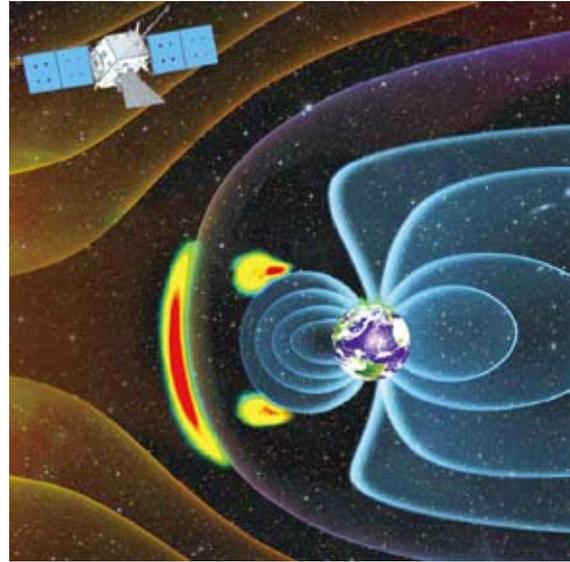
technological innovation at national scale. “We received \$550 million for the first batch of missions during 2011-2015. We are expecting a flat or even more satisfying budget for the next five years. It is clear that space science, as an emerging area, has earned the recognition of the Chinese government,” WU said.

However, the way these missions are funded needs to be improved, from a special space science program to a top-down, more steady and sustaining channel such as “annual government budget”, the director suggested. Since there is no dedicated agency for the overall deployment and management of space activities in China (like NASA or ESA), space-related projects have been proposed and approved in a case-by-case manner.

Nevertheless, China is reaching out for international collaboration to compensate institutional disadvantage and lack of experience. According to Maurizio Falanga, project manager at the International Space Science Institute (ISSI) in Bern and founding director of ISSI-Beijing, who has been heavily involved in the assessment of these candidate projects, the second batch is “more open for international collaboration or contribution”. “Space science is one major area which engenders international cooperation,” he said. “We can avoid duplicate projects, share high costs and work towards common discoveries.”

WU stressed that NSSC is looking for all opportunities to work with overseas colleagues, “on existing and future missions”.

However, such cooperation is usually complicated and does not always work out. For instance, the Kuafu Solar Observatory, a joint mission initiated by CAS and international partners a few years ago as one of the



The Solar Wind Magnetosphere Ionosphere Link Explorer is an approved CAS-ESA joint mission to explore the interaction between the Earth's magnetosphere and the solar wind.

first batch along with DAMPE, Shijian-10, QUESS and HXMT, has been infinitely postponed due to financial situation change of some international partners.

“These days, all big projects involve international collaborations, for various reasons including the fact that they are expensive, but also because different international partners bring different insights, experience and expertise to the table,” said de Grijs. “China is making great progress in space-related developments, so as a mature nation it would be well advised to act as a senior partner and consider inputs from a wide variety of stakeholders, partners and even competitors. This will ultimately benefit us all, anywhere in the world.”