Quarterly Report

on the Chinese Space Programme

July - September 2013 (No. 11)

a GO TAIKONAUTS! publication

Notice for the Issue 10 of GoTaikonauts!

The Go Taikonauts! team has been participating in the 64th International Astronautical Conference 23 - 27 September 2013 in Beijing.
During the course of the week, we have been able to conduct numerous interviews, collect valuable materials, had exciting discussions and followed breaking-news plenaries and presentation.

Each of us came home with a treasure of information which we will be pleased to share with our readers. Go Taikonauts! is going to dedicate the issue no 10 to the outcomes and results of the 64th IAC 2013. To provide the best quality of journalistic work and analysis the publishing will be shifted to end of November 2013.
In the meanwhile we are happy to provide you with the regular Quarterly Report.

If you are interested in receiving previous or future issues of our magazine or the Quarterly Report, please, send an e-mail to: <info@go-taikonauts.com> to request it for free.

Quarterly Report on the Chinese Space Programme

July - September 2013

by Chen Lan

Highlights

- Qinzhou small launch vehicle made an unexpected debut.
- Long March 5 development back on track. Major progress made.
- China's manned lunar landing plan rumoured to be halted, at same time more details revealed.
- IAC 2013 held in Beijing. More details of the Chinese Space Station disclosed.
- Chang'e 3 arrived in Xichang, ready for the December launch.
- China hopes to launch a Mars orbiter with lander and rover in 2018.
- China tests satellite rendezvous and space robotic arm.
- China successfully tested an inflatable structure in space.
- CAST is reportedly working on space solar power station technologies.
- UN plays a major role in international cooperation with the Chinese Space Station.

Launch Event

From July to September, China made five space launches:

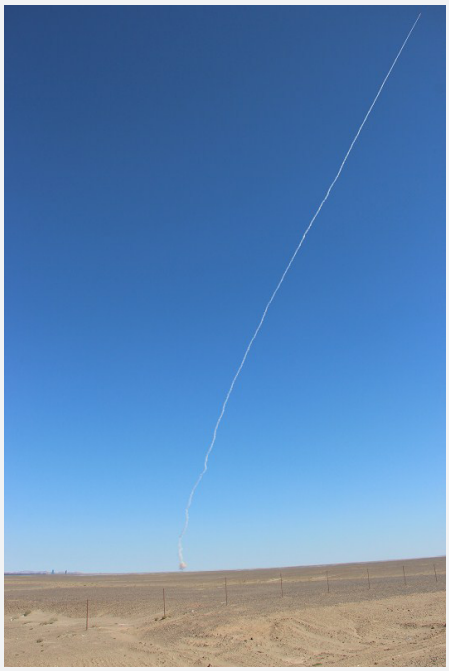
- On 15 July, at 17:27, the SJ-11-05 satellite was successfully launched from the Jiuquan Satellite Launch Centre by a CZ-2C. It was thought to be the replacement of the SJ-11-04 that was lost in a launch failure on 17 September 2011. The failure was caused by a structural failure of the servomechanism of the vernier engine on the second stage, leading to attitude loss of the rocket. The CZ-2C used in this launch is the first one equipped with the dual inertial unit to increase reliability. It also created a Chinese record, the shortest launch preparation time of 30 days from the satellite's arrival at the launch site to launch.

- On 20 July, at 7:37, a CZ-4C lifted-off from Taiyuan Satellite Launch Centre, putting three satellites, the CX-3 (Chuangxin 3), SY-7 (Shiyan 7) and SJ-15 (Shijian 15), into orbit. They were reportedly to perform "space debris observation" and space robotic arm test.

- On 2 September, at 3:16, another CZ-4C took off from Taiyuan and sent the three YG-17 satellites into space. YG-17 is thought to be China's ocean surveillance satellite and the follow-on of YG-9 and YG-16.

- On 23 September, at 11:07, China launched the FY-3C polar orbit weather satellite from Taiyuan using a CZ-4C rocket. It was the first time that three consecutive CZ-4C launches occurred in just a little more than two months. FY-3C was the third of the second generation polar orbit weather satellite, and will join the FY-3B to form a morning - afternoon satellite system. Interestingly, the launch happened just moments after the opening ceremony of the 64th International Astronautics Conference (IAC 2013) being held in Beijing, and seen as a gift to the conference.

- The most surprising launch happened two days later on 25 September. China suddenly announced the successful launch of the Quaizhou 1 satellite by a Quaizhou launch vehicle (Quaizhou means Fast Vessel or Fast Ship) in Jiuquan at 13:04 the same day. The satellite was developed by Harbin Institute of Technology and the launch vehicle by the China Aerospace Science and Industry Corporation (CASIC). CASIC had two unsuccessful launch attempts in 2002 and 2003 with its KT-1 (Kaituozhe 1) small launch vehicle. This launch makes CASIC the first Chinese organisation outside of CASC (or CALT and SAST) capable of developing a space launch vehicle and making a successful space launch. There were no further details or any launch images revealed through the official media. The Quaizhou 1 rocket is believed to be a small solid-fuelled, responsive mobile launch vehicle. The Quaizhou 1 satellite is also rumoured to be a satellite integrated with the upper stage. A satellite photo shows its possible launch site is about 6 km east of the existing pad 921 and 603 in Jiuquan.



Alleged Kuaizhou 1 launch from Jiuquan (credit: Chinese internet)

Space Transportation

In early August, the YF-100 engine made another 500-second long duration hot-firing and achieved another success. The engine was tested in flight configuration and the test covered a normal flight sequence. So far, the engine has been tested more

than 100 times and has accumulated more than 4,000 seconds of firing time, paving the way for its maiden flight.

The Long March 5 development made significant progress in this quarter. It seems that development has been back on track after difficulties in the manufacture of the 5 m diameter hydrogen tank have been overcome. In early July, the separation test of the payload fairing of Long March 5 was completed successfully. It is the largest and heaviest payload faring ever made in China. It adopts a two-piece, horizontal separation method. At the beginning of August, a review committee approved the plan to start the Long March 5 engineering model development. By mid-August, the first 5 m diameter, 33 m long core-stage was in final assembly and would be ready one month later for planned testing.

In Hainan Island, infrastructure construction and equipment installation was also in full swing. On 11 July, the liquid hydrogen and oxygen facility for the launch centre was completed. It covers more than one square kilometre, and includes a raw material storage area, liquid hydrogen and oxygen production area and storage area, safety facility and office area, etc. On 17 July, the closure work of the hydraulic structure of the New Qinglan Port was finally finished, marking completion of the underwater engineering of the Qinglan Port extension project. According to the design, one pier was constructed especially for launch centre use.

On 11 July, the third stage of the Long March 6 launch vehicle made a successful test-firing. Its first and second stage test-firings were made in 2012 and earlier this year. So far, all three stages of the Long March 6 have completed hot-firings.

There was also an unofficial message circulating on the internet, stating that the human lunar landing project had failed to be approved in a recent Chinese government decision-making process. But it is believed that pre-studies on the 500 t kerosene/LOX engine and the 220 t cryogenic engine still continue. During the 64th International Astronautics Conference (IAC 2013) held in Beijing, Chinese officials, in plenary speeches, still listed the manned lunar mission and the super heavy launch vehicle as future objectives. One presentation slide showed a moon landing flight profile using two cargo launches and one manned launch, a newly designed Apollo-like manned spacecraft, and two dockings using both Earth Orbit Rendezvous (EOR) and Lunar Orbit Rendezvous (LOR) approaches. Another slide showed that the super heavy rocket (aka. Long March 9) will have a launch mass of around 3,000 tonnes, and LEO/LTO capability of 100 and 35 tonnes respectively. It will be a three-and-a-half stage launcher. There are eight 500 t thrust LOX/kerosene engines on its first stage and four strap-on boosters. While its second and third stages use cryogenic engines.

Long March 5 fairing separation test (credit: spacechina.com)

Satellites

On 21 August, China's first civil-use new technology test satellites, Shijian 9 (SJ-9), were delivered for use. The satellites were developed by China Spacesat (or directly translated as DFH Satellite), a child company of CAST. The customer is its grand-parent company CASC. SJ-9 A and B were launched on 14 October 2012, and made a successful testing of an electrical propulsion system in November 2012, for the first time in China. Their role also included a testing of long-life components, inter-satellite communication and formation flight.

Development of new civil satellites also made progress:

- It was reported in early July that China's next generation geostationary meteorological satellite FY-4 has completed reviews on the status of all sub-system development and acceptance reviews for all single units. Development of the electrical test model had also been started.

- In August, the DFH-4E comsat bus completed its design review. The enhanced satellite bus will increase the payload mass to 1,000 kg and total mass to 6,000 kg. An electrical propulsion system will also be installed on the DFH-4E.

- In mid-August, the project of ground integration and verification for the satellite electrical propulsion system was approved, paving the way for development of the DFH-3B, DFH-4E and DFH-5 new generation communication satellites.

There are also a few updates on science satellites under development and proposed:

- In early August, a test to verify command uploading to the HXMT (Hard-X Ray Modulation Telescope) was successfully completed in CAST.

- Development of the Shijian 10 engineering model was approved in late September and would start immediately. SJ-10 is a recoverable satellite designed to carry-out microgravity experiments.

- The Institute of Atmospheric Physics, Chinese Academy of Sciences made a breakthrough on the inversion algorithm for China's first carbon-sniffing satellite, TanSat. At the same time, simultaneous carbon dioxide observations on the ground and by JAXA's GOSAT satellite was performed in August, paying the way for the TanSat onboard equipment

development.

During IAC 2013, Northwestern Polytechnical University (NPU) showcased its Aoxiang 1 CubeSat. At least six Chinese universities have participated in the QB50 Project, and the 2 kg Aoxiang 1 is one of the planned QB50 nanosats. NPU is also responsible for one of three mission control centres of QB50.

Manned Space Flight

During the IAC 2013 in September, China disclosed more details of its space station plan through plenary speeches and technical papers. Here is a summary of some interesting new information:

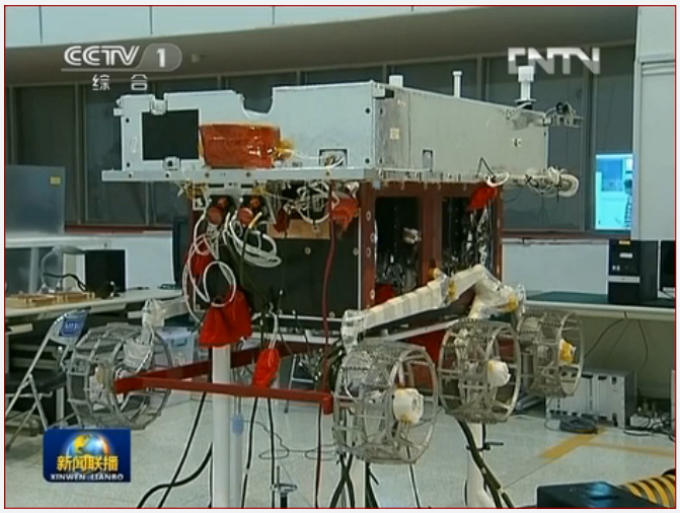
- The extension plan of the Chinese Space Station (CSS) was further confirmed. That is, three more modules developed purposely for international cooperation. It will be completed by 2022, two years later than previously planned, as told by Wu Ping, spokeswomen of CMA, in a special IAC session.
- In the future, at the active part of the docking mechanism, three additional electromagnetic brakes (dampers) will be added to enhance the energy-buffering capacity in order to support the large mass docking conditions. A probe-cone docking mechanism and low impact docking system are also under study and in testing. China is also closely following the International Docking System Standard (IDSS).
- The CSS scientific utilisation plan has been preliminarily established through work performed since 2006 involving 70 universities and institutes. There are now 200 projects on the candidate list.
- CSS is able to support 17 tonnes of research facilities and provides 12 kW power to them. The research facilities of the CSS will be deployed in all of the modules. The racks for microgravity science experiments are arranged in the core module and experiment module 1.
- Scientific payloads include standard pressurised payloads, special customised payloads (like the proposed telescope at CSS) and exposed payloads (i.e. on the outside of the CSS). The former will be arranged in standard scientific racks similar to those on the ISS (the so-called International Standard Payload Racks – ISPRs). 12 racks have been planned:

  - Ecology Science Experiment Rack (ESER)
  - Biotechnology Experiment Rack (BER)
  - Science Glove-box and Cryogenic Storage Rack (SGCSR)
  - Fluids Physics Experiment Rack (FPER)
  - Two-phase System Experiment Rack (TPSER)
  - High-Temperature Material Science Experiment Rack (HTMSER)
  - Container-less Processing Experiment Rack (CLPER)
  - Varying-Gravity Experiment Rack (VGER)
  - Low Micro-gravity Level Rack (LMGLR)
  - Payload on Orbit Service Support Rack (POSSR)
  - Two racks for fundamental physics

- There will be eight or more 0.6 x 0.6 m exposed platforms on the CSS. The experimental payload separation facility includes an eject launch system and manipulator (robotic arm) launch system.
- The interface standard of both the pressurised payloads and exposed payloads is planned to be released to the international space community for international cooperation.
- Microwave power transmission is proposed to be demonstrated on the CSS. The proposed test will incorporate a 2.4 x 0.6 m transmission panel and will be supplied by the station with 5 kW of power. It is anticipated to transmit 2.5 kW power from LEO to the ground with footprint of 55 km diameter. The Qian Xuesen Laboratory of Space Technology, CAST proposed this demonstration that has already been tested in ground development in the laboratory.

In space, the Tiangong 1 space laboratory performed two orbit manoeuvres during the night of 11 September, raising itself from

Chinese probe-cone docking mechanism in test (credit: IAF)



Lunar rover in testing (credit: CCTV)

343 x 351 km to 355 x 367 km, according to USSTRATCOM data. This is consistent with conclusions made by CAST in a review on 30 September that Tiangong 1 is still in good health, and has sufficient resources to support continuous operation and the extended mission. However, it did not confirm if there will be an extended mission or what it would consist of.

Lunar and Deep-Space Exploration

After 21 months of design, 26 months of prototype development and 20 months of flight model development, the Chang'e 3 development has entered its final stage during this quarter, including a key test, the soft landing cushion test, that was completed successfully at the beginning of July. On 19 August, it passed the flight model development assessment by an independent committee. On 24 July, a review for shipping to the launch centre was completed.

At 3:19, on 11 September, the Chang'e 3 lunar probe departed from CAST in seven vehicles. It arrived at the Capital Airport of Beijing at 5:51. It was then moved into an Ilyushin IL-76 cargo plane. At about 6:00, 12 September, the cargo plane took off and arrived in Xichang three hours later. The spacecraft will take three months for testing and will be launched in early December.

In late September, China launched a worldwide public naming campaign for the Chang'e 3 rover. It was through the web site of the Xinhua News Agency and QQ.com. Unfortunately, they are all in the Chinese language!

While Chang'e 3 prepared for launch, Chang'e 2 is still in a good state, and has reached a position 50 million kilometers from the Earth on 14 July. Development of Chang'5 and Chang'e 6 moved forward silently. The 3,000 N engine to be used by the planned probe also made a successful thermal calibration test-firing on 6 August.

There is also news about Mars. In mid-September, Long Lehao, a well-known rocket scientist, revealed to Chinese media that as early as May 2018, China would launch a Mars orbiter, carrying a lander and maybe even a rover. It seems that China has probably merged the previously planned separate orbiting and landing missions into one. In late September, the Shanghai based Jiefang Daily reported that Shanghai Fudan University has completed a pre-study of a radar that may be used to detect the stratigraphic structure of Mars from a depth of a few hundred metres to a few kilometres.

Advanced Technology

From early August, one of the three satellites launched on 20 July, named Payload C by USSTRATCOM, changed its orbit and manoeuvered closely to another satellite, payload B. They were in an almost identical orbit for more than ten days. China had announced earlier that the 20 July launch had an objective to test a space robotic arm. It is speculated that China was testing a new technology for one satellite to capture another satellite by using the robotic arm. It is unknown if the target satellite is cooperative or non- cooperative, or which of the three satellites, SJ-15, SY-7 or CX-3, carries the robotic arm, and which is the target.

China Space News reported on 17 July that China's first inflatable space structure was successfully tested on the XJY-1 satellite launched in November 2012. The 3 m long inflatable arm was developed by the Institute 508 of CAST. It is used as the gravity gradient boom on the satellite.

Li Ming, Vice Director of CAST, revealed during IAC 2013 to Chinese media, that CAST is studying space solar power station technologies with a focus on its assembly and attitude control.

International Cooperation

During 23 to 27 September, the 64th International Astronautical Conference (IAC 2013) was held in Beijing. It had been 17 years since the last time the IAC was held in Beijing in 1996. The conference received 3675 papers and attracted about 3700 participants from all over the world. The Heads of Space Agencies of the United States, Russia, Europe, Japan, India and China also attended the conference and met with the media and students. Seven plenary, 170 technical sessions and 300 other activities, including a technical exhibition, technical visits, student forum, art exhibition and cultural events, etc., were held during the conference.

China showed its openness during the conference. Chinese authors contributed more than 200 papers and two plenary sessions specifically on Chinese space development were held, revealing more details of its space programme. During the conference, China reiterated its willingness to open the Chinese Space Station (CSS) to international partners. More interesting is the United Nations' role in promoting international cooperation on the CSS. According to the document released by the UNOOSA (United Nations Office for Outer Space Affairs) in June, China offered the utilisation of the facilities on its planned manned space station to the world during the 55th session of COPUOS (United Nations Committee on the Peaceful Uses of Outer Space). The HSTI (the Human Space Technology Initiative), launched by UNOOSA in 2010, will work with the China Manned Space Agency to review a possible collaboration in utilising China's space station. Just one week before IAC 2013, the UNOOSA and China jointly hosted the Workshop on Human Space Technology in Beijing with a focus on international cooperation. In a speech made by an UNOOSA representative in IAC 2013, it was revealed that the international cooperation on CSS has been included in the framework of HSTI, and the UNOOSA will invite international partners to join the cooperation programme on CSS.

The Business Standard, a Pakistan newspaper, reported on 18 September that Pakistan would like to be the "first candidate" for a manned mission when China opens up its future space station, as stated by Ahmed Bilal, Chairman of the Pakistan Space and Upper Atmosphere Research Commission. The newspaper also said, quoting Yang Liwei, the first taikonaut, that China had received many requests during the course of building a permanent station.

NASA administrator Charles Bolden went to Beijing to participate in IAC 2013. On 25 September, he met with Bai Chunli, president of CAS. Bolden said NASA was "highly serious" about working

with the Chinese, and that he wished for more cooperation in fields such as space-to-Earth observation.

On 24 September, the first tripartite talk between CNSA, ESA and Roscosmos was held in Beijing. The three parties signed the meeting minutes and reached consensus on cooperation for mutual support in scientific research and mission operations in the field of Mars exploration, and also agreed to explore the cooperation in other deep-space exploration targets of interest. They also decided to build a mechanism for high-level talks to be held once a year, and establish a tripartite joint working group to draw up an action plan about cooperation in the field of deep-space exploration, and submit it for further consideration and decision making before the tripartite talk of 2014.

On 25 September, Dr. Ma Xingrui, Administrator of China National Space Administration (CNSA), met with Mr. Enrico Saggese, President of Italian Space Agency (ASI) and signed the Memorandum of Understanding between ASI and CNSA on Cooperation in the China Seismo-Electromagnetic Satellite (CSES).

On 4 July, the Seventh Meeting of the Council of Asia-Pacific Space Cooperation Organization (APSCO) was held in Beijing. Eight member states of APSCO, namely Bangladesh, China, Iran, Thailand, Pakistan, Mongolia, Peru and Turkey, and the signatory country, Indonesia, sent delegations to attend the meeting. On 5 July, Dr. Ma Xingrui, Vice Minister of the Ministry of Industry and Information Technology (MIIT), as well as Administrator of CNSA, was elected as the third Chairman of the Council. On the same day, China and APSCO signed an agreement to share China's Earth observation satellite data. CNSA makes full use of the remote sensing satellites, including GF-1, resource satellites, meteorological satellites, and oceanic satellites, to provide the APSCO member states with satellite remote sensing application services, to reduce natural disaster risks and losses in the Asia-Pacific Region.

On July 16, the inauguration ceremony of the International Space Science Institute-Beijing (ISSI-BJ) was held in Beijing. ISSI-BJ is jointly established by ISSI, headquartered in Bern, Switzerland, and National Space Science Center (NSSC) in Beijing, with support from the Bureau of International Cooperation and the Space Science Strategic Program of CAS. ISSI-BJ will advance the internationalisation of space science research, as well as provide an important window on Chinese space science to the scientific community. During this year, ISSI-BJ will support one international team, and four forums on the science topics of four background space science projects, including X-ray timing and polarization (XTP), space-based millimeter wave very long baseline interferometry (Space VLBI), solar polar orbit observation (SPORT) and magnetosphere-ionosphere-thermosphere coupling (MIT), for discussion and further demonstration of the scientific topics with the worldwide space science community. On 16-18 September, first of them, the Space VLBI Forum was held in Beijing.

Other developments on international cooperation between China and other countries:

- It was reported that Poland is discussing with China to launch a Polish smallsat Hevelius on a Chinese rocket CZ-4.
- A Beidou reference station for continuous operation was completed in Laos in early September. It increases the Beidou positioning precision in the south-east Asia region to the centimetre or decimetre level. Also, China and Pakistan signed an agreement during IAC 2013 to push internationalisation of the Beidou system.
- Steve Durst, founding director of the International Lunar Observatory Association, revealed in the Galaxy Forum workshop held in Beijing on 22 September, that their researchers will use the ultraviolet lunar telescope on board the Chang'e 3 to conduct astronomical imaging for educational purposes. And researchers from CNSA and National Astronomical Observatories of CAS can use the ILO-X and ILO-1 lunar telescopes that will go to the Moon with a privately sponsored lunar lander in 2015. The association signed a memorandum of understanding with the CNSA in August.

Commercial Space

Chinese media reported progress on a few commercial satellites under development. In early July, the LaoSat 1 comsat completed its preliminary design review. It is based on the new DFH-3B bus using electrical thrusters. LaoSat 1 will be the first satellite using DFH-3B. In mid-August, Bolivia's first comsat Tupac Katari completed its Compact Antenna Range Test, followed by a thermal vacuum test in early September

On 2 September, China delivered the ground facility and the ground application system of the VRSS-1 remote sensing satellite to Venezuela. VRSS-1 was China's first in-orbit delivered remote sensing satellite and was launched on 29 September 2012.

China Asia-Pacific Mobile Telecommunications Satellite (APMT), a subsidiary of CALT, revealed in a news release that it is discussing with the Zambian government on cooperation using a Chinese satellite and launch service.

During IAC 2013, China Great Wall re-affirmed its commitment to the $70 million price tag for the Long March 3B launch, despite SpaceX providing a lower price.

The Barcelona Moon Team, a Google Lunar XPRIZE competitor, announced on 13 September that after reviewing its technical milestones calendar to include the integration of the propulsion system in China, the launch will now take place in June 2015. The team has signed with China Great Wall to use a Chinese launch vehicle to send its rover to the lunar surface.

Miscellaneous

Ground Facility
In mid-July, the 70-tonne electrodynamic vibration generator completed all testing work and is now ready for use. It was designed to test large spacecraft and was reportedly the world's largest.

Imprint

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