All About The Chinese Space Programme

Go Taikonauts!

龙腾太空

Issue 8

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Mist Around the CZ-3B Disaster

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Go Taikonauts!

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Mist Around the CZ-3B Disaster

In memory of those deceased in Xichang in 1996

15 February 1996 (14 February UT) is an unforgettable date for Chinese space scientists and engineers, as well as Chinese space enthusiasts. That day, just four days before the Chinese New Year, the country's largest launch vehicle ever built by that time, the Long March 3B (CZ-3B), made its maiden flight carrying an Intelsat 708 communication satellite. At 3:01 Beijing time, the CZ-3B was ignited and ... page 7

History

Brief History of Xichang Satellite Launch Centre

In 1969, a serious border conflict between China and the former Soviet Union occurred. In the late 1960s, China was planning its first manned space programme - the Shuguang Programme. The situation forced the Chinese decision makers to consider a new space launch site because the Jiuquan Satellite Launch Centre (JSLC) is too ... page 15

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Editor's Note

The Chinese space programme has made great progress in the last two decades. People are talking about a Chinese Space Station and even a Chinese manned Moon landing. How did China make such achievements? On what kind of basis are they built? What kind of price had the country to pay? A recent article by Anatoly Zak reminds us of what's behind the progress. It brings up again a disaster from 17 years ago - the CZ-3B launch failure in Xichang in February 1996. It was described as the worst space accident in Chinese space history, and even in the space history of mankind. Zak's article provides new testimonies from two US-American engineers who were involved in the launch in Xichang. However, it does not answer many questions that have existed for the last 17 years.

The cover story of this issue tries to answer some, though not all, of the questions about the disaster. The story covers various witness' reports from Chinese media since 1996, analyses geographic conditions and the population distributions and its growth, and makes a few conclusions about the impact site and the casualty number. The most important conclusion is that it is unlikely that the casualty figure exceeded one hundred. Also, this issue includes a brief history of the Xichang Satellite Launch Centre and a set of pictures of the launch centre in the gallery. They can be referenced to each other while reading.

This issue also has two other articles of particular interest. The second part of Brian Harvey's article describes the future of Chinese space science. The officially published Roadmap 2050 looks very ambitious and visionary. Chinese space science is expected to progress rapidly after a long dormancy which has lasted for decades. We also hope that the interview with Prof. Mazlan Othman, Director of the United Nations Office for Outer Space Affairs (UNOOSA), is able to provide a valuable viewpoint and insight, not only from an UN official, but also from an Asian and a woman, on international space cooperation and the Chinese space programme.

June of this year will again become a grand party for Chinese human space flight. The Shenzhou 10 mission is supposed to be similar to the Shenzhou 9 mission which occurred last June. Both missions will have had two male taikonauts and one female taikonaut onboard, autonomous and manual dockings with Tiangong 1, and living and working in the space lab, but a little bit longer in the case of Shenzhou 10. Will it give us some surprises with something interesting? We will report on that in the next issue.

(Chen Lan)

correction for issue no 7 - page 15:
the correct name of the former Chinese Prime Minister is: Wen Jiabao.

Imprint

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Chinese Space Quarterly Report

January - March 2013

by Chen Lan

Highlights

- Long March 5 development encounters difficulties; Maiden flight delayed to 2015
- Long March 11 will make its debut in 2015
- First civil hi-res imaging satellite and 3 international nanosats to be launched in April
- Electrical thrusters of DFH-3B successfully tested
- Shenzhou 10 arrived in Jiuquan; Fly-around planned
- Approval of the manned lunar landing is years away, but consensus has been made; 2025 likely
- An experimental lunar return spacecraft to be launched before Chang'e 5
- First asteroid probe in definition phase; Mars probe stalled
- China studies "propellantless" space thruster
- China - ESA manned space cooperation progresses steadily

Launch Event

There was no launch event in this quarter.

Launch Vehicle

In January, CALT completed a key review on the control system of the Long March 5 launch vehicle, marking the completion of the prototype phase and start of the engineering model development. The review was focused on redundant design and fault tolerance. Before that, all 27 major tests for the rocket's control system have been completed. The last test was the pyrotechnics testing, done in early January. In early March, the hydrostatic test of the Long March 5 hydrogen tank was successfully completed. Acoustic emission technology was used in this test.

At the end of February, Long March 7's first core stage tank rolled-out of the production line. It was the longest 3.35 m diameter tank China has ever built. In March, the first oxidiser tank of the strap-on booster was completed and delivered. Long March 7 development is on track, Chinese media reported in March.

The Long March 7 first core stage tank (credit: CALT)

To speed up developments, in March, CALT held mobilisation meetings for the two rocket projects separately. The target of the maiden flight of Long March 7 was set for 2014. While for the Long March 5, it has been delayed to 2015. The CALT Head, Liang Xiaohong, revealed in March at the annual session of the National People's Congress that Long March 5 development has encountered serious problems related to the 5 metre diameter hydrogen tank that caused delay. He also disclosed that a solid rochet small launcher, Long March 11, will make its maiden flight by 2015. Long March 11 is a low cost, fast response small launch vehicle.

Propulsion

CALT announced on 29 January that it will develop a 220 tonne thrust liquid hydrogen and liquid oxygen engine to be used in the future super-heavy launch vehicle. Pre-studies for this engine have been started. CALT developed China's all cryogenic engines including YF-73, YF-75 and is developing the YF-77 and YF-75D for the Long March 5 family. Up to now, the largest cryogenic engine is the 50 tonne thrust YF-77. CALT is preparing the first full-system test firing of the YF-77 on Long March 5 in the second half of 2013.

In March, during the annual session of the National People's Congress, Tan Yonghua, Head of the China Academy of Aerospace Propulsion Technology (AAPT), disclosed that it is studying re-usable engines for a future RLV.

Satellites

China's first civil high-resolution imaging satellite, Gaofeng 1, was undergoing its final testing – an aging test - in late February. Before then, it had completed the thermal test and magnetic test of the flight model. Gaofeng 1 is the first satellite in the High-Resolution Earth Observation System consisting of 5-6 satellites by 2020. The satellite is to be launched by a CZ-2D in late April. The two-stage launcher will also carry three piggyback nano satellites, Turksat-3USAT of Turkey, NEE-01 Pegasus of Ecuador and CubeBug-1 of Argentina.

It was revealed during the annual session of the National People's Congress that China will launch 4-5 experimental global navigation satellites for the third phase of the Beidou

Navigation System. The first phase of Beidou is the dual-sat active regional navigation system launched in 2000 - 2007. The second phase is the 14-sat passive regional navigation system completed at the end of 2012. The third phase needs 30 satellites and will provide a global navigation service by 2020. The first experimental satellite is to be launched by the end of 2014.

In the field of communication satellites, a leap forward was made in March. The electrical propulsion system of the DFH-3B comsat bus did a successful test firing, paving the way for China's new generation communication satellite. In the testing, the electrical thruster was integrated with the engineering model of the new satellite. It lasted 18 days.

Chinese media also reported the development status and future plan for various Earth observation systems, including meteorological satellite, oceanic satellite and Earth resource satellite:

- In January, FY-3C was under electrical testing. It was to be followed by thermal vacuum test, mechanical test and aging test.
- In mid-March, it was reported that the engineering model of China's second generation geostationary meteorological satellite, FY-4, was under final assembly. The flight model is expected to start development within 2013.
- On 1 February, reviews of the proposals for HY-1C/D and HY-2B was completed in Beijing. These satellites are replacements of China's first generation oceanic satellites. The new satellites will have a longer working life and enhanced capabilities.
- Xinhua reported in January that China will establish a comprehensive mapping satellite system including optical stereo cartography satellite, interference radar satellite, laser altimetric satellite, gravity measurement satellite etc. The second ZY-3 mapping satellite will be launched in early 2014 to form a dual-sat system and increase the ground resolution to 2.5 m.

On 6 January, the working meeting for the application system and payload of the HXMT astronomical satellite was held in Beijing. Messages revealed from the meeting showed that it has made impressive progress. Development of its ground application system has also started.

Manned Space Flight

One of the most anticipated Chinese space missions in 2013 is the Shenzhou 10 - Tiangong 1 docking mission. From the beginning of the year, progress of the mission was reported frequently:

- 09 January: the Shenzhou 10 capsule has completed the leak test. Everything is on track.
- 05 February: the CZ-2F for Shenzhou 10 has completed the last round of testing making it ready for shipping in April.
- 17 February: a rehearsal for testing at the launch site was made in Beijing.
- 28 February: CMSA announced that Shenzhou 10 will be launched between June and August. It will be the first operational flight for the Chinese manned space system. The Shenzhou 10 spacecraft has completed assembly and is undergoing testing.
- 19 March: CZ-2F passed the shipping review.
- 20 March: the Shenzhou 10 spacecraft has completed the system level review.
- 25 March: the SAST team for the Shenzhou 10 mission departed from Shanghai.
- 31 March: the Shenzhou 10 spacecraft was transported to Jiuquan by two Ilyushin 76 transport planes. It arrived in Jiuquan the same day, with CCTV reporting the operation for the first time.
- 31 March: Shenzhou 10 will make a fly-around of the Tiangong 1 during the mission. It will also be the longest Chinese manned space mission lasting 15 days, two days more than the Shenzhou 9 flight.

To journalists, the annual session of the National People's Congress is usually an exciting moment for Chinese space news. Many space officials, also representatives of the Congress, were interviewed by media in this year's annual session in March. News included:

Shenzhou 10 re-entry module in testing (credit: Chinese internet)

Liu Yang in the annual session of the National People's Congress (credit: China Daily)

- Shenzhou 10 will carry one female and two male taikonauts, similar to the Shenzhou 9.
- Shenzhou 10 taikonauts will make a space lecture for teenagers from Tiangong 1.
- Tiangong 1 will continue to work in orbit after the Shenzhou 10 mission.
- Tiangong 2 will test cargo ship docking and space refueling.
- Micro satellites will be released from the future space lab.
- A Chinese manned lunar landing has not yet been approved; but various departments have already reached a consensus on it.
- Chinese manned lunar landing targets 2025.

Liu Yang, the first female taikonaut, also attended the National Congress annual session as a new representative. She told the media that none of the Shenzhou 9 crew will fly the next manned mission but they will support it during the flight.

Lunar and Deep Space Exploration

Chang'e 2 made a dramatic flyby with asteroid Toutatis in December. It continued its deep space venture afterwards. On 5 January, it reached a point 10 million kilometres away from the Earth. Twelve days later, it was at a distance of 12 million kilometres. On 28 February, the probe hit the 20 million kilometres mark. Chang'e 2 has now become China's longest resident spacecraft in "deepest space". With only 5 kg propellant left onboard, it has been impossible to change its orbit to any new target. However, it provides a good opportunity for Chinese ground controllers to test deep space tracking and communication for future missions.

One month after the Toutatis flyby, in January, Chinese scientists released more information about the flyby on the 8th Meeting of The NASA Small Bodies Assessment Group (SBAG). (See Issue 7 of Go Taikonauts! for details).

Meanwhile, Chang'e 3 lunar landing mission entered a critical phase. On 8 January, China Aerospace Science and Technology Corporation (CASC) and the Lunar and Space Engineering Centre of COSTIND kicked-off an independent review of the Chang'e 3 flight model development. By the end of March, the Academy of Aerospace Propulsion Technology (AAPT) had delivered the propulsion sub-system of the Chang'e 3 spacecraft. It developed the variable thrust landing engine for Chang'e 3 that made another successful testing on 17 March. In March, China Academies of Sciences delivered the flight model of the lunar terrain camera. At the end of March, CAST was preparing an important testing – a thermal vacuum testing - of Chang'e 3.

Chang'e 3 undergoing thermal vacuum testing (credit: CCTV)

Warmed-up by the Chang'e 3 mission, anticipated by end of the year, there was also more and more news in the Chinese media about the Chang'e 5 lunar sample mission. On 3 March, the Chang'e 5 laser docking radar completed a review in Chengdu (we have reported a review for another Chang'e 5 docking radar - the microwave docking radar, in the Quarterly Report Q4 2012). In the annual session of the National People's Congress in March, a lot of messages were disclosed. The Chang'e 5 landing site has been selected in China's northern grassland, very probably at the Shenzhou landing site. An experimental spacecraft will be launched before 2015 to conduct crucial re-entry tests. The satellite will consist of the Chang'e 2 structure as well as the Chang'e 5 return capsule. Chang'e 5 has been approved by the government and will be launched in 2018.

On 11 March, CAST and the Purple Mountain Observatory held a seminar in Nanjing focusing on China's first asteroid exploration mission. They discussed scientific objectives, key technologies, mission profile and ground observation support, etc. A few days prior, another seminar was held in Purple Mountain Observatory, about the organic component analyser, aiming to drill and analyse in-situ at the surface of the asteroid.

While robotic asteroid exploration is taking shape, China's first independent Mars mission is not in the official plan, Ye Jianpei, a respectable Chinese space scientist confirmed during the National People's Congress session.

Research and Development

Wired UK reported on 13 February that Chinese scientists have built and tested a radical new space drive, developed by a team headed by Professor Yang Juan at the Northwestern Polytechnic University in Xi'an. The paper entitled "Net thrust measurement of a propellantless microwave thruster", published in 2012 in the academic journal Acta Physica Sinica, gives the test results in detail, showing that with a couple of kilowatts of power, it can produce 720 mN of thrust. The drive, called an "EmDrive", is a closed conical container which, when filled with resonating microwaves, generates a net thrust towards the wide end. EmDrive was invented by British engineer Roger Shaywer. The technology is controversial because of the keyword "propellantless". Many scientists criticise that it violates the law of conservation of momentum.

International Cooperation

In mid-January, an NSSC (National Space Science Centre) delegation led by Wu Ji visited the ESA Technical Centre (ESTEC) at Noordwijk in the Netherlands and participated in the 3rd Meeting for ESA-China Cooperation on Geo-sounder. NSSC and ESA agreed in mid-2012 to cooperate on payloads of

China's next generation geostationary FY-4 microwave weather satellite. ESA is responsible for the humidity sensor. The ESA delegation then paid a return visit in early March, further exchanging information on the cooperation.

On 8 February, the German media Spiegel Online reported that representatives of ESA's Human Spaceflight Directorate, along with a young European astronaut who is studying Chinese visited to the Astronaut Centre of China in January. Just weeks earlier, a group of Chinese experts including taikonauts had visited the European Astronaut Centre in Cologne. Thomas Reiter, ESA's Director for Human Space Flight and Operations told in a press conference that "in case at a later point in time, at end of the decade, maybe a European vehicle or an international vehicle could dock to the Chinese Space Station. ... We have not yet started any direct developments but we are at least trying to understand where are the links, where are the possibilities that we have, where are the options for cooperation."

In late February, the renowned space web site Space.com, gave more details of the cooperation quoting Bob Chesson, an ESA human spaceflight adviser. According to Chesson, China is very interested in the IBDM (International Berthing and Docking Mechanism) because the Chinese APAS system needs a higher velocity in docking, and may have structure fracture mechanics problems in future station assembly. The report also confirmed that ESA has provided introductory Chinese classes for its astronauts at the European Astronaut Centre. Three ESA-China working groups, on rendezvous and docking, astronaut training and payload facilities and experiments respectively, have been formed. Exchange visits are becoming regular. A delegation of ESA astronauts and trainers will be going to Beijing in April. All these signs show that manned space cooperation between China and ESA may be progressing.

On 7 March, the Egyptian Authority for Remote Sensing and Space Sciences (NARSS) announced that it and the China Academy of Space Technology (CAST) have signed a Memorandum of Understanding to build a satellite assembly plant in Egypt. The Chinese side will review and approve the design of the Egyptian satellite "Egypt Sat 2", which is expected to be finalised by the Egyptian side in July 2014. The new satellite will be manufactured, assembled and tested in the plant to be established in Egypt.

Commercial Space

On 3 January, U.S. President Barack Obama signed legislation allowing the White House to remove satellite technology from a list of export-controlled munitions and other military-grade components. However, under the Authorization Act, satellite exports would remain prohibited for launches from China, North Korea, Iran, Cuba, Syria and Sudan. The International Traffic in Arms Regulations (ITAR) was expanded in 1999 to include satellites after an investigation accusing China of spying on U.S. satellite technologies. The restrictions compelled some satellite builders to offer "ITAR-free" commercial satellites for launch in China that did not include U.S. components.

In early March, the VRSS-1 remote sensing satellite was formally in-orbit delivered to the Venezuela side. VRSS-1 was built by CAST and was launched from Taiyuan by a CZ-4B on 29 September 2012. It was China's first remote sensing satellite exported to other countries.

Development of two commercial communication satellites, the Belarus Sat 1 and LaoStar 1, were kicked-off in January and February respectively. The Belarus Sat 1 will be based on the DFH-4 bus, while the LaoStar 1 will incorporate the newly-developed, smaller DFH-4S bus. Both of them are expected to be launched by 2015.

(Chen Lan)

Mist Around the CZ-3B Disaster

In memory of those deceased in Xichang in 1996

by Chen Lan

15 February 1996 (14 February UT) is an unforgettable date for Chinese space scientists and engineers, as well as Chinese space enthusiasts. That day, just four days before the Chinese New Year, the country's largest launch vehicle ever built that time, the Long March 3B (CZ-3B), made its maiden flight carrying an Intelsat 708 communication satellite. At 3:01 Beijing time, the CZ-3B was ignited and then slowly raised from Pad 2 in Xichang Satellite Launch Centre (XSLC), located in southwestern China. The launch was broadcast live on CCTV and the signal was also transmitted to Intelsat in the United States. During the first two seconds, it seemed everything went well. But to everyone's surprise, when the rocket was only half above the umbilical tower, it veered off and then started to fly horizontally. 22 seconds later, it fell down and exploded, turning night into day.

Official Accounts

On the same day (15 February), China's official Xinhua News Agency published a newsflash. Here is the full text:

At 3:01 today, our country's newly developed Long March 3B carrier rocket failed to launch the Intelsat 708 communication satellite in Xichang Satellite Launch Centre. It was the maiden flight of this launch vehicle. The parties concerned are investigating this accident.

About two weeks later, on 2 March, there were more details from another Xinhua report:

... According to analysis and interpretation of telemetry data, it is considered that the accident was caused by changes of inertial baseline after lift-off. The particular cause is to be further analyzed and verified. ... At 3:01 on 15 February, our country's newly developed Long March 3B carrier rocket lifted off. Anomaly in flight attitude appeared about two seconds later. The rocket pitched down and went right off the flight path. About 22 seconds later, the rocket crashed with nose down and exploded violently. Both the rocket and the satellite were lost. There were no large debris on the site. ... Up to today, 49 of 57 wounded have been cured and discharged from hospital and 8 are still in hospital. Arrangement has been made for the 6 dead. Checkout and testing shows that launch and testing capability of the Xichang Satellite Launch Centre was not affected. ... It is able to resume normal operation at beginning of March. More than 80 local houses nearby the launch centre were damaged. The launch centre and the local government provided temporary housing and relief fund to the victims. ... Except for short time pollution at the explosion site and in air, water source, plant and food were not polluted. ... China Great Wall has informed all customers and the international insurance industry progress of the investigation. On 28 February, Intelsat was invited to participate in the investigation.

It has to be noted that early reports did not give the location of the impact site. In recent years, many Chinese official news sources have indicated that it was 1,850 m away from the launch pad. One of the earliest such claims was on the China Aerospace magazine published in April 2000.

Though there was no official information about the casualties and damage since then, investigation progress was reported. By the end of February, the fault was localised on the inertial platform. One month later, four possible failure modes were determined. Then, three of the four modes were ruled out one by one after careful test and analysis. In mid-May, closed-loop semi-hardware simulation concluded that a circuit fault of the follow-up frame was the most possible cause of the failure. Further analysis and test, as well as inspection on various components, made between 17 June and 6 July, led to the final conclusion that the root cause of the launch failure was a poor gold-aluminium bonding point inside the power output module of the follow-up frame's servo-loop, preventing output of current from the loop and finally causing failure of the inertial platform.

Urged by international insurance companies, China established an independent review committee to assess the results of the failure investigation made by China, as the premise for the former to insure the follow-up Apstar-1A launch. The committee consisted of six experts from the United States, Germany and Britain. According to Chinese records, it was founded on 15 April and terminated on 13 May. Only two meetings, one on 22 - 23 April in the United States and the other on 30 April - 1 May in Beijing, were held.

Two years after the accident, the Cox Report was published in the United States, accusing China for spying sensitive technologies through the launch failure investigation. It resulted in a more strict space technology export control policy on the U.S. side, and China's withdrawing from the commercial launch market. The CZ-3B accident changed not only the commercial launch market but also the course of the Chinese space programme.

However, for many people in the West, the extent of the accident's casualties is still the largest unanswered question.

Because of the historical non-transparency of the Chinese space programme and lack of information about this accident, they never trust the Chinese official accounts. Someone even described the CZ-3B accident as the worst space disaster in history, overshadowing the Nedelin tragedy in 1960 in the Soviet Union. Seventeen years later, there is still a mist around the accident. In fact, more details have been revealed in recent years. Though not all questions are answered, we are now able to reconstruct the event in most aspects and are able to draw some conclusions. The mist is drifting away slowly.

Western Witness

Western suspicions emerged on 23 March 1996 when Israel's Channel Two television broadcast what it said was smuggled video footage from Xichang. The video, said to have been made on the day after the launch, shows flattened houses and apartment buildings without walls and roofs, along the road to the launch centre. The video was obviously taken from a moving vehicle. The number of damaged houses and buildings in the video shows how large the scale of the disaster was. Many people then believed that much more than six people were killed in the accident, and the Chinese government was trying to cover up the truth, as they always believe. There were different figures of speculated casualties in the Western media, from a few dozens to 300, and even 500. Chinese official media denied the large casualty figure and involvement of any Israeli citizens in the launch. The name of the Israeli who took the video has never been revealed. Today, the video can be easily found on YouTube. It has to be noted that there are at least two video clips, one of which was obviously broadcast on the Japanese Edition of Discovery Channel. The two clips were taken from

The highly unusual launch of CZ-3B on 15 February 1996. The four frames captured from video show the rocket veering off course 2 seconds after lift-off. The video was taken from a position near the launch pad. (credit: CCTV)

CZ-3B's final flight and huge explosion. This video was supposed to be taken from the roof of the Mission Command and Control Centre. (credit: CCTV)

Screenshots from the video taken by the alleged Israeli engineer. The top two frames show the small park. We can see a damaged rocket fairing mock-up in the left one, and the monument of the ancient rocket, but only the base, in the right one. The hotel was in the background of the scene in these two frames. The bottom two frames show the Coordination Building and the flattened village houses. (credit: internet)

Screenshots of another video clip taken by the alleged Israeli engineer. It shows interior damage, the Coordination Building and village houses. (credit: internet) vehicles going in opposite directions - one was leaving the centre and the other was entering the centre. Were they taken by one person? Where they originated from is still a mystery.

It was not until December 2012 that the first detailed witness report from the West appeared in the media. Anatoly Zak published an article in the Air & Space magazine in December 2012. He interviewed a former safety specialist who worked for the satellite builder Space Systems Loral in Xichang to support the Intelsat 708 launch. Zak also accessed the diary of an unnamed U.S. engineer who participated in the launch.

During the launch night, the two American engineers were in the Satellite Processing Building, about 2.5 kilometres away from the launch pad. According to the diary, everything went well during countdown. The Chinese inserted a 9-minute hold at T-2:51 minutes and another 45 seconds at T-1 minute, without a reason stated. When the rocket lifted-off, Bruce Campbell, the American safety engineer, was on the roof of the building watching the launch. While the engineer who wrote the diary ran outdoors just after the lift-off. Both of them witnessed the abrupt veering off and immediately realised something unusual happened. The diary described the explosion 22 seconds later in the following terms: "A tremendous light turned 3 a.m. into noon. ... I heard the biggest explosion of my life, I turned and started to run. ... I left the ground, I was on the ground, scrambling, wondering why I was down there. ... I heard glass breaking and shit was flying everywhere." Campbell and others on the roof descended and scrambled into the building. When a violent shock wave hit the building, a large glass-enclosed entrance shattered into thousands of fragments. They entered the fuelling facility of the building and shut down all air-cons to prevent any toxic gas influx. They remained, or were stranded there until the following morning.

In the morning, worried that the Chinese were delaying their departure to clean up the crash site, Campbell and one of his colleagues rushed down by bicycle to their hotel near the impact epicentre. "As they approached their hotel, the scale of devastation became fully apparent. In the nearby residential complex, hardly a single structure had escaped damage. At the impact site, several craters punctured the granite mountainside, and the resulting dirt and rocks had buried the railway line below. Just 200 feet to the east of the epicentre, the American hotel and a larger dormitory for Chinese specialists bore the brunt of the blast, though both buildings still stood. But a barbershop and a small market in front of them were flattened.", Zak described in his article. Inside the hotel, every door, window, and piece of furniture was destroyed. "There were holes in the walls," Campbell recalled. He also noted that a monument to ancient Chinese rocketry in a little park in front of the hotel, had been blown off its pedestal. The diary-keeping engineer also described the damage of the nearby village. The passengers were horrified by what they saw. "Every house for several hundred meters was levelled," he wrote.

According to the article, Campbell did not see human casualties but the Americans had suspicions. The night before launch, when he was in a van going from the hotel to the Satellite Processing Building, Campbell saw many dozens, if not hundreds, of people gathering outside the centre's main gate. After the accident, when he returned to the residential area, just inside the gate, Campbell saw hundreds of Chinese soldiers and military vehicles were flooding into the area. They were suspected of removing bodies. Zak also mentioned in his article that eyewitnesses in Xichang described many flatbed trucks carrying what appeared to be covered human remains to the military base and hospitals in the town, along with dozens of ambulances. However, the eyewitnesses are unnamed and the contents of the trucks are purely speculation.

Shaking the Sky

It was more than 7 years after the accident when the first witness report appeared in the Chinese media. In July 2003, Dajiang Weekly, a publication in Jiangxi Province, had a report based on an interview with the CCTV journalist Zhang Heng, who was in charge of the live broadcast that night. According to Zhang Heng, he had planned to go to the launch pad, but due to an interview the next morning, he had to go to the Mission Command and Control Centre (MCCC) instead. He arrived there at 2:00 am and started broadcasting at T-5 minutes. However, the countdown was interrupted at T-59 seconds. He was told that there was a problem but he never knew what exactly it was. The lift-off was followed by a burst of applause. But Zhang felt that the rocket seemed drunk as it ascended slowly. The applause stopped as everyone stared at the screen on which the rocket was turning horizontal. They saw it dive to the ground with a bright flash. Seconds later, came a horrid thundering and violent shaking. The control room was suddenly in darkness. A few minutes later, lighting recovered. Shortly afterwards, CCTV 4 cameraman Lu Xiaobing came in, with his face blanched. Lu was shooting the launch on the roof. He made a flip in the air, pushed by the violent shock wave but he never stopped the filming. His video showed a giant mushroom cloud rising from the hill. Later, the Vice-Commander of the launch base came and said the crash site was at a hillside to the right of the main gate. He also said that some local houses were damaged and 7 people were killed. Zhang was not allowed to leave the hall until 6:00. When he was back to his dormitory, he found the glass in some windows broken. At noon, he was notified that he could take the plane back to Beijing at 15:00.

Wang Yimu, author of the above report, republished the article on his blog on 11 August 2009 with a few more details. However, what the Vice-Commander said became "several people were killed".

In October 2003, days before the historic Shenzhou 5 mission, CCTV started to broadcast a 10-episode documentary series, "Shaking the Sky", about the Chinese space programme. Its sixth episode, "Space is Not a Dream"(or: "Space is not dreaming" in the sense that space is a serious business?), is mostly about the CZ-3B accident in 1996. It was so far the most detailed record about the disaster. Many who were involved in the launch were interviewed and talked about their unforgettable experiences:

Wang Zhiren (Cryogenic Engine Expert of CALT): *I looked up. But nothing went up. Suddenly, it came almost horizontally. What a trajectory! ... Something must be wrong, we have to stay down. Luckily there was a drainage ditch under foot, about one Chi wide and one Chi in depth (Chi: Chinese traditional length unit, roughly equivalent to feet). We lay in it. Immediately it exploded.*

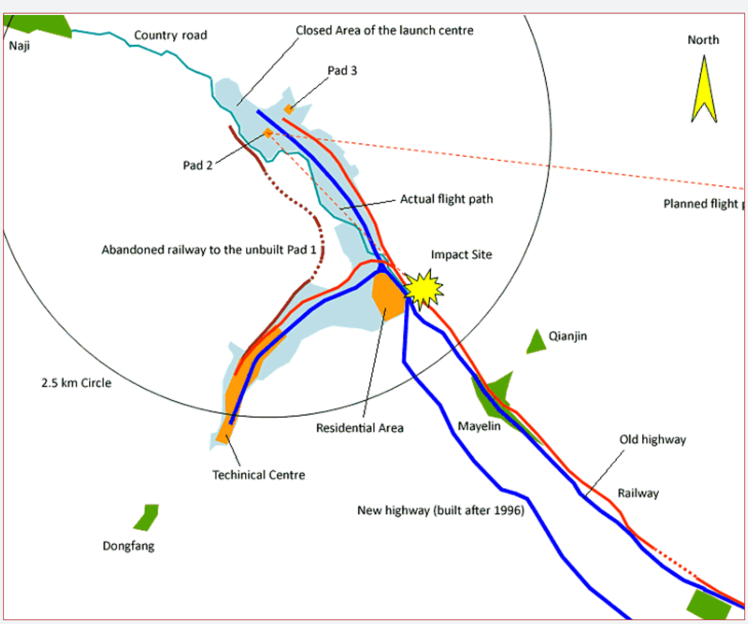
Then came the shock wave, like a strong wind. I remember my hair was caught and everything else like dirt, grass, leaves, blew over my head. Then the second bang ... Back to our dormitory, looking around the building, doors, windows, all was gone. Glass fragments were everywhere. Later we were told to take the suitcase and leave as soon as possible.

He Zhuming (Deputy Chief Designer of CZ-3B, CALT): *We knew there were some special issues in the (inertial) platform. But finally it was replaced and passed testing. Testing at the launch site was also quite smooth. We didn't feel anything wrong and all were confident ... That bang was very loud. We felt the shaking even in the bunker. ... Half of the hill was blown up. The Coordination Building (a building used as office and dormitory by the launch crew) where we lived was in ruins. People sat on the ground like refugees. ... At about 5 or 6 o'clock, it was heard that someone was killed. ... The shock wave broke the windows. The glass fragments hit the head of the victim who then bled to death. Two in the launch crew died. I heard that two or three villagers were also killed.*

Yu Menglun (Trajectory Expert of CALT): *All of us there didn't know what to do ... (narrator: unfortunately, a Senior Engineer who designs trajectory for the rocket became a victim) ... He lived at the ground floor. Because the launch time was at midnight after two o'clock, we discussed after dinner where we*

Chinese witnesses talking in the TV documentary Shaking the Sky. Top from the left: Wang Zhiren, He Zhuming. Bottom from the left: Yu Menglun, Cheng Jiapei. (credit: CCTV)

Other video screenshots captured from 'Shaking the Sky'. Top from the left: Intelsat 708 contract signing ceremony, Intelsat 708 transported to the launch pad. Bottom from the left: People in the control room in shock (on the left is Hu Shixiang, Director of the launch site by that time), screen of the control room one second before the explosion. (credit: CCTV)



Map of the residential area of the launch centre (credit: Go Taikonauts!)

Map of the launch centre and nearby villages (credit: Go Taikonauts!)

go to watch the launch. The proposal was the roof of the hostel where it has better views. Sun Shijie and the other three left their rooms together and went upstairs. He (the dead) was at the first. At mid of the stairs, the rocket exploded. The shock wave blew him off the staircase, thrown him from the window, and dropped him on the ground. ... We both worked in the field of trajectory and have rare opportunity to watch launch. Normally we are in the control room. But during that launch, there seemed no much work for us. I discussed with him to watch launch outside and to find a place for it. We made a deal. But later I got a call from the launch pad. They had something to process and needed me to come there. I went before launch. As a result, I avoided the disaster. If I were with him, today I would ...

Chen Zhenguan (CALT researcher on rocket mechanical environment): *I was with Academician Yu (Menglun). ... This is the hill. There is the launch pad. And this is the road. It came horizontally along the road. It looked really horrified. ... There are many hills. ... If it had avoided this hill and continued to fly along the road, it would be much dreadful. That's the Mission Control Centre where there were many visitors. You often see it on TV. There were many people, many experts. If the explosion were there, that would be very terrible.*

Cheng Jiapei (CALT designer on control system): *In my department, a classmate of mine died. Two were seriously injured and nearly died. There were 3 or 4 cuts on his face. His neck artery was broken. The solider pressed on the cut all the way to Xichang City where it was finally stitched. ... It's the first time our own people from the First Department (of CALT) died at the launch site.*

More Chinese Witnesses

Since 2003, there have been a few more witness reports in the Chinese media, providing additional details about the accident.

Shi Wei, the former Beijing Youth Daily journalist, now the Deputy Editor in Chief of the Daily, posted detailed reminiscences on his Sina blog on 14 February 2006, on the eve of the 10th anniversary of the tragedy.

Shi's account started from the last afternoon before launch. At 15:00, or T-12 hours, the 2-km main road from the residential area to the launch pad had already been closely guarded. Two documents, the Pre-launch Evacuation Plan and the Mission Rescue Plan were distributed to all teams. He remembered that the veterans comforted him as saying all these are just routine. Shi arrived at the frontier Launch Command Centre (LCC) near the launch pad at 23:00. At 2:00, a siren warning filled the air. A bus took the people to be evacuated to a safe place down in the valley. At 2:30 and 2:45, more were evacuated. He saw the lift-off and the rocket's weird turning on the big screen. Almost at the same time when he heard a big bang like a dull thunder from far away, he felt the ground shake. The big screen flickered and all lights, except for the emergency lamps, went out. Long Lehao, Chief Designer of the CZ-3B launcher, stood up slowly. His face was unable to be seen clearly in the dim light. When the shock wave came, Shi Wei felt pressure in his ears. He was given a wet towel that was prepared as an emergency measure before launch. Covered with a wet towel on his face, Shi Wei went outdoors. This was 3:20. He saw the empty launch pad under stellar light. Soon after, someone came from the impact site. When asked about the situation, "Too bad", the guy bit his lips, with tears in his eyes. Shi Wei also recorded a detail in his article that when reporting to Beijing, the officer at the launch pad mentioned the location of the rocket falling down - on the side of the Coordination Building.

At 4:50, two buses came to take the people away from the launch pad. Shi Wei noticed that all windows of the buses were gone and glass fragments were scattered everywhere inside the buses. At 6:30, most people, roughly a few hundred, were back to the residential area at the main gate and gathered near the Coordination Building. They were ordered to rescue as much as possible documents and important materials from the building. The building still stood there in morning sunshine. But all its windows, doors and balconies were torn off. The saved material was packed in a number of green wooden boxes. Around noon, military trucks came and transferred these boxes to somewhere else. At 14:00 the stranded people were moved to Xichang City in three groups. Long Lehao was in the last group. Later the same day, three China United Airlines planes carried all the people back to Beijing.

In March 2008, the Chinese version of the National Geographic magazine published an article on the history of China's launch sites. The author is Liang Dongyuan, a writer and also an insider of the Chinese space programme who has published a series of articles and books. What he described about the CZ-3B accident in this article, mostly happened in the MCCC, is quite similar to the story told by the CCTV journalist in 2003. For example, the T-59 second hold during final countdown and the casualties message from the Vice-Commander. But in Liang's article, there was no exact casualty number. What the Vice-Commander said was that a quick check immediately after the accident concluded that several people including a space technician who refused to be evacuated were killed.

Geng Kun, the China Great Wall spokeswomen since 1997, provided more detail in an article published in July 2010. In the aftermath of the accident, China Great Wall was responsible for customer communication and arrangements for the on-site investigation by the insurance companies. Geng described what she saw at the main gate shortly after the accident. She was touched by a young guard who saluted to her and helped her vehicle pass through the gate. He looked obviously injured as there was blood on his face. Fortunately, the name of the guard can be identified in a story about his heroic deeds on the official China Military web site (Chinamil.com.cn). Ren Jianjun, the guard, was at his post just about 30 metres away from where the rocket exploded. He was thrown into a ditch of water by the shock wave and injured. But he persisted in his duty helping people and vehicles going through the gate. Four and half hours later at 7:30, he was sent to hospital. Today, he still works in XSLC.

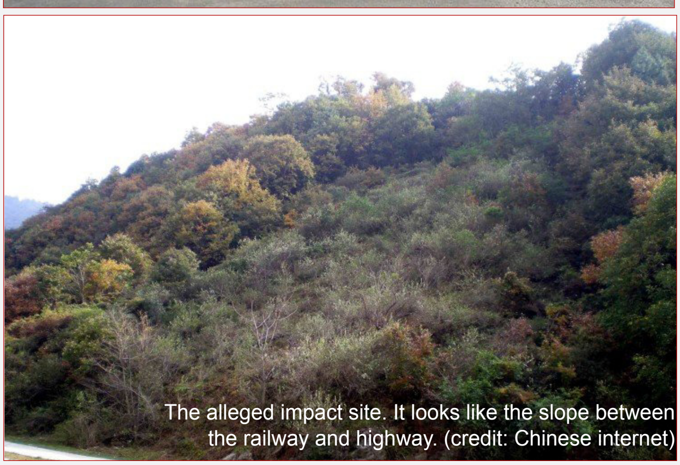
The most recent information about the accident was revealed in a CCTV programme on 23 April 2012. The TV documentary was about 50 launches of the CZ-3A series (it includes CZ-3A, 3B and 3C). It recorded the commemorative meeting held on the same day of the 50th launch, the ApStar 7 launch, on 31 March 2012. Liang Xiaohong, the Party Head of CALT made an address. "I would like to take this opportunity to lament Comrade Qian Zhiying and Yang Linzhen who died in the line of duty on 15 February 1996." Liang said. This was the first time names of the dead were disclosed.

Crash Site

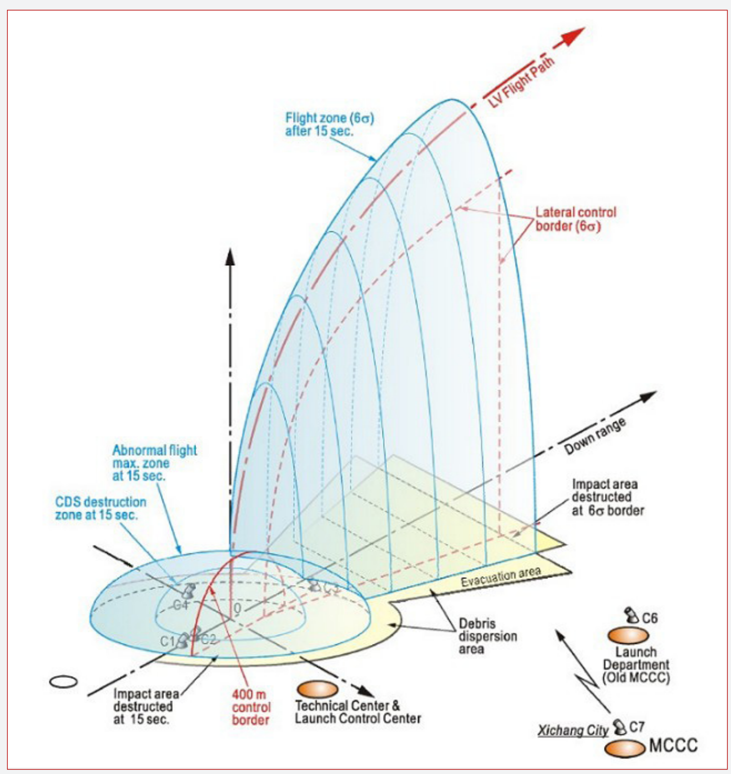
Xichang Satellite Launch Centre consists of four major areas - the launch area (launch pads and fuelling facility, etc.) at northwest, the technical centre (launcher and payload processing facility, etc.) at southwest, the Mission Command and Control Centre at southeast, and the residential area in the middle. The four areas are connected by roads and railways. According to the CZ-3B User's Manual published in 1999 and 2011, the vehicle's launch azimuth is 97.5 degrees, i.e. it should be launched towards 7.5 degrees south of east. However, the first CZ-3B in 1996 flew off the normal flight path, towards about 40 degree south of east, which unfortunately is towards the residential area, where it crashed.

The residential area is just inside the main gate of the launch centre. Two roads, an old one and a new highway branch from the expressway at east (built after 1996), join before the main gate and pass it from southeast to northwest. A railway, in parallel with the old road, is at its northeast side. After the gate, both the highway and the railway have a branch to the technical centre. Inside the gate, at southwest side of the main road, there is a small park, the hotel and the Coordination Building where Chinese launch crews usually live and work. There is also a hospital and other logistics facilities in the residential area. To

Left: A car-park about one hundred metres away from the main gate. At the right, there is a hillside where the suspected impact site of the crashed CZ-3B in 1996 is located. Please note that the railway is not visible in this photo, but the slope between the railway and highway can be seen. This photo was taken by a tourist in recent years. (credit: Chinese internet)



The alleged impact site. It looks like the slope between the railway and highway. (credit: Chinese internet)



drawing above: A picture in the User's Manual of the Long March 3A Series Launch Vehicle showing range safety control in the XSLC. (credit: CGWIC)

photo left: The villagers and the main gate. Villagers can go to Naji and Bayi Villages through a country road (at the right on the photo) crossing the launch centre. (credit: Chinese internet) the northeast side of the road are just mountains.

According to official news and various witness reports, the rocket crashed at “1,850 m away from the launch pad”, “a hillside to the right of the gate”, or “on the side of the Coordination Building”. It can almost be sure that the crash site is at a hillside northeast of the road, just opposite the two buildings across the main road. Zak’s article also concluded that the rocket crashed just across the road from the hotel for the foreigners. All this evidence is very consistent. The only conflicting testimony is what the American safety engineer Campbell recalled that his hotel is 200 feet to the east of the epicentre. From the map and the nearby terrain, it seems unlikely. At 200 feet west of the hotel, there is only a small park. However, Campbell’s other claim, that the railway below the hill was buried by rocks and dirt after the explosion, confirmed the impact site was at northeast of the road where there is mountain terrain. It is at least 200 metres from the hotel and the Coordination Building. Finally, the Chinamil story about the guard indicated that the impact site was only about 30 metres from the guard post at the gate. From the map, the nearest hillside can be found about 100 m away from the gate. The distance is obviously overstated, but it shows how close the impact site is to the gate. It is actually the most reliable evidence for the impact site. The crash site is about 900-1,000 m south from the normal path.

The question is, since the anomaly appeared almost at the beginning, why the Chinese did not destroy the rocket by radio or why the rocket’s self-destruct system was not activated. In fact, Chinese rockets have both the ground controlled and the on-board automatic destructive systems since the earliest CZ-2. There is also a special procedure. During the first 15 seconds for those launched from Xichang, the destructive system will not work so as to protect the launch site, even the launcher goes wrong. Also, if the on-board system detects an anomaly, it will delay 15 seconds before exploding the rocket, which allows the ground control to select a relatively safer impact zone by sending a manual destruct command. It is still unclear why the destruct command was not executed between the 15th second and the 22nd second when it crashed. Maybe the auto system had already issued the destruct command, but the rocket crashed before the 15 second delay was reached. It may also be too short for the ground control crew to respond within the 7 second time available to manually destroy the launcher.

Casualties

The biggest question is about the number of casualties. Confirmed information includes: two engineers from CALT, Qian Zhiying and Yang Linzhen, perished. At least one of them was among the four who were still in the Coordination Building at the moment the rocket crashed. The rest of the four survived in a building only about 200 metres from the epicentre, though they were severely injured and nearly died. Liang Dongyuan’s article in National Geographic and many other reports all mentioned that they violated the order for evacuation. The Beijing Youth Daily journalist and official accounts showed that evacuation was planned and performed. Unfortunately the CALT casualties and injured and the guard story show that the execution was not very strict.

Witnesses at the launch pad (the Beijing Youth journalist) and technical centre (American engineers), as well as those at the MCCC (the CCTV journalist) - all reported a strong shock wave that smashed glass into fragments, but no one saw any fatalities or severely injured.

Two dead from the launch crew from outside of XSLC could be believed a credible number. There was wording in internet forums that no persons from the launch centre (a military unit) died in this accident. It could not be seen as reliable but we have some clues from official sources. The Chinamil web site recently published a report mentioning that 30 launch site staff have died on duty from its being established up to 2010. We have identified more than 10 from various reports on Chinese media who did not perish in the 1996 accident. In other words, even if there were casualties in launch site staff, there were definitely not many. It, in turn, suggests that evacuation was indeed done in a certain way. Otherwise, much more launch staff (in and outside XSLC) would have been killed.
But how about nearby villagers? Videos have shown large-scale damage along the road to the centre. Many sources, including numerous official news and photos during the last two decades, as well as Zak’s article, have confirmed that farmers stay and work very close to the launch centre. Though there was no trace of burning, it is true that the powerful shock wave must have pushed down countless houses. It is reasonable to speculate that a catastrophe like this would kill many people.

It will be helpful to take a look at the distribution of local houses and population near the launch centre. In fact, Xichang Satellite Launch Centre (XSLC) is not located in Xichang City. Instead, it is located within the Zeyuan Township, Mianning County, Sichuan Province, about 60 km from Xichang City. It has to be noted that China’s rural administrative hierarchy has four levels: province - county - township - town/village. Within the jurisdiction of the Zeyuan Township, there are 10 villages. Within 4 km from the launch pad, there is Bayi Village to the northwest and Naji Village to the west, Dongfang Village to the south of the technical centre, Mayelin Village just outside the main gate, and Qianjin Village to the east of Mayelin. The latter two villages are down range of the launch centre. Four villages, Bayi, Dongfang, Mayelin, and Qianjin were previously within the launch centre. They were relocated to current locations in the early 1980s before the centre was put into use. Bayi was further relocated to a place 8 km from the launch pad after the 1996 disaster. However, their farmland is still around the centre. Farmers often come back and work there. The centre (except for the MCCC) is a closed area which blocks the two northwest villages (Bayi and Naji). As a result, an isolated country road from the main gate to west of the launch area was built to allow villagers to traverse the launch centre without entering it.

The fifth population census completed in November 2000 shows that the Zeyuan Township has a population of 9,861 people. In 2007, it was about 12,000. Among six nearby villages, Qianjin and Dongfang have only a few dozen residents while all others have more than 300 people. Mayelin is the largest one, having about 1,200 registered residents in 2007. It grew rapidly to 1,600 in 2010, among which about 1,000 live there all the year and the rest are in cities as immigrant workers. Unfortunately, it is only about one kilometre from the crash site. This village extends hundreds of metres along the road. It is very consistent with the smuggled videos showing large-scale damage along the road.

The key to the casualty number is whether evacuation was done in villages, especially Mayelin, in 1996. In 2007 and 2010, China launched two lunar orbiters from Xichang. These two launches were the most significant and most open space launches in Xichang in the last decade which attracted a lot of journalists. As a result, there are a lot of reports on the launch centre and nearby villages as well as people there. According to interviews with local farmers, evacuation in Mayelin and other villages started as early as 1984. From 1998, all villagers were asked to leave the 2.5 km circle and all people at 2.5 - 6 km from the launch pad to go to an empty space, for example the playground of a school. But there were always some people, mostly elderly people, who refused to leave their houses, even in recent years. In the early days, if it was a night launch, the launch centre always arranged a film show at the school playgrounds with sweets given to children.

Let's assume that there was no evacuation in February 1996, resulting in a great number of casualties, for instance 500, as rumoured in the West. Such casualties should be mostly in Mayelin because the next nearby village, Qianjin, had only a few dozen people, and is behind a hill that would have been able to block the shock wave. A little further away is a small town and the MCCC where no large damage or casualties were reported. Also, at 3:00 am, people were very unlikely to be working in their fields. Back to Mayelin, considering its population growth in recent years, the number of residents 17 years ago should be reasonably predicted to be between 500 – 1,000, or even less. If 500 died there, Mayelin would have become a dead village for many years, or even never allowed to exist because of safety reasons. But it was not. It is hard to believe its population continues to grow and even doubled following the catastrophe. Also, there were so many people who lived nearby the launch centre, or who were involved in the launch and rescue operation. But there has been not a single piece of evidence on the internet indicating heavy casualties during the last 17 years. China's internet has become an open space for public opinion with increasing freedom. It is difficult to cover-up a disaster on such a scale, even it happened 17 years ago. Another piece of evidence supporting the smaller casualty number, is what the Vice-Commander said in the MCCC a few hours after the accident. Whether the initial death number was "7 " or "several" which are similar in Chinese pronunciation, it was obtained through a quick check. Considering the efficiency and capability of China's centralised management system, a large error in the number is unlikely. Furthermore, just one year before (in 1995), a CZ-2E exploded during launch and its debris killed six people. It would be quite illogical to not to enforce evacuation after such a launch failure, especially for the maiden flight of a new vehicle. All of these facts tend to lead to a conclusion that evacuation was indeed performed, though not as strictly as it should have been, and most villagers had survived.

There are rumours about local dead on the Chinese internet. One story is that the dead include a widow and her son, and a farmer just outside his door, who all refused to leave home. A police officer who was responsible for the evacuation and also had a close relationship with the widow committed suicide a few days later. However, this story is difficult to verify.

There are still two questions that remain unanswered: the trucks and the crowd at the gate, described in Zak's article. According to Chinese witnesses, the trucks just carried boxes packed with material rescued from the Coordination Building. While in Zak's article, it is the unnamed eyewitness who draws conclusions by guessing. Its reliability is even much lower than the Chinese testimony and it could not be considered as evidence. Then, the crowd gathered at the gate is unable to prove anything. It was many hours before the launch and they could have been easily moved out during the last minutes, if the evacuation was performed as planned.

So far, we are unable to prove whether the official casualty number is accurate or not. But we can almost certainly rule out heavy casualties. It could be six people or more than six, but very unlikely to have been hundreds. The official number is still the most worthy source to trust, unless counter evidence can be provided.

* * *

Mist around the CZ-3B disaster in 1996 has been there for 17 years. With information publicised during these 17 years, from both Chinese and Western witness reports, to messages revealed from official sources, we are now able to see the disaster much clearer than before. Many details have been confirmed. Heavy casualties can almost certainly be ruled out. But there are still a string of questions to be answered. How many people exactly were killed in this accident? Was there really an Israeli and why has he disappeared since then? Why was the rocket not self-destroyed? What are the particulars of the dead villagers? Why were they in their homes and killed? All these questions are left to future historians - unless China decides to take this up on its own. In the recent past, China has seen increasing transparency and more open discussions about controversial historical events, policy and societal developments. To fully clarify the details around the 1996 launch failure could become another milestone in the development of the modern China. Whenever China decided to lighten up the dark of the past it has earned the increasing respect from the international community. The events during the night of the 15 February 1996 would offer another such an opportunity.

Brief History of the Xichang Satellite Launch Centre

by Chen Lan

1970 - 1975 : Building for the Manned Programme

In 1969, a serious border conflict between China and the former Soviet Union occurred. In the late 1960s, China was planning its first manned space programme - the Shuguang Programme. The situation forced the Chinese decision makers to consider a new space launch site because the Jiuquan Satellite Launch Centre (JSLC) is too close to the border and more importantly, the Soviets were heavily involved in the planning, designing and construction of the site. There were no secrets with the Soviets. It would be very dangerous if a war would break out between China and the Soviet Union. China needed an inland site with both strategic concealment and long-term availability.

In December 1969, a team of 40 people from the JSLC began the survey for the new site. Within three months, they visited 81 sites in 9 provinces including Sichuan, Gansu, Guizhou, Yunnan, Hubei, Shanxi, etc. Finally, three candidates were selected from 16 proposals. The initial decision for the site was Yuexi, Sichuan Province, where it has better down range safety when launching manned vehicles towards the northeast. However, it was found that the electricity supply, traffic and construction were difficult there. Then, a site near the newly completed Chengdu-Kunming Railway became an alternative option. That is Xichang. By June 1970, a comprehensive investigation involving geographical conditions, climate, seismic activity and technical requirements was completed. On 29 July the same year, JSLC formally submitted the proposal for the site change. It was approved on 14 October and was assigned with the codename:“Project 7201”, meaning it had to be completed before 1972.

The ground breaking for the new launch site took place in December 1970. It began with the construction of infrastructure including a highway, railway, bridge, electric and communication system, etc. According to the plan, the launch site would be built in a Y-shaped valley. At the centre of the Y-shape, there would be the residential area for the launch staff. Two kilometres northwest of this area, a flat field was planned for launch pads which were actually built later. Two kilometres further west, at Qinggangba, the manned launch pad (Pad 1) would be built. One kilometre west of the residential area, there is a small village called Mayelin, the territory of which was reserved for future pads. The Technical Centre and the Mission Command and Control Centre (MCCC) are at the south and east respectively.

In September 1971, Lin Biao, China’s number two in power tried to defect to the former Soviet Union, but his plane crashed in Mongolia. The event ended the Shuguang manned space programme. Though not officially terminated, without enough funding, construction in Xichang ran into trouble. Up to 1975, the infrastructure was only partially completed, including a highway and a railway to the centre. Another 5 km railway to the un-built manned launch pad was also completed but never put into use. Today, bridges and tunnels of the abandoned railway at the southern hillside can still been seen.

1975 - 1988 : Focusing on GEO Launches

On 31 March 1975, China approved a project, codenamed “Project 331”, to build and launch communication satellites. It includes five subsystems - satellite, launch vehicle, ground communication stations, tracking and control system and the low latitude launch site. Xichang was again on the agenda. Although Hainan Island was once proposed but was quickly rejected because its location was felt to be too exposed to potential enemies. Xichang’s latitude of 28 degree south, altitude of more than 1,500 m, together with its concealment and the half completed infrastructure made it the best choice for the required new launch site. According to the plan, the three-stage Long March 3 (CZ-3) would be the launch vehicle to put China’s first communication satellite into GTO. At the same time, the Long March 4 (CZ-4) was developed in parallel in Shanghai as the back-up. Both would be launched from Xichang. As CZ-3’s third stage uses liquid hydrogen as propellant, storage and fueling facilities for cryogenic propellant had to be built, which was all new for China.

In mid-1978, China launched three campaigns to speed up the construction work in Xichang. The first campaign was in mid-September to complete the concrete pouring for the flame trench. Then, from mid-October to late December, the launch tower was assembled and raised from the ground. The final task was completed at the end of the year. It was “Cave 302”, used as the Launch Command Centre (LCC) inside the mountain. With these key milestones reached, construction of the centre went on smoothly.

In 1982, 12 years after ground breaking, the launch centre was finally completed. It consists of a launch pad (Pad 3) that supports both conventional and cryogenic fueling, a technical centre for satellite and launcher testing, and a modern Mission Command and Control Centre that, for the first time in China, had a large screen. The Pad 3 was designed for the new three stage Long March 3 that is capable of sending satellites to geostationary orbit. The launch tower has a height of 77 m with 11 rotating platforms. It incorporates the similar launch method as used in JSLC, that is, vertical assembly and vertical testing.

On 29 January 1984, the first Long March 3 launch vehicle carrying the DFH-3 comsat lifted-off the Pad 3 of XSLC. During 1984 - 1988, five more Long March 3 launchers flew from Xichang. XSLC became the busiest spaceport that time.

1988 - 1998 : Expanding for Commercial Launches

In October 1985, China announced it would enter the international commercial launch market. Three years later, it had made significant progress. In November 1988, the Chinese and the United States governments finally signed the first of three MOUs on technology safeguard, launch responsibility and international trade issues. According to the agreement, China would be able to launch no less than 9 U.S.-made comsats over the next 5 years. On 31 October 1988, China signed a contract

Building the launch site in 1970s (credit: Chinamil.com)


The Building 581 - the satellite test hall (credit: CGWIC)

with Hughes, to use the new CZ-2E launcher to launch Optus B1 and B2 comsats. At that time, the CZ-2E was still on the drawing board. There was also no launch pad available for it. Just a little more than two months later, on 2 January 1989, another contract to launch the Asiasat 1 comsat was signed.

The Optus contract was a great challenge to China. It asked for a test launch before 30 June 1990. If China failed to meet the schedule, the contract would be terminated and a fine of one million U.S. dollars would be incurred. China completed the development of the CZ-2E strap-on heavy launcher in 18 months, increasing its LEO capability from 2 tonnes to 9 tonnes. Construction of the new launch pad for CZ-2E, the Pad 2, took only 14 months. In June 1990, the new launch vehicle was standing at the new launch pad on time. It was a miracle.

The Pad 2 includes a mobile service tower with a height of 97 m and a fixed umbilical tower with a height of 74 m. They are linked together via a rail 200 m in length. When the 4,640-tonne mobile tower joins together with the umbilical tower, it is able to provide a closed testing environment for the launcher and its payloads. The Pad 2 was initially used by CZ-2E, and later it was used to launch CZ-3A, CZ-3B and CZ-3C vehicles.

In parallel with the Pad 2 construction, preparations for the Asiasat 1 launch were underway. It was China's first commercial launch that came more than one year before the maiden flight of CZ-2E. To meet strict test environment requirements of the Western satellite company, a new satellite test building, Building 581, was built. The 3,000 square metre test hall reached a clean room level of Class 10,000. Living facilities for Western technicians, including a new hotel at the residential area, were also built. The hotel was primitive by today's standards. But it was luxury if compared to the Chinese technician's living facilities by that time. Later in 1993 and 1994, near the hotel, a small park and a recreation centre were also built, using a donation from a Hong Kong businessman.

In September 1989, just seven months before the Asiasat 1 launch, a landslide hit the centre and damaged the highway, railway and a few facilities. At least three people were killed. The Chinese repaired the damaged facilities and restored the centre's capability within short time. The Asiasat 1 launch was successful.

However, launches from Xichang encountered a string of failures in later years. In April 1992, the first Optus B1 launch attempt terminated just a few seconds after ignition. In December the same year, the Optus B2 exploded in high altitude. In January 1995, Apstar 2 encountered the same failure. All these launches had no damage to the launch centre but six villagers were killed by fallen debris in the Apstar 2 failure.

The most serious launch accident happened on 15 February 1996. It was the maiden flight of the CZ-3B, China's most powerful rocket. Just 2 seconds after lift-off, it veered off and flew horizontally. 22 seconds later it hit a hillside near the residential area with a huge explosion. The official report indicated six dead and 57 injured, with about 80 local village houses damaged. In the residential area, almost all buildings including the hotel and the dormitory for the Chinese launch crew (the Coordination Building as the Chinese call it) were heavily damaged.

XSLC recovered operation in less than 5 months with the successful CZ-3 Apstar 1A launch on 3 July. From August 1996 to August 1998, it supported 5 more commercial launches. But since then, China has quit the international launch market because of the new technology export policy of the United States.

1998 - 2013 : Progressive Upgrading

From 1998 to 2005, the Xichang Satellite Launch Centre was used for only domestic space launches. It resumed the launch of foreign-made commercial satellites in 2005 when the French-made Apstar 6 was launched by a CZ-3B from Xichang. Since its establishment, Xichang has been mostly used for GTO launches. In the new century, it was also used for IGSO, MEO and SSO launches. For example, the TS-1 and TS-2 (Double Star) scientific satellites and non-GEO Beidou navigation satellites were all launched from Xichang. In recent years, XSLC has become the busiest spaceport in China. In both 2011 and 2012, 9 or nearly half of the annual domestic launches happened in Xichang.

To support more and more launches, XSLC has undergone a lot of upgrading. The most significant project was the rebuilding of the Pad 3. The old Pad 3 was built in 1978 and was only able to support launches of the CZ-3 baseline model. With CZ-3 phased out after 2000, the Pad 3 was only used for occasional polar launches by CZ-2C. In 2006, the launch tower of the Pad 3 was demolished while its flame trench was preserved. A new tower, but at a place 2.5 m backwards of the old tower, was built. It weighs 1,800 tonnes and has a height of 85.5 m. The new tower is able to support CZ-3A launches, as well as CZ-2C polar launches. In early 2007, it was put into use. Later that year, China's first lunar orbiter Chang'e 1 was launched from the new pad. The Pad 2, the technical centre and other facilities have also been upgraded with new equipment. XSLC is now able to support simultaneous testing of three satellites and two rockets. The launch preparation time has been reduced to 15 days, and the annual launch capability increased to 10-12 launches.

Another major change was the use of the new Mission Command and Control Centre in Xichang City, 60 km away from the launch centre, as of 2004. Also, a new Launch Command Centre (LCC) at the technical centre replaced the old one in the Cave 302.

The infrastructure was also largely improved. A new high-grade highway was built at the south in parallel with the old highway. The Coordination Building, rebuilt in 1996 after the CZ-3B disaster, was remodeled with new facilities. The hotel has also been rebuilt after the accident. The small park was also rebuilt and named Space Park, with a new staff centre in the park.

In 2003, XSLC becomes the first space launch centre in China to be open to tourists. But it is still limited to only Chinese citizens. During non-launch periods, visitors are able to enter the centre and go close to the launch tower. If there is a launch, the centre has to be closed, but visitors can view the launch from a few viewing platforms.

2014 and Beyond: Retire As Backup

2014 will be a turning point for China's space launch sites. The maiden flight of the new generation CZ-7 launch vehicle will take place in the Wenchang Satellite Launch Centre at the east coast of the Hainan Island. It will be followed by the maiden flight of the heavy launcher CZ-5 in 2015. The new site in Hainan, currently under construction, will replace Xichang to become the primary launch site for GTO launches. XSLC will be retired gradually but its capability will be reserved as back-up of the Hainan site.

It is interesting to note that the Wenchang Satellite Launch Centre will not be independent. It will be under the management of XSLC. Therefore, XSLC will never retire. It will begin its new life in the Hainan Island.

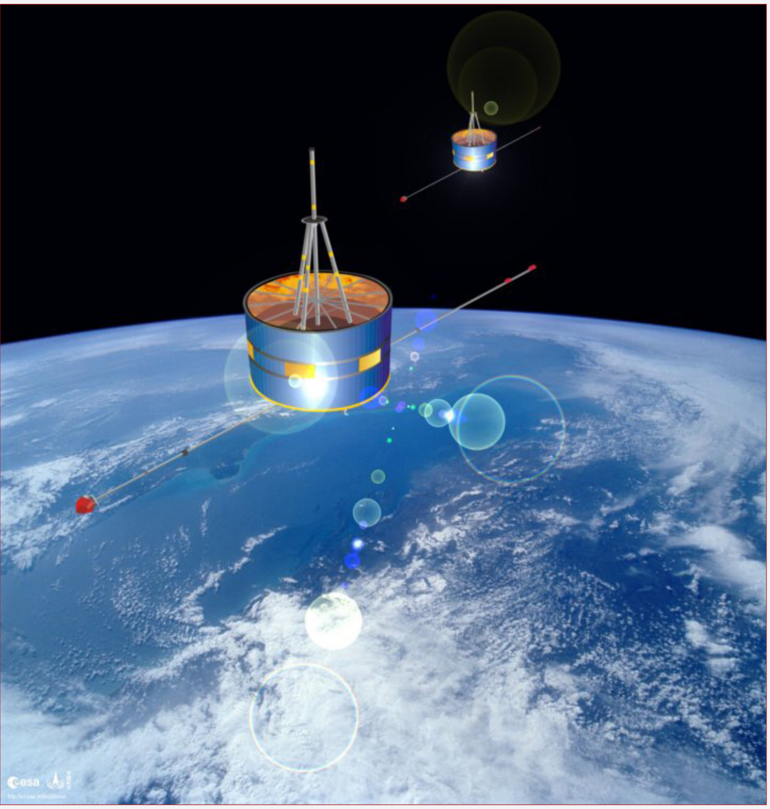
Construction of the new tower of the Pad 3
(credit: Chinamil.com)

New Mission Command and Control Centre in Xichang City
(credit: China Pictorial)

Chinese Space Science (Part II)

by Brian Harvey

Brian Harvey is author of a new, contemporaneous account of the Chinese space programme, China in Space – The Great Leap Forward, published 27 March 2013 by Praxis-Springer.



Tan Ce 1 & 2 (credit: ESA)

Outlets and publications

Before looking at the future of the Chinese space programme, it is worth saying a few words at how its scientific results are made known. As noted earlier, we know little about the scientific results of the programme prior to 1990: either there were no publication outlets, or the data were archived, or even lost. This began to change when China joined COSPAR, the international committee on space research set up in the early days of the space age so that the Soviet Union, the United States and other countries could share the results of their first space probes, through publications (Advances in Space Research), biennial assemblies and workshops. A condition of joining COSPAR is the provision of regular reports on the progress of space science and this provided the first international access to China's scientific results. China had, earlier, joined the International Astronautical Federation, an older body set up by space enthusiasts in the early 1950s and which holds an annual congress that encompasses the entire range of space activities, such as engineering, applications, Earth observations and space science. Early Chinese attendance was intermittent, but has grown exponentially in recent years, including many of the young and up-and-coming scientists. China also participates in the annual lunar and planetary science conferences run every spring by NASA since the moon landings. Between them, we are able to get a good picture, broad outlines and up to date news of progress in Chinese space science and especially in recent years in the lunar programme.

Just as Soviet space science had its own publication, Kosmicheski Issledovatl (Space Research), so too China has developed its own, the China Journal of Space Science (CJSS), published quarterly, indeed with military precision. This was published originally only in Chinese, but then began to publish English abstracts. In recent years, it has published a mixture of both. Although it dates to 1981, it did not seem to have the same function as Space Research, for it carried remarkably few outcomes of Chinese spacecraft in its early years: indeed, articles in the 1980s were based largely on ground observations (e.g. the Sun, comets) and secondary analysis of data collected by other countries (e.g. Hipparcos, GEOS, ISEE).

There are some intriguing exceptions, such as a 1984 article with Shi Jian 1 results, with later results from FSW biological missions such as the effects of space on shrimps and artemia eggs, Qi Qi balloon air density results and radiation detection by Feng Yun. Limited though they are, I have never seen Chinese scientific results from CJSS cited in western scientific journals, even though one loses count of the number of times the Chinese are accused of running a 'secret' programme. In case by some chance your local library does not stock the China Journal of Space Science, it is all on line now at www.cjss.ac.cn.

Future of Chinese space science

The Chinese have mapped out in some detail how the lunar programme will proceed. Chang e 3, due this autumn, will explore the Sinus Iridum and enable China to build a detailed micro-map of a distinct area of the moon. On board will be panoramic cameras, instruments to study moon rocks, telescopes, radar to probe underneath the surface, and particle detectors. Chang e 4, later, may well land at a polar region and shed light on the presence of water on the moon. Chang e 5 in 2017 will be the first of two sample return missions. Although the probe will be based on the Soviet Luna 16, 20 and 24 sample return missions, it is possible that they will bring back larger sample sizes, because we have learned that the samples will be brought into lunar orbit first before being sent back to Earth. The return of samples will be a significant development, for chemical analysis will enable the Chinese to build a detailed history of the evolution of the lunar rock, providing a ground truth that remote sensing from lunar orbit can never provide. They will be the first moon rocks brought back to Earth since Luna 24 in 1976 and will enable the Chinese to construct their own interpretive narrative of the moon and our part of the solar system.

China should already have received its first data from Mars orbit by now - if Yinghuo 1 (Mars 1, or Firefly) had left Earth orbit with its mother spacecraft, Russia's Phobos Sample Return mission in 2011. Yinghuo was a clever mission, for it was intended to drop the Chinese spacecraft off in Mars orbit, calibrated with instruments on Phobos Sample Return, thus giving crossreferenced results from two spacecraft in quite different orbits around the planet. Yinghuo carried a plasma package, fluxgate magnetometer, radio occultation sounder and wide-view camera, but the main scientific direction was geared to answering the question: Where has the atmosphere gone and why? Yinghuo was intended to reconstruct the history of Mars' atmosphere, a task which will now be carried out by the American MAVEN mission, due to reach Mars in 2014.

Chastened by this experience, the Chinese decided to fly the next mission to Mars themselves on a Long March 3B, but it was decided to go for a more ambitious mission, rather than repeat the tasks set for Yinghuo or likely to be carried out by MAVEN. The next mission, presumably called Yinghuo 2, will be for a 2,000 kg orbiter and a 50 kg demonstration lander, with sites already in selection on the southern fringes of the southern arctic. It is due to fly in late 2015, coinciding with the first stage of the new Russian-European Exomars mission. The tasks of the orbiter will be divided between the analysis of the surface and the environment around Mars: the instrument suite is likely to be a camera, surface penetrating radar, infrared spectrometer, gamma ray spectrometer, high-energy particle detector and solar wind particle detector. Just as in the case of the moon, a successful outcome will mean that China will have its own reference model and map of Mars and the Martian environment.

Roadmap 2050

As noted earlier, science has not been a high priority of the Chinese space programme and the 7 % given thereto is overshadowed by the investment in the communication, applications, military observations and manned programme. That is about to change. In 2009, the government entrusted the Academy of Sciences with a mammoth task: to outline the future of Chinese science until 2050, but with the exhortation that China should be the world's leading scientific nation by mid-century. The Academy singled out 22 technology areas for development, such as photosynthesis, geothermal energy, nanotechnology, regenerative medicine, synthetic biology, mathematics - and space technology. This report went almost unnoticed in western countries, though the headline commitment to a moon base by 2040 and Mars base by mid-century might have merited a mention. A worthy exception was Springer, which published the text in English.

For an official report, it is remarkably self-critical, as well as being urgent and ambitious in its tone. It set the objective that China should publish more scientific papers in the world than any other (this process is visibly under way), create more inventions than any other and make all the major discoveries in science. The volume on space research covers all fields, including applications and the manned programme, as well as the technologies necessary to make this happen. Here, the Roadmap 2050 outlined a dazzling set of key technologies and targets to master, such as long-distance high speed communications (100 Gbps), autonomous navigation (accuracy of 30 m) and power supplies, as well as propulsion methods about which we still know little (e.g. microwave electric propulsion like the EmDrive), intelligentization and nanotechnologies. Some of these are areas which so far, in China, are little developed, such as autonomous navigation. The roadmap was quite precise in identifying the next level of instrumentation that would be required for these missions, like high-precision telescopes, so the report did its homework thoroughly. All these would be necessary if the promise of Roadmap 2050 to send space probes across the solar system were to be fulfilled. The Roadmap outlined an ambitious set of missions to come:

2014
- Kuafu: set of observatories to study Sun-Earth system
- POLAR aboard Tiangong 2 (gamma burst sky survey)
- Dark matter detection satellite

2015
- Hard X-Ray Modulation Telescope (HXMT)
- Space Solar Telescope
- Space Variable Object Matter (SVOM)

2018
- Magnetosphere - Ionosphere - Thermosphere mission (MIT)
- X-Ray Timing Polar Telescope (XTP)

2020
- Optimized Solar Maximum mission
- X-Ray Timing Polarization mission
- Installation of 3-tonne 'cosmic lighthouse' on space station

2025
- SPORT solar polar orbit mission

2035
- Space Optic Interference Telescope

2050
- Space probe to the heliospheric boundary

Some of these missions have been in preparation for some time: the Solar Space Telescope is, in effect, the current iteration of the original Tianwen mission. HXMT was proposed as far back as 1994, but did not attract funding until 2011.

Some of these missions are designed to complement, rather than duplicate, the missions of other countries and thus obtain original data and new discoveries for the first time. For example, HXMT will search for x-rays below the range currently being explored by the European - Russian INTEGRAL. Dark matter is currently the frontier area of space physics and considered the key to unlocking the development and evolution of the universe. It is an area where the United States have no dedicated missions scheduled, to the point that American scientists have warned ominously of a 'new dark age for space astronomy' - at least, for them. The first such satellite will fly in 2014, but the planned cosmic lighthouse on the large ISS-class space station will be dedicated to dark matter. According to Shuang-Nan Zhang of the Institute of High Energy Physics, the main spokesman on the programme, 'there has been an explosion of interest in this area in recent years - but we still don't know the answer to the fundamental questions'. China's main rivals are likely to be the planned Russian Spektr observatories: although the first one, Spektr R, is now successfully in orbit, its companions RG, UF and M have been long delayed.

Other missions are logical extensions of scientific work already begun, like Kuafu, which follows Tan Ce by putting three satellites at a distance from the Earth suitable for observing what happens when the solar wind and solar eruptions reach the Earth's magnetosphere: two will be in polar orbits out to 670,000 km, while one will be at L1. MIT will be like Tan Ce, but with four satellites this time.

SPORT will be China's first probe out to Jupiter, where it will follow a path similar to Europe's famous Ulysses, before taking a gravity assist to loop over the north pole of the Sun, where it will deploy as many as eight sub-satellites to get a 3D multidimensional view of the Sun that will warn of flares and coronal mass ejections heading our way.

Roadmap 2050 outlines these missions in some detail, including the planned instrumentation suites, so the plan is not just an aspirational wish list, but a detailed programme. Several of these missions aim to attract international participation and this has already been obtained from Europe, for example, in the case of SVOM (France) and MIT (Ireland). It is true there is a long way between a plan on the one hand and government approval and investment on the other. Nevertheless, the Academy would not have presented a plan that did not work within an agreed range of ambition and have an underlying expectation of governmental support. China has demonstrated an impressive capacity to put together missions at rapid speed: Chang e 2, for example, went from concept to pad in less than two years. With powerful new rockets coming on line (e.g. Long March 7), China will have no difficulty lifting these payloads.

An interesting feature of Roadmap 2050 is the focus on fundamental science. There is no mention of probes to Mercury (in Chinese, the hour star, Chen hsing), Venus (the great white one, Thai pai), Jupiter (the year star, Sui hsing) or Saturn (the exorcist, Cheng hsing), all of which have received or will receive substantial attention from Russia, Europe and the United States, with Jupiter likely to be target of significant Russian missions in the 2020s. China appears to be following a distinctive path in space science, with a range of ambitious and promising missions. The Roadmap promises the brightest future for Chinese space science since the programme was founded in 1956. When we are watching television in the next few years, will we hear: Breaking news of a big scientific discovery in space. Over to our correspondent in Beijing...? That is certainly what they hope for.

UNOOSA and International Space Cooperation

Interview with Prof. Mazlan Othman, Director of the United Nations Office for Outer Space Affairs (UNOOSA)


Prof. Othman is delivering her key note speech “Bringing the Benefits of Space to Humankind” during the Yuri’s Night event on 12 April 2013 in Vienna. (credit: Karola Riegler/http://karolariegler.at/)

Mazlan Othman was born 11 December 1951 in Seremban, Malaysia. Already at school, she developed a special interest in mathematics and science that consequently led her to study physics at the University of Otago in New Zealand, where she also earned her Ph.D. in astrophysics in 1981, becoming the first woman to do so since the university was founded in 1869. After her degree, Mazlan Othman returned to Malaysia to serve her country as the first astrophysicist. Since the early days of her academic career she aimed at building up public awareness and the understanding of astronomy and space issues within the general public. Her most important achievements in Malaysia are the establishment of a curriculum in astrophysics at the national university, her appointment as the Head of the Planetarium Negara in Kuala Lumpur, and the setting-up of the highly successful microsatellite development programme in the early 1990's. In 1994 she received a full professorship.

In November 1999, Secretary-General of the United Nations, Kofi Annan, appointed Mazlan Othman as the Director of the United Nations Office for Outer Space Affairs (UNOOSA) in Vienna. At the request of Malaysian Prime Minister Mahathir, she returned to her home country in July 2002 to establish a national space agency and serve for five years as the founding Director General of "Angkasa" - the Malaysian National Space Agency. The cumulation of her successful work was the launch of the first Malaysian astronaut, Sheikh Muszaphar Shukor. An interesting aside: Last summer, in an interview for the BBC, Professor Othman admitted that she would have loved to fly to space herself. However, the Malaysian Defence Minister (later to become Prime Minister) told her that her responsibility was to run the programme – but it was still a hard decision for her to make.

In 2007, Prof. Othman was re-appointed as Director of UNOOSA by then Secretary-General Ban Ki-moon. At UNOOSA she implements the decisions of the General Assembly and of the United Nations Committee on the Peaceful Uses of Outer Space. Her office deals with issues of international cooperation in space, space debris, use of space-based remote sensing platforms for sustainable development, coordination of space law between countries, and the risks posed by near-Earth asteroids.

On 12 April 2013, Prof. Mazlan Othman, Deputy Director-General of the United Nations Office in Vienna and Director of the Office for Outer Space Affairs (UNOOSA) gave the keynote speech "Bringing the Benefits of Space to Humankind" for the Yuri's Night event in the Vienna Planetarium. Among others, she spoke about the Committee for the Peaceful Use of Outer Space - COPUOS and the tasks of the own office, UNOOSA.

The same evening she received the "Polarstern-Preis" (Polarstar Award) from the Austrian Space Forum. This award is given to persons for their outstanding engagement to inspire the public for space above and beyond the call of duty. The jury decided to honour Prof. Othman's life-long effort in the promotion of space and science to the general public, and in particular the young generation.

The Austrian Space Forum pointed out: “Throughout her professional career, Dr. Othman has been devoted to promote the fascination of manned space flight and astronomy. She was the driving force behind the fact that a country like Malaysia, her home country, which has hardly been engaged in space activities has become a space nation with its own space agency.”

Prof. Othman replied: "I am delighted to accept this great honour. I would like to make the observation that this Award is made for contributions “above and beyond duty”. In this context, I would like to refer to the fact that I have had the exceptional privilege of performing duties given to me. The duties I performed in Malaysia were part of a national strategy, but I would be remiss if I did not inform you that I was immensely inspired by the vision of my Prime Minister, which moved me to reach out and struggle beyond everything I imagined I could do. In the United Nations, my duties with regard to outer space activities were guided by Member States. But, I would like to say that it was the aspiration and commitment of developing countries that particularly motivated me. Thanks to them, I could envision where the best benefits could be applied and where their contributions could best be invested.And so, I accept this honour on behalf of the people of Malaysia whom I duly served and the developing countries whose dream of participating in space activities has been realised.I am thankful for this light in my soul that has been set ablaze and I assure you this fire will never be extinguished.”

After the award ceremony, Maria Pflug-Hofmayr, editor and publisher of the Austrian space publication "Der Orion" had the opportunity to conduct the following interview with Mazlan Othman for "Go Taikonauts!".

Prof. Othman has always been a promoter of the young generation. On this photo she is surrounded by members of the Space Generation Advisory Council (SGAC) participating in the Yuri's Night event on 12 April 2013 in the Vienna Planetarium. From the left: Silvana Hysa (SGAC, Albania), Klaus Kornfeld (SGAC, Austria), Reinhard Tlustos (SGAC, Austria), Mazlan Othman (UNOOSA), Jane MacArthur (SGAC, UK), Ryan Laird (SGAC, UK), Vojna Ngjeqari (SGAC, Albania) (credit: Klaus Kornfeld/Space Generation Advisory Council)

What is the function of the United Nations Office for Outer Space Affairs (UNOOSA) and why was the office located inVienna?

The unit was created within the United Nations to serve the Committee on the Peaceful Use of Outer Space. This was 51 years ago. Since that time the office has evolved from being a unit to the full office that it is today. In the beginning indeed the work was done with three or four people only, but then it soon grew.

The reason for moving to Vienna is that we received an invitation from the Austrian government. The responsible persons within the Austrian government thought that here are very nice buildings and therefore they could be dedicated to space and the Office for Outer Space Affairs. It was just a purely political decision.

How did it come about that you became the Director of UNOOSA?

In 1999, the first time when I took the head position for the Office, I was asked to apply because they knew about me and my work within the COPOUS meetings. But I couldn't stay long, because my government wanted me to go home and set-up a national space agency. But the reason why I came back in 2007 was because I thought I had done enough for Malaysia, and I just thought that my work in the UN was not finished. And so I came back.

Being in charge of UNOOSA from 1999 to 2002, and then again since 2007 is quite a significant time period. Do you think you have provided focus to the work of UNOOSA, while giving it your personal note and/or distinctive direction?

I think when I was here for the first two years, I didn't have time to give it my own personal leadership. And I just did what the Office had been doing for many years before. But when I came back in 2007, I knew that I wanted to stay longer, and therefore I decided that I would change things to make the Office more efficient, and the staffing of the organisation more logical. So the most distinctive thing I did for the Office was to reorganise the structure of the Office. The reorganisation is not completed yet. It will have taken me three years when it will be completed.

But of course in terms of the developing countries, so what we do for the developing countries is that I started two new initiatives: The basic space technology initiative and the human space technology initiative. I feel very happy about those two because they are an extension of what I did for Malaysia. I started the satellite programme for Malaysia, which is actually space technology. I felt that developing countries really need this capacity in basic space technology. This is why I promoted the basic space technology initiative. Secondly, I felt that even though we were a developing country in Malaysia, we needed to inspire our people by sending someone into space. I established the astronaut programme, got an astronaut to space, but I felt that it is not only Malaysia which has this dream. Many other developing countries have this dream. But the programme is not in the first place about sending an astronaut into space, but about doing science at the space station. Because doing science in space is the next leap of innovation which will happen in the future. Developing countries need to start thinking about this. That's why we established the human space technology initiative. I felt that in the five years I have been there those two are significant initiatives which I personally associate with.

In October 2003, taikonaut Yang Liwei conducted China's first human space flight. Chinese Central Television - CCTV showed Yang Liwei aboard his Shenzhou V spacecraft holding a UN flag next to a Chinese flag into the camera. In June 2012 the UN was given a BeiDou satellite model by Chinese representatives. During this ceremony, you accepted this gift on behalf of the UN. How did it happen that the UN flag flew on board of Shenzhou V and how did it come that China donated BeiDou satellite model to the UN?

When the first Chinese went into space they wanted to show that they are not going up there for China alone, but for the world. And in order to show that they were in space also for the whole world, to bring the United Nations flag was the most natural symbol, and the easiest action, to show that this space flight is for humanity.

With respect to the Beidou I have to say that the United Nations receive many, many gifts from all over the world. So if you go to our exhibition area in the Vienna International Centre you will see that there are many models of satellites and rockets given to us by many countries. We already had the model of the US-American global positioning system. Since the Chinese are also about to become a provider for global positioning services, we thought it would be nice to have the model of the Beidou satellite in our collection. Recently we received a model of the Russian global positioning system, the Glonass. Now we have one model from GPS, one from Glonass and one from Beidou. And maybe one day we will receive a model from the European global positioning system Galileo.

Dr. Gernot Grömer, President of the Austrian Space Forum (OeWF) is presenting the "Polarstern-Preis" (Polarstar Award) to Prof. Othman on 12 April 2013. (credit: Karola Riegler/ http://karolariegler.at/)

How important were these events for the international community represented within the UN and for China? Was there a message connected to these gestures?

Yes, the message is that the Member States including China, Russia and the US want to showcase to the world what they have. And to showcase is to give a model. Because the UN attracts people from all over the world all the time. This is a way of promoting to the world what you have. It is a short-cut to the world. This is what it is.

What is your opinion on the Chinese involvement in international space affairs?

The Chinese are investing a lot of money in space. It is part of their national policy and their national strategy, just like it is part of the US-American policy and strategy or part of the Japanese strategy and policy or the Russian or even the Malaysian policy and strategy. So if you going to be a world power which they will be or already are, like they are an economical world power they also want to be a world power in other fields: in science, maybe could also be in biotechnology, or others. Space is one of those fields. If we look at all these powerful countries in the world they are also leading space powers: Germany, France, the UK, Russia, the US. Once a country achieves a certain stature, space becomes an important part of their strategy. So it is natural that China too, has the same strategy. Look at Japan, India, I didn't mention India! You see how important space is for India. So it is the same. It is about positioning yourself, to be a power.

What are the hurdles, and what is the potential to include China as an equal member of the international community of space-faring nations?

Every country in the world is an equal partner. If Austria wanted to enter into space – with respect to space activities - it would be an equal partner to all other countries in the world. Of course we are not all equal because of the money that our governments are investing. All the money that the rest of the world – put together - is spending on space does not even equal the money the US is spending on space programmes. But that does not make us less of an equal partner. We are less in terms of technology, but in terms of our right to explore space and our right to benefit from being in space we are all equal, all equal. No matter whether you are Burkina Faso, or whether you are Japan or the United States or India. This logic also applies to China. We cannot think of China as being less equal than anybody else and therefore in the eyes of the United Nations all countries are equal. When it comes to your sovereign right to benefit from space and for you to contribute to being a space actor and contribute to humanity by being a space actor – we are all equal. As I said we are not equal in terms of technology nor are we equal in terms of science but we are equal in terms of rights and our potential. We have to be equal. We cannot prejudge and pre-empt that.

In ten-twenty years from now, how would you like to see how outer space affairs have developed?

In ten-twenty years there will be more cooperation, there will be more results of cooperation. We only see it for the International Space Station. Because of the necessity to do that, no one country will be able to undertake that trip to Mars on its own - not in terms of the money to be invested, not in terms of the technology to be developed or the science you want to do. In ten to twenty years there will be more coming out of doing this thing together. Because going to Mars is the ultimate cooperation, but in doing so you could be developing your technology, doing new science. As it is now, if you look what needs to be done for the world, to track near-Earth objects, which are a threat to Earth or to think about ways to get rid of space debris, or thinking about ways how we can learn more about the universe, there has been cooperation. And cooperation is at the core of all the things I have been mentioning. So there will be more of this kind of cooperation. I expect there will be more outcomes from this. I am very confident about that.

Maybe there are also some answers to this question about space affairs of the future in the new UNOOSA book: "Messages from space explorers to future generations" which you "launched" today (on 12 April) in Vienna?

No. The book is all about having astronauts and cosmonauts giving a message to future generations in their own writing, in their own language. There are many different messages in the book. One of the messages, which I read today is: "Listen to your mother!" I think this is very nice but different astronauts say different things. This book we will keep forever. Maybe in 50 years from now, somebody will read this book and see the handwriting, the language and the message that is given to future generations. It is like leaving an autograph behind, a type of time capsule

China's Navigation Satellites

Satellite	Bus	Launch Vehicle	Launch Date	Launch Mass (kg)	Orbit	Status
Beidou 1A	DFH-3	CZ-3A	10/31/2000	2,300	GEO 59°E to 140°E	Out of service
Beidou 1B	DFH-3	CZ-3A	12/21/2000	2,300	GEO 80°E	Out of service
Beidou 1C	DFH-3	CZ-3A	05/25/2003	2,300	GEO 110.5°E	Backup. Out of service
Beidou 1D	DFH-3	CZ-3A	02/03/2007	2,300	Super-synchronous orbit	Failed to GEO
Compass M1		CZ-3A	04/14/2007		MEO 21,500 km / 55°	Experimental
Compass G2	DFH-3A	CZ-3C	04/15/2009	3,050	Drifting in GEO	Satellite failure
Compass G1	DFH-3A	CZ-3C	01/17/2010	3,050	GEO 144.5°E	In service
Compass G3	DFH-3A	CZ-3C	06/02/2010	3,050	GEO 84.6°E	In service
Compass I1	DFH-3	CZ-3A	08/01/2010	2,300	IGSO 118°E / 55°	In service
Compass G4	DFH-3A	CZ-3C	11/01/2010	3,050	GEO 160°E	In service
Compass I2	DFH-3	CZ-3A	12/18/2010	2,300	IGSO 118°E / 55°	In service
Compass I3	DFH-3	CZ-3A	04/10/2011	2,300	IGSO 118°E / 55°	In service
Compass I4	DFH-3	CZ-3A	07/27/2011	2,300	IGSO 80-112°E / 55.2°	In service
Compass I5	DFH-3	CZ-3A	12/02/2011	2,300	IGSO 79-110°E / 55.2°	In service
Compass G5	DFH-3A	CZ-3C	02/25/2012	3,050	GEO 58.75°E	In service
Compass M3	DFH-3	CZ-3B	04/30/2012	2,160	MEO 21,500 km / 55°	In service
Compass M4	DFH-3	CZ-3B	04/30/2012	2,160	MEO 21,500 km / 55°	In service
Compass M2	DFH-3	CZ-3B	09/19/2012	2,160	MEO 21,500 km / 55°	In service
Compass M5	DFH-3	CZ-3B	09/19/2012	2,160	MEO 21,500 km / 55°	In service
Compass G6	DFH-3A	CZ-3C	10/25/2012	3,050	GEO 80.2°E	In service

Note: DFH = Dōngfānghóng

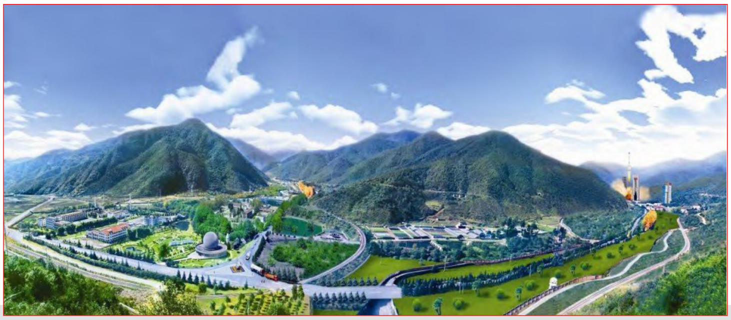
China's Military Earth Observation Satellites

Satellite	Bus	Launch Vehicle	Launch Date	Launch Mass (kg)	Orbit (Perigee x Apogee/ Inclination) (km / degree)	Status
ZY-2A	Phoenix-Eye-2	CZ-4B	09/01/2000		474 x 481 x 97	Optical imaging
ZY-2B	Phoenix-Eye-2	CZ-4B	10/27/2002		484 x 499 x 97	Optical imaging
ZY-2C	Phoenix-Eye-2	CZ-4B	11/06/2004		559 x 615 x 97	Optical imaging
Yaogan 1		CZ-4B	04/27/2006	2,700	627 x 629 x 98	SAR (wide-angle #1)
Yaogan 2	CAST2000	CZ-2D	05/27/2007		630 x 655 x 98	Optical (wide angle #1)
Yaogan 3		CZ-4C	11/12/2007	2,700	626 x 629 x 98	SAR (wide angle #2)
Yaogan 4	CAST2000	CZ-2D	12/01/2008		633 x 651 x 98	Optical (wide angle #2)
Yaogan 5	Phoenix Eye 2	CZ-4B	12/25/2008		480 x 492 x 97	Optical (narrow angle #1)
Yaogan 6		CZ-2C	04/22/2009		511 x 513 x 98	SAR (narrow angle #1)
Yaogan 7	CAST2000	CZ-2D	12/09/2009	800	625 x 656 x 98	Optical (wide angle #3)
Yaogan 8		CZ-4C	12/15/2009	1,040	1,192 x 1,205 x 100	Optical (wide angle, hi-res #1)
Yaogan 10		CZ-4C	08/10/2010		607 x 621 x 99	SAR (wide angle #3)
TH-1-01		CZ-2D	08/24/2010	1,000	492 x 504 x 97	Mapping
Yaogan 11	CAST2000	CZ-2D	09/22/2010		625 x 656 x 98	Optical (wide angle #4)
Yaogan 12	Phoenix Eye 2	CZ-4B	11/09/2011		480 x 490 x 97	Optical (narrow angle #2)
Yangan 13		CZ-2C	11/30/2011		505 x 510 x 97	SAR (narrow angle #2)
TH-1-02		CZ-2D	05/06/2012	1000	490 x 506 x 97	Mapping
Yaogan 14	Phoenix Eye 2	CZ-4B	05/10/2012		473 x 479 x 97	Optical (hi-res and infrared #1)
Yaogan 15		CZ-4C	05/29/2012		1,202 x 1,206 x 100	Optical (wide angle, hi-res #2)

Note:
1. The table includes only optical and radar imaging satellites. Signals intelligence and infrared detection satellites are not included.
2. The table includes only those satellites whose primary mission is imaging. i.e. The table does not include satellites having cameras, but whose primary mission is something other than imaging, e.g. Shenzhou.
3. Experimental nano or pica satellites are not included.

Gallery

Xichang Satellite Launch Centre


Panorama of the Xichang Satellite Launch Centre (XSLC). The residential area is at the left. The Coordination Building, the hotel and the park where the staff centre (the dome) is located, can be seen in the left foreground. The technical centre is at the upper middle at the end of the highway and the railway leading in. The launch area is at the far right. (credit: CGWIC)


XSLC seen at distance from the east. This photo was taken from the top of a building near the Mission Command and Control Centre, about 7 km away from the launch pad. (credit: Chinese internet)


XSLC seen at distance from the west. This photo was taken in Naji Village where farmers still live and work. (credit: Chinese Internet)


The main gate. At the right of the main gate, there is a country road that traverses through the launch centre and connects the Naji and Bayi Villages. (credit: Chinese internet)


The memorial site of the 1996 CZ-3B accident. This was actually the largest piece of debris found after the huge explosion - a nozzle of an engine. The memorial stands in the Space Park in the residential area of the centre, just near the main gate. (credit: Chinese internet)


The monument of the ancient Chinese rocket and the hotel. The monument is in a small pond in the park near the main road. It was flipped over in the 1996 accident. The hotel in the background was also damaged in the accident. What the photo shows is the newly built one after 1996. (credit: Chinese internet)


The Space Park near the main gate. It was built in the early 1990s and rebuilt after 1996. The dome seen in this photo is the staff centre. (credit: Chinese internet)


The railway terminal near the launch pad. Pad 2 and the abandoned railway and tunnel to the unbuilt manned launch pad, Pad 1, can also been seen. (credit: Chinese internet)


Looking down on the launch area, showing the Pad 2 and the new Pad 3. The abandoned railway and tunnel to the unbuilt manned launch pad (Pad 1) can also be seen. (credit: Chinese internet)


The first Chinese comsat DFH-2 was launched by a Long March 3 from the old Pad 3 of XSLC on 8 April 1984. (credit: Chinese internet)


ZX-12, a military comsat, was launched by a Long March 3B rocket from the Pad 2 on 27 November 2012. (credit: Chinese internet)


Chang'e 1, China's first lunar probe, was launched by a Long March 3A from the new Pad 3 on 24 October 2007. (credit: Chinese internet)

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