All About The Chinese Space Programme

# Go TAIKONAUTS!

龙腾太空

Issue 21 | April 2018


China's new space entrepreneurs: Lu Yulong (Dragon Drive), Zhang Changwu (LandSpace), Hu Zhengyu (LinkSpace). credit: Dragon Drive, LandSpace, LinkSpace

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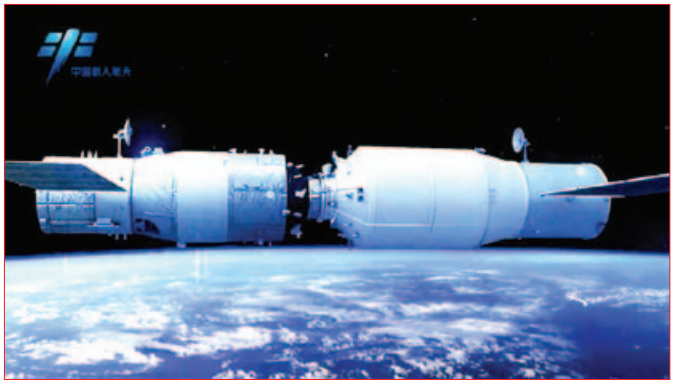
# Chinese Space Quarterly Report
## July - September 2017
by Jacqueline Myrrhe

## MANNED SPACE FLIGHT

At the end of September, Roscosmos's Head of Space Programmes, Igor Komarov, told media at the 68th International Astronautical Congress (25-29 September 2017) in Adelaide, Australia, that Russia is considering cosmonaut missions to the new Chinese Space Station (CSS). Such a possibility depends on a new law to be introduced within the next months. The Russian parliament needs to ratify such a legal regulation to allow the exchange of rocket technology. If so, options "will open for full-fledged and full-scale cooperation", stressed Komarov.

### Tianzhou 1 - Tiangong 2

On 1 August, the Silu 1 cubesat was released. For more details, please, see "Launches" section.



Artist's impression of joint configuration of Tiangong 2-Tianzhou-1. credit: CMSA.

After 3 months of formation flight at approx. 390 km altitude, Tianzhou 1 (TZ) and Tiangong 2 (TG) were docked together again on 12 September. The 3rd and last docking of the two craft followed the automated fast docking procedure which was tested for later use also with crewed Shenzhou vehicles. Ground controllers in mission control sent the initial docking command on 12 September at 17:24 Beijing Time (BJT). Docking was already completed 6 ½ h later at 23:58 BJT – instead of the previous 30 orbital manoeuvres.

On 16 September 2017, the TZ-1 cargo craft completed its 3rd and last in-orbit re-fuelling of TG-2 space lab by transferring 250 kg of fuel from TZ-1's eight tanks into the four of TG-2. The procedure took 3 days and confirmed the technical results obtained during the previous re-fuelling operation.

The final undocking from TG-2 was initiated by ground control one day later, on 17 September at 15:29 BJT. TZ-1's undocking from TG-2 was concluded at 16:15 BJT. After separation, TZ-1 remained in an orbit of around 400 km and operators continued to run automated experiments.

On 22 September 2017, around 18:00 BJT, ground controllers commanded the TZ-1 cargo craft to conduct two breaking manoeuvres which lowered the orbit and consequently initiated the re-entry into the denser layers of the Earth's atmosphere. The destructive re-entry over the Pacific Ocean ended a five-month mission of testing 3 times docking, 3 times re-fuelling operations and conducting automated experiments.

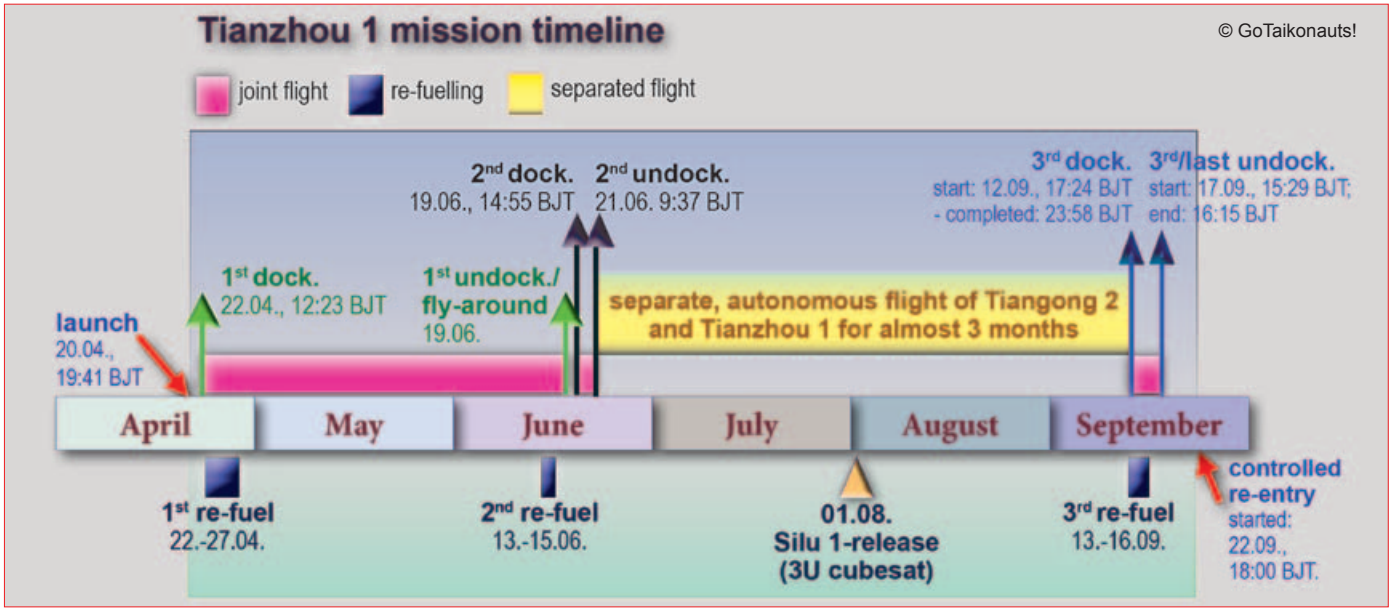
### WET Sensor for Shenzhou 11 mission

In August 2017 it became known that a multi-parameter WET Sensor, developed by Cambridge-based British company Delta-T Devices was used during the 33-day Shenzhou 11 mission to the TG-2 space lab for a lettuce growing experiment.

Jing Haipeng and Chen Dong spent 30 days aboard TG-2 in October and November 2016. One of their experiments was to cultivate lettuce in a culture system consisting of 3D-printed cultivation boxes filled with vermiculite, starting with day 2 of their stay in TG-2. "The WET Sensor played a key role in the space lab experiment, providing frequent accurate data on substrate moisture, temperature and pore water conductivity. This information allowed the astronauts to precisely assess growing conditions (including nutrient values) on a regular basis. The experiment was a success…", said the Delta-T Devices press release.

### Sea Survival Training

On 21 August, a group of 16 taikonauts and the two ESA astronauts Matthias Maurer and Samantha Cristoforetti completed a 17-day joint sea survival training off the coast of Yantai in East-China's Shandong Province. The astronaut sea survival training base in a suburb of Yantai was made operational shortly before. It was not only the first time taikonauts



have been conducting survival training in the ocean but it was also the first time that foreign astronauts joined their Chinese colleagues. The training programme was jointly organised by the Astronaut Centre of China (ACC), the China Manned Space Agency (CMSA) in cooperation with the Ministry of Transport's Beihai Rescue Bureau. The trained skills included exiting the capsule by themselves, survival at sea and rescue.

**International involvement for CSS**

China's first taikonaut and Deputy Head of CMSA, Yang Liwei, said at a press conference after the completion of China's first sea survival training that more than 10 countries, mostly developing countries, have been interested in China's assistance in selecting and training astronauts. They hope to prepare astronauts for prospective joint missions to the future Chinese Space Station CSS. Yang Liwei confirmed that China would adapt the 4-year standard training programme for candidates from foreign countries to take the specific pre-conditions into consideration. Therefore, it is now the right time to begin with such programmes for other nations, he stressed. Straight from the beginning, the scientists and designers of the CSS have allocated resources for international cooperation. He added that there are space station adapters that will enable the docking of foreign space craft to the CSS and that CMSA is about to draft policies and rules for the selection and training of foreign astronauts.

Scientists from Russia's "science town", Akademgorodok at the outskirts of Novosibirsk, have submitted 3 applications to conduct experiments under microgravity conditions at China's future space station. No other details are known.

**Photo Exhibtion**

On 26 July, an opening ceremony of an exhibition of photography taken by astronauts was held in Beijing. Yang Liwei, China's first taikonaut and Deputy Director of CMSA, said on that occasion that photos taken by astronauts from different periods reflect the development of China's space exploration. He hopes that the exhibition will cultivate an increased interest in space among the general public: "Space exploration is a massive project which needs the support of more people, especially youth."

Yang Liwei, confirmed that China will select its third group of taikonauts in 2017. In contrast to the first two astronaut groups where all were air force pilots, the third group will also include engineers who will be responsible for maintenance, assembly and scientific tasks.

## LUNAR and DEEP-SPACE Exploration

### Lunar

During the 68th IAC (25-29 September) in Adelaide, Australia, Tian Yulong, Secretary General of the China National Space Administration (CNSA) told media that the unsuccessful launch of the CZ-5 on 2 July caused delays to several major national missions.

For the lunar far-side mission Chang'e 4, initially planned for 2018 and the lunar sample return mission Chang'e 5, originally planned for November 2017, new launch windows would be announced by the end of 2017. The launch of the CSS's core module Tianhe 1 has been moved to 2019. The assembly of Tianhe 1 was completed 2016 and the launch was expected for 2018.

### MARS

Organised by the Chinese Academy of Sciences, the 3rd International Forum on Lunar and Deep-Space Exploration (LDSE 2017) took place from 19-22 September 2017 in Beijing.

Zhang Rongqiao, Chief Designer of China's first Mars Exploration Mission and Chief Designer of China's Deep-Space Exploration Strategy, is currently supervising the formulation of the corresponding China Deep-Space Exploration Roadmap 2030, as well as a series of practical and innovative deep-space exploration missions. He also served as Deputy Chief Designer of the National Key Project "Lunar Exploration". During LDSE2017 he told the audience:

- Preparations for China's first Mars mission are going according to plan. Launch is expected for July or August 2020 with arrival at Mars in 2021. The project includes orbital and surface exploration in a single mission, carrying 13 scientific payloads – 7 on the orbiter and 6 on the rover.
- The scientific objectives for the orbiter comprise collection of data about Mars' atmosphere, electromagnetic field, temperatures, surface landscape and other key scientific parameters.
- The 200-kg rover is supposed to record surface data, as well as testing other equipment to pave the way for a future sample return mission between 2025 and 2030. Mission control will be at China's Space Command Centre in Taiyuan, Shanxi Province.
- Mars will become the key focus of China's deep-space exploration in the future.

**Simulated Mars Station**

China has selected a remote site in Northwest China's Haixi Mongolian and Tibetan Autonomous Prefecture belonging to Qinghai Province, to establish a "Simulated Mars Station" which will also be used for geological field studies for astronauts or to test space exploration equipment, like Moon and Mars rovers, solar panels or other hardware. Additionally, it is intended to set-up a research lab and opportunities for practical science education as well as tourist attractions combining science, science fiction, nature, ecology and culture. The location, 2,000 m above sea level, would also be suitable for TV and movie filming. The Simulated Mars Station will be situated at

**Mars-Like Qinghai Hopes New Space Base Will See Economy Soar**
A report by Jiang Chenyue about the unique landscape of the Qaidam Basin, about the origin of the "Simulated Mars Station", about the people living in the region and their hopes connected with the Mars analogue site project.

View of the Red Cliff region in Da Qaidam Basin. credit: www.news.cn

the Red Cliff region in the Qaidam Basin, a hyper-arid region with landscapes reminiscent of that on Mars. The climate is cold, windy and dry. The Gobi Desert stretches over 95,000 km$^2$ of the Qinghai province with China's largest Yardang landform, and peripheral mountains, grasslands, rivers and lakes.

The Mars simulation base will consist of two areas connected by road: the Mars Community and the Mars Campsite. Next to module-like accommodations and recreation facilities, the campsite will have a number of experimental spots for experiential learning in aerospace, astronomy, geography and new energy.

An agreement was signed on 25 July 2017. On 5 September, planners completed a 400 million RMB (US$ 62 million) development plan. Construction of the Simulated Mars Station is expected to be completed by 2020.

## SCIENCE

**Micius-QUESS (Quantum Experiments at Space Scale)**
At the beginning of July, the Pan Jianwei research team for China's Quantum Project at the University of Science and Technology in Hefei, published the successful teleportation of a particles' properties and demonstrated that they could transmit quantum encryption keys in space. This is the first time that these two techniques have been demonstrated in space. Previously in June, they demonstrated the transfer of entangled quantum particles to receivers on Earth.

On 24 July, the Pan Jianwei team revealed in an article for "Nature Photonics" that they could demonstrate long-distance free-space quantum key distribution during daylight – achieving another breakthrough in quantum communication and laid a foundation for a satellite-constellation-based global quantum network. The team had overcome the sunlight noise and managed free-space quantum key distribution over 53 km during the day with the following technical parameters: 1,550 nm wavelength; free-space single-mode fibre-coupling technology; ultra-low-noise up-conversion single-photon detectors.

On 10 August, Nature magazine published that the Pan Jianwei team had realised quantum key distribution from the Micius-QUESS satellite to ground stations in Xinglong, in North-China's Hebei Province, and Nanshan near Urumqi, capital of Northwest-China's Xinjiang Uygur Autonomous Region. The distances between QUESS and the ground varied from 645 km to 1,200 km. The quantum key transmission rate from satellite to ground was up to 20 orders of magnitude more efficient than using optical fibre of the same length. During the satellites 10-min overflight over China, 300 kbit secure keys can be generated and sent by the satellite.

On 29 September, a 2,000-km quantum communication line opened between Beijing and Shanghai, becoming the world's first trunk line of secure quantum telecommunications. The "Jing-Hu Trunk Line" connects Beijing, Jinan, Hefei, and Shanghai as well as the Micius-QUESS quantum satellite. Bai Chunli, President of CAS, used the line to talk to colleagues at the University of Science and Technology of China in Hefei, Jinan, Shanghai, and at the Urumqi ground station in Xinjiang Uygur Autonomous Region. Later in the day, he also made the world's first intercontinental quantum satellite video call with Austrian quantum physicist Anton Zeilinger at the Institute for Quantum Optics and Quantum Information in Vienna. Zeillinger congratulated his Chinese colleagues on the success made in quantum communication and hopes to strengthen cooperation. Pan Jianwei, Chief Scientist of the Micius-QUESS satellite, the Jing-Hu Trunk Line, and Head of China's Quantum Project, said that the 75-min quantum video call between Beijing and Vienna went through several nodes (there are 32 nodes between Beijing and Shanghai), which were not all built by Chinese scientists. He added that the ground-to-space network functioned very well and that it is planned to conduct intercontinental quantum key distribution research with Germany and Italy. Ground stations in the two countries will be ready by the end of 2017. The long-term aim is to launch more quantum satellites for the formation of a hack-proof global quantum communications network.

China's Bank of Communications, the Industrial and Commercial Bank of China (ICBC) and Alibaba, have already used the quantum communication technology for information transmission. China is likely to issue national standards for quantum key distribution equipment within the next few years.

The Chinese research team is looking to integrate quantum communications with the traditional fibre network and to form a ground-space integrated quantum communications network by 2030.

China's government is supporting the establishment of a National Laboratory for Quantum Information Sciences in Hefei, capital of Anhui Province with 10 billion US$. The institute is planned to be ready by 2020.

### FAST

China's Civil Aviation Administration has set up two restricted flight zones, cancelled two routes, and added or adjusted three other routes around FAST (Five-hundred-metre Aperture Spherical Telescope) to protect the electromagnetic environment. 10,000 residents within 5 km of the telescope have been relocated. Visitors are obliged to hand in all their digital devices.

China's Academy of Science has issued a vacancy note for the position of FAST's Chief Scientist. The offer includes 1.2 million US$ annual salary plus benefits. A foreign expert astronomer is wanted with extensive experience at a senior level and on similar projects to become FAST's Chief Scientist.

### HXMT

China's Academy of Science (CAS), confirmed that data of its Hard X-ray Modulation Telescope (HXMT) "Insight" will be open to scientists from all over the world after it starts regular observation in November 2017. Insight detected a gamma-ray burst already 10 days after launch, still during its test phase. Chinese scientists from 6 CAS institutes and 10 universities submitted 90 proposals for observation targets. In the first year of

left: Bai Chunli, President of the CAS (in the middle of right screen), during the video call with Austrian quantum physicist Anton Zeilinger (left screen), using a quantum link-up from Beijing via the Micius-QUESS satellite to Vienna on 29 September 2017.
credit: www.news.cn

**A life of quantum entanglement**
– a portrait of Pan Jianwei, Chief Scientist of the Micius-QUESS satellite, Project Scientist of the Jing-Hu Trunk Line and Head of China's Quantum Project.

operation, 30-40 % of observation time will be used for scanning the Galactic Plane and the rest on pointing observations. The science team will set-up a calibration database and offer more than 300 data products. Insight's first data package of high-quality data with a total size of 2.1 gigabytes was received by the Kashgar ground station in Northwest-China on 16 June.

## SATELLITES

**Fengyun 4A**
The State Administration of Science, Technology and Industry for National Defence (SASTIND) announced that Fengyun 4A, the first of China's 2nd-generation GEO weather satellites, became operational on 25 September. Tests on the satellite platform, payload and ground application system have been successfully completed and the test results during its in-orbit operation met projected targets.

**TanSat**
The China Meteorological Administration reported that all in-orbit tests of China's first orbiting carbon observatory satellite, TanSat, were successfully completed. Tests included the simultaneous observation experiments, executed in parallel with ground meteorological centres and lunar calibration tests. TanSat uses a new spectroscopic technology called: molecule absorption.

With its high-resolution grating spectrometer and a wide-field imaging spectrometer, the satellite's data will provide at least 3 years of global space-based observations of atmospheric carbon dioxide and its change over the seasons.

## NAVIGATION

Wang Nuanrang, Project Leader for the development of a new generation of atomic clock at China Aerospace Science and Technology Corporation CASC, said by the end of July that his team is working on a microwave mercury ion clock for the use on the Beidou Navigation Satellite System. An experimental mercury ion clock system to conduct scientific tests will be ready within the next 4 years. The microwave mercury ion clock is currently one of the most accurate tools for measuring time by tracking atomic movement in the microwave range. Apart from satellite navigation it has applications in deep-space exploration.

On 16 September, the Global Navigation Satellite System and Location Based Service Association of China (GLAC) presented a new chip developed by Shenzhen-based Allystar Technology for the new generation of BeiDou-3 satellites for high-precision navigation and positioning. The positioning accuracy of the chip reaches the sub-metre level without ground-based augmentation and has also applications in unmanned driving systems, wearable devices, precision agriculture and smart logistics.

On this occasion, GLAC announced that the value of the satellite navigation and Location Based Service (LBS) industry comprised 212 billion RMB (31 billion US$) in 2016, up 22.1 % from 2015. The total output accounted for 80.8 billion RMB, 70 % of which originated from BeiDou Navigation Satellite System BDS. It is expected that the volume of the BDS industry will reach 240 billion RMB by 2020.

## TELECOMMUNICATION

Hong Kong communication satellite operator AsiaSat is planning for AsiaSat 10, a small high-throughput satellite with possibly a flexible beams capacity, to cover the Chinese market. AsiaSat 10 is supposed to be operational by 2020.

China Mobile International Limited (CMI), a subsidiary of China Mobile Ltd, has been buying colocation space at African data centre operator Djibouti Data Centre (DDC), using it as its first deployment in Africa. CMI is aiming for an expansion into the whole African continent "to meet the growing demands in the international telecommunications market". DDC will support CMI to establish cable head access, cross-connect, and colocation facilities directly adjacent to Djibouti Telecom's cable landing station.

**Feiyun**
A research institute under the China Aerospace Science and Industry Corporation (CASIC) plans to build a near space-based, solar-powered drone (UAV) telecommunications network called "Feiyun" (flying cloud). The main purpose of the network would be to provide a quick-response, operationally flexible, independent, short-term emergency assistance to the ground. The network would be able to transmit remote sensing and telecommunications relay signals or could be used as "airborne Wi-Fi hubs". First tests are planned for the end of 2017.

Two weeks after its launch, the communications satellite Zhongxing 9A entered its planned orbit. A performance abnormality of the CZ-3B carrier rocket's roll control thruster, part of the attitude control engine, during the third gliding phase, delivered the satellite into a lower than expected orbit. After 10 orbit adjustments with its on-board thrusters, controlled by the Xi'an control centre, Zhongxing 9A reached its pre-set GEO position at 101.4 degrees East on 5 July. The fuel consumption for this manoeuvre could shorten the projected lifetime of 15 years by 2 to 3 years.

China Aerospace Science and Technology Corporation (CASC), the satellite manufacturer and operator (via its subsidiary ChinaSatcom), confirmed that the satellite's systems are operational and the transponders are on and a series of tests will be carried out.

## ADVANCED TECHNOLOGY

The atomic clock experiment CACES - Cold Atomic Clock Experiment in Space – which was launched together with the Tiangong 2 space lab in September 2016, has passed its test in space and is performing as expected, said Project Lead Liang Liu. CACES was designed and built by the Shanghai Institute of Optics and Fine Mechanics, attached to CAS. CACES is not the most advanced atomic clock, but its operation in space gave China the opportunity for technology demonstration and to gain operational experience for introducing improvements for the installation of a more stable clock on board the future Chinese Space Station, with links to the ground.

## COMMERCIAL

On 20 July, the Chinese telecom company Hytera Communications, based in Shenzhen, closed a deal to buy the Vancouver-based satellite communications company Norsat International for 85.2 million CAN$.

The planned joint venture between U.S. satellite connectivity provider Global Eagle Entertainment, California, USA and Shareco Technologies, Beijing, China did not get the required approval of the Committee on Foreign Investment in the United States (CFIUS). Global Eagle planned to exclusively sell antennas, inflight Wi-Fi services and equipment for aircraft of China's HNA-group.

**3rd CCAF**
On 30 August, the 3rd China (International) Commercial Aerospace Forum, took place in Wuhan, Hubei Province of

China. 400 government officials, company representatives and industry experts from more than 20 nations, including the United States, Russia, Iran, UK, The Netherlands, Germany, together with several African countries like Burundi, Gabon, Kenya and Madagascar, attended the event and discussed the latest space technology developments and international business opportunities. The full-day conference was organised by China Aerospace Science and Industry Corporation CASIC and the Beijing Institute of Aerospace Information. 28 speakers and presenters contributed to the wide spectrum of topics of the programme, ranging from policy, business models, launch services, research opportunities, to education, marketing, and grassroot efforts for space start-ups. Most impressive however, is the establishment of the Wuhan National Aerospace Industry Base over the next years. For more details, please, read the report on pages 12 to 19.

**Hongyun**

By 2025, a constellation of 156 LEO satellites, operating in 1,000 km altitude will bring reduced latency communication, remote sensing, navigation and broadband internet access to areas with low signal strength and places with adverse natural environments, and also to airplanes and ships on the oceans. The Hongyun project by CASIC intends to serve China and less-developed countries as well as support commercial space development. The first experimental satellite will be launched by 2018 to verify the technology. Four more will follow until 2020, with the final configuration being completed by 2025.

The Hongyun Project was announced on 30 August at the 3rd CCAF in Wuhan. (also see report on pages 12 to 19)

**Sea Launch**

Tang Yagang, Deputy Head of the Aerospace Division of the No.1 Institute of the China Aerospace Science and Technology Corporation (CASC), said that it is planned to provide as of 2018 a sea launch service based on solid Long March rockets for international commercial customers. A 10,000-tonne freighter was modified as a sea launch platform. The carrier rocket key technology features will be tested in 2017.

**LinkSpace / New Line 1**

In mid-September, LinkSpace Aerospace Technology Group, China's first space start-up, publicly presented the design and some basic technical parameters of its two-staged New Line 1 (Xin Gan Xian 1) launch vehicle, a small launcher for micro and nanosatellites of 200 kg into sun-synchronous orbit (SSO). The 20.1-m tall, 1.8-m diameter launcher has a lift-off weight of 33 t. The New Line 1 first stage is propelled by 4 liquid oxygen/ kerosene engines with gas generator cycle, producing 400 kN thrust. The first stage is intended to be re-usable. The launch costs are calculated with 30 million RMB (~ 4 million Euro = 27.000 Euro/kg payload, assuming P/L is 150 kg) which could fall to around 15 million RMB (~2 million Euro = 13.500 Euro/kg payload, assuming P/L is 150 kg) when a re-used first stage is applied. Link Space aims for 2020 to serve commercial as well as governmental customers.

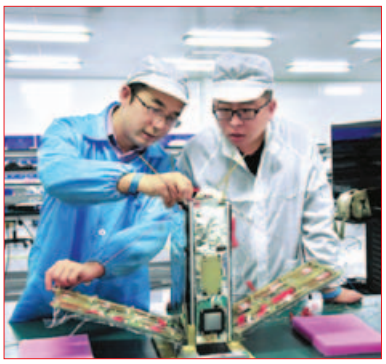
In 2016, Link Space demonstrated hover flight capability with a single vector-thrust engine. The company works on a deep-variable-thrust liquid rocket engine, a vertical take-off/vertical landing (VTVL) rocket flight platform, a flight control algorithm and control system, a servo actuator and far future plans for a re-usable second stage.

The estimated development costs for the New Line 1 are given with 300 million RMB (~38 million Euro). (also see page 22)

**SpaceTY**

Between 2018 and 2023, Tsinghua University and Changsha-based nanosatellites manufacturer Tianyi Space Research Institute (SpaceTY Co Ltd) plan to launch a series of 24 microsatellites carrying scintillation detectors to find and locate short Gamma-ray bursts and support studying gravitational waves. SpaceTY is in charge of the majority of the programme's engineering work. Research and production for the first technical test satellite will be finished by the end of 2017 and launch is expected in 2018.

Spacety Co Ltd also plans to launch 20 satellites by the end of 2018. The satellites are supposed to provide data to paying customers like research institutions and commercial businesses.



SpaceTY's engineers are working on one of its commercial cubesats. credit: SpaceTY

SpaceTY also intends to launch a time-sharing space telescope. Users could rent viewing time by the hour and control the space telescope's functions via a website. One hour of operations time would cost 2,000 RMB (295 US$) to 3,000 RMB while the total investment in the project is calculated to be more than 10 million RMB. The time-sharing satellite is expected to go online within one year.

China is heavily promoting the "sharing economy" policy, aimed at distributing resources of everyday things to reduce costs and allowing people to enjoy services that were previously unaffordable.

**Middle East customers for CGWIC**

At the end of November, Fu Zhiheng, Vice-President of China Great Wall Industry, said on the side lines of the Symposium on International Space Cooperation Promoting Economic and Social Development of Developing Country in Beijing, that Chinese satellites are attractive for developing countries because, they are as reliable as Western models and because CGWIC is able to provide solution packages including design, launch, operation and training. Fu Zhiheng commented: "In addition to traditional clients, we pay great attention to finding new customers. For instance, we are striving to tap the space market in the Middle East that is dominated by the United States and European firms. What I can tell you now is that we have made substantial progress in this region."

**Commercial Space Education**

In May, China's internet firm Tencent Holding, which owns and operates the QQ instant messaging service, initiated the QQ X Project, a multi-media and multi-platform Earth exploration programme. For the project, any Chinese older than 18 years can apply to the project by uploading their video entries onto the project webpage with their smartphones. Winning entries will then be selected through an open audition with Chinese internet users acting as the judges. Then, Tencent tasks the winners to go on exploration missions and share their findings and experiences with internet users worldwide. For the 2017 edition, the theme is "Starry Sky for Namibia". 15 young Chinese are travelling to Namibia, filming the sky and broadcast their findings. Other topics are: "Species for the Galapagos Islands", "Ocean for the South Pacific" and "Polar Regions for Antarctica".

The project has also received support from the Embassy of Ecuador in China, the Embassy of Namibia in China, Chinese Arctic and Antarctic Administration, China Ocean Mineral Resources R&D Association, the Charles Darwin Research Institute and the World Wildlife Fund, among others.

## INTERNATIONAL COOPERATION

### APSCO

The 10th Meeting of the Administrative Heads of APSCO (Asia-Pacific Space Cooperation Organisation) was held from 5-8 July 2017 in Harbin, in North-China. In parallel, the APSCO training course on "Space Law and Policy" took place from 4-8 July 2017 at Harbin Institute of Technology (HIT). It was co-organised by APSCO and HIT for 40 participants from 10 countries or regions. The course was aimed at strengthening the students' skills and knowledge on space law and policy related to space technology application. A moot court was conducted to use the Education Curriculum on Space Law prepared by UNOOSA.

HIT continued to host another APSCO event from 10-12 July. Around 70 participants attended the 4th APSCO Space Law & Policy Forum 2017. This biennial activity was a joint effort by APSCO, HIT, CNSA and co-sponsored by the Institute of Air & Space Law of McGill University, Canada. 16 executives from APSCO Member States dealing with space law and policy were invited. Space law experts from 7 non-APSCO countries including Austria, China, Canada, Indonesia, Italy, Japan, USA and UNOOSA took part in the Forum.

After the formal kick-off of the APSCO Student Small Satellite (SSS) Project in mid-December 2016, the 1st APSCO SSS Summer Camp took place from 14 August to 1 September at Beihang University in Beijing.

The students from APSCO Member States worked together for 3 weeks to get an education in space technology, satellite engineering, international project management and also to start with the actual project work in different working configurations: assignment work, team project, presentations. Experts from APSCO, CNSA, DFH Satellite Co., Ltd., China Academy of Launch Vehicle Technology, SJTU, Technical University of Madrid, and Beihang University helped them to clarify the mission, its purpose, the project management structure, and responsibilities. Technical visits to space companies and space museums as well as touristic excursions completed the Summer Camp.

From 11-14 September, the 11th APSCO Council Summit took place in Tehran, Iran. 50 participants from APSCO Member States (Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey) attended the meeting. The delegates reviewed the work of the organisation over the last months, discussed the upcoming activities, the financial budgets, and changes in the Council Members and the portfolio of the Secretariat's international staff.

11th APSCO Council Summit in Tehran. credit: APSCO

APSCO Secretary-General Li Xinjun and Islamic Republic of Iran's Minister of Communications and Information Technology, Mohammad Javad Azari Jahromi, met on 13 September and held talks on two APSCO programmes Iran wishes to join: APOSOS - Asia-Pacific Ground-Based Optical Space Observation System and DSSP – the Data Sharing Service Platform. Following an evaluation of Iran's space achievements and an approval of Iran's advancements in its technology sector, Li Xinjun stressed that Iran is well prepared for APSCO's Space Development Programmes. Iran will contribute but also benefit from DSSP, mainly in the context of data availability in case of response to natural disasters. APOSOS serves APSCO's Member States in the area of space situational awareness, providing space object locations and collision avoidance alerts. Iran has already contributed a ground telescope to that initiative.

Li Xinjun emphasised that all APSCO Member States are equal, which consequently means that when the member countries decide to cooperate, they share their technology equally.

### AUSTRALIA

Australia announced the establishment of a national space agency during the 68th International Astronautical Congress (IAC2017) held from 25 to 29 September in Adelaide, Australia. Justin Gong, co-founder of Chinese drone manufacturer Xaircraft with an Australian division, said there is a big opportunity to engage with an Australian space programme. Chinese robotics firm UBTech's Chief Strategy Officer, Bruce Ren, said that the geographical neighbourhood of Australia gives both countries a certain incentive. "China and Australia share an innovation outlook, we are in the same time zone and China has been investing heavily in space technology." Acting Australian Industry Minister Michaelia Cas stressed: "The agency will be the anchor for our domestic coordination and the front door for our international engagement."

### BRICS

From 3-5 September 2017, the 9th BRICS Summit, headlined by the motto "Stronger Partnership for a Brighter Future" took place in Xiamen, China. At the end of the Summit's plenary session the "The Xiamen Declaration" was issued. The BRICS nations pledge to abide by the principle of utilising outer space for peaceful purposes: "We adhere to the principle of utilising outer space for peaceful purposes and emphasise the need to strengthen the international cooperation in space activities in order to use space technologies to respond to global climate change, environmental protection, disaster prevention and relief and other challenges faced by humankind." Brazil, Russia, India, China, are the BRICS' four space-faring nations, while South Africa has a nascent space programme.

A statement from the South African National Space Agency (Sansa), issued on 4 July, said the country joined the Brazilian Space Agency (AEB), the Russian State Space Corporation Roscosmos, the Indian Space Research Organisation (ISRO) and the China National Space Administration (CNSA) to create the BRICS Remote Sensing Satellite Constellation. This constellation will create a system for sharing remote sensing data, meaning the data from each of the member countries' existing Earth observation satellites will be made available to all the other members. The BRICS Remote Sensing Satellite Constellation is realised in 2 phases: Phase 1 comprises a virtual constellation of existing satellites, and Phase 2 a new satellite constellation.

A joint committee meeting was held in Haikou, China, on 3 July to review and deliberate on the progress of the Remote Sensing Satellite Constellation and to discuss a draft agreement to be signed later this year.

## FRANCE

During the 68th International Astronautical Congress (IAC2017) held at the end of September in Adelaide, Australia, Jean-Yves Le Gall, President of the International Astronautical Federation (IAF), and President of the French Space Agency CNES, expressed his hope to strengthen cooperation with China in the field of tackling climate change. CNES is currently cooperating with CNSA on the oceanography satellite, CFOSat (China-France Oceanography Satellite) and SVOM (Space-based multi-band astronomical Variable Objects Monitor).

## GERMANY

China National Space Administration CNSA signed a Memorandum of Understanding (MoU) with the German Space Agency DLR agreeing on cooperation for the Chang'e 4 lunar far-side lander mission following the meeting between Chinese President Xi Jinping and German Chancellor Angela Merkel on 5 July in Berlin. "Both sides will follow the path of open, innovative and win-win in their cooperation, deepening their partnership in hi-tech fields of space, smart manufacturing and industrial internet", President Xi said at the joint press conference with Chancellor Merkel.

Scientists of the Christian-Albrechts-Universität zu Kiel, in Northern Germany, are developing the Lunar Lander Neutrons & Dosimetry Experiment (LND) for Chang'e 4's lunar lander. The LND will detect and measure on the lunar surface non-thermal and thermal neutrons. The data will help to improve the understanding of the lunar neutron spectrum.

In the presence of the Chinese President Xi Jinping and German Chancellor Angela Merkel, a cooperation agreement between DLR and CNSA on the lunar mission Chang'e 4 was signed by Chinese Minister of Foreign Affairs Wang Yi and Head of Central Management of DLR, Andreas Wolke. credit: Presse- und Informationsamt der Bundesregierung

## INDIA

The former Chairman of the Indian Space Research Organisation (ISRO) G. Madhavan Nair said on 27 July that he was hopeful of a joint space programme between India and China. "We have attempted many times a space programme with China but so far we have not succeeded. However, I hope it happens in the near future," said the eminent space scientist after delivering the second lecture of the A.P.J. Abdul Kalam Lecture Series organised by the Indian Institute of Management Shillong.

## RUSSIA

Denis Lyskov, Chief Executive Officer of Russian launch service operator Glavkosmos held a meeting with Chinese space experts in mid-August. The talk was part of the second meeting of the Sino-Russian working group on space cooperation. Meeting attendees paid special attention to the discussion of a new five-year Sino-Russian space cooperation programme for 2018-2022. The intention is to sign the agreement during the regular meetings of the heads of government, which is scheduled for October.

Glavkosmos is involved in the drafting of the programme and is the coordinator and contractor for parts of the resulting work. Cooperation with Chinese partners envisages the exploration of the Moon and deep-space, space vehicles and ground infrastructure, hardware components and special materials, Earth remote sensing data and space debris research.

China and Russia have signed space cooperation agreements in the past, but it is the first to cover a partnership spanning 5 years. This allows for more ambitious plans. However, there are voices in Russia, saying that the initiative is too cautious, insufficiently large in scope and extremely slow.

Glavkosmos is also working with Chinese commercial partners on the issue of flying experiments aboard the International Space Station and providing remote sensing data from Russian satellites.

Russia and China are going to broaden cooperation in the field of space operations commercialisation.

## UAE

The United Arab Emirates (UAE) are aiming at the development of a "sustainable" human spaceflight programme with scientific applications and will start an astronaut selection of approx. 4 astronauts by the end of 2017, a representative of the UAE space agency said during IAC2017 in Adelaide. The flight of the first UAE astronaut is planned for 2021, however it was not revealed which space nation would become the partner of choice for the UAE. The current strategy is to partner with all the major space agencies.

## UNITED NATIONS

During the 68th International Astronautical Congress (IAC2017) held from 25 to 29 September 2017 in Adelaide, Australia, the Director of the United Nations Office for Outer Space Affairs (UNOOSA) Simonetta Di Pippo, highlighted the important role China is playing within her office. China is an active member of the United Nations Committee on the Peaceful Uses of Outer Space and is opening its space missions to other countries. She added: "We are trying to negotiate in a bilateral way between UNOOSA and the Chinese government how we can be part of the Belt and Road Initiative, an important initiative that China is putting forward. Clearly, we are focusing on the space segment, space aspect, space elements of the Belt and Road Initiative. We have signed several agreements with different Chinese institutions ranging from disasters management and emergency response, the use of space-based data, and the infrastructure of disasters management and emergency response, up to issues related to opening up of the scientific data to everyone in the world, cooperating in exploration and innovation." Also, China is playing a significant role in co-chairing an important action team for the preparation of UNISPACE+50. DiPippo said: "We have a very interesting agreement since last year with China Manned Space in the field of human space flight. China Manned Space, through the agreement we have, is opening up China's future space station to everyone in the world, especially to the developing and emerging countries." For later in the year, an announcement of opportunities for developing countries using the Chinese space station for their experiments is expected. Director DiPippo concluded: "The continuous and increased engagement of China in the future exploration of the solar system will help the country to develop even more, and for sure will help us through the strong agreements that we have with the Chinese government to help developing countries. So, it's a very good global approach. The discussions that we are having inside the Committee on the Peaceful Uses of the Outer Space are always very constructive from the Chinese delegation, because clearly the global exploration of the solar system can only be global. So, all the main players have to work together."

### UK

Professor Sir Keith Burnett, Vice-Chancellor of the University of Sheffield, visited China at the end of July where he met with fellow academics and government representatives. The university already has close links with a number of Chinese institutions, including universities in Beijing and Nanjing. Its Advanced Manufacturing Research Centre is currently working on projects with the Shanghai Academy of Spaceflight Technology, which is responsible for the Chinese space programme. “I am really delighted to see the way our university’s partnerships are growing in China with the country’s most highly-regarded universities and with industry.” Prof. Burnett sees tremendous opportunities to innovate together and for developing new products in the area of next generation space vehicles. He looked forward to welcoming senior experts from Beijing and Nanjing.

The 12th UK-China Space Workshop on Space Science and Technology, was held in Edinburgh from 5 to 7 September 2017. Chris Lee, Head of International Space Partnerships at UK Space Agency is convinced that the UK is a natural partner for China when it comes to satellite applications, since the UK has some key strength in this area and since there is an increasing market demand for satellite applications in China. In 2015, the UK set up the STFC (Science and Technology Facilities Council) Newton Agri-Tech Fund under the auspices of the UK-China Space Science Joint Laboratory. The aim of this project is to use the UK’s expertise in remote sensing and modelling in the area of agricultural technology to work with and aid the Chinese farming community.

The 12-million-pound (15.68 million US$) fund is spread over five years and will make use of the breakthroughs in satellite imaging, remote sensing and modelling to help provide facilities and technologies that will support research driven, decision making tools for farmers and policy makers. Chris Lee hopes that once the joint projects have been successful in China, there is an opportunity to take those capabilities out to the rest of the world. Such a strategy is attractive, since the UK has been interested for a long time in the Belt and Road Initiative to see exactly how space can contribute to that particular process.

## EDUCATION

### UK-China Virtual Space Education Centre

Leading space scientists from the UK and China signed a partnership agreement during the UK-China Space Workshop on 6 September in Edinburgh, which aims to promote and strengthen both sides’ space education and space cultural activities. Under the MoU, a new Virtual Centre will be established to lead space education and space cultural activities between the two countries.

Already in 2016, a series of intensive masterclasses for hundreds of Chinese students and teachers were held. Its success laid the foundation for the MoU.

In a next step, the partners aim to select 100 primary and middle schools in China, the UK, and countries along the Belt and Road Initiative to test the education programme in a trial run. While the centre will help spread space education across China, British students and teachers will be offered to participate in summer school programmes including visits to China’s astronaut training and launch centres, and Britain-China education experiments will be developed to fly in China’s space programme.

Britain’s National Space Academy and The Consortium of Chinese Laboratories (CCL) will take responsibility for the centre. In the areas of cultural and education programmes, it will be supported by the University of Nottingham.

### Taikonauts on terrestrial mission

Liu Yang in Bangkok, Thailand. credit: Xinhua news

On 26 August, on the invitation of the Thai Ministry of Science and Technology, Liu Yang, China’s first female taikonaut, visited Bangkok where she attended the Thailand’s National Science and Technology Fair 2017 and gave a presentation on her mission to young Thai students.

On 26 September, Wang Yaping was speaking at the InnoTech Expo at the Convention and Exhibition Centre in Wan Chai, Hong Kong. She told the audience that her dream was to return to space and explore further into unchartered territory. Also, she recalled that Hong Kong students were fortunate to have played a part in the Shenzhou 11 mission last year when the crew carried out three experiments designed by Hong Kong students. One of the experiments involved raising silkworms in space. She added that, “Hong Kong people will definitely have opportunities to join the nation’s space missions in the future.”

### APSCO school competition

Peruvian school student Sebastián Cueva Obando, 16 years old, won the first place at the 2017 edition of APSCO Youth Space Contest “Future Space Homeland”, a space science and technology competition hosted by APSCO in Beijing and open to 15-19-year-old high school students from APSCO Member States. Cueva submitted the English language video “Amazing life chances on Mars” which explained scientific ideas and innovations for a future migration of humans to other planets. For instance, he contemplates the use of devices that turn carbon dioxide into oxygen or the use of radiation-resistant clothes, so that life on Mars becomes a reality.

## MISCELLANEOUS

A Yuanwang-class surveillance vessel left a military harbour in eastern China’s Jiangsu province on 10 September for the Pacific Ocean for a satellite tracking mission, the official military newspaper PLA Daily reported, without providing any more details.

Cambodia’s Apsara Authority, responsible for the Angkor Wat archaeological park and UNESCO World Heritage in Siem Reap, has extended a 2013 MoU with China’s International Centre on Space Technologies for Natural and Cultural Heritage to continue using its remote sensing technology to discover and preserve ancient temples in Cambodia’s Siem Reap province for another 3 years. The spokesman of the Apsara Authority told media on 26 September that the space data gave them accurate readings of the Angkor Park but also of changes in water, both on the surface and underground, important for the archaeological site. Imagery is updated every four days. Additionally, Cambodia requested China to provide further training to Cambodian officials on the use of the technology.

Nan Rendong, Chief Scientist with the world’s largest radio telescope project, died on the night of 15 September at the age of 72, according to the National Astronomical Observatories of the Chinese Academy of Sciences. As the founding father of the

Five-hundred-metre Aperture Spherical Telescope (FAST), Nan had been in charge of the project since 1994. Despite illness, Nan continued working, living up to his favourite motto: “Refuse to be average.”

On 9 August, the 50th anniversary of the Xi’an Satellite Control Centre, a balance was drawn: the control centre had successfully resolved major faults in over 10 satellites, saving the country billions of RMB in possible losses. Alone, over the last three years, the centre has debugged hundreds of satellite glitches. Founded in 1967, the centre is tasked with routine telemetry, orbit control and failure diagnosis and maintenance of satellites. The centre also sent the communications satellite Zhongxing 9A into a correct orbit, applying 10 orbit adjustments after the satellite had failed to enter its pre-set orbit when launched on 19 June. The centre currently monitors and manages over 100 Chinese space craft in orbit.

A portrait of Wang Shuqun, 47, the Chief Technician at the Shanghai Academy of Spaceflight Technology and special technician at the Shanghai Aerospace Equipment Manufacturer. He was the Chief Fitter behind the docking system when China’s Shenzhou 8 spacecraft docked with the Tiangong 1 space laboratory in 2011. The article explains his motivations and aims for the future.

Robert Bigelow, famous for his inflatable space habitat and his real estates around Los Angeles is trying to push for a Moon settlement. In the 1960s Werner von Braun gained support from Walt Disney to get the Moon message across. Today, Bigelow is using cartoons to urge the U.S. lawmakers to take up the Chinese challenge of Moon exploration - quite a creative way of addressing the audience at a NASA conference.

## LAUNCHES

2017-failure
2 July - 11:23 UTC (19:23 BJT)

**launch site:** Wenchang Space Launch Centre LC101
**launcher:** Chang Zheng 5-Y2, CZ-5 Y2
**payload:** Shijian 18 (SJ-18)

The second test of the Chang Zheng 5 rocket on 2 July was unsuccessful. Approximately 350 seconds after lift-off, one of the two main engines of the first core stage seemed to have a malfunction, possibly related to problems with the turbo pump. The second YF-77 main engine of the core stage worked until all fuel was used up - around 100 seconds too long. The YF-75D second stage engines could not compensate for the deviation from the projected flight path. The Beijing mission control centre made efforts to save the mission, including changing the flight path but finally had to give in. The satellite was commanded to fall into the Pacific Ocean near the Philippines. In October 2017, the Chinese maritime research vessel Xiang Yang Hong 09 was seen at that impact region, deploying the JiaoLong submarine, obviously surveying the area for pieces of hardware.

First investigations concluded that there was a production fault in the malfunctioning main engine of the first core stage. The four first stage strap-on boosters seemed to have worked nominally.

The launch was broadcast on national TV. After one hour, the Chinese government declared the launch a failure, which was quickly made public. First speculations were focusing on a malfunction in the upper stage before its second ignition. Contrary to this interpretation, the screens in the Wenchang control centre showed already during the rocket’s ascent a deviation from trajectory and speed.

On board of that CZ-5 was the 7,6 t Shijian 18 hyper-modern and ultra-high performance experimental GEO communications satellite - the heaviest China had ever built and the heaviest GEO satellite to date.

SJ-18 was the first CAST-built satellite based on the new DFH-5 satellite bus. According to CAST, the satellite featured innovations such as 2 cross-shaped 2D double folded semi-rigid solar arrays of 18 kW power performance in total, advanced thermal control systems with deployable radiators, and a new type of self-controlled propellant system. The satellite payload was 1.5 t but the overall capacity of DFH-5 is scalable up to 2.2 t.

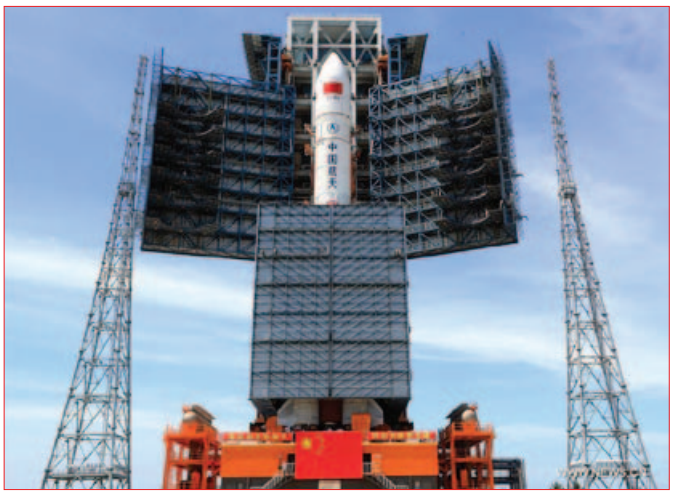
The satellite was intended for tests of satellite system modules, tests of satellite-to-ground laser communication technology, Q/V band satellite communication and for testing of the advanced Hall ion propulsion system LIPS-300, which would have been used for entering the GEO orbit and for station keeping. After the testing phase, SJ-18 would have supported HDTV broadcasting and high-performance internet services. The high-throughput unit uses Ka-Band and several high-capacity beams with a data rate of 70 Gbps.

The actually planned parking orbit was a 19.5 degree, 200 x 46.000 km highly elliptical orbit.

The 57-m high, 5-m diameter CZ-5 accomplished its first flight in November 2016 also from Wenchang. With a payload capacity of 25 t into LEO and 14 t into GEO, CZ-5 is doubling the capacity of the existing models of the Long March family. It uses the environmentally friendly fuel kerosene, liquid hydrogen, and liquid oxygen. It was said that more than 80 % of the technology used in the CZ-5 is new.

The test on 2 July should have been the last one before launching the Chang’e 5 lunar sample mission by the end of November 2017. The failure was the second Chinese launcher problem within two weeks. Already on 19 June, a CZ-3 rocket, launched from Xichang Satellite Launch Centre, could not deliver the Zhongxing 9A communications satellite into its correct orbit. The Xi’an Satellite Control Centre applied 10 orbit adjustments, using the satellites orbital manoeuvring engines and fuel so that Zhongxing 9A finally reached its spot in GEO orbit at 101.4 degree East on 5 July.

The 2 July launch failure will not only affect the lunar sample return mission Chang’e 5, but also the modules for the Chinese Space Station CSS and the 2020 Mars mission that need CZ-5’s lifting capacity.



On 26 June 2017, the CZ-5 Y2 carrier rocket, carrying the Shijian 18 communication satellite, was vertically transferred to the launch area at Wenchang Space Launch Centre. credit: Xinhua/Zhang Wenjun

2017-058A
2017-058B
2017-058C
29 September - 04:21 UTC (12:21 BJT)

**launch site:** Xichang Satellite Launch Centre, LC ?
**launcher:** Chang Zheng 2C, CZ-2C
**payloads:** YG-30 01-1 / YG-30 01-2 / YG-30 01-3

On 29 September, almost 3 months after the CZ-5 failure on 2 July, China resumed its launch activities. Three small military remote sensing satellites, Yaogan 30 01-1 to 30 01-3, were placed into a 600-km LEO orbit by a two-stage CZ-2C, taking off from Xichang. The three Yaogan-30 satellites will join the larger Yaogan 30 satellite launched in May 2016 (2016-029A) to form a constellation for monitoring electromagnetic signals and will be used for other technological tests. It was reported that the satellites are equipped with highly sensitive sensors designed to intercept communication signals and which can detect electromagnetic pulses generated by a nuclear explosion. Sometimes the satellites are also referred to as YW.

The 3 Yaogans were built by the Micro-Satellite Research Institute at the Chinese Academy of Sciences in Shanghai. It is expected that the trio is the first batch of a planned global surveillance network where three satellites flying in triangular constellation form a network node.

2017-021F
1 August - 07:03 UTC (15:03 BJT)

**launch site:** LEO
**launcher:** Tianzhou 1
**payload:** Silu 1

After 104 days in flight, the Silu 1 3U cubesat was successfully released from the outside of Tianzhou 1 cargo spacecraft on 1 August 2017, 15:03 BJT. China Aerospace Science and Technology Corporation (CASC) confirmed that signals from Silu 1 were received by mission control right after the release. The cubesat for the Xi'an Survey Bureau was launched together with Tianzhou 1 and was deployed in-orbit rather than during launch. This was a test for later launches of micro- and nano satellites from the future CSS.

## Chinese payloads on non-Chinese launchers

2017-057A
28 September 18:52 UTC; 29 September 00:52 Baikonur Time

**launch site:** Baikonur cosmodrome
**launcher:** Proton M/Breeze M
**payload:** AsiaSat 9

AsiaSat 9 comsat was successfully launched on board a Proton-M rocket on 29 September 2017 from Baikonur, Kazakhstan.

AsiaSat 9 is AsiaSat's next generation satellite, launched to replace AsiaSat 4 at 122 degrees East Longitude. AsiaSat 9 is a Space Systems Loral 1300 satellite equipped with 28 C-band and 32 Ku-band transponders, and a Ka-band payload. AsiaSat 9, operated by Hong Kong-based Asia Satellite Telecommunications Co. Ltd. (AsiaSat), will provide additional capacity, enhanced power and coverage for direct-to-home video distribution, private networks and broadband services across the Asia-Pacific region. The satellite is box-shaped and equipped with two solar panels. The launch mass was 6.141 kg, the satellite's lifetime is 15 years.

Initially, the satellite was supposed to carry also the commercial meteorological payload STORM (Sounding and Tracking Observatory for Regional Meteorology) of the GeoMetWatch Corp. Additionally, the launch was originally planned with SpaceX but because of schedule issues was then booked with ILS.

**NOTE: Cygnus CRS-7 (2017-019)**
The Chinese QB-50-Cubesat LilacSat 1/Zidingxiang 1 (QB50-CN02) from HIT that was transported to the ISS by Cygnus CRS-7 and which was released from the ISS on 25 May 2017 was designated by AMSAT as LilacSat-OSCAR 90 (LO 90).

**ADMENDMENT to QR 2-2017, published in Issue 20**
Earlier on 25 May 2017, the 2U NJUST-1 (QB50-CN03), from Nanjing University of Science and Technology and VKI (Von Kármán Institute) was also released.
On 26 May 2017, the PolyITAN-2-SAU, a 2U cubesat (QB50-UA01) was deployed from the ISS. The PolyITAN-2-SAU is a cooperation project between the Kiev Polytechnical Institute and the Shenyang Aerospace University.

Up to August 2017, the QB50 project supported five cubesats with full or partial Chinese participation: LilacSat 1; NJUST 1; Ao Xiang 1; PHOENIX; and PolyITAN-2-SAU.

***Ralf Hupertz*** *and* ***Arno Fellenberg*** *kindly contributed information to the section Chinese Space Launches. Other sources of informations are:*

*http://news.xinhuanet.com* *https://www.nasaspaceflight.com* *https://spaceflightnow.com*
*http://spaceflight101.com/china/* *http://www.spaceflightinsider.com* *http://www.planet4589.org/space/jsr/jsr.html*

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# Wuhan – China's centre of the commercial universe

## including interviews with Enrique Pacheco, Andrew Paliwoda, Philippe Cyr

**By Chen Lan, Dr. William Carey, Jacqueline Myrrhe**


Entrance to the conference hotel. credit: GoTaikonauts!


The CASIC Wuhan administration, just across the hotel. credit: GoTaikonauts!

For the GoTaikonauts! Team, and most likely for many of the foreign guests as well, it was the discovery of the year 2017: the 3rd China (International) Commercial Aerospace Forum (CCAF) which took place on 30 August 2017 in Wuhan, the capital of central China's Hubei Province. The annual forum was held only twice before and in 2017, for the first time, it went international – and this – with unprecedented success.

Around 400 government officials, company representatives and industry experts from more than 20 nations, including the United States, Russia (with the largest foreign delegation), Canada, Costa Rica, Germany, the UK, The Netherlands, Iran, Singapore, and African nations like Burundi, Gabon, Kenya, and Madagascar, followed the wide range of presentations, discussed technological developments and last but not least: evaluated business opportunities in the commercial space sector, making the forum a priceless networking opportunity.

But why Wuhan? For sure, the conference venue was a perfect choice: the Eurasia Convention International Hotel, with very good facilities for a conference of this scale offered a generous ballroom, state-of-the-art technical equipment including for simultaneous translation, convenient services for lunch and breaks, and areas for the accompanying exhibition by space companies, making it easy to get in direct contact with commercial players.

But there is more to Wuhan, a mega-city which is home to 11 million inhabitants and a university cluster where more than 1 million students learn and live. The forum was made possible through a strong partnership between the organisers, co-organisers, sponsors, and supervisors – consisting of local and central governmental authorities, state-owned space companies, private companies, as well as international companies and organisations. For a foreign observer, the most striking fact was the enthusiastic and serious commitment by the local, regional, provincial and central government politicians in full support of commercial space efforts. The leading role in all of this was with CASIC, the China Aerospace Science and Industry Cooperation. CASIC is also the driving force behind the country's first commercial space industry base. And this is what makes Wuhan primarily special.

### WUHAN NATIONAL SPACE INDUSTRY BASE

Almost all speeches and presentations given during the forum by Chinese representatives reflected on this unique project: the National Space Industry Base in the Yangluo Economic

### CASIC

China Aerospace Science and Industry Corporation, CASIC, headquartered in Beijing, is a large state-owned, hi-tech enterprise under direct management of the central government. It employs 150,000 people. Next to being the biggest missile weapon designer and manufacturer in China, CASIC is responsible for a very wide range of high-tech products in aerospace defence, information technology, equipment manufacturing and intelligence industry.

CASIC contributes to space delivery systems, micro and small satellites, various types of space payloads and satellite applications, and has made important contributions to China's manned space flight programme, to lunar exploration, to the Beidou satellite navigation system, and the high-resolution Earth observation system.

CASIC's advanced aerospace technology in casting, welding, surface treatment has been even applied in the manufacturing of Buddha statues or monuments like the "Lotus in flourishing age" in Macao or the "Forever Blooming Bauhinia", a present given by the China Central Government to the Hong Kong Special Administration Zone.

CASIC also exploits new fields like trade, financial affairs, securities and investment.

Recently, the state enterprise has taken the lead in the commercialisation of the country's space technologies. It supports more than 6,000 private innovative, entrepreneurial programmes and has set up eight innovation incubators across the country.

The main activities in the field of commercial space are focused on the development of a reusable Earth-space-Earth delivery system, on low-cost and highly-reliable solid fuel rockets, micro and small satellite constellations, near-space resources and the development of space technology applications.

In 2015, CASIC founded the CASICloud Internet platform, which helps enterprises globally to find the advanced technologies they need.

In a move to promote innovation and entrepreneurship, the State Council of the People's Republic of China approved in 2016 the National Space Industry Base in Wuhan, strongly aiming at the integration of the available resources of talent, capital and policy support. CASIC took the responsibility for this mammoth project.

Development Zone of Wuhan's Xinzhou District, with a total investment plan encompassing 150 billion RMB.

The initiative goes back to a proposal, made by CASIC President Gao Hongwei in May 2014. His idea called for the establishing of "The Third National New Comprehensive Development Base of Space Industry" in Wuhan, which was to be dedicated as the first national commercial space hub in China. (The first two Development Bases of Space Industry are in Beijing and Shanghai.) The proposal got the support of Premier Li Keqiang and in the autumn of 2015, CASIC signed the investment framework agreement with Wuhan's municipal administration. In parallel the 1st CCAF took place. Already the next year, in late summer of 2016, the National Development and Reform Commission approved the plan as national high-tech industrial base. In September the same year, during the 2nd CCAF, CASIC, the Hubei provincial administration, and the Wuhan municipal government signed a cooperation agreement and marked officially the starting point of the industrial base.

In April 2017, a public-private partnership between China Fortune Land Development and the Xinzhou District of Wuhan City was agreed. On China's 2nd National Space Day, 24 April 2017, the construction of the 68.8 km² Wuhan National Space Industry Base started officially with the first three projects: the General Production and Assembly Line for Carrier Rockets, the new materials facility and the high-end equipment production. It is expected that at least 100 enterprises involved in the space industry join the Wuhan commercial base before 2020, while the overall construction period will last for 10 years.

CASIC is not only the main driver behind the commercial hub in Wuhan but also - with its commercial spin-off Expace Technology Co - the entity behind the commercial rocket production and assembly facility for its new flagship rocket, the Kuaizhou launcher, developed by CASIC's Fourth Academy. The rocket production will become China's first commercial research and development business for rocket development, production as well as applications and represents the commercial hub's core business. CASIC settles into Wuhan's National Space Industry Base with an investment volume of 1.7 billion RMB and expects to be operational in 2018. Calculations estimate that CASIC should be able to generate within two years an annual turnover of 1.5 billion RMB what translates into approximately 20 Kuaizhou rockets per year.

Next to the development of carrier rockets, another focus of the Wuhan base is on satellite development and manufacturing, aerospace ground equipment production, and applications of satellite data. In the realm of satellites, the main investor will be CASIC's Second Academy with a budget of 300 million RMB for the construction of a research, development and manufacturing complex for small satellites. The production capacity might reach an annual output of 40 satellites over 100 kg and up to 100 satellites under 100 kg weight. As from 2018, CASIC plans to install a LEO constellation of 156 small communication satellites, the Hongyun Project, to form a global coverage network. One can expect that those small satellites will be "Made in Wuhan".

Expace Technology Co. might be seen as the backbone of the Wuhan National Space Industry Base but the space hub has attracted interesting neighbours also. The National Memory Base, a semiconductor manufacturer for memory chip mass production and the National Intelligent Connected Vehicle Demonstration Zone, a test area for self-driving cars have also settled in Wuhan along with a geo-information applications industrial base and a laser optics innovation centre.

Against this background, the city of Wuhan was a natural choice for hosting a commercial aerospace forum which introduced already in its third year of existence an international reach. And indeed, the forum showcased a balanced programme of Chinese and international presentations – reflecting the latest state of progress in the field of commercial space efforts.

## Aerospace as a top-priority

Opening remarks came from officials of all levels of political life. On the municipal level, Liu Yingzi, the Deputy Mayor of the town of Wuhan gave an enthusiastic, welcoming and highly encouraging speech. She stressed that the Wuhan National Space Industry Base is one of the top priorities of the municipal administration. She is convinced that the aerospace industry

Deputy Mayor of Wuhan, Ms Liu Yingyi. credit: GoTaikonauts!

### Commercial Space Activity Definition

In China, a commercial launch usually means a space launch financed by an entity other than the Chinese government or a military agency.


right: Map of the town of Wuhan with the Wuhan National Space Industry Base - marked in red. credit: Wuhan National Space Industry Base Investment Guide CFLD - China Fortune Land Development

is having a positive impact on other parts of the economy. Wuhan City is making sure that the investors find the best possible conditions, starting with infrastructure connectivity and ending with policy support, and the full attention of the local and central government. Liu Yingzi's speech was also particularly noticeable because she spoke clearly and continuously without reference to any notes.

### A spirit bigger than space

On the provincial level, Zhou Xianwang, the Vice Governor of the Hubei Province outlined his clear understanding of the strategic importance of the aerospace industry which is an emblematic indicator of the overall industrial strength of a country. Disruptive technologies, regularly emerging from the aerospace sector, are leading other industries to new inventions and developments, cross-fertilising innovation. Also, the active and purposeful integration of resources will translate into more business opportunities and services. Hubei Province is providing a fund of 10 billion RMB to boost aerospace industries. He also pointed out that the Wuhan National Space Industry Base needs a global view and he wishes that the initiative attracts global talents and foreign experts. Zhou Xianwang ensured the conference participants that the provincial government would actively push forward a policy system to create a favorable development environment in a bid to support the aerospace industry development. He ended his remarks with a quote by President Xi Jinping, who said that China is small compared with space but - we Chinese - have a big spirit, bigger than space.

### Aerospace on the overtaking lane – a strategic choice

Tian Yulong, Chief Engineer of the State Administration of Science, Technology and Industry for National Defence represented the central governmental level. He explained the idea that the Chinese government connects with the promotion of China from being a big country of aerospace to becoming a great country of aerospace. Aerospace is a strategic choice, taken by President Xi Jinping's introduction of the National Strategy of Aerospace Development.

While embracing globalisation, China is looking for new models of innovation, new applications and for an accelerated transformation of the governmental aerospace sector into a commercial one. The government feels responsible for setting up the suitable legal framework to guarantee IP rights, technology development and technology transfer.

Those thoughts were reiterated by Xia Mingjiu, Deputy Director of the State Administration of Foreign Experts Affairs. He added the dimension of human resources when he spoke about the governmental initiative of the talent recruitment system to attract global talents to China.

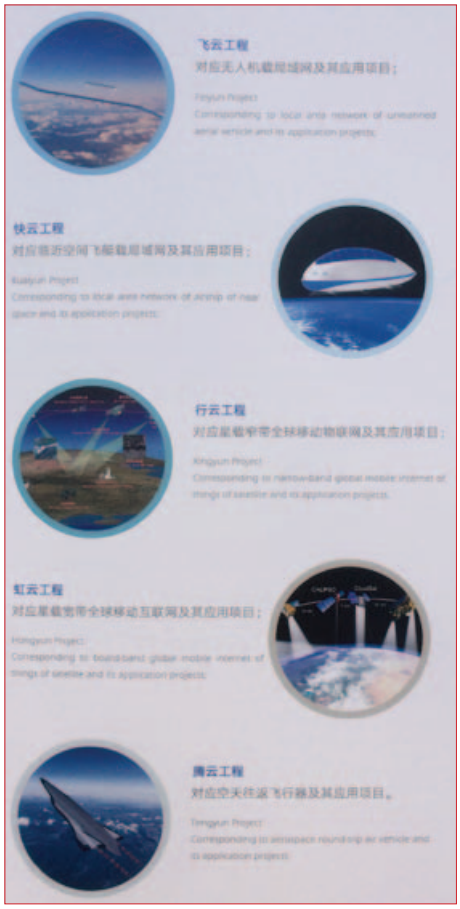
### The super jet engine, called market economy

The last introductory talk was given by Gao Hongwei, Chairman of CASIC and the mastermind of the Wuhan National Space Industry Base. He put it in a nutshell: "Market economy acts like a super jet engine. It absorbs all available resources, processes them with a series of innovative work in technology, business model and management, and eventually creates some remarkable innovations that drive all industries in this system to thrive … In China, the socialist market economy is a strong institutional support for market-driven competition in the commercial aerospace industry, which makes clear sense for CASIC to join in the development and ecological establishment of global commercial aerospace industry."

### CASIC's Five Clouds

The first technical presentation of the day was by Liu Shiquan, CASIC's Vice President.

Under the title "Develop Commercial Aerospace with Innovative Business Model", he explained that knowing that aerospace is a tool for economic development and after analysing the global status quo, CASIC realised the importance of innovation in the development of business models and the implementation of the new strategy of transformation from governmental driven aerospace activities to commercial business models. He gave an overview on the commercial projects, CASIC is working on: Kuaizhou launcher development, the CASICloud platform, and the Five-Clouds Projects – see box below.



Also, Liu Shiquan announced CASIC's plan to develop an ultra-high-speed maglev vacuum tube train with a speed of 1,000 to 4,000 km/h.

left: CASICs Five Cloud Projects.
credit: Wuhan National Space Industry Base Investment Guide
CFLD - China Fortune Land Development

### CASIC's Five-Clouds Projects

In addition to the focus on rocket production, CASIC identified five core projects, the so-called: Five Clouds (or Five-Yun. 'yun' means 'cloud' in Chinese), for its Wuhan National Space Industry Base aiming at becoming the national centre of excellence in those respective fields:

**Feiyun Project**
- Local area network of unmanned aerial vehicles (UAV) and its applications

**Kuaiyun Project**
- Local area network of near space airships and its applications

**Xingyun Project**
- Narrow-band global mobile internet of things of 56 satellites and its applications

**Hongyun Project**
- Broad-band (Ka-band) global mobile internet of things of 156 satellites and its applications

**Tengyun Project**
- Aerospace round-trip air vehicle (two-stage to orbit, horizontal take-off and landing TSTO HTHL) and its applications

### The Case for Space: hands-on and down-to-Earth

Sun Weigang, Chief Engineer of China Aerospace Science and Technology Corporation (CASC) gave some interesting impetus and food for thought with his talk, titled: “Develop Commercial Aerospace with Intelligence to Expand Precisely.

He outlined that the rise of global commercial aerospace is the result of a transformation process. In the past, space technology has been traditionally a “high-end” industry for governmental endeavours in defence and space exploration. On the global scale, aerospace technology and applications are becoming the fields of increasing venture capital investments. Aerospace products and services are growing fast, becoming more present in the everyday life of ordinary people, becoming “hands-on” or “down-to-Earth” for civil purposes. This again, generates a higher interest in aerospace and consequently feeds a circle of fruitful interdependence and constant exchange of technology, products, and services between purely space applications and terrestrial applications. The more present space applications are in everyday life, the more creative will people use and improve them. As a consequence, investments will follow, leading to the integrated development of space technology and terrestrial applications, because commercial aerospace means more than rockets and satellites.

### Costa Rica

The speech by Carlos Alvarado Briceño, President of the Central American Association for Aeronautics and Space (ACAE), was an event all of its own. With his refreshing Latin American spirit – full of enthusiasm and passion - Carlos Alvaro represented his small Central American country of Costa Rica with a stage performance which embraced the audience entirely and let everybody for 20 minutes travel virtually to his homeland. He spoke about the beautiful nature, the determination by the government and citizens to follow ecological and sustainable development. In support of this, a crowdfunding activity was started to build and launch Irazú - the first Central American satellite, made in Costa Rica. The 1U cube sat is designed to provide environmental data to monitor the country’s contribution to climate change. The second aim of the project under the lead of ACAE and in cooperation with the Costa Rica Institute of Technology (TEC) is to go through the full cycle of a space engineering project to give the young generation experience in a space mission. Irazú is scheduled for launch to the ISS by SpaceX CRS-14 in April 2018. From there it will be deployed from the KIBO module using JAXA’s cubesat dispenser.

In Wuhan, Carlos Alvarado also spoke about the National Stadium of Costa Rica which was financed and built by China.


Carlos Alvarado is talking about: “Identifying opportunities for China and Costa Rica in the aerospace field”. credit: GoTaikonauts!

In March 2016, in the very same stadium, astronauts from 6 nations spoke to 10.000 young Costa Ricans about space and exploration. It was impressive to see, how motivated a small country, more famous for coffee than space initiatives, is to use science and technology for its long-term sustainable future.

### Information Network is key to the future

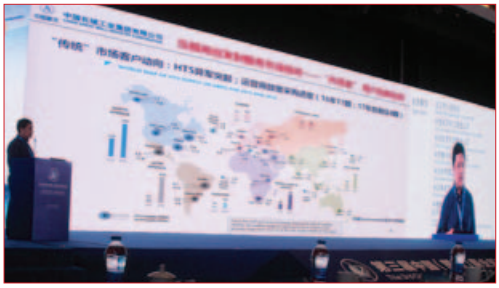
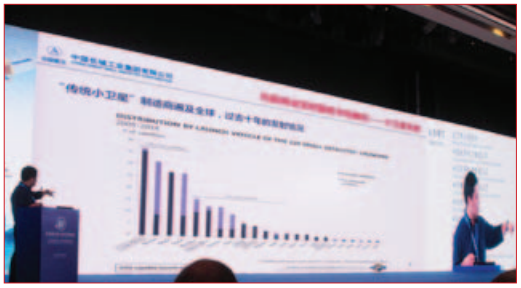
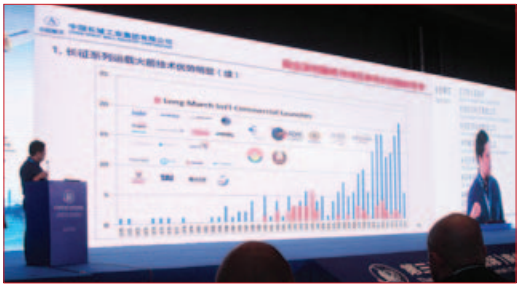
Wu Wei, Chief Scientist of the China Electronics Technology Group Corporation, gave a presentation on the “Construction and Operation Plan of Space-ground Integrated Information Network”. He outlined the proposed implementation of a Space-Ground Information Network. The starting point of his remarks was a thorough analyses of the existing global and Chinese capacities as well as plans in the tele-communication sector.
China’s domestic economic demands along with requirements stemming from the Belt and Road Initiative are calling for a unified and standardised information network infrastructure, combining space-based facilities with terrestrial infrastructure contributing to China’s National Civil Space Infrastructure.

Quite an analysis Wu Wei presented. credit: GoTaikonauts!

### A strong alliance

It was the task of Chen Xingai, the Secretary of the CPC of Xinzhou District, to give an overview presentation on how the Wuhan National Space Industry Base fits into the comprehensive development of the Xinzhou District and the surrounding region. He confirmed that the initiative is based on a solid foundation. There is a 3D transportation infrastructure of rail, motorways, water and air connections already in place. He outlined the plans which Wuhan has for the establishment of a commercial industry park also housing an industrial base for geo-data applications and for laser optics supporting the Beidou Satellite Navigation System. Chen Xingai explained that the investment will be done in three phases, fed by the 100 billion RMB fund made available by the provincial administration.
He also mentioned that the success of the project is owed to the fact that CASIC succeeded in building up a strong alliance of complementary stakeholders.

Chen Xingai is explaining the importance of the Wuhan National Aerospace Industry Base. credit: GoTaikonauts!

Si Yuan, General Manager of Americas for the China Great Wall Industry Corporation showed an extensive analysis of the capacities of current launch service providers in the world, of global HTS capacities and a balance of the commercial launches by Long March. He concluded that China has a matured technology already in place. However, launch services alone is becoming less and less attractive. The current main business focus is the delivery of turn-key satellites to customers. credit: GoTaikonauts!

## NANORACKS - the "Concierge to the Stars"

Clearly, NanoRacks's Managing Director Jeffrey Manber's presence in Wuhan made the audience sit up and take notice. Less of a surprise was that no other U.S. company was present. Needless to mention that Manber is an excellent speaker with neat and professionally designed slides. He explained the portfolio of his company, without missing the opportunity to state that NanoRacks is a truly commercial space company, working with private money and its own real-estate, aka hardware, in space. NanoRacks achieved the feat of flying the first Chinese experiment on the ISS, outstripping – actually embarrassing - other potential organisations like ESA or European national space agencies, who have long-standing relations with China's science institutions and could have built on that to achieve this accomplishment.

Jeffrey Manber put a lot emphasis on the fact that the first Chinese payload on the ISS was approved by all appropriate U.S. governmental authorities. He stressed that is was not China but a university, which happened to be a Chinese university, coming to the ISS. Nevertheless, he admitted that it was an unusual mission but more in the sense that everything worked: the payload was ready in time, the launch was in time, and the experiment, dedicated to DNA research, ran flawlessly. He also outlined his ambitious plans for the future like the installation of NanoRack's own air-lock on the ISS or the utilisation of spent second stages or repurposing in-space launch vehicle components for building space stations, calling it "Space Stations for Everyone". Last but not least, Manber did not forget to flatter the Chinese audience a little bit when he let drop that he considers Chinese universities among his most important customers. It was beyond any shadow of doubt that he is seeking further cooperation with China including commercial activities on the planned Chinese Space Station (CSS) culminating in a scenario of sustainable equal cooperation. "We look forward to growing our relationship with the Beijing Institute of Technology and involving other Chinese universities!" One can trust that he means that.

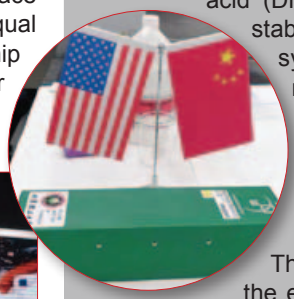

Jeffrey Manber is giving his talk. credit: GoTaikonauts!

### U.S. "Concierge to the Stars" gives China's Research Access to the ISS

The agreement was signed in summer of 2015 and already two years later the Chinese experiment was floating in Earth's orbit, was unpacked and stored on board of the International Space Station ISS.

When the Falcon 9 rocket lifted-off from LC39A at Kennedy Space Center in Florida, U.S.A. on 3 June 2017 at 21:07 UTC (17:07 local time), inside the cargo space craft Dragon CRS-11 were 25 of NanoRacks' commercial payloads, including the NanoRacks Module-70, housing the experiment of the Beijing Institute of Technology (BIT) School of Life Science. All one can do, is to congratulate NanoRacks on this feat of becoming BIT's "FedEx to Outer Space" and conducting the first-ever Chinese experiment on the ISS – confined to the NanoRacks platform on the ISS. Chinese scientists have been contributing to ISS experiments before but this is the premiere of an independently designed and built one.

Back in 2015 it was reported that BIT partnered with NanoRacks for the transport of the 3.5 kg research facility, for on-board data collection and payload return to Florida, paying around 200,000 US$ for the overall service. The figureheads in this initiative were Deng Yulin, Dean of BIT's School of Life Sciences and jack-of-all-trades Jeffrey Manber, CEO of NanoRacks. BIT Professor Zhuang Fengyuan, served the project as adviser, consultant and facilitator – becoming the good soul of the endeavour.

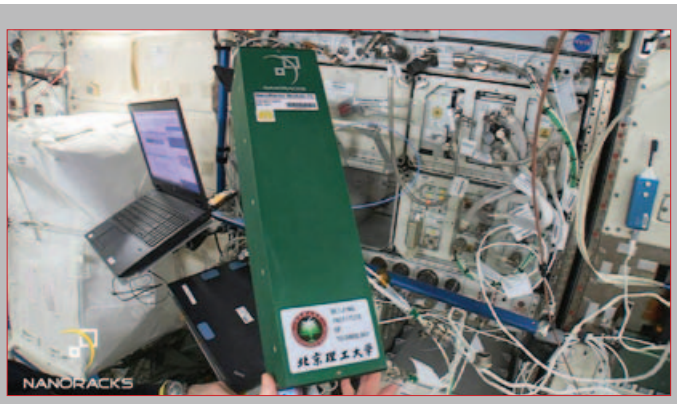


The experiment "DNA Mismatch during a PCR Reaction Exposed to the Space Environment is about studying the effect space radiation has on different types of deoxyribonucleic acid (DNA) – on the rapidly changing and more stable parts - that create the human immune system. By activating the polymerase chain reaction (PCR) the synthetic DNA samples will duplicate. The DNA samples will be returned to Earth and analysed to see whether strand breaks occurred during the replication process.

The research had already been flown on the earlier Chinese Shenzhou 8 space mission in 2011. The scientists detected after return a DNA abnormality but they could not identify whether this was caused by microgravity or radiation. The 2017 flight opportunity to the ISS was hoped to help answer this question.

Knowledge about how radiation might damage different types of DNA is not only useful for astronauts during long-duration missions in space. To understand the different speed of gene mutation gives a profound insight into genetic diseases and respective cures or can even support preventive medicine.


The BIT team preparing the experiment. In the left middle of the back row: Deng Yulin, Dean of BIT's School of Life Sciences and to his right: Professor Zhuang Fengyuan. credit: BIT credit: GoTaikonauts!




NASA astronaut Jack Fischer is holding the BIT DNA experiment – the first-ever Chinese experiment on the International Space Station, launched via NanoRacks. credit: NanoRacks

On 5 June 2017 Dragon berthed with the ISS and NanoRacks Module-70, containing the experiment from Beijing, was stored into the General Laboratory Active Cryogenic ISS Experiment Refrigerator (GLACIER). In the morning of 7 June, the crew took the payload out of the deep-freeze and installed it into the NanoRacks Platform-2 in the Japanese Experiment Module (JEM). Next day, on 8 June, the experiment was stored back into GLACIER where it remained until 19 June. That day, the samples were installed for a second 24-h period into the NanoRacks Platform-2. On 20 June, the NanoRacks Module-70 was put into final storage in the deep-freeze until it was prepared for departure with Dragon CRS-11 on 2 July and splash down in the Pacific Ocean the next day.

"Our mission at NanoRacks is to democratize access to space," said Jeffrey Manber in a NanoRacks press release after the launch. "Professor Yulin and his team have been conducting innovative DNA research for years, regularly publish in Western journals, and have shown a dedication to space exploration. For us, it's not about a political statement, but that we now have another unique international customer — and we're thrilled to be facilitating this access to space. We look forward to growing our relationship with the Beijing Institute of Technology, to working with new partners in China, and to partnering with other educational institutions around the world and at home. Exploring the universe is a global effort, and NanoRacks is proud to be the leading provider of access to low-Earth orbit, making it possible for researchers around the world to access the greatest unknown."

And Deng Yulin told Chinese media: "This is a new model of cooperation that we can follow in the future".

Enrique Pacheco, CEO of the Mexican space company inComSpace – Innovation in Communications and Space - spoke about the situation in his country with respect to space companies and international cooperation. In 2016, when the city of Guadalajara in Western Mexico hosted the International Astronautical Congress, the global world community realised how much the government of Mexico is committed to welcome the space sector in the middle-American country. Enrique Pacheco has been fully involved in the organisation and management of the very successful IAC2016, which deeply impressed the space world. In Wuhan, he confirmed the strong governmental support for space start-ups. Therefore, the current activities for establishing a space port supporting the launch of approx. 200 kg payload has good chances to succeed.

## ALBA ORBITAL

Andrew Paliwoda, Business Development Manager of Alba Orbital in Glasgow, UK, gave an amazing introduction to 'Pocketcubes' - small cubesats that can literally fit in your pocket. To prove the correctness of the title of his talk: "The

### Enrique Pacheco
**CEO inComSpace –**
**Innovation in Communications and Space, Mexico**
**Presentation: Development of SpacePorts Capabilities in Mexico for Commercial Activities**

**What was your objective in attending the 3rd China (International) Commercial Aerospace Forum in Wuhan?**

As one of the few space companies in Mexico, we think it is very important to look for opportunities to participate in the new space economy and this meeting was without any doubt a great opportunity for that. The Asian market and in particular the Chinese participation and achievements on space are the perfect place to explore alternatives to present the Mexican and Latin American space ecosystem and try on that to find synergies to develop new products, systems and services.

**Was it worthwhile for you or your company to attend the conference?**

Both, personally and as a company I think the meeting exceeded my expectations. On the personal side I was lucky to share the floor with many highly appreciated colleagues from the space sector and to make new professional contacts was very important. As a company we were able to use the meeting as an opportunity to develop new strategic alliances for future projects and that has proven to be very important to us!!

**What are your plans for the future with respect to cooperation with China? Do you plan to attend the next year's conference?**

China is an important space leader, we look forward to cooperate and develop a joint effort that helps to achieve a win-win relationship, we are very optimistic and we truly believe that this will be an important path for our customers in Mexico and Latin America. Yes, we are very excited to participate in the next year conference to continue to develop our relationship with China and Asia!!

### Andrew Paliwoda

**Business Development Manager AlbaOrbital, Glasgow, UK**
**presentation: The Future is Small: New Space, Pocket Qubes and the Future of Space**

**What was your objective in attending the 3rd China (International) Commercial Aerospace Forum?**

Our objective was to learn more about what China is doing in the space world. Being a NewSpace company we are constantly looking for innovative solutions to problems, from the trip we made many great connections which will help us to build and launch more PocketQubes. To companies in the West, the Chinese space industry is really unknown.

**Was it worthwhile for you or your company to attend the conference?**

Yes, speaking at the conference was a great experience. Everyone was amazed at how advances in technology are allowing further miniturisation of satellites. It's built further market interest in the PocketQube format which was definitely worthwhile.

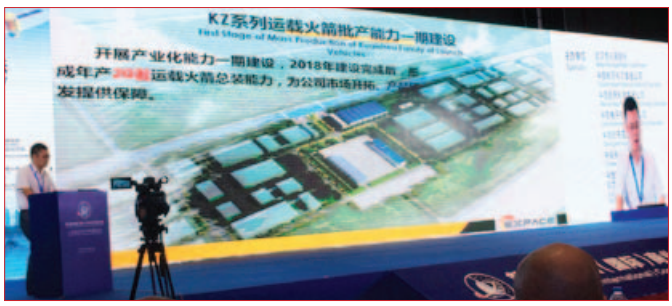
**What are your plans for the future with respect to cooperation with China? Do you or your company plan to attend the next year's conference?**

We will see what the future holds.

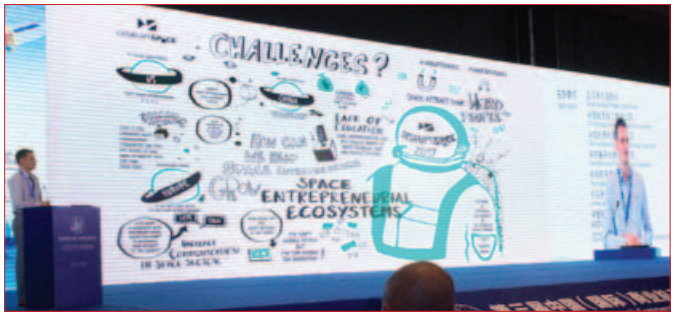
www.albaorbital.com


Andrew Paliwoda during his presentation in Wuhan. credit: GoTaikonauts!


Zha Xiongquan introduces the Expace Technology Corporation. credit: GoTaikonauts!




Zha Xiongquan showed an overview of the Expace buildings for the mass production of the Kuaizhou launcher. credit: GoTaikonauts!




Philippe Cyr could show in his presentation how versatile, flexible and creative the young and dynamic team of Disrupt Space operates. credit: GoTaikonauts!

Andrew Paliwoda is showing his PocketQubes at the Space Tech Expo Europe in October 2017 in Bremen, Germany. credit: GoTaikonauts!

Future is Small: New Space, PocketQubes and the Future of Space", Andrew had this very impressive pocket cubesat innovation from the Scottish start-up company with him and could show hands-on that the young team in Glasgow is indeed working on a future which is small – almost tiny.

## Kuaizhou – faster and cheaper

The 3rd China (International) Commercial Aerospace Forum (CCAF) saw many more Chinese and international presentations which have all been highly interesting. However, the project, the media reported the most about, was the commercial launch services provided by Expace Technology Corporation, a commercial subsidiary of CASIC, and responsible for the Kuaizhou series of launchers. The media attention has been triggered by some brand-new announcements which Zha Xiongquan, the Vice President of Expace Technology Corporation made with his talk "Kuaizhou series commercial launch services".

He spoke about the intention to launch several Kuaizhou 1A rockets in 2018. The solid-fuel rocket carrier would transport each time a remote-sensing satellite into orbit.

Kuaizhou 1A has a liftoff weight of 30 t and a payload capacity of 200 kg into SSO or 300 kg into LEO. It flew for the first time in January 2017, launching 3 satellites from a mobile base at the Jiuquan Satellite Launch Center.

Zha Xiongquan also informed the audience about the new generation, a solid-fueled Kuaizhou 11, the improved version of Kuaizhou 1A, likewise designed and manufactured by CASIC.

### Philippe Cyr
**Disrupt Space, co-founder, Shanghai, China**
**presentation: How Entrepreneurs are building Space Start-ups: Grassroots Perspective**

**What was your objective in attending the 3rd International Commercial Space Forum?**

My work relates to supporting entrepreneurs building space ventures. This emerging community of 'space entrepreneurs' really do come from all over the world so connecting key players from entrepreneurial ecosystems for space in different regions has become a significant part of my job.

Although it is well known that China has made significant achievements in space, I don't think many people know about the increasing amount of Chinese space start-ups that have popped up over the past few years. From my experience, our team first started engaging with Chinese space entrepreneurs in 2015 by organising a hackathon called 'Start-up Weekend Space: Shanghai'. In 2016 and 2017 we worked with a local partner to organize several B2Bs and investor-start-up meetings with Europeans and Americans wanting to connect with Chinese space start-ups. This grassroots community is growing, and growing fast.

I participated in the Wuhan space forum because I saw it as a valuable touchpoint to meet established players in China's space sector. Community building requires engaging with key stakeholders, so these types of touchpoints are quite useful for me to gain a better understanding of what different organisations are working on and to hear their thoughts about entrepreneurial space.

**Was it worthwhile for you or your company to attend the conference?**

The conference was useful because I gained some good contacts and saw how other international participants were pitching various ideas to work with Chinese organisations. Whether these ideas come to fruition is another question, however, it is very insightful to better understand the internationalisation of space projects in more detail. It would have been great if more companies and organisations from outside the space sector were to participate, but I recognise this is a broader problem for the entire space sector.

**What are your plans for the future with respect to cooperation with China? Do you or your company plan to attend the next year's conference?**

We will definitely continue collaborating with community leaders to develop China's entrepreneurial ecosystem for space. In practice this means figuring out what combination of touchpoints - hackathons, meetups, workshops, start-up-investor meetings, etc. - need to be organised. The growth of quality space start-ups over the past few years is incredible and we want to continue supporting this trend. I would certainly consider attending next year's conference as it directly helps us achieve our ecosystem building goals.

www.disruptspace.io

Kuaizhou 11 uses a mobile launch platform allowing for short preparation time and quick-response to launch demand. It has a lift-off mass of 78 t and can carry satellites of 1.5 t into LEO or 1 t into SSO. The first Kuaizhou 11 launch is planned to carry six satellites. While currently the cost per kg payload are in the range of less than 10,000 US$, CASIC aims at a further reduction of the costs with its Kuaizhou series, bringing it down to the range of 5,000 US$ per kg payload. This fact alone almost counts as a sensation!

## DISRUPT SPACE

The last presentation of the forum was given by the young Canadian entrepreneur Philippe Cyr. His company 'Disrupt Space', based in Germany with a branch in Shanghai, is helping start-up companies on their entrepreneurial journey, including Chinese start-up's who in particular face the impression that "China is a black box". Disrupt Space is quite a big name, poised to attract attention. For the moment, Philippe Cyr might pale against the commercial capacities such as Manber, but it was evident that the mindset of people like Paliwoda, Cyr, Manber and the Chinese space experts is similar. Space business needs a long breath. Manber's Mir Corp adventure was surely disruptive but had to give in to unfavourable conditions. What honours Manber is his endurance, creativity and his business accumen – something commercial space, regardless whether it is based in China, Europe or the Americas, needs more than any other sector.

Although meant as an opening remark, CASIC President Gao Hongwei's words sum up in a poetic and sincere way what the Wuhan spirit was about: "Life itself is meaningless; it is the unremitting pursuit and striving spirit of humans that have enriched the connotation and significance of life. As explorers of aerospace technologies and pioneers of commercial aerospace cause, we share a common goal, that is, to exploit a new living space for humans in the outer or even deep-space and expand the range of human civilization through our endless endeavours."

## Brilliant hospitality

Explicit Thanks! and gratitude goes to Professor Yang Yuguang of CASIC. He has been an excellent host, making sure that all the foreign guests felt particularly welcome. He was instrumental in creating a warm, cooperative and open atmosphere. After the experience of Wuhan 2017, one is inclined to make sure not to miss the 2018 edition.

Welcome to the CCAF 2017. credit: GoTaikonauts!


CASIC building in Wuhan, on the other side of the road opposite the conference venue Eurasia Convention International Hotel. credit: GoTaikonauts!

# Commercial Space Takes Off in China

by Chen Lan

## SpaceX's Impact

History turned the first page of China's commercial space endeavours in 1990 when a Long March 3 rocket launched the Asiasat 1 comsat. It was a golden time in the 1990s. However, due to the limitation of technology transfer by the U.S. and a few serious launch failures, China's commercial activities faded from the international launch market around the turn of the new century. Although China recovered commercial launch services later, and started to export satellites by in-orbit delivery, commercial space is still a limited business and the privilege of the state-owned space giants. Government policies did not allow private companies to enter the space area.

In the early 2000's, when SpaceX announced the launch of its own rocket, or in the late 2000's when SpaceX was preparing the Falcon 1 launch and encountering a string of failures, no one in the Chinese space industry took a serious look at Elon Musk. They have a rigid thinking that launch vehicles and spacecraft are very difficult to develop and there is the need of spending a lot of money and time which private companies cannot afford. In contrast, China has a large space sector. It is supported by the central government and has enormous resources, private companies are unable to access. The managers in China's space industry did not think SpaceX would pose a threat to China, even when SpaceX had successfully launched the first Falcon 9 and announced a lower price than Long March.

However, when SpaceX continued to advance, making breakthroughs one by one, people in the Chinese space industry started to change their mind. SpaceX demonstrated that a private company can do much faster and better than the government (or China's state-owned companies) does. The fact is also corroborated in China by the successes of the Chinese IT/Internet companies, especially BAT (Baidu, Alibaba, Tencent). In the beginning, people were impressed and surprised, but then they started to become concerned, and called for a quick reaction, appealing for China's own commercial space. One example is, when in August 2017, the Party Head of CALT (China Academy of Launch Vehicle) gave a lecture, especially on Elon Musk, for new staff. He told Musk's life story, praised the "Musk Spirit" as he described it, and called for young people to learn from Musk. The lecture was in English throughout. "CALT needs Musk" he said.

It seems that the Chinese government and decision makers heard the demand. The government relaxed the industry's access control and allows private companies to be suppliers of the state-owned space companies. In recent years, there are more new policies with greater strength. For example, PPP (Public Private Partnership) and Military Civil Integration. The former allows private capitals to partner with the government on large space projects, while the latter tries to break the barrier of the previously closed military area, allowing technology transfer to civil sectors. There is also a broader framework, called Mixed Ownership Reform, that allows private capitals to enter stated-owned companies and convert the latter into the so-called "mixed ownership companies". All these policies are not only for the space sector but also for other military industrial organisations. But undoubtedly, SpaceX's impact was, and is, a major driving force for changes in Chinese space policy.

The policy does work. Private space appears in China, for the first time in history. State-owned companies are keen to talk about commercial space and repack their product or business to be commercial so as to attract investment. Capitals are also inspired and start to invest into this unfamiliar area. A new commercial space business has taken off in China.

## Major Players

There have been dozens of commercial space companies that have emerged in recent years in China. They can be classified into two categories. One is composed of state-owned companies, either as a spin-off of the two state-owned space giants (CASC and CASIC), or new space companies established by non-space related government institutes and local governments. The other category is formed by private start-ups, founded by former space professionals or space fans. The following paragraphs present an overview of the major players in the Chinese commercial space arena divided into five categories: launch vehicles, remote sensing satellites, communication satellites, satellite platforms and miscellaneous areas.

## Launch Vehicles

### Long March Rocket *

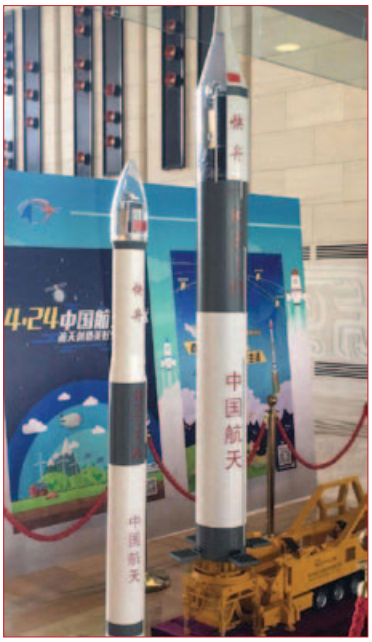
The predecessor of this company is APMT (Asia Pacific Mobile Telecommunication), a company under CASC (China Space Science and Technology Corporation) established in the late 1990s to operate the planned GEO mobile communication satellite. The plan was cancelled due to export restriction by the U.S. government while the company was left and switched to other business. In 2016, the company was renamed to Long March Rocket to carry out commercial space launcher business. The Long March series launch vehicle has a monopoly on the domestic market. It is unknown if all launch vehicles will be run by the company, or only for small launchers. In March 2018, it announced that it will develop a mini solid launcher and will provide suborbital space tourism flight and simulated space experience service.

### Expace (or: CASIC Rocket Technology) *

Expace is a spin-off of CASIC (China Space Science and Industry Corporation). It is focused on commercial launch services using the Kuaizhou (KZ) launch vehicle that is CASIC's first space

*(Please, note that those marked with an * are state-owned companies, or mixed ownership companies whose major shares are state-owned.)*

KZ-1 launch.
credit: Chinese internet




KZ 1 and KZ11 models.
credit: Chinese internet

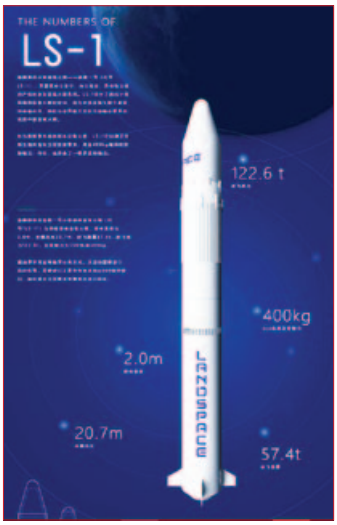
KZ 1 on mobile launcher.
credit: Chinese internet

launcher developed to compete with CASC's CZ-11. CASIC completed two successful launches of its KZ-1 in 2013 and 2014. In January 2017, within one year after Expace was established, the upgraded KZ-1A launcher completed the company's first commercial launch, sending the Jilin 1-03 remote sensing satellite into orbit. KZ-1 and 1A launchers are capable of putting 200 kg into SSO. Expace is expected to launch the larger KZ-11 launcher (1,000 kg SSO) in 2018. It has also planned the much larger KZ-21 (20 t LEO) in future. Expace was established in February 2016 with a registered capital of 500 million RMB. In December 2017, it signed an agreement for a 1.2 billion RMB Series A funding with 8 investors including Shenzhou Capital Group, State Nuclear Power Investment, CICC (China International Capital Corporation), and Zhejiang United Investment Group (ZUIG) among which only ZUIG is a private investment company. It was so far the largest commercial space investment in China.

### LandSpace

LandSpace is a private start-up company developing small launchers. It was established in 2015 by Zhang Changwu, a senior financial professional. He was joined by Dr. Wu Shufan, a senior space engineer, who once worked in ESA-ESTEC involved in the development of the ATV cargo vehicle, and later CTO of Shanghai MicroSatellite Engineering Centre of CAS (China Academy of Science). LandSpace's LS-1 launcher has an SSO capability of 400 kg. It signed a commercial launch


LandSpace CEO Zhang Changwu.
credit: LandSpace



LandSpace-1 rocket specifications.
credit: LandSpace

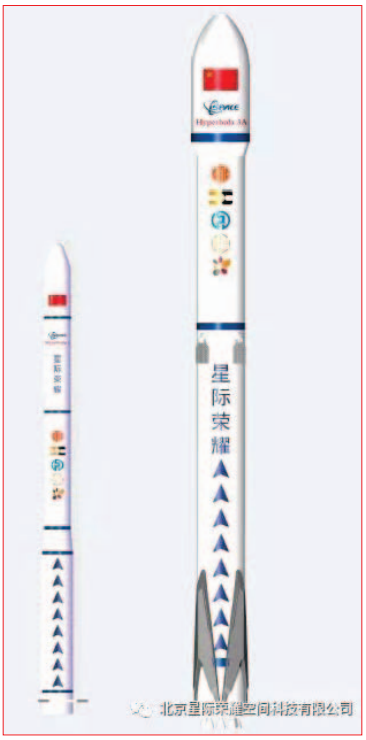
Signature ceremony for the launch agreement between LandSpace and GomSpace of Denmark. credit: LandSpace

agreement with GomSpace of Denmark for a launch in 2018. However, LS-1's solid motor supplier is CASC and LS-1 is almost identical to its CZ-11 small launcher (it is understandable as they use the same motor). They are competitors. In the first half of 2017, CASC ceased execution of its agreement with LandSpace on the grounds of restrictions on sensitive technology. LandSpace then revealed that it is developing a 10-t class LOX/methane engine, indicating that it has switched to a self-developed liquid-powered launcher. In March 2018, the thrust chamber of the new engine made a successful test fire. LandSpace was initially funded by FunDream and multiple individuals followed by Yungpark Capital, Shaanxi High-end Equipment and Technology Investment Fund, etc. with an undisclosed amount of funding.

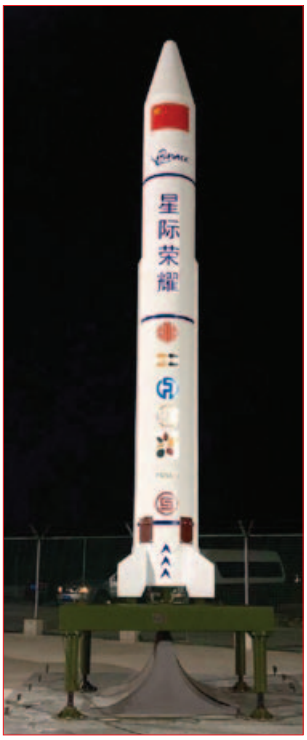
### OneSpace

OneSpace is another private start-up launcher company. Inspired by Elon Musk, it was founded in 2015 by Shu Chang, a graduate of aircraft design and former VP of Lenovo Capital. Its angel fund was from Lenovo Star, Chunxiao Capital and HIT (Harbin Institute of Technology) Robot Group with 10 million RMB. In October 2016, OneSpace announced that it had completed its Series A funding with more than 100 million RMB from Zhengxuan Investment, HIT Robot Group and Chunxiao Capital. In January 2018, it announced the successful completion of a 200+ million RMB Series A+ funding that was led by QHMA (Qianhai Merges and Acquisitions Funds) and co-invested by Zhengxuan Investment, China Merchants Group, Aplus Capital, etc., which marks that its total investment has exceeded 500 million RMB

The OneSpace team with Shu Chang in the middle. credit: OneSpace




Hyperbola 1 (left) and Hyperbola 3 (right).
credit: Space Honour




Hyperbola 1S.
credit: Chinese internet


Launch of Hyperbola 1S. credit: Xinhua

after 4 rounds of funding. OneSpace recruited experienced engineers from existing space companies and universities. On 22 December 2017, it test-fired its solid motor. The company plans to launch its OS-M1 small launcher in mid-2018. The launcher has a 300 kg LEO capability. It is planned to launch the OS-X1 rocket for sub-orbital flights for the first time on 17 May 2018.

### Space Honour

On 5 April 2018, a news surprised the commercial space community in China. It was reported that a company called Space Honour successfully launched a rocket into space that flew over an altitude of 100 km. It was a single stage solid rocket named Hyperbola 1S. The company claimed that the rocket was only launched to verify technologies. They will launch two more rockets in 2019 and 2021. It is also developing liquid-fueled rockets. Space Honour is a low-key company. There is not much information about the background of the company. It is known that its founders and key staff are from CALT, and it got an undisclosed amount of investment at the end of 2017.

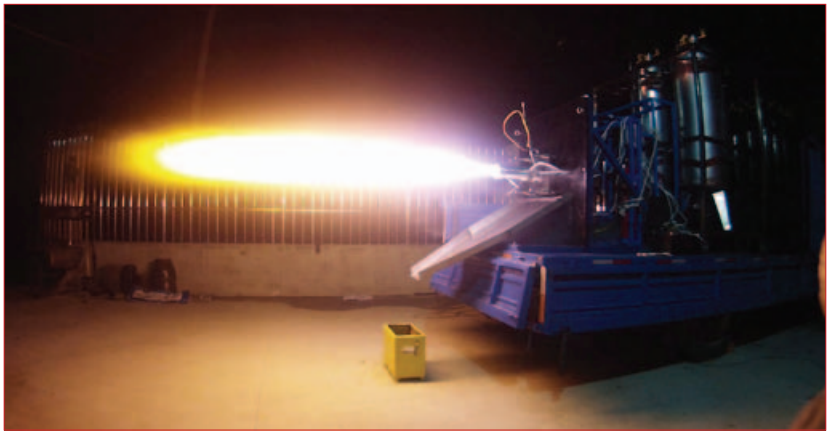

Test fire of OneSpace's solid motor. credit: OneSpace

### LinkSpace

LinkSpace was founded in 2014 by Hu Zhengyu, a then a 21-year-old rocket enthusiast who once led a sounding rocket project in KCSA (a non-government, non-profitable space research community - see part 2 of this article). Since its establishment, LinkSpace has launched 3 sounding rockets and developed a variable-thrust liquid propelled engine and a small VTVL (vertical take-off and vertical landing) rocket that has made more than 200 tethered suspension tests. In January 2018, the VTVL rocket accomplished the first free flight, which was claimed as China's first. In May 2017, LinkSpace launched the one million RMB "Top Challenge", a competition for anyone who programmes the LinkSpace VTVL rocket to complete its first free VTVL flight, and the flight with longest horizontal distance. LinkSpace's long term objective is to build a reusable launch vehicle to launch small satellites. The company has reportedly received 5 million RMB of angel funding from AngleCrunch and support from Chinese business tycoons Feng Lun and Wu Ying. However, Hu is controversial on Chinese media for his hype and recklessness - he once used the dangerous TATP (an explosive chemical) as fuel for his rocket and transported it in public areas without permission. The technology of his company is also questioned.

Free flight test of LinkSpace's VTVL rocket.
credit: LinkSpace

Tethered suspension test of LinkSpace's VTVL. credit: LinkSpace


LinkSpace's engine test fire. credit: LinkSpace

### Dragon Drive

Another controversial company. Its founder, Lu Yulong, was a genius teenager who has filed some inventions and became famous in China's Got Talent (TV Show). In 2012, he founded Dragon Drive and aimed to develop his own small space launch vehicle. On 4 February 2016, he launched his first sounding rocket using a liquid fueled engine. He claimed it was China's first privately funded large liquid fueled rocket. He also launched a rocket project "DAS 02", supported (and funded) by a few mobile game and internet companies. But so far there has been no update on the project. There are no reports on the funding of the company itself, however. Lu's hype and over exaggeration have brought criticism and skepticism as well, in similarity with LinkSpace.

Dragon Drive founder Lu Yulong. credit: Dragon Drive


Dragon Drive sounding rocket. credit: Dragon Drive

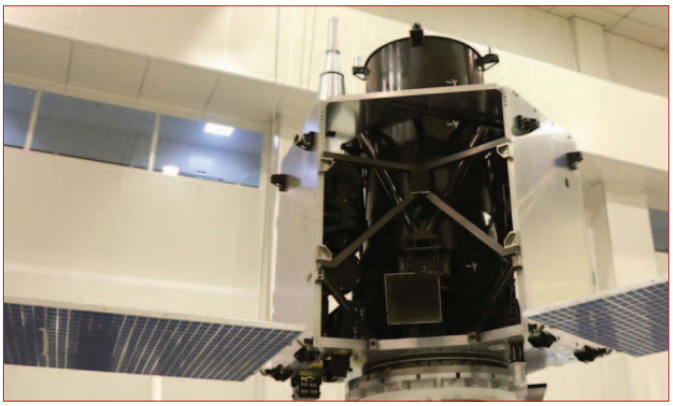

Engine test. credit: Dragon Drive

## Remote Sensing Satellites

### Siwei Gaojing Remote Sensing *

Siwei Gaojing is a state-owned company under CASC. It was established in 2016 to run CASC's commercial remote sensing satellite constellation, or Gaojing (translated as SuperView) constellation. CASC plans to launch more than 24 satellites including 16 optical imaging satellites with 0.5 m resolution, 4 SAR satellites, 4 so-called "high-end" remote sensing satellites and a number of video and hyperspectral imaging satellites. It was claimed as the most powerful commercial imaging satellite system in the world. The first two Gaojing 1 satellites (01 and 02) were launched on 26 December 2016 followed by another two (03 and 04) on 9 January 2018. The constellation is expected to be completed in 2022. Siwei Gaojing has introduced investment from Zhejiang Industrial Fund, a government fund, so that it was registered in Hangzhou, capital of Zhejiang Province, with a registered capital of 1.2 billion RMB.


Gaojing 1 satellite. credit: CASC


Jilin 1 satellite. credit: Chinese internet

### Chang Guang Satellite Technology *

Chang Guang Satellite Technology was established by the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), the Development Fund for Small Enterprise and Private Economy of Jilin Province, and a number of individuals. On 7 October 2015, the company launched the Jilin 1 optical imaging satellite (0.7 m resolution), a smart imaging demonstrator and two video satellites, all were developed by CIOMP. On 9 January 2017, 21 November 2017 and 19 January 2018 respectively, one, three and two more video satellites were launched. It has planned an imaging satellite constellation of 60 satellites by 2020 and 128 satellites by 2030. The company is building a satellite and drone development facility in the "Space Information Industrial Park" of Changchun that was established by the Jilin Province Government with a total investment of 5.4 billion RMB. Once it is completed in 2021, it will have a capability of producing 30 satellites per year.

### Twenty First Century Aerospace Technology *

A private company that launched China's first commercial remote sensing satellite, Beijing 1, in October 2005. Its successor, Beijing 2 (DMC3, consisting of three satellites) was launched on 11 July 2015 by an Indian PSLV rocket. Both satellites were built by UK's SSTL (Surrey Satellite Technology Ltd) with the latter improving the ground resolution from 4 m to 1 m. The company has been for a long time supported and partially owned by the Beijing Municipal Government. Compared to other commercial satellite companies, the company has neither a plan to build a global satellite constellation, nor a high-profile fund-raising plan.

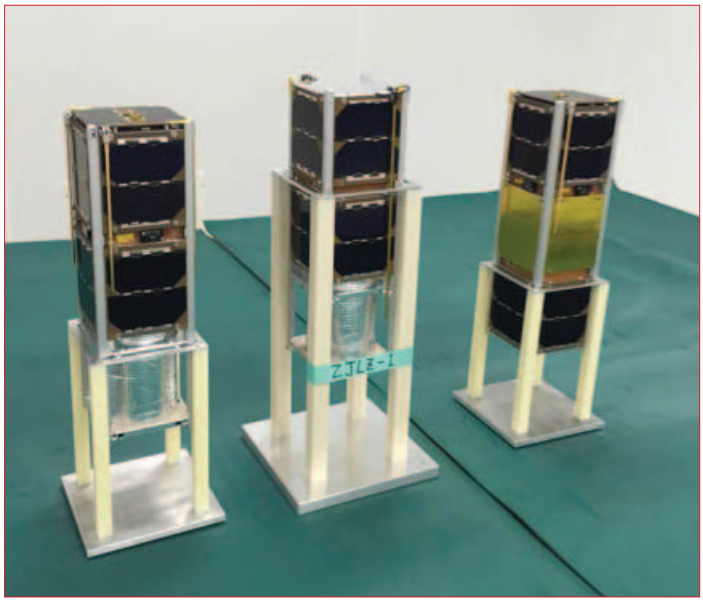
### Orbita

Zhuhai Orbita is a Shenzhen listed private company manufacturing SoC chips, electronics components and IT systems. It plans to establish the Zhuhai 1 remote sensing satellite constellation based on 34 small and micro satellites, which will be followed by a data communication constellation and an Earth electromagnetic monitoring constellation in the future. Its first satellites, Zhuhai 1A and 1B (or OVS 1A and 1B) developed by China Spacesat (Aerospace Dongfanghong Satellite), were launched with the HXMT telescope (Huiyan) on 15 June 2017. Both the 55 kg satellites are equipped with a high-resolution video system. In July 2017, the company changed its name from "Orbita Control Engineering" to "Orbita Aerospace Science and Technology". At the end of 2016, Orbita announced that it will issue a non-public offering of stock for 1.082 billion RMB among which 0.882 billion was to be used for the satellite system.

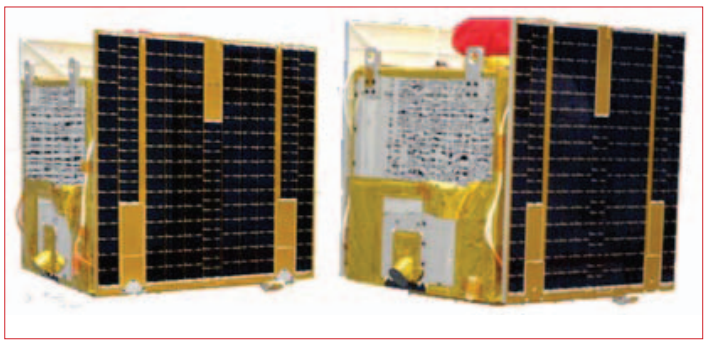
### Liya Electronics

Zhejiang Liya Electronics is a private company established in 2015 by a few individuals. It launched its first small imaging satellite, Lishui 1, on 10 November 2016. It also claims that it will launch a constellation consisting of 80-100 satellites. There is no further information about the satellite and its developer, the founders, funding or the company background. Recent government records show it is under the process of liquidation, indicating that the project may have failed.

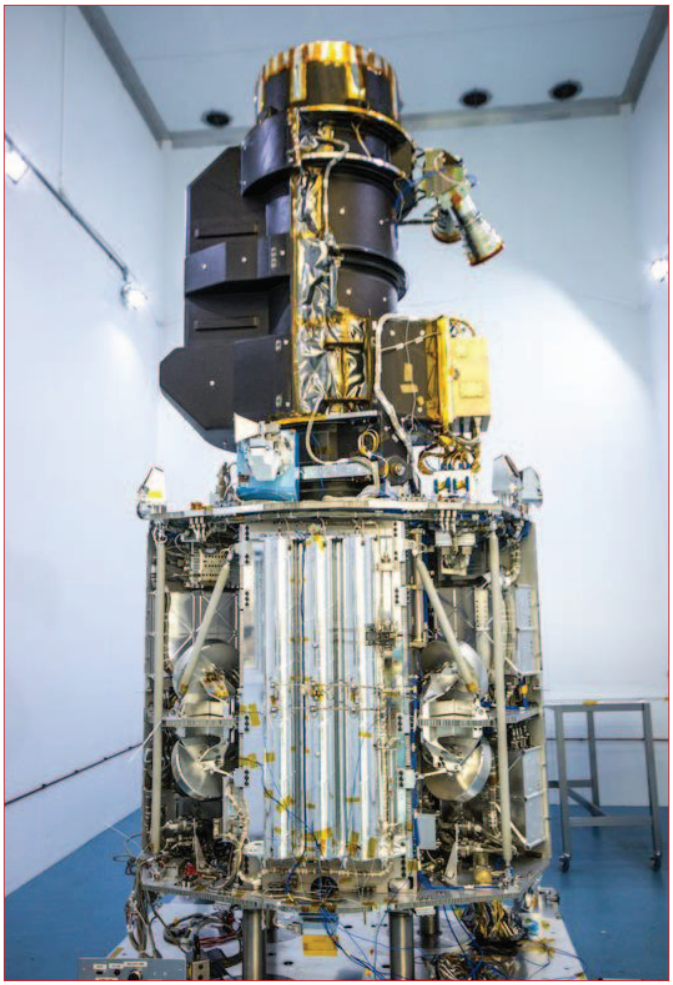
(to be continued in the next issue - no 22)




Lishui satellites by Zhejiang Liya Electronics. credit: Chinese internet



Zhuhai 1A and 1B Zhuhai Orbita. credit: Chinese internet



Beijing 2 satellite. credit: Chinese internet

# My EPIC Experience Watching My First Ever Space Rocket Launch - the Long March 5 - at China's Wenchang Space Satellite Launch Center!

**by Donovan - Don's ESL Adventure https://www.donesladventure.com/**

I caught my first ever rocket launch of the Long March 5 in Wenchang, China, on 2 July 2017, and boy was it a hell of an experience!

First off, I am a big fan of NASA and anything space related. Black holes, UFOs, sci-fi flicks, space tech; these are subjects that I have been very fond of since I was old enough to read books and watch TV.

And nothing would please me more than to catch a live NASA Space Shuttle launch in Cape Canaveral. In fact, this dream currently holds the #1 spot on my list of things to see before I kick the bucket.


Donovan, the author, in front of the space exhibition at Wenchang Space Centre.
credit: Don's ESL Adventure https://www.donesladventure.com

It's just something about watching a Shuttle or rocket blast off into space. It not only embodies the marvellous advances made by mankind and the possibilities to come, but it also evokes a strong sense of achievement and pride in one's country that is unparalleled.

Back in 2015 I made the first 'small step'; I had the opportunity to see a real NASA Space Shuttle - the Endeavor Shuttle - at the Mission 26: The Big Endeavor Exhibit at the California Science Center in Los Angeles.

Observing a real Space Shuttle up close was mind-blowing!

What was the next step? Catching a live rocket launch - the Long March 5 launch - from the Wenchang Satellite Launch Center in China, my home of the past five and a half years.

**Day 1**

Day 1 of my trip to Wenchang started off with a mid-day, 3-hour flight from Shanghai.

After landing at Haikou Meilan International Airport, I hopped on a high-speed train at Meilan Railway Station and arrived at Wenchang Railway Station in less than 20 minutes.

From there I waved down a "taxi" and negotiated a price of 150 RMB to take me to my hotel, which was an hour away.

I checked into the Moonbay Bedom Apartments, a sprawling complex situated up the street from a beach, but surrounded by absolutely nothing else but trees and a highway, just after 23:00 h Day 1 was officially over.

**Day 2**

Day 2 in Wenchang began around 12:30 h. The launch didn't start until 19:30 h so I had plenty of time to sleep in. I woke up starving, so the first thing I did was throw on some clothes and head over to the hotel across the street for lunch.

The menu was riddled with Chinese cuisine that I had eaten a hundred times over but the dishes I ordered managed to taste delicious and fill me up nevertheless.

Next up was a trip to the beautiful beach just outside the hotel. It was blazing hot outside so I'd spend the next hour basking underneath the waves and testing out my GoPro Hero 5 to see if it'd work underwater. Thank God it did!

By 15:00 h I had made my way back to the hotel, took a quick shower, put on my clothes, charged up my camera batteries, and left by 16:00 h for the satellite launch center.

The first thing I did was ask the hotel manager to call a taxi for me but she said there were no taxis around. Womp. She said I should try the bus, but a security guard at the front of the hotel claimed that buses weren't running this day. Womp. I was really out of luck, but I didn't want to give up. Heck, I was willing to hitchhike along the road if I had to!

I made my way outside of my hotel complex when I stumbled upon a group of early 20-something-year-old looking Chinese


The beach site of Wenchang Island.
credit: Don's ESL Adventure https://www.donesladventure.com


Space exhibition.
credit: Don's ESL Adventure https://www.donesladventure.com


The security check before entering the visitor's area.
credit: Don's ESL Adventure https://www.donesladventure.com


Entrance to Wenchang Satellite Launch Center's visitors area.
credit: Don's ESL Adventure https://www.donesladventure.com

guys sitting at the bus stop along the road. First, I asked if any of them spoke English. Two did, though not that good. Check. Next, I asked if they knew if the bus was running. They said it was. Check. Then I told them that I was heading to see the Long March 5 launch. They said they were going there too and I could follow them. H-A-L-L-E-L-U-J-A-H! H-A-L-L-E-L-U-J-A-H! Did you see the bright golden light shine down from above too?

The bus arrived within 10 minutes and we were on our way, all for a measly 10 RMB.

To our surprise, fifteen minutes into the ride we were stopped at a security check that was about 3 km from the entrance of the satellite launch tourist center.


All passengers had to get off the bus, pass through a metal detector, have their luggage screened, and face the presence of 2 dozen or so members of police, the army, and even bomb sniffing dogs all squeezed into a tight area. They weren't playing around!

And then it happened: 15 minutes later we arrived at the Wenchang satellite launch tourist center. I was more than thrilled by the fact that I actually made it, but there was just one problem.

The security at the entrance informed us that we needed tickets to enter, and all the tickets had already been sold out. DAMN!

After some careful "sweet talk" the security had informed us that we could wait around until 18:30 h when more people arrived and he'd see about getting us in. And that's what we did.

Over the next hour and a half, we'd step off to the side, chill out, and make small conversation. We chatted about everything from basketball and popular sports in China to famous Chinese actresses and the Kardashians. You heard me, the Kardashians! They wondered why the family became so popular all across the world. And well...oh brother.

By 18:00 h we made our way back to the entrance and the security told us it was okay to go in to buy tickets. Yes! However, this time around he suddenly mentioned that as a foreigner I wasn't allowed to go too far in to watch the launch. C'mon man!

Before arriving into Wenchang I had already known that China's space programme was very secretive and that foreigners weren't allowed to visit most launch centers scattered around the country, including the Jiuquan and Xichang facilities. Yet, my Chinese friends had done some research and told me that the Wenchang Satellite Launch Center was open to all tourists; well, at least it's viewing area.

Nevertheless, I was committed. One of the guys from the group went in, bought our tickets for 30 RMB a pop, and we made our way to the security check.

"This is it", I thought. They'd probably say turn around and leave as soon as they saw me.

I went first. A guard looked at me with surprise then asked for my ticket. I walked through a detector and within 5 seconds I was still alive and kicking on the other side. THAT was it! I didn't need to show my passport, answer any questions, or anything. We all made it in without a problem.

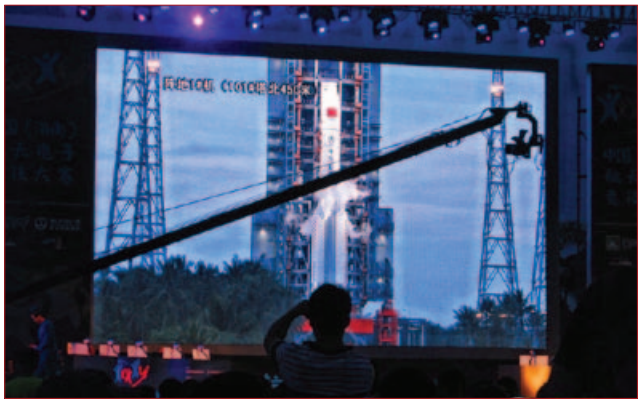
Now I must admit, the satellite launch-viewing center was definitely not what I thought.

Inside there was a massive open space riddled with thousands of chairs, a stage, and a large screen showcasing a live shot of the Long March 5. What the f@#!

I could see the command center and actual launch pad of the rocket but it was in the far distance; I thought it'd be closer.


The area with the video screen for showing the live launch transmission.
credit: Don's ESL Adventure https://www.donesladventure.com


The launch facility.
credit: Don's ESL Adventure https://www.donesladventure.com



The live video transmission on the big viewing screen.
credit: Don's ESL Adventure https://www.donesladventure.com


The CZ-5 short after take-off.
credit: Don's ESL Adventure https://www.donesladventure.com

The guys had found out that there was in fact a closer viewing platform somewhere in the area but those tickets were definitely unattainable at this point. So, we grabbed our seats and took in the sights.

The party began around 18:50 h, where we had the chance to watch a few entertaining musical acts on stage. I wondered if the launch site at Cape Canaveral was this entertaining?

After a while I made my way around the premises and stumbled on a few interesting items, including a mini-museum that housed real artefacts from China's satellites and rocket ships, and a large replica of a rocket ship.

I also made my way over to some booths that sold delicious fruit drinks and pancakes. I couldn't resist grabbing a mouth-watering coconut milk drink, after all, I was in Hainan.

By 19:15 h everyone's eyes were glued to the big screen as an announcer began a countdown initiation.

5...4...3...2...1 and boom! Jets of fire unleashed below the rocket and lit up the screen. Within 5 seconds the whole audience stood on their feet and turned to catch the first live glimpse of the Long March 5 rocket slowly lifting off into the sky.

Everyone in attendance had his or her phone out to record the scene, including me. I used one hand to record video using my Canon camera and the other to take pictures with my GoPro Hero 5.

Within the first minute of the Long March 5 lift-off I had felt extremely elated. I was watching my first ever rocket launch in China, and I could feel the sense of pride and accomplishment spewing from the thousands of locals around me.

What's more, it was the coolest thing in the world to actually see this massive object being propelled into space. I couldn't help but think of all the science, tech, and manpower that went into preparing for such a momentous occasion.

Additionally, one thing I'll never forget was that the first 15 seconds of the launch produced the loudest sound I had ever heard in my life, especially considering how far we were viewing it from. The entire experience was incredible!

Before long the Long March 5 had become a small burst of light miles above us and it had gotten so high that even its smoke trail had almost disappeared.

With that the guys and I agreed that we'd hurry up and leave the premises before the crowds.

Strangely enough, there were no taxis or illegal cab hawkers waiting for visitors outside. In fact, it was a pretty dead scene. That was a first!

Furthermore, the guys couldn't pick up a Didi, aka Uber, and so I convinced them to walk towards a bus station we had passed on the way to the site. They wound up hailing down a taxi but they insisted that the driver take me home first - he'd charge me 100 RMB, which was ridiculous - and then return to pick them up. No kidding, these were some of the nicest people I had ever met!

Just then a motorcycle taxi pulled up and after letting him know where I lived, he offered to give me a ride for a mere 30 RMB. B-O-O-Y-A-H! I said my thanks and goodbyes to the group and made off down the pitch-black highway at 60-70 km an hour for 20 minutes straight on the motorcycle. I feared for my life - quietly!

Watching my first ever space rocket launch in China was an experience of a lifetime, and I was very lucky to have had everything go as smoothly as it did along the way. One day I'll make a journey over to NASA's Cape Canaveral launch site to watch some real American power blast off into the cosmos. And when I do, you better believe that I'll have another story to tell!

Safe and happy travels!


The CZ-5 is speeding up.
credit: Don's ESL Adventure https://www.donesladventure.com


Happy crowd.
credit: Don's ESL Adventure https://www.donesladventure.com

video of the launch:
https://www.donesladventure.com/china-blog-china-attractions-china-things-to-do-live-in-china/my-epic-experience-watching-my-first-ever-space-rocket-launch-the-long-march-5-at-chinas-wen-chang-space-satellite-launch-center