All About The Chinese Space Programme

Go TAIKONAUTS!

龙腾太空

Issue 26 | September 2019

The Intercontinental Wuhan Expo - the venue of the 2018 edition of the China (International) Commercial Aerospace Forum - 4th CCAF. credit: GoTaikonauts!

Content

Chinese Space Quarterly Report
October - December 2018
by Jacqueline Myrrhe, Chen Lan

SPACE TRANSPORTATION

CZ-5
CCTV reported in October that the 3rd CZ-5 rocket was undergoing final assembly at the Tianjin facility.

CZ-5B
The CZ-5B prototype underwent multiple verifications and tests. After a technical review on 29 November, engineers of China Aerospace Science and Technology Corporation (CASC) and China Academy of Launch Vehicle Technology (CALT), approved the start of the construction of the flight model. The CZ-5B's payload capacity of up to 20 t is needed for launching the CSS modules.

Reusable CZ-6X
During the 20th China International Industrial Fair in Shanghai, a model of the Long March-6X derived from the standard CZ-6 but with reusable features has been exhibited. The reusable CZ-6X is under development at the Shanghai Academy of Spaceflight Technology (SAST). By landing the first stage after use, the launch costs could be reduced by 30 %. The first flight is planned for 2021.

Reusability
Several tests regarding launcher reusability have taken place in the last quarter of 2018. CNSA (China National Space Administration) said that the development of reusable rocket stages and boosters is rather driven by 'safety' concerns than cost considerations.

top: Yuanwang 7 departs on 26 November for its maritime space monitoring and communication missions. Credit: Chinanews.com

left: The Aerospace Intelligent Technology Innovation Centre and the National Key Laboratory of Aerospace Intelligent Control Technology successfully carried out the verification test of the vertical recovery guidance and control technology for a future launch vehicle.

Credit: National Key Laboratory of Intelligent Control Technology

- In September CASC tested the use of a parafoil on the payload fairing to better control the return trajectory and consequently prevent debris landing in inhabited areas but also for eventual reuse of the fairing.
- The test of data recording and tracking devices attached to the boosters of the Long March 3B, launched on 15 October, delivered data of the altitude and flight time of the spent rocket stage, useful for future parachute landings.
- On 29 October, the Space Technology Innovation Centre of the Aerospace Institute of Automatic Control in Beijing (12th Institute of CALT) tested the navigation and control system for a later reusable vertical take-off and landing and operation system. The project team, working since less than a year, made trajectory calculations and demonstrated booster recovery.

Yuanwang 3
After return from its previous mission on 7 August, Yuanwang 3 (YW) was maintained and prepared for its next deployment which started on 2 October when YW-3 departed from its Yangtze River home port in Jiangyin in Jiangsu Province to the Pacific Ocean for a space monitoring and communication mission in support of the Beidou 3 launch and other missions.

Yuanwang 7
After its Beidou support mission in mid-August, Yuanwang 7 continued its first space tracking mission in the Indian Ocean by supporting the launch of Yaogan 32-01 and -02 on 9 October. 10 min after take-off at 10:43 h from Jiuquan, the tracking ship received the satellites telemetry and carried out data processing, status monitoring and data transmission.

YW-7 departed on 26 November from Jiangyin for its 3rd maritime space monitoring and communication mission in 2018. Positioned in the Pacific Ocean, YW-7 supported the launches of the Chang'e 4 lunar mission and a Saudi-Arabian satellite on 7 December.

About the importance of bolts and screws for high-tech space endeavours

When it comes to rocket science, nuts and bolts may appear to some people to be the least-complicated parts. Wang Huiping would argue otherwise. In the run-up to the 9th flight of the Long March 2F carrier rocket with three taikonauts in 2012, engineers raised concern that there were no standards for technicians to follow when mounting bolts and screws, which could affect the quality and safety of the rocket. Wang, the rocket's Chief Structural Designer, and her colleagues were tasked with setting those standards.

The report also tells the story of the earlier Shenzhou 3 mission. During a routine examination before launch technicians found there was something wrong with one small electronic component. They did a thorough inspection of all 77 similar components and concluded that all needed replacement. Over the next three months, engineers replaced all the defective parts and re-examined the spacecraft, making sure that it was 100 percent reliable. Shenzhou 3 launched successfully in March 2002.

MANNED SPACE FLIGHT

Tiangong 2
At a science conference mid-December in Beijing the outcomes of the Tiangong 2 (TG-2) operations were presented. Since its launch on 15 September 2016, the TG-2 instruments gathered about 37 trillion bytes (37 TB) of Earth observation data, used in 61 institutes for 76 projects, including 15 national departments, 14 scientific research institutes and 32 universities. These projects cover multiple areas: resources, atmosphere, lakes, agriculture and marine meteorological support.

CSS

A 37-person expert technical committee, led by Chinese Space Station (CSS) Chief Engineer Zhou Jianping, has been established to define until 2020 national standards, as well as military standards, for research and development of manned space technology, its applications and related services on the CSS.

Next Generation Spacecraft

- **Landing Technology Development**

In November, engineers of the Beijing Institute of Space Mechanics and Electronics (BISME - 508th Institute of CAST) used a helicopter for a drop test of the combined two-group parachute and airbag landing system of a model of the 7 t re-entry section of the next generation space capsule. The new, large multiple parachute system is combined with an airbag system to increase the recovery capacity from 3.5 t to 7 t and to achieve the reusability of the parachutes. The multiple parachute system includes two smaller deceleration parachutes for reducing speed in the early stage of re-entry and three main parachutes for the landing phase. (So far, the Shenzhou capsule landing relied on a single parachute.) The design of the main parachutes was optimised with respect to folding, stretching and inflating to ensure the synchronisation of deployment.

The airbag system includes multiple bags. Breakthroughs were made in the structure design and the active exhaust control technologies to keep the spacecraft's stability during landing. The phase for the airbag deployment is very short, requiring the use of the most sensitive detectors to get a quick and controlled response. The airbag system could also be reused.

This progress in recovery technologies could be applied for rocket recovery and heavy equipment airdrop, and is important for the realisation of manned lunar missions and paves the way for recovering loads of 15 tons.

The first test flight is scheduled for 2019, to demonstrate the new aerodynamics, avionics, separation mechanism, heat shield, parachutes, re-usability and recovery operations.

Reusability technologies will also be applied to the Tianzhou cargo spacecraft and free-flyer retrievable satellite.

LUNAR AND DEEP-SPACE EXPLORATION

Mars - 2020 mission

During the 69th IAC at the beginning of October in Bremen, Li Ming, Vice President of the China Academy of Space Technology (CAST) confirmed that China's Mars mission is on track for launch in 2020. The Beijing Institute of Space Mechanics and Electronics (BISME) was carrying out drop tower campaigns for landing tests, using innovative high-precision autonomous obstacle-avoidance landing technology.

Terraforming Mars

In an effort to control desertification in Dalad Banner in the Inner Mongolia Autonomous Region, researchers from the Institute of Hydrobiology of the Chinese Academy of Sciences (CAS) in Wuhan successfully used an algae species able to convert desert sand into soil suitable for vegetation. The team has used these algae in microgravity research during the Shenzhou 8 mission, investigating whether they are suitable for life support systems or could play a role in terraforming Mars.

Moon

International Cooperation

On 1 October, during the 69th IAC, Zhang Kejian, Director of CNSA, announced that the Chang'e 6 mission will have 10 kg of payload available for international partners. Zhang also reaffirmed that the Chang'e 4 mission will launch in December 2018.

Chang'e 4

According to CAST, preparations for the launch of the Chang'e 4 (CE-4) mission were progressing at Xichang Satellite Launch Centre in October. Teams were performing pre-launch tests and verifications on the CE-4 lander and rover.

7 December (8 December BJT)

The launch placed CE-4 directly into a 200 km x 420,000 km Earth-Moon transfer orbit. *also, see section:* ***LAUNCHES***

8 December

The 1st orbital correction manoeuvre was planned for 8 December at 19:42 BJT (11:42 UTC). Because of highly accurate trajectory injection after launch it was cancelled.

9 December

The 2nd orbital manoeuvre, a deceleration, took place as planned in the vicinity of the Moon on 9 December at 16:42 BJT (8:42 UTC). The status of the probe was checked and communication was tested.

11 December

The 3rd manoeuvre was planned for about 24 hours before entering lunar orbit, on 11 December, 16:42 BJT (8:42 UTC). It could be cancelled because the trajectory after the 9 December manoeuvre was accurate enough.
The cancelled manoeuvres saved fuel, available for the landing phase or later operations.

12 December

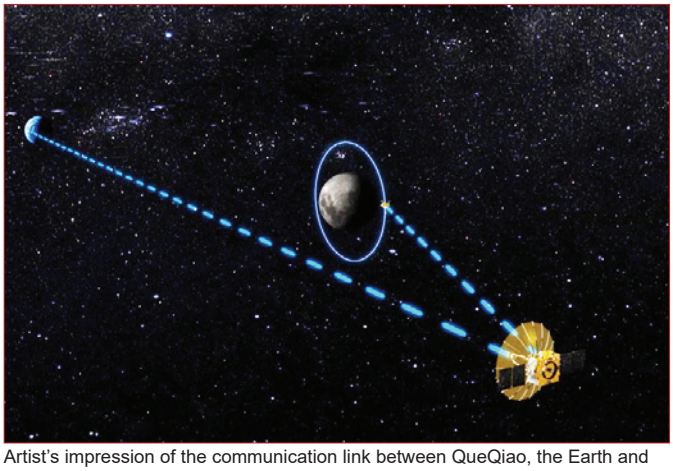
On 12 December, after 110 hours of flight and upon command from the flight controllers in the Beijing Aerospace Command and Control Centre (BACC), CE-4 fired its main engine at 16:39 BJT. CE-4 was 129 km above the lunar surface. The probe slowed down and entered at 16:45 BJT (8:45 UTC) an elliptical lunar orbit with a perilune of 100 km and an apolune of 400 km. From this orbit, CE-4 monitored the planned landing area and conducted communication tests with Queqiao.

19 December

Up to the 19 December, mission control tested several times the communication link between the probe and the Queqiao relay satellite. Engineers also checked the imaging instruments and ranging detectors to ready them for the later landing.

30 December

On 30 December, CAST confirmed that CE-4 was prepared for landing by entering an elliptical lunar orbit with a perilune of 15 km and an apolune of 100 km above the lunar surface at 8:55 BJT. No exact landing date was revealed but was expected in early January.



Artist's impression of the communication link between QueQiao, the Earth and the Far Side of the Moon. Credit: CGTN

SCIENCE

SKA - Square Kilometre Array

The Shanghai Municipality will support the building of a Chinese SKA data centre, part of a global network of computing centres which will store and provide access to SKA science data products for astronomers around the world.

Rocket fairing integration for the CE-4 lunar probe. Credit: CGTN

The Moon's Far Side and China's Space Strategy

By 2019, China will become the first nation on Earth to have sent a lunar probe to the Far Side of the Moon. With Chang'e 4, China has yet again proven that it is serious about its deadlines set for its ambitions in space. The aim to land on the Far Side of the Moon was articulated by China's space agencies years ago, and 2018 was set as the year when they would launch. And here we are, in 2018, with another Chinese space mission goal achieved as per the deadline set.

FAST Five-hundred-meter Aperture Spherical Radio Telescope

In preparation of FAST's formal operation in 2019, the provincial natural resources department will conduct 4 times per year remote sensing checks in the radio-quiet zone (30 km radius around the telescope), to ensure the operation of FAST will not be affected by electromagnetic interference. Radio stations, communication facilities and high voltage substations in 15 towns in 3 Guizhou counties and 2 counties of neighbouring Guangxi Zhuang Autonomous Region will be monitored.

Wukong

The Dark Matter Particle Explorer science satellite "Wukong" reached the end of its expected 3-year life on 17 December. It had orbited the Earth 16,597 times while detecting around 5.5 billion cosmic particles. The satellite's original objectives have been completed with some results exceeding expectations. Since Wukong's performance was still nominal, its operation was extended by two years.

SMILE

Between 10-12 October, Chinese and ESA scientists reviewed the mission requirements, the systems and the progress of the joint China-ESA SMILE mission at ESA-ESTEC in Noordwijk, The Netherlands. They also decided that the SMILE spacecraft will be launched in 2021 on Arianespace's Vega-C rocket.

Tianqin Project

The Tianqin satellite project for the detection of gravitational waves in space, planned to consist of 3 satellites, has made breakthroughs in key technologies, such as inertial sensing, laser interferometry, drag-free control systems and satellite platforms. The detection of gravitational waves will be based on high-precision laser interferometry technology to measure the changes of the distances and locations of the 3 satellites. The intention is to detect gravitational waves at lower frequencies than the LIGO (Laser Interferometer Gravitational-Wave Observatory) project.

The first test satellite is planned for the end of 2019. The detector satellite could be in space by 2030. The 4-phase Tianqin Project was started in 2015 with a financial envelope of 15 billion RMB (2.3 billion USD). Scientists from Germany, Italy and Russia have expressed interest for cooperation.

University of Hong Kong – science investment

The University of Hong Kong (HKU) has made available a budget of 10 million HKDollar (1.28 million USD) to build a new space research laboratory at the University of Hong Kong Zhejiang Institute of Research and Innovation (HKU-ZIRI) near Hangzhou in Zhejiang Province. This strategic investment will include astronomy and planetary sciences and space-related activities into the HKU expertise.

The Earth and Moon imaged by a Saudi-Arabian camera on the Chinese Longjiang-2/DSLWP-B microsatellite, a part of the Chang'e 4 mission. credit: Harbin Institute of Technology

Chang'e 4 lunar lander is a small step towards a great leap

In a 10 min interview with CBC Radio, space author and writer Brian Harvey explains China's lunar ambitions. He gives a comprehensive overview on the nation's motivations, its long-term approach to lunar exploration and points out what the importance of Chang'e 4 landing on the Far Side of the Moon is. Finally, he gives the reasons why China can become a - or even: the - leading space power by 2050.

Lobster-Eye X-ray Telescope

HKU is also working with the Nanjing University, BISME of CAST, and two private space companies on a 50 million RMB (7.28 million USD) microsatellite planned for launch in 2019. The HKU-1 microsatellite will host a 50 kg X-ray telescope, built and tested by CASC in Beijing. It is equipped with a detector that looks like the eye of a lobster mimicking its wide-angle sight vision and was therefore called the "lobster-eye X-ray telescope".

The satellite will look for dark matter, study hot gas in galaxy clusters, investigate comets in the solar system and explore the interaction of the solar wind with the Earth's magnetosphere.

Lobster-eye instruments to detect X-rays in space are in use elsewhere, but none has yet been sent into space. China started with the development in 2013 and accomplished the core technology in 2015. The lobster eye has a reflective structure above a convex retina. Most complex eyes use refractive ray concentrators, or lenses, and a concave retina. In 2016, HKU and other organisations joined in a bid to apply the technology for space astronomy.

SATELLITES

Fengyun (FY)

After a 4 month in-orbit testing phase and nominal performance, the FY-2H was declared operational on 22 October.

In July, FY-2H was moved to its final position at 79°E over the Equator to better serve the "Belt-and-Road" countries.

On 30 November, FY-2H and FY-3D satellites have been officially delivered to the China Meteorological Administration (CMA), responsible for the satellites' operation. As the 4th of the 2nd generation polar-orbiting meteorological satellites it will conduct network observation with FY-3C. A global data acquisition network composed of 4 ground stations in China and 2 polar stations can realise a 2-hour complete global sounding data acquisition.

On 5 November, during the 9th China International Aviation and Aerospace Forum, Laos, Myanmar, Iran, Maldives, Thailand, Philippines, Algeria, Uzbekistan, Tunisia and Mongolia have become users of the "Emergency Support Mechanism for International Users of Fengyun Meteorological Satellites in Disaster Prevention and Mitigation".

Fengyun Users
On 12 November, the 5th Session of the International Strategic Consultative Committee on Chinese Meteorological Satellite Programmes and the 1st Fengyun Satellite Users' Conference were held in Chengdu. National and international experts discussed the development of FY satellites in the next 10 years, and exchanged views on how to improve and extend the satellite data application capabilities.

Fengyun and APSCO
From 14-16 November, the APSCO (Asia-Pacific Space Cooperation Organisation) 10th Anniversary High Level Forum under the theme "Community of Shared Future through Space Cooperation" was held in Beijing. CNSA, CMA, and APSCO signed a FY meteorological satellite cooperation agreement, which will optimise the configuration of the FY series satellite constellation, and enable data resources and services of FY satellites to benefit APSCO and its Member States.

China Industrial Award
On 9 December, the Fengyun series of meteorological satellites developed by the Shanghai Aerospace Technology Research Institute was awarded the China Industrial Award, the highest award in the Chinese industry.

Recoverable Satellites
The first of CAST's new-generation retrievable satellite was undergoing testing, integration and assembly. The 3,5 t satellite can be reused up to 15 times. It can be configured for battery-powered short-term and solar panel-powered long-term flights. The payload capacity is 500 to 600 kg. China may start offering the satellites to commercial users from next year on.

CFOSat - China-France Oceanography Satellite
One month after launch, still in the test phase, CFOSat has collected and transmitted its first batch of marine environmental data. The data showed the distribution, location, intensity and movement of cyclones and typhoons.

Tianhe Project
The Shanghai Academy of Spaceflight Technology (SAST) is developing 6 satellites for the Tianhe network to monitor the dynamic of atmospheric water vapour. In the Sanjiangyuan (means: origin of three rivers) area on the Tibetan Plateau in the north-western Qinghai Province, 3 big Asian rivers spring: the Yellow River, Yantze and Mekong. Scientists found that over that region at the border between the upper layers of the atmosphere and troposphere is a passage way of water vapour from the western Indian Ocean, eastern Indian Ocean, Yunnan-Guizhou Plateau and Central Asia. This passage is called "Tianhe - River in the Sky". The Tianhe satellite constellation with an hourly revisiting time over Sanjiangyuan is expected to provide vertical information of the water dynamics there. The first two satellites, based on the SAST-ML1 platform, will be launched into LEO in 2020. They are equipped with a microwave temperature meter and microwave hygrometer for the detection of the vertical distribution of atmospheric temperature and humidity, determining the distribution of water vapour in the air. The precipitation measurement radar can monitor the 3D distribution of precipitation. The water vapour detector maps the atmospheric clouds and detects the surface environmental characteristics of the Sanjiangyuan area. Combined with data from a ground system it is hoped that abundant atmospheric water resources could be directed to regions in need of water. The full constellation is planned for completion in 2022. The model of the Tianhe 1 satellite was on display at the 12th China International Aviation and Aerospace Exhibition Zhuhai in November.

HONGYAN satellite constellation
On 30 November, the launching ceremony of the Global Low-Orbit Satellite Mobile Communication and Space Internet Project and the founding ceremony of Dongfanghong Satellite Mobile Communications Co., Ltd. were held in Chongqing. The "Space 5G" and "Hongyan Constellation" headquarters was settled in Chongqing Liangjiang New District. It will be complemented by an operations centre, a talent training base, and a supporting industrial park, investing 20 billion RMB in the first phase.

Dongfanghong Satellite Mobile Communication Co., Ltd. was jointly established by Aerospace Science and Technology Group, China Telecom, China Electronics, Guoxinguo and related enterprises with a registered capital of 2 billion RMB. Dongfanghong Satellite Mobile Communication Co., Ltd. will be responsible for the construction and operation of the global low-orbit satellite mobile communication and space internet system, providing various terminal products and services, and constructing a new integrated world-wide information network integrating sea, land, air and space. These value-added services include smart terminal communication, Internet of Things, mobile broadcasting, navigation enhancement, aviation navigation monitoring, and broadband internet access.

NAVIGATION – BDS-Beidou

Beidou - Achievements
At a press conference of the State Council Information Office on 27 December, the Director of the China Satellite Navigation Office, Ran Chengqi, said the construction of the primary Beidou Navigation Satellite System-3 (BDS) had been completed. Beidou is expanding from a regional to a global navigation system, the 4th one in the world after GPS, GLOSNASS and Galileo. By the end of 2018, in total 33 BDS satellites are operational, including 15 BDS-2 satellites and 18 BDS-3 satellites. The BDS-3 technologies have been greatly improved: communication, data transmission, and ranging among satellites is done via inter-satellite links. BDS-3 sats are equipped with high-precision rubidium und hydrogen atomic clocks, developed in China. The service availability is better than 95 %, the positioning accuracy has reached 10 m globally and 5 m in the Asia-Pacific region. Its velocity accuracy is 0.2 m/sec, while its timing accuracy stands at 20 nanosec. For the complete global network 11 BDS-3 and 1 more BDS-2 satellites are planned within the next 2 years.

Over the last 5 years, about 6.17 million vehicles, 35,600 postal and express delivery vehicles, as well as 80,000 buses in 36 major cities, have been installed or become compatible with BDS. Beidou is also used in 3,230 inland river navigation facilities and 2,960 marine navigation facilities.

The indigenous developed Beidou chips are now in the range of the 28 nanometre-category. China's satellite navigation patent applications totals 54,000. After completion of the full Beidou 3 system in 2020, the scale of China's satellite navigation industry will exceed 400 billion RMB. The wide application of the Beidou system is estimated to employ more than 500,000 people.

Beidou – UN-ICG
The 13th Meeting of the United Nations International Committee of the Global Navigation Satellite Systems (UN ICG) took place from 5-9 November in Xi'an, Shaanxi. President Xi sent a congratulatory letter, stressing that China is willing to share the BDS achievement with the world and to jointly promote the development of the global satellite navigation industry. 400 representatives from 16 countries and regions, as well as 16 international organisations, exchanges their views on 20 topics of global navigation satellite system (GNSS) development.

In a statement the delegates call for the joint development of global navigation satellite systems, the enhancement of system compatibility, inter-operability, technology innovation, service transparency as well as cooperation and exchange. Providers should aim for coverage on land, sea, air and space, and for high-

precision, safe and reliable performance; to combine satellite navigation solutions with other PNT (Positioning, Navigation and Timing) technologies; to build a comprehensive PNT architecture to fully meet future user PNT service requirements. After the ICG-7 Meeting in 2012, China was hosting the event for a 2nd time.

Beidou-Cooperation with Russia

The 5th Meeting of the China-Russia Commission on Important Strategic Cooperation in the Field of Satellite Navigation took place on 28 September in Beijing under the lead of Wang Zhaoyao, Co-Chairman of the Commission as well as Chairman of the China Satellite Navigation Committee, and Dmitry Rogozin, Co-Chairman of the Commission and Director General of Roscosmos. The 50 delegates reached consensus on an agreement text for cooperation between China and Russia in the field of satellite navigation. The commission discussed reports from 4 working groups and acknowledged the progress of collaboration on site construction, service platform monitoring and assessment, cross-border transportation application and other 6 important cooperation projects. The Commission also deliberated and confirmed a cooperation demonstration project of BDS/GLONASS precision agriculture, and agreed to put it on the Cooperation Project List of The Commission as the 10th project. It was also decided to hold the China-Russia Satellite Navigation Cooperation Forum in May 2019 in Shanghai.

The China-Russia Commission on Important Strategic Cooperation in the Field of Satellite Navigation was formed in 2015 within the framework of the Committee for the Regular Meeting of the Chinese and Russian Prime Ministers.

Agreement on China-Russia Intergovernmental Cooperation on Satellite Navigation

The 23rd Regular Meeting of the Chinese and Russian Prime Ministers was held at the Great Hall of the People on 7 November in Beijing. Witnessed by Li Keqiang, Prime Minister of China and Dmitri Anatolyevich Medvedev, Premier of the Russian Federation, Wang Zhaoyao, Chairman of the China Satellite Navigation Committee, and Dmitry Rogozin, Director General of Roscosmos, signed the “Agreement between the Government of the Russian Federation and the Government of the People’s Republic of China on cooperation in the peaceful use of the GLONASS Global Navigation Satellite System and the Beidou Navigation Satellite System”. The document provides a legal and organisational frame for the cooperation in satellite navigation, comprising a series of investment projects in energy, oil, gas, oil refining, high technologies, including manned space exploration, satellite navigation systems, innovative materials, and IT, including artificial intelligence.

Also signed was the “Agreement between the Roscosmos State Space Corporation and the China National Space Administration on cooperation in monitoring space debris and the use of collected data”.

Beidou + Hongyan = Kuilong Programme

CGWIC initiated the Kuilong programme, an integrated satellite data application, where BDS and data from the 60-satellite LEO constellation Hongyan (HY) are combined. This will allow users as of 2022, to determine their exact position within 10 cm precision and within less than 3 min, regardless of their location. Once the full 300 satellite constellation is operational, the response time will decrease to 1 min.

The Kuilong system involves a sophisticated chain of electronic transactions from ground to space. BDS will obtain basic positioning data and then transmit it to ground control, which will use algorithms to improve accuracy before sending the information to the HY constellation. HY satellites with augmentation devices, will further process the positioning data and deliver it to end users around the globe. The first Hongyan satellite was launched on 29 December. (*see section:* ***LAUNCHES***)

ADVANCED TECHNOLOGY

Space-Based Solar Power

Chongqing University, CAST and the Xidian University signed on 6 December a cooperation agreement with the Bishan District government of Chongqing Municipality in China’s Southwest. The project aims at collecting solar power in space and transmitting it back to Earth. The first experimental research facility will be built within the next two years and will be located on a 13.3 hectare site in Bishan District. The budget for this first phase is 200 million RMB (29 million USD). The research centre will test microwave power transmission technologies, investigate the effects of the microwave beams on plants and animals. Four to six tethered balloons will be used to carry solar panels to an initial height of 1,000 m and then beam the energy back to the ground. So far, energy transmission via a distance of 100 m has been achieved. In a next step, balloons will be deployed in near space. The construction of a small- to medium-sized power station with solar arrays positioned in the stratosphere is planned between 2021 and 2025.

After that, a megawatt power station orbiting in GEO would be tested. Construction is scheduled to begin in 2030 with start of operation before 2040. The station would be positioned in a way that it can provide energy 99 percent of the operational time.

Finally, a gigawatt commercial space-based solar power station would be launched by 2050, supplying energy to Earth but also beaming it to deep-space exploration spacecraft.

SAR Technology

A synthetic aperture radar (SAR) remote sensing experiment site of 46,000 m^2 was unveiled in Zhangjiakou, Hebei Province. The site, jointly operated by CAS and the municipality of Zhangjiakou, has a comprehensive remote sensing experiment centre and a remote sensing information centre. It is a platform to conduct remote sensing technology research and identify innovative applications.

Quantum Communication

A 609 km long Wuhan-Hefei extension of China’s already existing quantum communication landline between Beijing-Jinan-Hefei-Shanghai (operational since 2017) was put into service on 13 November during the 3rd Optics Valley Aerospace Laser and Quantum Technology International Forum hosted by China Aerospace Science and Industry Corporation (CASIC), the network’s major builder. China’s quantum communication network can be used for civil communications, financial and energy purposes and other government and military purposes.

Laser Technology

The 1st International Conference on Space Laser Technology and Applications was held on 26/27 November in Beijing. More than 200 scientists, engineers and project managers from 8 countries and regions including China, the US, Canada, Japan, the UK, and the Netherlands attended the event, hosted by the Aerospace Science and Technology Group Beijing Telemetry Technology Research Institute and focused on space laser remote sensing and space laser communication.

Fancy Technology

On 10 October media reported that the town of Chengdu intends to launch an “artificial Moon” in 2020. Wu Chunfeng, the Chairman of Chengdu Aerospace Science and Technology Microelectronics System Research Institute Co., Ltd., explained during a public event that the satellite is supposed to complement the street lights in a controllable radius of 10 - 80 km.

COMMERCIAL SPACE

Investment

In its Space Investment Quarterly for the 3rd quarter of 2018, New York-based angel investment and venture capital firm Space Angels reported that Chinese private space companies could attract in the reporting period 69 million USD and accumulative 217 million USD up to September 2018. Although only 3 % of the historical worldwide investment in commercial space since 2009 has gone to Chinese companies, it is not little considering that investment in commercial space in China is only possible since 2016. Overall, the US has seen 60 % of the 16.1 billion USD in investments in commercial space since 2009.

Commercial Launchers

Chinarocket

Chinarocket Co., Ltd., a commercial spin-off of CASC, revealed that the Jielong (Smart Dragon) No. 1 will make its first commercial mission in the first half of 2019. Within two-three years, the rockets will be upgraded for reusability.

Chinarocket is developing two types of rockets for commercial purposes: the solid-fuel Jielong series and the Tenglong series propelled by liquid fuel and for larger payloads.

Jiuzhou Yunjian

Jiuzhou Yunjian Space Technology Co., Ltd., tested a combustion chamber for its "Lingyun" 10 t thrust methalox engine in December.

Landspace

On 27 October LandSpace attempted its first orbital launch from the Jiuquan Satellite Launch Centre. The 3rd stage of the Zhuque 1 rocket malfunctioned. For details see the section **LAUNCHES** *and page 20 - 23 in GoTaikonauts!, issue no 23.*

Landspace secured 300 million RMB (43.2 million USD) in a B+ round financing for the development of its TQ-12 methalox engine, the Zhuque 2 rocket and infrastructure development. The money came from venture capital firm China Growth Capital with Zhongji Investment, 36Kr, Juzhuo Capital and others. The total raised funds accumulated to over 800 million RMB (115.3 million USD).

Landspace's CEO Zhang Changwu reiterated that he considers the future of his company in the production of medium-lift carrier rockets with liquid-fuelled, rather than solid-fuelled motors.

On 12 December 2018, Landspace inaugurated in Huzhou the first privately owned carrier rocket factory in China, and the largest of its kind in Asia. Currently being used to conduct technical tests of the new Tianque-12 (TQ-12) methalox rocket engine, Landspace will start in Huzhou mass production of 15 ZQ 2 rockets and 200 TQ-12 engines annually as of 2022. Before LandSpace, there was only Japan's private rocket manufacturer Interstellar Technologies with its own production facility in Taiki, on Hokkaido island. *Also, see our report in GoTaikonauts!, issue no 25, p. 15-19.*

OneSpace

OneSpace conducted in late October tests of the 3rd and 4th stage engine. Structure static test, a comprehensive electrical system test, an attitude control test, and a propulsion system vibration test for the OS-M1 were concluded until the end of 2018/beginning of 2019.

Linkspace

After a take-off and landing demonstration with its RLV-T5 technology demonstrator earlier in the year, Linkspace completed ignition tests with its five RLV-T5 engines in October.

Commercial Satellites

Cloud Constellation

Los Angeles-based Cloud Constellation designing the "SpaceBelt" constellation of orbiting cloud data centres, plans to receive a 100 million USD investment from HCH Group of Hong Kong, formerly Hughes China Holdings Company Limited.

CGWIC - Superview

On 6 November, China Great Wall Industry Corporation (CGWIC) and China Siwei Surveying and Mapping Technology Co., Ltd., (China Siwei) signed the "Contract of Superview 1 Satellite Data Overseas Marketing". Since the launch of Superview 1-01 and -02 in December 2016, CGWIC and China Siwei have been jointly working on the international marketing of the Superview 1 satellites. The contract is the 2nd marketing agreement between both sides on the fully commercial operation of the satellites. Currently, 4 satellites are in orbit, providing daily revisiting data with a resolution of 0.5 m on the panchromatic sensors and 2 m for multispectral channels.

China on the way to becoming a major space power

Yang Yiqiang, the 1st Chief Commander of the Long March 11 solid-fuel carrier rocket project, describes in an interview with GlobalTimes, China's space policy priorities and to-do lists toward turning the nation into a major space power. He gives a profound analysis of the beginning of China's commercial launch activities, the emergence of commercial space in the U.S. and compares that with the conditions for the private space sector in China today. Despite commonalities and overlaps, there are significant differences which will help to turn Chinese commercial space projects into success stories.

CGWIC - Small GEO platform

On 6 November, on the sidelines of China Airshow 2018, CGWIC and APT Mobile SatCom (HK) Ltd., (APSATCOM) and APT Satellite Company Ltd., (APT (HK)) held the signing ceremony of "Letter of Intent for the APSTAR SMALL GEO Communication Satellites System".

The three parties agreed to develop the APSTAR Small GEO Communication Satellites System based on CAST's DFH-4 full-electric Small GEO platform for small payloads. With a lift-off mass of 1,000 kg (max. 1,300 kg) and full electric propulsion, the platform can carry 300 kg (max. 450 kg), an equivalent of 15-25 active transponders or to be designed as a high-throughput satellite (HTS) payload, achieving an end-of-life payload power of 3 kW (max. 4.5 kW). The designed operational life is 15 years.

Galaxy Space

Galaxy Space secured an unknown amount of A+ round financing from Shunwei Capital Partners, Morningside Venture Capital, IDG Capital, Gaochun Capital, and Source Code Capital.

Jilin 1

The market share of high-definition data has gradually risen to 85 % in China, said Xu Wen, President of the China Centre for Resources Satellite Data and Application, Science and Technology Daily. Instrumental in this move was the installation of the first 6 civilian Jilin 1 satellites. 138 of them are planned until 2030, increasing the revisiting time to 10 min.

LinkSure Network

Internet technology company LinkSure Network unveiled on 27 November in Shanghai the LinkSure 1 satellite, the first of its LinkSure Satellite Network Project comprising the LinkSure Swarm Constellation System to provide worldwide free WiFi service. LinkSure 1 will be launched from the JSLC in 2019. By 2020, 10 satellites are planned with the full constellation consisting of 272 satellites by 2026. The LinkSure Constellation could become the world's leading two-layer hybrid orbit constellation system: 72 core satellites at 1,000 km orbits, and 200 data processing node satellites at 600 km altitude.

By covering regions, difficult to install terrestrial telecom infrastructure, satellite constellations can become an alternative or complementary asset for internet access and helping to bridge the digital divide in the world. LinkSure Network plans to invest

3 billion RMB (431.4 million USD) into the project. The satellite constellation can become profitable by combining different applications in communication, navigation, and monitoring.

Commsat Technology Development

Commsat Technology Development sold 10 commercial satellites as secondary payloads on the Saudi-Arabian twin-satellite launch. For details see section: **LAUNCHES**

ORBCOMM's services in China

ORBCOMM Inc., announced that it received permission to provide satellite services and solutions in China. The company is supported by its local partners Asia Pacific Navigation Telecommunications Satellite (APNTS) in Hong Kong and Shenzhen. ORBCOMM target heavy equipment, logistics and maritime industries.

Space-Based Internet of Things Industry Alliance

On 26 December China's first "Space-Based Internet of Things Industry Alliance" was founded.

The alliance was initiated by Aerospace Science and Technology Co., Ltd. of Aerospace Sanjiang, a subsidiary of CASIC. The aim is to bundle the potential of relevant companies to create a comprehensive ecosystem around space-based IoT industry, its value chains and applications.

OneSpace CEO on its progress, plans, and China's space industry

SpaceTech Asia spoke with Shu Chang, founder and CEO of OneSpace, about his current work, the support of the government and investors for OneSpace, and of course his vision of the future. Shu Chang explains why the development of a reusable rocket is not the first priority right now but that he sees big prospects for commercial aerospace in China.

Will China's private aerospace firms fall into quagmire like EV makers?

As China's private aerospace firms take inspiration from SpaceX, China's electric vehicle (EV) start-ups aim to repeat the success story of Tesla Inc. As start-ups making EVs have run into troubles lately, some fear the nation's aerospace firms will take a similar track. The Global Times interviewed industry insiders who said the two groups of firms face a different future. Commercial rocket investors had a consensus that they are in this for long-term results, not short-term profits. Also, in terms of the cash needed, commercial rockets are much less demanding. As private commercial rocket companies will be primarily a complementary one to existing State-backed space companies, they won't face so daunting a task to defend their niche market from traditional giants in the field, industry insiders said.

RESEARCH AND DEVELOPMENT

Carbon Nanotube for Space Elevator

A research team from the Department of Chemical Engineering of Tsinghua University in Beijing, said that it has developed a new "ultralong" carbon nanotube fibre strong enough for use in a space elevator. 1 cm^3 of the fibre, which weighs 1.6 g, can bear 88 t - equivalent to a tensile strength of 80 gigapascals. They have patented the technology and published their finding in the journal *Nature Nanotechnology*. Beside space applications, the material has utilisation potential in many other sectors.

INTERNATIONAL COOPERATION

APSCO – Space Science School

The 2nd APSCO and ISSI-BJ Space Science School was held from 10-19 October in Sanya, China. Under the topic "Study on the effects of space weather between the Sun and the Earth", 51 students from China, the UK, the Netherlands, Thailand and Peru and 30 international lecturers and tutors, among them Wu Ji and Roger Bonnet, joined the programme. The students learned about the elements of space weather, its effects on the Sun-Earth environment, analysis of space weather satellite data and data modelling.

China's commercial aerospace companies are flourishing

What motivates young Chinese to found a space company from scratch? How are the officials at the national space centre Jiuquan Satellite Launch Centre looking at them? And last but not least: what do investors expect from providing money to those ambitious start-ups?

APSCO Council

The 12th Meeting of the Council of APSCO was held from 11-13 November 2018 in Beijing. The Council Members and Member States representatives from Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand, Turkey and Observer State Mexico attended the meeting. The Member States reported on their activities and progress. The APSCO Council approved the feasibility studies on 4 projects: Forest Carbon Stock Assessment Using Geospatial Technologies; APOSOS Project Phase-II; DSSP Project Phase-II; and Earthquake Signatures Project Phase-II. It also approved cooperation Agreements on Degree Education with three top space-related Universities: NPU, HIT, and BUAA, and MoU with NPU on the establishment of an APSCO-NPU Talents Training Base. Furthermore, another tripartite Agreement between CNSA-APSCO-CMA on the Application of FY Meteorological Satellite Data was approved. The Council confirmed the budget for 2019 as well as the proposal of the establishment of the new department of "Programme Operation and Data Service".

APSCO - 10th anniversary

In a congratulatory letter to the 10th anniversary of the Asia-Pacific Space Cooperation Organization (APSCO) on 14 November in Beijing, Chinese President Xi Jinping said that the international community should strengthen cooperation in outer space on the basis of equality, mutual benefit, and inclusiveness.

"China has consistently advocated the rational exploitation and utilisation of space resources, space environment protection, and hopes the space industry could bring more benefits to mankind." President Xi stressed that China will continue to support APSCO in its engagement of the advancement of the space industry as well as economic and social development.

During the Forum, Council Members of APSCO, signed the APSCO *Development Vision 2030* which is aiming at the utilisation of the resources of Member States, and exploiting the unique geographic advantage, and strengthening talent cultivation. APSCO is determined to promote the social and economic development in the Asia-Pacific Region. There were signature ceremonies for the agreements which were prepared during the 12th Meeting of the Council of APSCO the days before.

Over the past decade, APSCO had built six cooperative networks, including the Data Sharing Service Platform Network, Space Segment Network and Inter-Connection of Ground Systems, Ground-Based Space Object Observation Network, Disaster Monitoring and Management Network, Space Application Network, and Education and Training Network.

Through the Data Sharing Service Platform Network, more than 8,000 satellite images have been provided to APSCO members for a wide range of applications, including research, disaster management, as well as environmental monitoring and assessment, with all data from China's 9 Earth observation satellites free of charge.

APSCO has also initiated 13 cooperative projects, with one for studying earthquake precursors in the ionosphere and another for observing space objects with ground-based optical facilities reporting completion of first-phase construction. Regional cooperation is helping bridging the technology and financial gap.

So far, with sponsorship from the China Scholarship Council, APSCO has supported more than 200 students to achieve doctor's and master's degrees, and offered training for over 1,000 people.

Belt-and-Road Initiative - BRI

During the 3rd Conference of Digital Belt-and-Road held in Tengchong, Yunnan Province, a Digital Belt-and-Road big Earth data platform in Chinese, English and French language was launched. Initiated by the Chinese Academy of Sciences (CAS) in 2016, the cloud service platform is an open international centre for big Earth data, incorporating 94 sets of satellite, ground-based and sea-based thematic data involving resources, environment, climate, disasters, heritages in countries along the Belt-and-Road initiative.

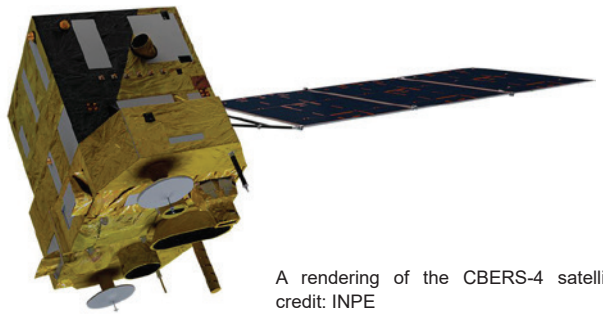
On 4 November, a launching ceremony of the 1st General Assembly of the Alliance of International Science Organisations (ANSO) in the Belt-and-Road region and the opening of the 2nd International Science Forum of Scientific Organisations on the Belt-and-Road Initiative was held in Beijing.

During the session "Building the Digital Belt-and-Road for Sustainable Development Goals (SDGs)", the talks were focussed on big Earth data applications in ecology, environmental monitoring, disaster risk reduction, big data-driven multidisciplinary data integration and applications. The objective was to provide a high-level academic exchange platform where scientific organisations and experts from diverse backgrounds could exchange their knowledge and experience in information and data and enhance their efforts through cooperation in the big Earth data application for sustainable development among the Belt-and-Road nations.

BRAZIL - CBERS

A ceremony was held on 22 November in Beijing marking the 30th anniversary of China-Brazil space cooperation, celebrating the CBERS project as one of the most successful examples of south-south cooperation in high technology. 4 million CBERS images have been downloaded from the internet for free.

On that occasion it became known that the Earth-observation satellite CBERS-4A is being assembled and undergoing tests in Brazil. It will become the 6th satellite jointly built by China and Brazil. Launch is scheduled for 2019. CBERS-4A will replace CBERS-4 and is planned to operate in a 628 km sun-synchronous orbit. The on-board sensors cover a swath of 90 km in high-resolution and transmit the data to ground control in real time. With a lifetime of 5 years, both countries have started technical discussion of the successors CBERS-5 and CBERS-6. China and Brazil hope to expand cooperation beyond the CBERS programme, which might lead to a BRICS Earth observation satellite constellation, where each nation could contribute 1 or 2 satellites.



A rendering of the CBERS-4 satellite. credit: INPE

China's efforts in international space cooperation

A look back in history shows how China found its own way of conducting space research and setting up cooperation projects. As early as the 1980s, China offered its capacities on retrievable satellites to France and Germany. The breakthrough came with the joint China-Brazil Earth observation satellite programme CBERS. Engineers involved in the programme from the beginning recall that because of language barriers, the team often worked with gestures and dictionaries. But it all worked out very well and now China is in the position to offer its coming space station to all interested countries within the United Nations framework for space cooperation.

ESA

On 29 November, ESA's (European Space Agency) Directorate of Human Spaceflight and Robotic Exploration and the CNSA's Lunar Exploration and Space Engineering Centre (CNSA-LESEC) jointly published a request for information relating to scientific collaborations for future lunar exploration between China and Europe. Deadline for the RFI was 20 December 2018.

The Joint Request For Information aimed at "identify and map existing scientific activities and opportunities for cooperation between European and Chinese scientific teams to support the missions of both agencies, enhance the overall scientific return and to prepare for an international lunar research station. Information sought includes:

- Existing research interests and major scientific achievements;
- Existing European/Chinese research collaborations;
- Research areas of interest for future collaborations;
- Potential science team contributions for planned missions of both agencies;
- Potential contributions to a joint International lunar Research Team and/or a CNSA-ESA Joint Laboratory for lunar Samples and Materials."

At an ESA press conference at the 69th International Astronautical Congress (IAC) in Bremen, Germany, ESA Director General Johann-Dietrich Wörner confirmed that ESA is in talks with China to fly European astronauts on Chinese spacecraft. But no agreement has been reached.

ETHIOPIA

Officials from the Ethiopian Space Science and Technology Institute (ESSTI) and China met in August and November for talks on technology transfer and to sign cooperative agreements on space activities. An environmental observation satellite will be built and launched by China for the African nation in September 2019. Some preliminary and critical design is done by Ethiopian engineers. The command and control centre will be based in Ethiopia. The satellite's costs are estimated at 8 million USD of which 6 million will be taken over by China. There are also plans to build a satellite assembly and test centre in Amharic, Ethiopia.

FRANCE

The Sino-French oceanic satellite CFOSat was launched on 29 October. *For more details, please, see the **LAUNCHES** section.*

An image of Yancheng City, Jiangsu Province, taken by the CBERS-4 satellite. credit: CNSA

CFOSat's CNES mission website

CFOSAT's eoPortal mission website

On 10 December the preparatory meeting of the French-Chinese Joint Science and Technology Committee was held in Beijing. CNES President Jean-Yves Le Gall reviewed the initial results from the CFOSat mission launched on 29 October and presented the status of space cooperation between the two nations. Le Gall advertised a nine-point action plan for French-Sino space cooperation:

- Pursue the major joint SVOM astrophysics mission;
- Identify a new Earth-observation mission focused on climate monitoring;
- Establish a framework for exchanging greenhouse gas data;
- Seek opportunities to work together on one of China's planetary exploration missions;
- Continue cooperation in the field of oceanography;
- Pursue ongoing cooperation in space medicine;
- Study future opportunities for cooperation in astrophysics;
- Study the possibility of working together in materials science;
- Develop collaboration in space with academia.

The action plan will be addressed at the next Space Science Survey seminar in October 2019. Meanwhile, the **SVOM** astrophysics mission, another cooperation project of the two nations, is proceeding according to plan.

MALAYSIA

Sheikh Muszaphar Shukor, the first Malaysian in space, expressed during an event on 29 October near Kuala Lumpur his hopes that the Malaysian government can send out the next angkasawan (Malaysian astronaut) around 2030 through a cooperation project with China. Given his good relationship with Chinese taikonauts, in particular Yang Liwei, he would be ready to support such a project. Sheikh Muszaphar Shukor also said the Ministry of Science, Technology and Innovation, indeed, has plans to send another astronaut to space by 2030.

PAKISTAN

Pakistani astronaut

At a meeting of the Federal Cabinet of Pakistan on 25 October, chaired by Prime Minister Imran Khan, the Cabinet discussed and ratified the space mission proposal to send a Pakistani astronaut with support by China into space. Already in December 2017, Air Chief Marshal Sohail Aman had announced that Pakistan will be able to send astronauts into space through cooperation with China within the next two years.

Pakistan Minister of Information, Fawad Chaudhry told media after the Cabinet Meeting that the flight will take place until 2022. While SZ-12 and SZ-13 missions are scheduled for 2020 and 2021, it is probably the SZ-14 mission - tentatively planned for 2022 - which Pakistan is targeting for its historic space endeavour. There was no official confirmation of the project from China.

During Pakistani Prime Minister Imran Khan's visit to China beginning of November, 15 memoranda of understanding were signed to strengthen science and technology cooperation, resulting in the establishment of "S&T parks" and technology transfer centres. Khan's visit to China emphasized: "The two sides agreed to promote the 2012-2020 Space Cooperation Outline between the China National Space Administration and the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO). Expressing satisfaction on the launch of the Pakistan Remote Sensing Satellite this year, the two sides agreed to strengthen bilateral cooperation in space technology applications. They agreed to strengthen cooperation in the field of manned space travel, and the China Manned Space Engineering Office and SUPARCO will sign a framework agreement on cooperation."

PORTUGAL

Until March 2019, Portugal and China will establish microsatellite manufacturing facilities in the Portuguese cities of Peniche and Matosinhos and in Shanghai, China, the Portuguese Ministry of Science, Technology and Higher Education said in a statement. The project is called STARLab. The microsatellites will collect data used in agriculture, fishery and oceanography.

The initiative is the result of a collaboration between the Science and Technology Foundation, the Tekever aerospace company and the Centre for Product Engineering and Development (which has projects in the field of maritime surveillance and deep-sea exploration) and CAS, through its institutes for microsatellites and oceanography. Each country will contribute 50 % of the overall investment of 50 million EUR over 5 years. The agreement was signed during a State Visit by Chinese President Xi Jinping from 4-5 December to Portugal.

RUSSIA

After several years of negotiations, Russian rocket engine manufacturer Energomash and the 6th Academy of CASC have signed at Airshow China 2018 a protocol of cooperation in the development and manufacture of liquid rocket propellants using oxygen-kerosene, oxygen-hydrogen and oxygen-methane propellant components. "Until the end of 2018, the Chinese side will send technical work requirements to Energomash and in January 2019 both sides will hold consultations to formulate their final version. After that, Energomash will draft and submit a package of documents to Russia's State Space Corporation Roscosmos for a government resolution on the possibility of cooperation in this area." a statement by Energomash reads." For this agreement, the governments of both States had to ratify the agreement "On Measures for Technology Protection in View of Cooperation in the Exploration and the Use of Outer Space for Peaceful Purposes, the Development and the Operation of Launch Vehicles and the Ground-Based Space Infrastructure". The areas of cooperation in the field of rocket engines were defined by the session protocols of the Russian-Chinese Commission for Cooperation in Carrier Rockets and Rocket Engines held in 2018 and were approved on 28 September 2018 in Beijing by a protocol of the 19th Session of the Sub-Commission for Interaction in Outer Space of the Russian-Chinese commission for preparing regular meetings of the Heads of Governments.

On 7 November, CNSA and ROSCOSMOS signed a cooperation agreement in the field of space debris monitoring and the utilisation of space debris data. China's Premier Li Keqiang and Russia's Prime Minister Dmitry Medvedev witnessed the signature ceremony. The agreement was signed by CNSA Administrator Zhang Kejian and Roscosmos' Director General Dmitry Rogozin.

*Also see section NAVIGATION: "**Beidou-Cooperation Russia"** and **"Agreement on China-Russia Intergovernmental Cooperation on Satellite Navigation"***

The Russian Central Aero-Hydrodynamic Institute (TsAGI) will cooperate with the China Academy of Aerospace Aerodynamics on the development of a Mars landing craft. A cooperation agreement was signed at the Airshow China 2018.

The New York Times quoted mid-December Dmitri Rogozin, Head of Roscosmos by saying that "Russia's preference is to press on with a space program entwined with the United States', on either the lunar program or another venture. But if talks fail, Russia can turn to China or India for partnership. China is offering many initiatives for cooperation, is asking us to help them develop, though they have already achieved a good level of development. They are suggesting creating a joint station."

Russia and China are considering joining their resources in an "equal partner enterprise" to build a base on the Moon. Dmitry Rogozin, Director General of Roscosmos State Space Corp., praised China as a "serious partner". Speaking to Channel One Russia, Mr Rogozin explained: "I don't rule out that as soon as we agree on the outlines of our lunar programme with the Americans, it is time for our manned lunar programme. The formation of a research station on the Moon's surface is likely to be carried out with our Chinese partners. They can be equal partners already in the coming years. We plan to land on the Moon. A drill will be activated to collect lunar soil samples that will be taken to Earth."

UN

The 1st United Nations World Geospatial Information Congress (UNWGIC), co-hosted by the United Nations, the Chinese Ministry of Natural Resources and Zhejiang Provincial Government took place from 19-21 November in Deqing, Zhejiang Province. Under the theme "The Geospatial Way to a Better World", about 1,000 representatives from the governments of the Member States of the United Nations, international organisations on geospatial information, academic circles and industrial circles came together to enhance communication, understanding, and application of geospatial information management, and pool talents to help address local, regional and global challenges.

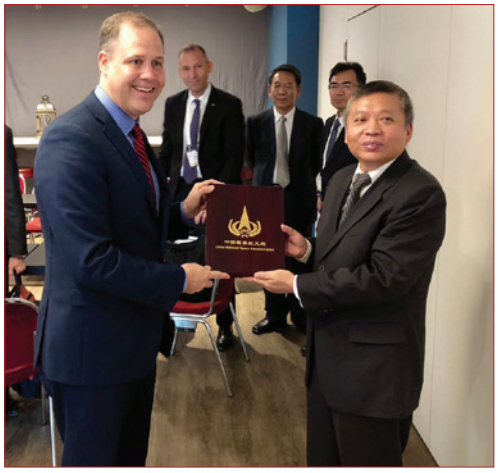
UK

The 13th UK-China workshop on Space Science and Technology took place 11-13 December in Ningbo, Zhejiang Province. Next to cooperation in the area of space applications for agriculture, e.g. soil moisture monitoring from space or an autonomous robot conducting chemical soil tests quickly and efficiently, UK scientists hope to participate in future Chinese lunar space projects.

USA

NASA Administrator Jim Bridenstine and Zhang Kejian of CNSA met at the IAC in Bremen and exchanged optimistic views about future space cooperation, provided the political landscape is favourable. Bridenstine tweeted a photo of himself and Zhang saying: "We discussed our respective program priorities." During the Heads of Agencies panel discussion, Bridenstine said that China's mission to the Far Side of the Moon is exciting, providing valuable data and information. Zhang emphasised that China's lunar exploration programme is open for international cooperation.

"CNSA is willing to join our hands with other international partners for the benefit of human civilization and progress of human society." A later question he answered by mentioning NASA could become a partner. Zhang said he believes that "the working teams of both sides can start preparation of a cooperation list. We can dash out those that cannot be implemented now, or are above our pay grade, and then we can start cooperating on the substantial part," including the exchange of scientific data and space situational awareness information, Space News reported.



Bridenstine and Zhang met at the IAC in Bremen.
Credit: Bridenstine/NASA

The C-Space Project Mars in Jinchang. credit: ChinaNews/ECNS

EDUCATION

On 11 October, The C-Space Project opened a 1,000 m² Mars Base space education facility for youngsters in the remote and barren territory of the Gobi Desert, 40 km from the small town Jinchang, in the Gansu Province. The public can learn about space exploration and living in confinement on Mars. The base is China's first cultural and tourist experience based on space education, Mars-themed tourism and scientific research. C stands for Community, Culture and Creativity. The unique landform and red rocks make the area a perfect place for tourists to experience the Red Planet on the Earth. There are nine cabins in the base, including airlock cabin, general control cabin and biopak, which restores the visionary simulation aspects of Mars. Visitors can learn how to live on Mars and make use of its resources.

At the Ngari Observatory, in the Ngari prefecture of Tibet Autonomous Region, an astronomical science education and popularisation base was inaugurated on 27 November. It will be followed by an online platform, allowing astronomy enthusiasts from all around the world to observe the night skies in Tibet in real-time through the remote control of the telescope. Ngari Observatory, situated 5,100 meters above the sea-level has 8 telescopes for scientific research.

MISCELLANEOUS

Science Fiction Movie

The launching ceremony of the first science fiction film jointly financed by Macau and mainland China, titled "Space Intellectual," was held on 12 December at the Macau University of Science and Technology. The press release says:

"Space Intellectual is set in the year 2049, when the launch of the cutting-edge spaceship Phoenix marks a new milestone of human space settlement. However, during the voyage, the ship disappears after an encounter with a black hole, prompting the ship's creator, professor Zhong Xingguo, to assemble and lead an international space rescue mission. In the film, Zhong is a resident of Macau and is the main driving force behind the rescue effort."

Filming is expected to be completed in 2019, with the premiere planned to take place in Macau. The project is consulting Yang Liwei, CNSA, China Space Foundation and the MUST State Key Laboratory of Lunar and Planetary Sciences in Macau. The film project is dedicated to the 70th anniversary of the PRC and the 20th anniversary of the establishment of the Macau SAR.

ON A SIDENOTE

Mike Griffin comments on China's lunar plans

Former NASA Administrator Mike Griffin, who is presently Under Secretary of Defence for Research and Engineering, said during a Users Advisory Group meeting of the National Space Council: "My opinion is, if the Chinese wanted to do it,

they could pretty easily be on the Moon within six, seven, eight years, no problem. … They never seem to be in a rush. They play the long game. So, I'm not saying they will be on the Moon in six to eight years, but if they wanted to be they could. And for them to be back on the Moon when the United States can't get back on the Moon is a travesty. ... I think such an event would cause a realignment of geopolitical thinking that would be extraordinarily damaging for the United States. Non-aligned countries want to do deals with, they want to collaborate with the nations that they believe are leaders in the world. When very large and visible accomplishments are made by people who declare themselves to be our adversaries, there's no possible way you could look at that and say it is good for the United States and our Western allies."

Exhibition

A grand exhibition dedicated to China's 40-year reform and opening-up was opened on 13 November at the National Museum of China in Beijing. 63 innovative achievements were showcased. Historical materials including photos, texts, videos, miniature models and interactive activities illustrated the changes. Models of the Dark Matter Particle Explorer (DAMPE) Satellite "Wukong", the manned submersible Shenhai Yongshi, and the Five-hundred-meter Aperture Spherical Radio Telescope (FAST) were among the exhibits.

AIRSHOW CHINA

The 12th China International Aviation and Aerospace Exhibition was held from 6-11 November in Zhuhai, Guangdong Province.

770 manufacturers from 43 countries and regions attended the six-day exhibition and 200 army and government trade delegations from more than 50 countries visited the event. It also attracted nearly 150,000 professional visitors and about 300,000 general visitors. Some 570 contracts and other business agreements worth more than 21.2 billion USD were signed and 239 airplanes of different types were sold.

CASC showcased 184 of its best and most recent products including the CZ-11, models of the new-generation Long March rocket series and the micro rocket Smart Dragon 1, also known as Lightning Dragon 1, developed by Chinarocket under CASC. A 17 m, full-scale model of the CSS core module was one of the main space attractions for the public. The Chang'e 4 lunar probe and Queqiao relay satellite could be seen as well.

The scale model of the next generation, partly re-usable spacecraft was shown on CAST's display. SAST presented 21 exhibits, including the CZ-6A, Fengyun 4 and upper stage.

ESA telecommunication engineers showed big interest in satellite manufacturer MinoSpace and its technology. They took the opportunity to get first-hand information on MinoSpace'a satellite platform, it's performance parameters and technology details. MinoSpace attracted a lot of attention from international experts.

On the occasion of the Airshow China, former CNSA Administrator Luan Enjie told media: "There are now 300,000 people working for China's space industry." (CASC alone has 170,000 employees.) "They all have worked hard to form their own set of methods and regulations, and systems for systematic engineering management that reflect the unique Chinese aerospace spirit." He stressed that China must adhere to developing high technology its own way. Advanced technology cannot simply be bought or given, we need to rely on our own scientists. And this kind of spirit is expected to be passed on to the next generation of space industry engineers and scientists."

see report by Donovan Cosby in GoTaikonauts!, no 23, p. 24-27

Asteroids named after Chinese Universities and Space Scientists

Two asteroids, discovered by astronomers at the Xinglong Observatory in northern China, were named by the Minor Planet Centre of the International Astronomical Union (IAU).

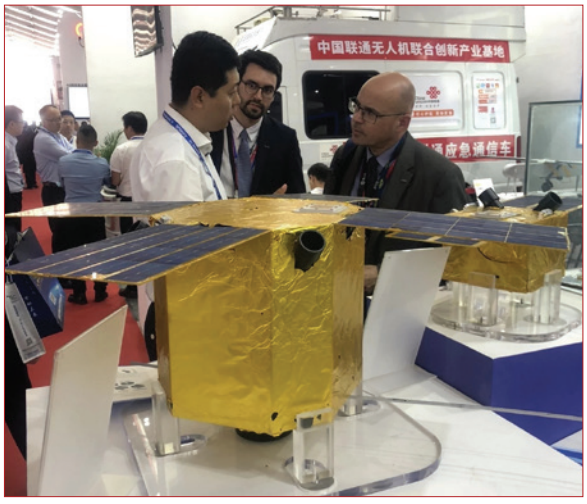
Asteroid 189018, discovered on 14 October 1998 is now Asteroid Guokeda. Guokeda is the Chinese abbreviation of the University of the Chinese Academy of Sciences.

Asteroid 79694, discovered on 25 September 1998 has been named after Nan Rendong (1945-2017), the founding scientist of China's Five-hundred-meter Aperture Spherical radio Telescope (FAST). Nan devoted 22 years of his professional career to the project. A sculpture of Nan was unveiled at FAST.

With approval from the Minor Planet Centre of the IAU, asteroid 8917 has been named Tianjindaxue, after Tianjin University. Asteroid 8917 was discovered in March 1996 by astronomers of the Beijing Schmidt CCD Asteroid Programme at the Xinglong Observatory in north China.

Asteroids 212796 and 212797 were discovered in October 2007 by a researcher from the Purple Mountain Observatory in Nanjing, Jiangsu Province. The IAU named them after Chinese space scientist Guo Yonghuai and his wife Li Pei, an applied linguist. Guo Yonghuai, a professor at the University of Science and Technology of China, was a pioneer of modern Chinese mechanics. He made great contributions to mechanics, applied mathematics and aeronautics as well as to the development of China's first atomic and hydrogen bombs and the preparation of satellite launches. He died in a plane crash in 1968, aged 59.

Peking University, Nanjing University, and the Harbin Institute of Technology have been used earlier as names for asteroids.



MinoSpace CEO in discussion with ESA experts. credit: MinoSpace


Engine technology on display. credit: Donovan Cosby

LAUNCHES

2018-077A
2018-077B
09 October 2018 - 02:34 UTC (10:43 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, LC43, LP94
launcher: Chang Zheng CZ-2C/YZ-1S
payloads: Yaogan 32 01-1
Yaogan 32 01-2

CALT used for the first time the simplified, re-ignitable Yuanzheng 1S (YZ-1S - Expedition 1S) upper stage, increasing the payload capacity of the CZ-2C from 1.2 t to 2 t into SSO. YZ-1S is designed for short flights of approx. 10 mins, capable of suborbital ignition and will be mainly used for commercial launches.
The launch added two Yaogan 32 remote sensing satellites to group 1. There is not much public information on the Yaogan satellites. Jonathan McDowell reported that the payloads were put into a 09:00 local time SSO and that the 2nd stage was most likely sub-orbital, with the YZ-1S making a single orbit insertion burn at apogee. He also mentioned that the dual-payload adapter (comparable to the European secondary payload adapter SYLDA) was left in orbit; the YS-1S then made a deorbit burn and re-entered around 82°E, 35°S in the southern Indian Ocean. Chinese media stated that the satellites had entered their planned orbits, angled by 98.3° related to the Equator, enabling near-global coverage. The satellites will be used for electromagnetic environment survey and other related technology tests with a reportedly electro-optical payload. The Yaogans were built by Aerospace Dongfanghong Satellite Co.

2018-078A
2018-078B
15 October 2018 - 04:23 UTC (12:23 BJT)

launch site: Xichang Satellite Launch Centre - XSLC, LC3
launcher: Chang Zheng CZ-3B/YZ-1
payloads: Beidou 3-M15 (Beidou DW 39)
Beidou 3-M16 (Beidou DW 40)

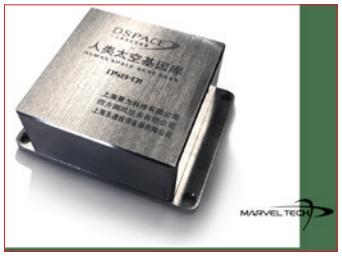
Two more Beidou 3 medium-orbit navigation satellites, Beidou 3-M15 and 3-M16, were added to plane A of the constellation. The twin satellites are also known as Beidou Daohang Weixing 39 and 40, meaning they are the 39th and 40th BDS Satellites or the 15th and 16th of the BeiDou-3 family. After flying more than three hours, the satellites entered their planned orbit in 21,400 to 21,500 km altitude, inclined by 55.5°, and will work with the 14 Beidou-3 satellites already in orbit. Both Typ-2 satellites with a launch mass of 1.060 kg each, were built by the Innovation Academy for Microsatellites of the Chinese Academy of Sciences. The 2.25 x 1.0 x 1.22 m satellite bus has a phased array antenna for navigation signals and a laser retroreflector.
All four boosters of the CZ's 1st stage were equipped with a booster parachute control system, tracking and logging data about altitude and timing of the falling boosters. CALT intends to install a parachute system on each booster to let them land into specific target areas. A first test is expected next year.
Since July, China launched 8 BDS-3 satellites, accomplishing one dual-launch per month. 2 MEO satellites and 1 GEO satellite are still planned for 2018 to establish service for the BRI countries.

2018-081A
2018-081B
2018-081C
24 October 2018 - 22:57 UTC (25 October - 06:57 BJT)

launch site: Taiyuan Satellite Launch Centre - TSLC, LC9
launcher: Chang Zheng CZ-4B
payloads: Haiyang 2B (HY-2B; HY-2-02)
Tangguo Guan
SPP (Space Proving Platform, DSB-01)

HY-2B is the second satellite of the 2nd generation of oceanographic satellites, forming a network with HY-2C and HY-2D, to be launched later on. Built by CASC's DFHSat (Dongfanghong Satellite Corporation Ltd.) and based on the CAST-968 satellite bus, the three-axis stabilised, 1,500 kg-satellite with an elongated shape is a box-like construction, equipped with one single solar panel. HY-2B's life time is five years in a 973 km SSO. The radar altimeter and scatterometer will provide 24/7 all-weather observation of 90 percent of the surface structure of the world's oceans, of wave height, wind speed, and rainfall level. The microwave radiometer can monitor the temperature conditions over the open sea. Laser retroreflectors and a DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) unit support the precision determination of the satellite's orbital location.
HY-2B will replace HY-2A, launched in August 2011. Similar in equipment as its HY-2A predecessor, the HY-2B has new instruments integrated onto its bus: an automatic identification system (AIS) to track and monitor civilian and certain military vessels, and a data collection system to receive, store and transmit buoy measurement data in China's offshore and other sea areas.
HY-2B is operated by a special governmental agency, the National Ocean Satellite Application Centre under the Ministry of Natural Resources.
During the first two years of its operation, the satellite will have a 14-day cycle followed by one year with a geodetic orbit - a 168 day cycle with a 5-day approximate sub cycle. Haiyang means: Ocean.

Along with HY-2B, two small secondary payloads were launched. One is called "Tangguo Guan" ("Candy Can"). Jonathan McDowell reported that it was not clear whether the cubesat remained attached to the rocket's 3rd stage, the L-14 upper stage or was finally released. It is owned by the online retailer AliExpress. The 20-29 kg cubesat is equipped with a solar cell on the outer body and will send promotional messages to customers' mobile phones. The cubesat is operated by Commsat Technology Development Co, a Beijing-based small satellite constellation operator.



The space gene bank by MarvelTech. credit: MarvelTech/China Internet

The other one, also attached to the upper stage, was China Aerospace's SPP (Space Proving Platform), one of whose experiments is by Shanghai-based ManWei Technology Company Ltd., (or Marvel Technology Company). Its DSB-01 satellite carries the DNA of eight Chinese people, described as the beginning of a programme to explore technologies for interstellar migration. DSB-01 can remain in space for 975 years.
Another secondary payload was the space router, designed and manufactured by the National University of Defense Technology. The router is a prerequisite for a future "space-ground integrated information network".

Zhuque 1 launch failure
27 October 2018 - 08:00 UTC (16:00 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, mobile platform
launcher: Zhuque 1 (ZQ-1)
payload: Weilai 1 (Future 1, CCTV)

The first orbital launch attempt by the private Chinese company LandSpace Technology Corp. Ltd. (LandSpace), was not successful. The first two stages of the solid-fuelled ZQ-1 operated and separated nominally. The 3rd stage ignited and worked for 37 s. At T+402 s, it lost attitude control. By that

moment the 3rd stage and the payload had reached a sub-orbital apogee of 337 km and a velocity of 6.3 km/s, before falling back to Earth and impacting the Indian Ocean West of Sumatra at about 15 min after launch.
Already a few days after the launch, the failure analysis pointed to a damage of the reaction control system, which caused a leakage in the propellant line.
The self-developed 3-staged solid rocket Zhuque 1 was planned to place the 40 kg broadcasting, space science and remote sensing satellite Weilai 1 into SSO. The 32 x 29.5 x 24.8 cm satellite with a 2-year life time was built by MinoSpace Technology, based on its MN10 platform. It was equipped with a remote sensing camera and two solar panels. Weilai 1 would have been used to broadcast the Chinese TV series “Cheers Science!” (加油！向未来) by China’s state broadcaster CCTV.
Despite the failure, LandSpace stressed, that the launch can be considered a milestone, demonstrating the success of military-civil integration which enables commercial space start-ups. The launch of ZQ-1 embodies the first real meaningful orbital flight performed by a private-owned company in Chinese space history. Also, LandSpace is the earliest private launcher company that has acquired the overall mandatory qualifications for the Chinese space industry access, being issued with the first “Chinese Civil Aerospace Launch License” for a private launch vehicle by CNSA.

compare report from the launch in GT! issue no. 23, p. 20-23

Link to a video showing the preparation of the rocket in the LandSpace facilities.

Link to the launch video, as posted on Weibo.

2018-083A
2018-083
2018-083
2018-083H
2018-083
2018-083
2018-083E
Note: The International Designator (COSPAR ID) for most of the payloads could not be determined.
29 October 2018 - 00:43 UTC (08:43 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, LC43, LP94
launcher: Chang Zheng CZ-2C
payloads: **CFOSat (Zhongfa Haiying Weixing)**
Xiaoxiang 1-02 (TY1-02)
Xinghe (Tianfu Guoxing 1, TY 1-03)
Changsha Gaoxin (TY4-01)
Zhaojin 1 (Tongchuan 1, TY 4-02)
Tianqi 1
unknown
CubeBel 1 (BSUSat 1)

The China-France Oceanography Satellite (CFOSat) entered a sun-synchronous orbit 520 km above the Earth. Its solar panels deployed 32 min after orbit insertion, marking the mission beginning. The 600 kg launch mass satellite is based on the CAST-2000 bus and was built by the DFH Satellite Corp. The box-shaped satellite has the dimension of 1,4 x 1,4 x 1.2 m and is equipped with two solar panels and one radar antenna. The projected life time is 3 years.
CFOSat is the first mission jointly conducted by China National Space Administration (CNSA) and the Centre National d’Études Spatiales (CNES). China contributed the SCAT (wind SCATterometer), a wind-field scatterometer, able to measure the strength and direction of winds. It is a rotating fan-beam Ku-band radar with incidence angles of 18~50°. SCAT delivers every 3 days a global coverage. It was designed by the National Space Science Centre of the Chinese Academy of Sciences.
CNES provided the SWIM (Surface Waves Investigation and Monitoring) radar altimeter instrument with 6 rotating Ku-band radar beams for the determination of ocean wave properties (length, height and direction). SWIM can cover the globe every 13 days. It was conceptualised by the French LATMOS institute for atmospheres, environments and space observations (CNRS/UVSQ/SU) and the LOPS physical and space oceanography laboratory (CNRS/IRD/Ifremer/UBO). SWIM was built by Thales Alenia Space. The two instruments will enable measurements of winds and waves to be acquired simultaneously for the first time. CNES is responsible for data processing and most of the instrument operations. Since the satellite itself is controlled from the Satellite Control Centre in Xi’an, the Chinese name “Zhongfa Haiying Weixing” was assigned. CFOSat’s almost real-time data will serve more accurate ocean forecasts including early warning of dangerous weather situations. Data could also support the study of interaction between the oceans and atmosphere, crucial for understanding the planet’s climate and improving climate models and the coupled ocean-atmosphere system. The satellite will also provide precise data on deep-sea wave conditions, which have a bearing on the impact of waves on coastal areas.
For the reception and procession of both instruments’ scientific telemetry, and the generating, archiving, and distribution of the CFOSat scientific products to the end users, two independent Satellite Mission Centres were set up in France (Toulouse) and China (Beijing).
After approximately one month of checking out the instruments, the mission will be ready to deliver data to science teams at LATMOS, LOPS and the marine forecasting department of Meteo-France and Beijing, who will then analyse and validate them. Data will be made available to the scientific community after 6 to 7 months. Each country will acquire all SCAT and SWIM science data via two French receiving stations in Canada and Sweden and three stations in China. Each partner nation will thus assure redundancy of science telemetry reception and processing.

On 29 October, Chinese President Xi Jinping and his French counterpart Emmanuel Macron exchanged congratulations on the successful launch earlier in the day.

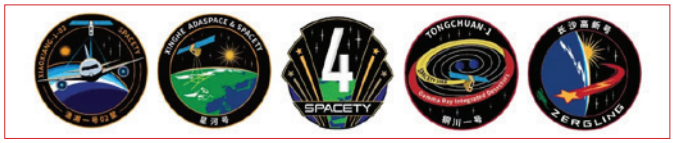
Together with CFOSat, seven secondary cubesat payloads were launched. Four of them - the “SpaceTY Four” - were built by the SpaceTY (Tianyi Research Institute). On 29 October, at 22:00 BJT, SpaceTY confirmed that the “SpaceTY Four” had established a stable telemetry and were in good health.

Xiaoxiang 1-02 TY1-02 (XX-1 S/N 02) is a laser communication technology verification satellite. It carries a laser communications payload for Shenzhen Hangxing Optical Network Space Technology Co., Ltd. (LaserFleet). It is a 6U cubesat of 8 kg launch mass and serves as a demonstration mission for the later laser communication constellation of 288 laser-comsats to provide high-speed internet access for civil aircraft.

Xinghe (‘Galaxy’) TY1-03, also: Tianfu Guoxing 1 is a remote sensing technology satellite, most likely of 6U and 8 kg launch mass. It was jointly developed by SpaceTY and Chengdu Guoxing Aerospace Technology Co., Ltd. (ADA Space) based in Tianfu New Area in Chengdu. Both partners aim at a global imaging constellation of 192 satellites with a coverage update within the range of minutes. The satellite is the first of the constellation and will test a series of commercial services.

Changsha High-Tech TY4-01 (Changsha Zergling TY4-01) is an radio amateur satellite named after Changsha High-Tech City. It is a 6U/8 kg test satellite for SpaceTY’s new 0805 satellite bus. It will serve on-orbit to ground communication test for amateur radio enthusiasts.

SpaceTY four satellites. In the same batch as the four TY satellites, three more small satellites were prepared for launch in December 2018. credit: SpaceTY



Tongchuan 1 TY4-02, (also: Zhaojin 1) is a 6U, 8 kg astronomical cubesat jointly developed by Tianyi Research Institute and Tsinghua University Astrophysics Centre and Tongchuan "China Space City" of Shaanxi Province. It hosts a Gamma Ray Integrated Detectors (GRID) and a high-sensitive X-ray detector to carry out astronomical observation tests to detect the remnants of gamma-ray bursts. It is the first of the 24-satellite network of the astrophysics project "Tiange Plan". Additionally, it will verify the inter-satellite communication technology and will also be used by Tongchuan City to test its commercial ground station (Zhaojin is a suburb of Tongchuan).

In addition the following satellites were launched:

Tianqi 1 is the first in the 38 satellite data-relay constellation "Tianqi" by Beijing Guodian HiTech Technology Co. Ltd. (Beijing Guodian Gaokeji YG). It will relay data from IoT devices. Its size is unknown.

Unknown - Xiaoxiang 1-05
Another cubesat reported to have been deployed on this mission is not identifiable. No publicly available information were provided.

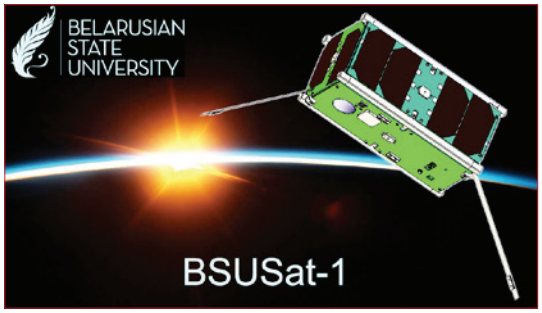
CubeBel-1 (BSUSat-1) is a 1.6 kg, 2U cubesat with a radio amateur payload, a digital camera, a radiation spectrometer and IF detector from Belarusian State University (BSU) with a five year life time. It is a LEO (500 km orbit) technology demonstration satellite to test satellite propulsion, communications systems, and data collection. University students will be trained how to receive and process telemetry and satellite imagery. BSUSat-1will also transmit radio signals that students can access by using a USB flash drive and learn how to receive amateur radio signals.

The agreement for the launch of BSUSat-1 was signed on 7 February 2018, less than 9 months before the launch.

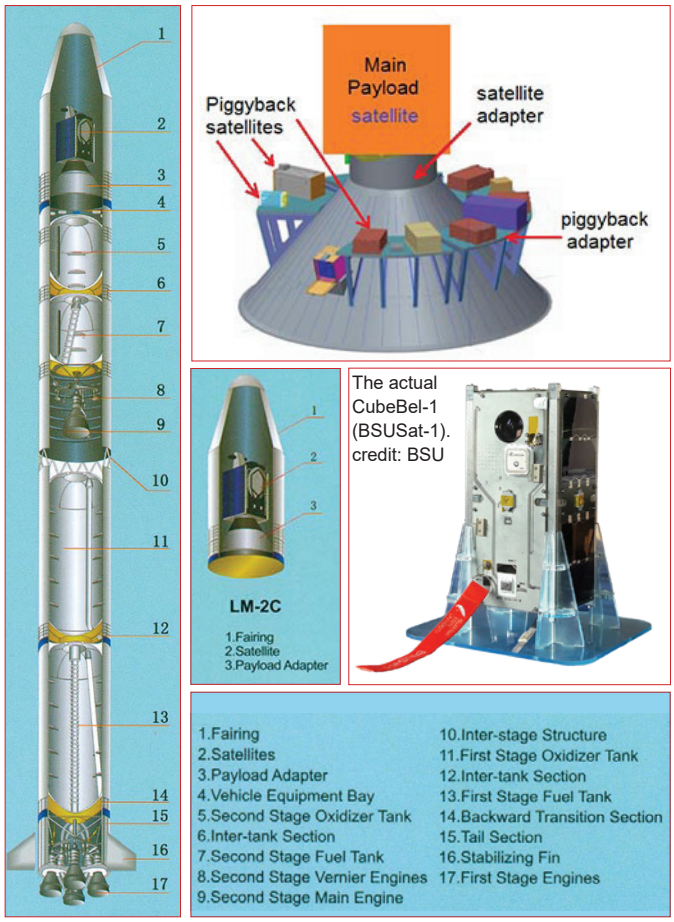
2018-085A
01 November 2018 - 15:57 UTC (23:57 BJT)

launch site: Xichang Satellite Launch Centre - XSLC, LC2
launcher: Chang Zheng 3B/G2
payload: Beidou 3-G1-Q (Beidou 41)

The Beidou-3G satellites are the GEO component of the 3rd phase of the Beidou satellite navigation system (BDS). Beidou 3-G1-Q is the 17th BDS-3 satellite, the 1st BeiDou-3 satellite launched into GEO and overall the 41st of BDS. It will replace G2-4 and will work with 16 other Beidou-3 satellites already in orbit. The Beidou-3G is a box shaped satellite, based on the DFH-3B bus and built by CAST. It has a launch mass of 4.6 t and is equipped with two solar panels, a phased array antenna for navigation signals, a laser retroreflector for correct orbit determination, and an apogee propulsion system for final orbit insertion. Also, the satellite carries a satellite-based



The 2U cubesat CubeBel-1 (BSUSat-1) built by students of the Belarusian State University (BSU).
credit: BSU



The actual CubeBel-1 (BSUSat-1). credit: BSU

LM-2C configuration. credit: Belarusian State University/CGWIC/CALT

augmentation system (SBAS). The nominal lifetime is 8 years. The navigation signals are transmitted in S/L-band and communication service in C-band. The short message service is greatly enhanced.
With completion of the Beidou Phase 3 system, the civil Beidou 1 signal will switch from 1561.098 MHz to 1575.42 MHz, the same as the GPS L1 and Galileo E1 civil signals.

2018-093A
2018-093B
18 November 2018 - 18:07 UTC (19 November 2018 - 02:07 BJT)

launch site: Xichang Satellite Launch Centre - XSLC, LC2
launcher: CZ-3B/YZ-1
payloads: **Beidou 3-M17 (Beidou 42)**
Beidou 3-M18 (Beidou 43)

The launch of the twin BeiDou navigation satellites M17 and M18 (Beidou Daohang Weixing 42 and 43) placed the two CAST-built Beidou 3-Type 1 satellites in medium circular orbit of approx. 21,800 km, inclined by 55 degrees and positioned in plane C. The Long March 3B rocket used the Expedition 1 upper stage for this mission. The satellite duo are the 18th and 19th satellites of the BDS-3 family and the 42nd and 43rd BDS satellites of the whole system. They will work with 17 other BDS-3 satellites already in space.

The satellites are equipped with a phased array antenna for navigation signals and a laser retroreflector for orbit determination. Each satellite has a launch mass of 1,014 kg, the dimensions are: 2.25 x 1.0 x 1.22 m.
With the launch of two new BDS-3 satellites, the basic BDS-3 constellation is completed and basic navigation services for the Belt-and-Road countries and full-time coverage over most of Asia, Africa and Europe can be provided by the end of 2018 - a key milestone for BDS in expanding service areas from regional to global. The accuracy improves to between 2.5 to 5 m.
2018 has seen 18 Beidou navigation satellites launched, the highest number in one year.

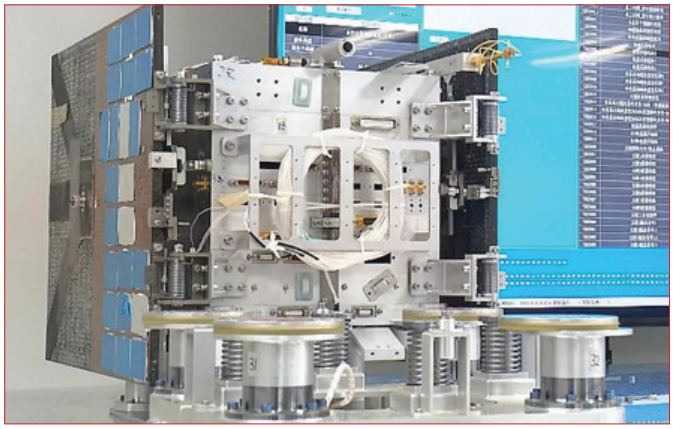
2018-094A
2018-094B
2018-094C
2018-094D
2018-094E
19 November 2018 - 23:40 UTC (20 November - 07:40 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, LC34, LP94
launcher: Chang Zheng 2D
payloads: **Shiyan 6 (SY-6)**
Jiading 1 (OKW-01)
Tianzhi 1
Tianping 1A (TP-1A)
Tianping 1B (TP-1B)

The main payload, Shiyan 6, is a new space environment research satellite. The box-shaped satellite was built by DFH/CAST. It features two solar panels. There is very little information available on this satellite.

Together with Shiyan 6, four other small satellites were sent into a 500 km SSO.

Jiading 1 (OKW-1) was developed by SpaceOK Co Ltd. based in the Jiading district of Shanghai. Jiading 1 is the first satellite for the Xiangyun LEO communications satellite constellation which intends to provide communication services, especially in technically challenging areas such as open sea and remote mountainous areas. It will carry out technical tests for the constellation project. The satellite also has a messaging system on board, capable of inter-operations with the Beidou messaging service. Jiading 1, based on the OKW-50 bus, has a launch mass of 50 kg (some reports claim 45 kg) and a size of 70 x 42,5 x 50 cm. Its expected life time is 3 years. By 9:16 BJT, the Xinjiang ground station received Jiading 1's first data set, confirming the successful solar panel deployment. SpaceOK stated that the cost for building the satellite was under 10 million RMB (1,4 million USD). Until 2022, 40 satellites will be launched for the Xiangyun constellation.
Tianzhi 1 (meaning: space-based intelligence) is China's first software-based and privately owned nanosatellite, conceptualised under the lead of the Institute of Software of the Chinese Academy of Sciences, together with the 771st Research Institute (Lishan Microelectronics Institute) of the 9th Academy (China Academy of Space Electronics Technology), the Optoelectronics Institute of CAS, and the Xiguang Institute of CAS. It was built by the Innovation Academy for Microsatellites of CAS. It is an elongated box-shaped satellite of 27 kg mass. It carries four China-made smartphones and a cloud computing system accessible to ground-based users via the mobile phones "Star Chasing App" to reconfigure and re-task the satellite, like change of frequency bands and area coverage on demand. Tianzhi 1's capabilities allow for in-orbit processing of satellite data and continuous software development for in-orbit experiments. Tianzhi 1 will lay the foundation for a network of software-defined satellites and will test key technologies for that. During the mission of Tianzhi 1, other sub-systems and one super camera and four large field cameras will be tested.
Currently, Tianzhi 2 to Tianzhi 10 are under planning. Tianzhi 2 is expected to be launched in the second half of 2019.


China's first privately designed LEO communications satellite Jiading 1, also named: OKW-01. credit: WeChat account - sh-jiading

Tianping 1A and **Tianping 1B** (TP-1A and TP-1B) of ADA-Space are both based on DFH's Pina satellite platform. TP-1A will serve as radar target and TP-1B will be used for equipment calibration on ground control stations. The CZ-2D second stage was deorbited.

2018-102A	2018-102E	2018-102J
2018-102B	2018-102F	2018-102K
2018-102C	2018-102G	2018-102L
2018-102D	2018-102H	2018-102M

07 December 2018 - 04:12 UTC (12:12 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, LC34-LP94
launcher: Chang Zheng 2D
payloads:
SaudiSAT 5A
SaudiSAT 5B
Tianyi ? Tianyi DF-1 (Xingshidai 2)
Tianyi ? Douyu-666 (TFSTAR)
Tianyi-3 01 (Xijiang Jiantong 1)
Piao Chong 1 (Ladybird 1)
Piao Chong 2 (Ladybird 2/Maowang Shouyinji Xing/Elvis Radio Sat)
Piao Chong 3 (Ladybird 3/Huami Xing/Hua Mi)
Piao Chong 4 (Ladybird 4/PandaSat)
Piao Chong 5 (Ladybird 5/Li Ke Da Jiaoyu Weixing/LindaEducation Satellite)
Piao Chong 6 (Ladybird 6/Tianmao Guoji Xing/Tmall International)
Piao Chong 7 (Ladybird 7/RE: X)
NOTE: The International Designator (COSPAR ID) for most of the payloads could not be determined. Also, the numbering of the Tianyi satellites is uncertain.

Two 425 kg Saudi-Arabian technology and Earth observing satellites, SaudiSAT 5A and 5B, were the primary payloads for the CZ-2D launch into SSO. They were both developed and built by Saudi Arabia's King Abdulaziz City for Science and Technology in Riyadh (KACST) and have a designed life time of 5 years. They will replace SaudiSAT 2 and 3 and have become Saudi Arabia's biggest EO satellites. Both SaudiSATs are box-shaped and have two solar panels. They are equipped with an hyper-spectral observation system for regional use. According to a governmental agreement between Saudi Arabia and Belarus, Belarus supported the satellite development with remote sensing technology. The launch agreement was signed during a visit of China's President Xi Jinping to Riyadh in January 2016. The agreement also includes China's support for the improvement of remote sensing facilities in Saudi Arabia and cooperation with the Chinese navigation system.

The rocket also carried 10 small satellites as secondary payloads. Seven of them are from the "ladybird series", constituting Internet of Things technology verification satellites,

designed and manufactured by Beijing Commsat Technology Development Co. Ltd. (Beijing Jiutian Satellite Techology), and will serve a wide variety of applications from wildlife protection, to entertainment, advertising, vehicle and ship monitoring and logistics tracing. Three of the other piggyback satellites are new technology or remote sensing experiment satellites designed and manufactured by SpaceTY Co. Ltd. (Changsha). Alibaba, Huami, Douyu each sponsored one of the cubesat or microsat. The three companies used space as a new marketing platform. The satellites have all entered the orbit.

Ladybird 1/Piao Chong 1 is a 100 kg (some sources say: 91.85 kg) IoT communication satellite equipped with five high-definition cameras and a LED screen for taking pictures of the outer space, which could be used as a panorama virtual reality application, simulating spacewalk experience for users. The satellite also allows people to upload selfies taken on Earth which would be shown on the LED screen and the onboard camera would take a photo of the screen with the backdrop of outer space. Piao Chong 1 is the first step for a later constellation, consisting of 72 satellites of the same type, to be implemented until 2022 by Commsat, a spin-off by the Xi'an Institute of Optics and Precision Mechanics.

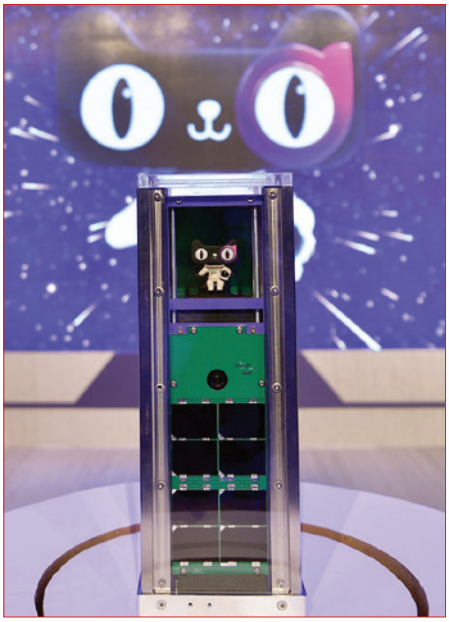
Ladybird 2/Piao Chong 2 (Maowang Shouyinji Xing) is a 6U cubesat for Elvis Presley Radio.

Ladybird 3/Piao Chong 3 (Huami Xing), a 6U cubesat, was sponsored by Smart watch maker Huami Technology, a partner of Xiaomi. The intention is that users of its Amazifit fitness smartwatch can send an emergency rescue call if they are lost or injured. The cubesat would also transmit the health data to the rescuers.

Ladybird 4/Piao Chong 4 (Panda-Sat) is a 6U cubesat, relaying data from a necklace, worn by giant pandas that have been released back into the wilderness. The data provide information about the panda's locations and body temperatures.

Ladybird 5/Piao Chong 5 is a 3U cubesat, also called "Li ke Da Jiaoyu Weixing" (Lida Education Satellite), for Li Da Education Technology Group YG of Shanghai. It will support teaching programmes and Earth observation.

Ladybird 6/Piao Chong 6: On the occassion of the 10th anniversary of Tmall, Alibaba online shopping group sponsored the 3 U cubesat Piao Chong 6. It is also called "Tianmao Quoji Xing" or "Tmall International". It carried 1,111 recordings of love confessions on the occasion of Singles' Day on 11 November (Double 11). The messages could be heard by opening a Tmall-Taobao app and while the satellite was passing over China. Tmall cubesat orbits the Earth once every 90 minutes. Alibaba's satellite attracted the most attention and successfully promoted its multibillion-dollar Singles' Day sales. Alibaba Group Holding owns the South China Morning Post.



The Tmall International satellite.
credit: China Daily/AliExpress

Ladybird 7/Piao Chong 7, a 3U cubesat, is called "RE: X" and is owned by Luhan Studio, associated with the Seoul-based Chinese musician Lu Han.

The other three secondary payloads use the Sagittarius-1 cubesat bus, jointly developed by ADA Space (Guoxing Yuhang Keji, Chengdu) and Tianyi Research (SpaceTY).
NOTE: Numbering of the Tianyi satellites is uncertain.

Tianyi ?/TFSTAR, or Douyu-666, was sponsored by e-sports live streaming platform Wuhan Douyu. "666" is Chinese slang for "smooth" or "skilled". The satellite is dedicated to the newly emerging field of space + entertainment. Having little connection to e-sports, the satellite will be used for connecting users of the Douyu.com video streaming platform. The satellite will broadcast a Christmas giveaway promotion where lucky winners get to meet their favorite game streaming anchors. (According to insiders, naming a satellite usually costs 5 to 10 million RMB. A research on a government purchase website by Commercial Space Magazin revealed that a purchased item named "The 7th World Military Games Brand Promotion Satellite Launch Project" indicated a budget of 5 million RMB.)

Tianyi ? (TY/DF1) is a test satellite for Tianyi's Xingshidai constellation.

Tianyi 3-01 (Xinjiang Jiaotong-01) relays IoT data from road construction, traffic and agriculture in the Xinjiang region.

Note: There is some confusion about Weina-1 03, a satellite from MinoSpace/Weina Xingkong Keji (Beijing), was also involved in this launch. We could not verify this information.

2018-103 (rover)
2018-103A (orbiter)
07 December 2018 - 18:23 UTC (08 December 2018 - 02:23 BJT)

launch site: Xichang Satellite Launch Centre - XSLC
launcher: Chang Zheng 3B/G3Z
payloads: Chang'e 4/Yutu 2

For the second time, China launched a lunar lander mission. CASC officially confirmed the successful launch less than one hour after lift-off, just after completion of trans-lunar injection which sent the craft on a five-day journey to the Moon. For the first time in space history, the mission objective was a soft-landing on the Far Side of the Moon. In preparation for this endeavour, in June 2018 the data relay satellite Queqiao was launched and placed in EML-2 (Earth-Moon-L2) halo orbit.
CE-4 is the repurposed back-up mission of CE-3 (launched in December 2013). The spacecraft have a similar design, consisting of a 1.2 t lander and a 140 kg rover with two solar panels and six wheels. The rover is roughly 1.5 m long, 1 m wide and 1 m tall. The engineers put a lot of effort into improving the rover's reliability, long-term durability and its terrain capabilities, keeping in mind that the CE-3 rover failed early during the CE-3 mission. CE-4's total launch mass was 3.78 t.

The scientific instruments on the lander:
- Landing Camera (LCAM),
- Terrain Camera (TCAM),
- A Low Frequency Spectrometer (LFS) with three 5-metre-long booms, and
- Lunar Lander Neutrons and Dosimetry (LND) (from Germany)
- Student outreach-inspired mini ecosystem

The scientific instruments on the rover:
- Panoramic Camera (PCAM),
- A Lunar Penetrating Radar (LPR),
- A Visible and Near-Infrared Imaging Spectrometer (VNIS) and,
- From Sweden, an Advanced Small Analyser for Neutrals (ASAN).

The scientific tasks of the Chang'e 4 mission include low-frequency radio astronomical observation, surveying the terrain and landforms, detecting the mineral composition and shallow lunar surface structure, and measuring the neutron radiation and neutral atoms to study the environment on the Far Side of the Moon. The lander is equipped with solar cells and a radioisotope thermoelectric generator (RTG battery).
On 30 December, Chang'e 4 entered into a low lunar orbit to prepare for landing during the first days of the New Year, after the sun has risen over the landing site. After careful analysis, the experts chose the Von Karman Crater, named after a Hungarian-American mathematician, aerospace engineer and physicist, situated in the Aitken Basin, as the landing site. The region is believed to have great research potential, and is at a similar latitude to the landing site of Chang'e 3.
The mission is expected to last at least 3 months.

2018-108A
21 December 2018 - 23:51 UTC (22 December - 07:51 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, mobile platform
launcher: Chang Zheng 11
payload: Hongyun 1 (Hongyun-Wuhan, Honygun GJYW)

The launch lifted CASIC's technology-experimental satellite (TES) as the first satellite of the Hongyun Project into the planned 1.100 km SSO. The satellite's full name is: Hongyun Gongcheng Jishu Yanzheng Weixing (Hongyun Engineering Technology Verification Satellite). Since the Hongyun satellites are developed and constructed at CASIC's Wuhan National Space Industry Base, the first satellite is called Hongyun-Wuhan.

The Hongyun Project (Rainbow Cloud project) will become China's first LEO communications satellite constellation of 156 satellites (500 MB/sec data rate per satellite) for global broadband internet services, in particular for remote areas or the pole regions.

The 247 kg cylindrical satellite will verify basic design of the Hongyun satellites and demonstrate the technology feasability, such as the multi-beam millimeter-wave phased array communication antenna. The expected life time is at least one year. According to CASIC, the main payloads are Ka-band transponders and transmission antennae and two solar panels. It also carries several scientific and technical devices, such as AIS and ADS receiver, a DCI data unit and a thermal-spectral scanner, to utilise Hongyun system's applications in science, environmental survey as well as air and sea transportation.

After the successful testing with Hongyun-Wuhan, CASIC plans to launch four serial-produced Hongyun satellites before the end of 2020 to form a small Hongyun trial network. If all goes according to plan, the full constellation could be ready by 2023.

Along with the Hongyun test satellite, gene samples of endangered animals, such as the South China tiger (Kangkang) and the snub-nosed monkey but also of plants like rice, bean and the dandelion flower were sent to space to be preserved in that environment.

The dried DNA powder of the tiger stemmed from a male animal of the Guangzhou Zoo. An aerospace technology company in Shenzhen, Guangdong Province, has jointly with China Academy of Launch Vehicle Technology developed containers for the dried DNA powder.


One of the container for holding the dry powder of DNA of a South China tiger. credit: Chinadaily

2018-110A
24 December 2018 - 16:53 UTC (25 December - 00:53 BJT)

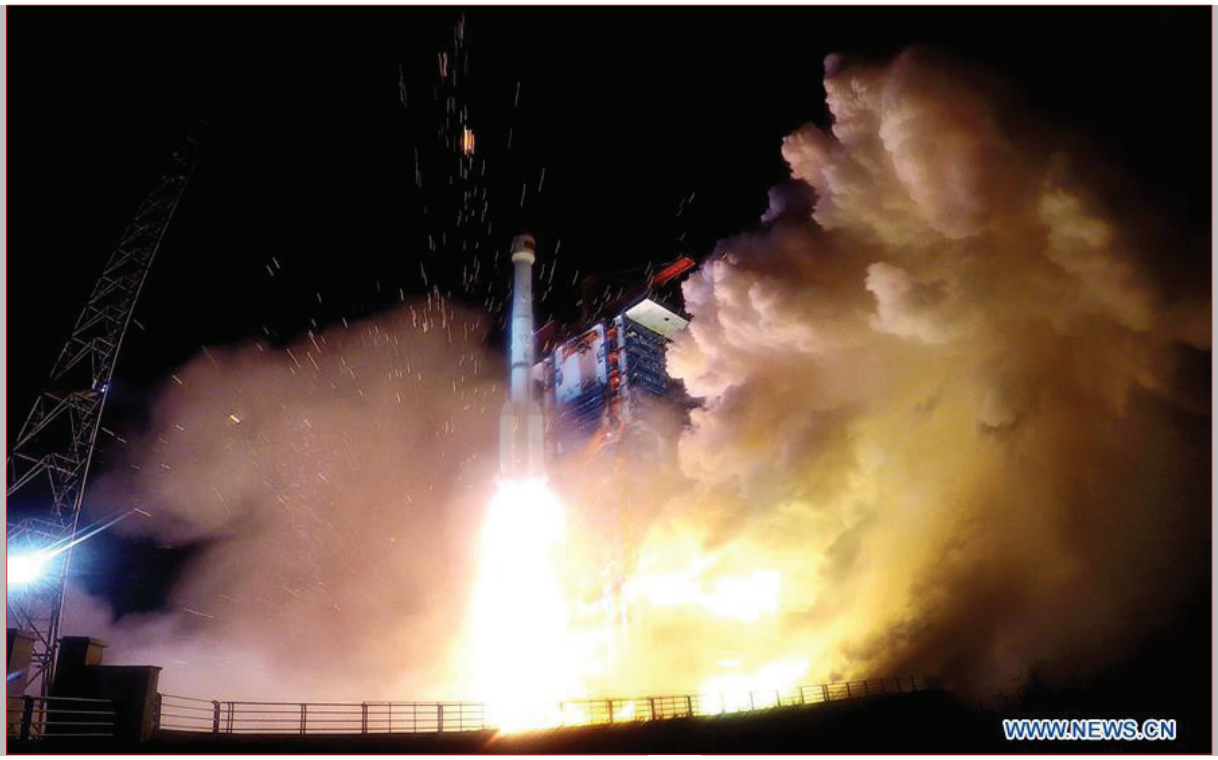
launch site: Xichang Satellite Launch Centre - XSLC, LC3
launcher: Chang Zheng 3C/G2
payload: TJS-3

The GEO communication test satellite TJS-3 (full name: Tongxin Jishu Shiyan Weixing - TJSW = Communications Engineering Test Satellite) was developed and produced by the China Aerospace Science and Technology Corporation. TJS-3 is reported to be a SAST/Shanghai payload, likely based on the SAST-5000 bus. Not much more information is available.
Jonathan McDowell wrote that TJS-3 - by using its apogee engine - reached GEO over 58°E on 31 December. On or before that date, the TJS-3 satellite ejected what appeared to be a sub-satellite. By 13 January both satellites were on station near 59°E about 100 km apart (0,16°). By 28 January the separation had been adjusted to about 90 km. Later on the supposed sub-satellite was observed at a distance of 200 km East of TJS-3.

2018-112A 2018-112B 2018-112C 2018-112D 2018-112E 2018-112F 2018-112G
29 December 2018 - 08:00 UTC (16:00 BJT)

launch site: Jiuquan Satellite Launch Centre - JSLC, LC43-LP94
launcher: Chang Zheng 2D/YZ-3
payloads: **Chongqing (Hongyan 1)** **Yunhai 2-01** **Yunhai 2-02** **Yunhai 2-03** **Yunhai 2-04** **Yunhai 2-05** **Yunhai 2-06**

With the launch of the first Hongyan satellite (Hongyan 1 or: Chongqing) the work on Phase 1 of CASC's 60 satellite constellation began. Until 2023, 60 Hongyans should be in orbit. The costs for this initial project phase was given with 20 billion RMB (2.9 billion USD). In the next phase until 2025, the constellation will grow up to 300 satellites. The Hongyan constellation is intended to facilitate two-way communications at all times across all terrain, providing a wide range of civilian services such as ground data collection and exchange, ship identification and tracking, mobile broadcasting and navigation signal enhancement. The full constellation can provide mobile connectivity to 2 million users, broadband to 200,000 users, and IoT to 10 million users within China and the Belt-and-Road countries. The constellation will be operated by the Aerospace Dongfanghong Satellite Company. Together with the Beidou navigation system, Hongyan will form the integrated satellite system "Kuilong" for ultra-precise positioning services.
Hongyan 1 is intended for technological demonstration, verifying the satellites' compatibility with low-orbit and data-transmission capacity in L- and Ka-band. It operates in an 1,100 km orbit. Hongyan satellites are six-sided, box-shaped satellites with two solar panels.
Together with Hongyan 1 (Chongqing), the meteorology satellites Yuanhai 2-01 to 2-06 were launched. The six Yunhai satellites are atmospheric environment research satellites, used to study the atmospheric environment, monitor the space environment, prevent and reduce disasters, and conduct scientific experiments. They were built by DFH Shenzhen.
For the launch on 29 December 2018, for the first time the Yuanzheng-3 (YZ-3) upper stage was used. Yuanzheng means expedition in Chinese. YZ-3 can re-start up to 20 times and can conduct 10 spacecraft separation events. On 29 December, YZ-3 deployed first the Hongyan 1 satellite and three of the Yunhai 2 secondary payloads. After two more burns, the remaining three Yunhai 2 satellites were released. Jonathan McDowell reported that the YZ-3 stage most likely made a deorbit burn and probably re-entered near Australia around 11:45 UTC.
This mission was the 39th and final Chinese launch of the year accounting for the highest number of launches by any nation in 2018.



Beidou launch 18 November. credit: (Xinhua/ Ju Zhenhua)

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

http://news.xinhuanet.com
http://www.xinhuanet.com/english/list/china-science.htm

AO	Announcement of Opportunity
APSCO	Asia-Pacific Space Cooperation Organisation
BACC	Beijing Aerospace Command and Control Centre
BDS	BeiDou satellite navigation System
BISME	Beijing Institute of Space Mechanics and Electronics
BJT	Beijing Time
BRI	Belt-and-Road Initiative
CALT	China Academy of Launch Vehicle Technology, 1st Academy of China Aerospace Science and Technology Corporation CASC
CAS	Chinese Academy of Sciences
CASC	China Aerospace Science and Technology Corporation
CASIC	China Aerospace Science and Industry Corporation
CAST	China Academy of Space Technology
CBERS	China-Brazil Earth Resources Satellite
CCT	China Communication Technology Satcom
CCTV	China Central Television
CE	Chang'e
CFOSat	China-France Oceanography Satellite

https://www.nasaspaceflight.com
http://www.spaceflightinsider.com

CGWIC	China Great Wall Industry Corporation
CLEP	China's Lunar Exploration Programme
CMA	China Meteorological Administration
CMSA	China Manned Space Agency
CNSA	China National Space Administration
CSS	Chinese Space Station/China Space Station
CZ	Changzheng, Long March
DFH	Dong Fang Hong
ESA	European Space Agency
EVA	Extravehicular Activity
FAST	Five-Hundred Metre Aperture Spherical Radio Telescope
GEO	Geostationary Orbit
GNSS	Global Navigation Satellite System
HKU-ZIRI	University of Hong Kong - Zhejiang Institute of Research and Innovation
HTS	High-throughput satellite
IAU	International Astronomical Union
IGSO	Inclined Geosynchronous Orbit
IoT	Internet of Things
KACST	King Abdulaziz City for Science and Technology
LEO	low Earth orbit

https://spaceflightnow.com
http://www.planet4589.org/space/jsr/jsr.html

LEOP	launch and early orbit phase
LIGO	Laser Interferometer Gravitational-Wave Observatory
MoU	Memorandum of Understanding
NSSC	National Space Science Center
PNT	Positioning, Navigation and Timing
P/L	payload
PRN	Pseudorandom noise
Roscosmos	Russia's State Space Corporation
SAR	Synthetic Aperture Radar
SAST	Shanghai Academy of Spaceflight Technology
SQX	Shuang Quxian
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
TG	Tiangong
UN	United Nations
UNICG	United Nations International Committee of the Global Navigation Satellite Systems
UNOOSA	UN Office for Outer Space Affairs
UTC	Coordinated Universal Time
YW	Yuanwang
ZQ	Zhuque

Imprint

Go Taikonauts! e-magazine - Copyright 1998-2019 © Go Taikonauts! Team

for issues 1 - 17, the **Go Taikonauts! e-magazine** can be downloaded **on iTunes**:
http://itunes.apple.com/de/app/go-taikonauts!/id454679742?mt=8
for issues 1 - 18, the **Go Taikonauts!** PDF can be downloaded **from the web**:
www.go-taikonauts.com > e-magazine iPad App
As of issue 19 you can subcribe to the printed version.

Go Taikonauts! team
Dr. William Carey - Dave Chen Qing - Chen Lan - Jacqueline Myrrhe
V.i.S.d.P.: Uwe Schmaling

Contact: info@go-taikonauts.com
Web site: www.go-taikonauts.com

Go Taikonauts! print version is issued by:
Initiative 2000 plus e.V.;
Dümperstrasse 5,
17033 Neubrandenburg,
Germany
copies can be ordered via e-mail:
rcspace@t-online.de

printing house:
WirmachenDruck.de
Sie sparen, wir drucken!

pricing

single printed issue:
mailing within Germany: 10 €
mailing outside Germany: 15 €
for consultants/analysts/members of media, space companies, think tanks, space organisations: 100 €

annual subscription of 4 printed issues:
mailing within Germany: 31 €
mailing outside Germany: 42 €
for consultants/analysts/members of media, space companies, think tanks, space organisations: 400 € (including two adverts of 1/3 page)

UNISPACE+50 – When the world talks space

Report from the United Nations Global Space Conference

by Jacqueline Myrrhe

There are a few real global space conferences that take place regularly.

The one which represents the highest possible level, hosted and organised by the United Nations, comes together on quite an irregular basis. In fact, since its inception in 1968, the break between the conferences has become longer and longer each time.

The first United Nations conference, dedicated to the exploration and peaceful uses of outer space, UNISPACE I, took place in Vienna in 1968. 14 years later, the platform for global exchange in the field of space matters, was UNISPACE II in 1982. 17 years after that, in 1999, the world joined for UNISPACE III. There were participants in 1999 who proudly showed all three conference badges of the first three UN space conferences. They had hoped to "collect" the "IV-Trophy" as well. However, it took another 19 years until the Director of UNOOSA, Ms. Simonetta Di Pippo, welcomed the global space community for its most recent summit: UNISPACE+50 – celebrating the 50th anniversary of the United Nations space conferences. It is not very likely that experts who attended the first UNISPACE conference in 1968 were still attending the forum 5 decades later in 2018. While in 1968, 24 nations were present, last year in Vienna UNOOSA represented 87 Member States. The latest count of Member States has reached 92 with 3 more applying this year, as Simonetta Di Pippo pointed out in a recent interview. (see: *GoTaikonauts!, issue no. 25, p. 27/28*)

This shows how dynamically the reality of space has changed. UNISPACE+50 was marked by both: the legacy of the 50th anniversary of the first UNISPACE conference, and taking stock of the contributions to global space governance on the one side and on the other as being the first United Nations space summit of the twenty-first century with the objective of looking ahead to guide the world for the sustainable use of outer space.

The UNISPACE+50 summit consisted of two main parts: the UNISPACE+50 Symposium, aimed at the broader space community, taking place on 18 and 19 June 2018; and the dedicated UNISPACE+50 High-level Segment of the 61st session of the Committee on the Peaceful Uses of Outer Space (COPUOS) on 20 and 21 June 2018. From 22 to 29 June, COPUOS continued with its regular session, the 61st COPUOS.

The 2018 UNISPACE event was the opportunity for the "increasing by numbers and becoming more diverse by scope world-wide space community" to gather and consider the future course of global space cooperation for the benefit of humankind. The "Space2030" agenda was discussed, aiming at the sustainable preservation of outer space for future generations and cooperation across all stakeholder groups of society.

Most important for the work of UNOOSA, the resolution entitled "Fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space: space as a driver of sustainable development" was adopted on 20

Space2030 agenda

2015 was the year when 3 forward-looking documents concerning mankind as a whole were published:

- the 2030 Agenda for Sustainable Development,
- the Sendai Framework for Disaster Risk Reduction 2015-2030 and,
- the Paris Agreement.

Because of its scale and global impact, it became obvious that supporting structures at all levels were needed to turn the words of these documents into a liveable reality for the citizens on planet Earth. Of particular relevance are "improved space-based data, space infrastructure, services and applications, underlining the need to consider space as one of the key drivers for the attainment of the internationally agreed development goals."

To meet those needs "the "Space2030" agenda outlines a comprehensive and inclusive long-term vision for space: the contribution of space activities to achieving the Sustainable Development Goals and to address overarching long-term development concerns, on the basis of the peaceful exploration and use of outer space."

"The "Space2030" agenda is aimed at reducing the space divide, defined as the gap between those nations that have developed space-related capabilities and technologies, and those that do not have access to such capabilities." The "Space2030" agenda introduces initiatives, programmes and projects "to bridge the space divide, make space accessible to everyone, everywhere, and foster synergies and collaboration between the space and non-space sectors; facilitates international cooperation in space exploration and innovation between space nations and emerging space nations and within the broader space community; addresses challenges relating to the safety, security and sustainability of outer space activities; and is aimed at strengthening international efforts to effectively use space-based data, science, technology and applications, including for the monitoring of climate variables, in order to address sustainable development- and climate-related challenges.

The "Space2030" agenda calls for actions under the four cross-cutting pillars and their strategic objectives:

- Space economy: development of space-derived economic benefits;
- Space society: advancement of the societal benefits of space-related activities;
- Space accessibility: access to space for all;
- Space diplomacy: building partnerships and strengthening international cooperation and the governance of space activities.

Some of the emblematic measures of the "Space2030" agenda are:

- Increase membership of the Committee on the Peaceful Uses of Outer Space to 120 States by 2030;
- Ensure that States are invited to and have participated in at least one training course/capacity-building activity of the Office for Outer Space Affairs;
- Achieve the balanced participation of women and men in those activities to ensure gender parity by 2025;
- The year 2025 should also be declared by the General Assembly as the "International Year of Space".

June, and together with the "Space2030" agenda and its implementation plan was forwarded for consideration to the 73rd session of the UN General Assembly on 26 October 2018.

In addition, a UNISPACE+50 exhibition attended by 40 exhibitors was held in the Rotunda of the Vienna International Centre from 18 to 23 June. China was present with one booth by CASIC/CASC, one by CNSA, one by CMSA and one by CSNO, the China Satellite Navigation Office.

At the panel "Space and Youth" on 19 June, Kaori Sasaki of the JAXA Space Education Centre showed a link to free education material, produced by JAXA:

During the panel "Space and Civil Society" on 19 June, Michael Simpson, the Executive Director of the Secure World Foundation pointed to the Handbook for New Space Actors by the Secure World Foundation:

Compared with UNISPACE III, UNISPACE+50 was very different. Back in July 1999 UNISPACE III consisted of two-weeks of events, entirely dedicated to the special gathering of UNOOSA Member States by that time. There were astronaut events, video trailers, daily press conferences, panels on different topics, and working groups active to define the "Vienna Declaration" (Space Millennium: Vienna Declaration on Space and Human Development) comprising 33 recommendations for a strategy to address the challenges in outer space activities. The Space Generation Forum for students and young professionals and the World Space Week were established. It was a mix of work, show, entertainment, and networking. Outside the conference venue, activists engaged with delegates to express their disagreement with the use of a radioisotope thermoelectric generator on board the NASA-ESA-ASI deep-space mission Cassini-Huygens, launched in October 1997. Inside the conference building, the US and Russia made active efforts to win over the present journalists by talking to them personally. A practice, which was not exercised anymore 19 years later.

And there was another noticeable shift: The rising space nation in 1999 was India, with Udupi Ramachandra Rao presiding over UNISPACE III. At UNISPACE+50 the newcomer was China. But India and China did not simply swap roles, China has become an active player within the UN arena. It is not only showing flag and significance, but also invests financially and plays the diplomatic soft-power card.

China organised the side event "China's Space Cooperation: Towards a Shared Future and Benefits for All" on Tuesday, 19 June, where the China Manned Space Agency donated the model of the Chinese Space Station to UNOOSA and the Beidou Navigation Satellite Office donated a model of the Beidou Navigation Satellite.

Also, during the event two agreements were signed:

1. Amendment to Framework Agreement between the United Nations, represented by the Office for Outer Space Affairs and the China Manned Space Agency concerning cooperation on the Utilisation of China's Space Station.
2. Declaration of Intent to Cooperate on the Belt and Road Space Information Corridor between the United Nations, represented by the Office for Outer Space Affairs and the China National Space Administration.

For the attentive observer, this event showed some degree of surrealism. First of all, the event room was packed - it could not accommodate all interested people. It was not that long time ago that China would call for an event and the interest would be moderate. Not in 2018 in Vienna: China received the full attention of the UNISPACE+50 community. On the other hand, it was strange to see the older generation of US space experts sitting in the last row, palpable at a certain distance to the centre of activity.

Before the event started, Yang Liwei arrived ahead of time but waited outside the room. All of a sudden a bustling buzzing and chirp filled the room and all those Chinese present rushed outside. One of the high-ranking officials must have asked Yang Liwei whether he would be ready for a photo shoot. So, the big crowd headed outside to take photos with him – jolly and chaotic.

After the event, Tian Yulong, Secretary General of CNSA was ready to talk to journalists. In a rare opportunity and in a casual atmosphere, he was answering any question without saying too much.

He confirmed what Shi Zhongjun, the Ambassador and Permanent Representative of the People's Republic of China to the United Nations in Vienna told GoTaikonauts! already in May 2018, when China and UNOOSA announced the opportunity for research on-board China's Space Station (*compare: Special Edition for UNISPACE+50, p. 6*).

Tian Yulong reaffirmed, that China is continuously making progress in the exploration of space. China is aiming for deep-space exploration, which will in the future also include manned deep-space endeavours. The overall support by the Chinese government for space activities is and will remain strong, which is indicated by the provision of long-term and growing governmental budgets.

Tian Yulong answered in the affirmative that China is striving to become a leading space nation. Along the way, it is a strategic objective to support the efforts of UNOOSA.

The UNISPACE+50 Symposium went on with the **Head of Space Agencies panel** on the afternoon of the 19 June.

The panel gave the floor to 29 representatives of international space agencies. The statements given here were often the same albeit shorter than given during the COPUOS High-Level

left: UNOOSA Director Simonetta DiPippo (2nd from left). Middle: Yang Liwei and Dumitru Prunariu. Right: Group photo with Yang Liwei. credit all photos: GoTaikonauts!

segment by the delegations in the afternoon of the 20 June and on the morning of the 21 June.

In general, all Member States agreed to the high importance of the work of UNOOSA. There is no alternative to the SDG (Sustainable Development Goals) of the UN, therefore concerted efforts have to be made in achieving them. It was widely recognised by the Heads of Agencies and the delegations that UNOOSA and the UN are the relevant and the only global political platform for exchange and dialogue and do act as a unifying force. UNOOSA is respected and demanded as the global authority of global governance regarding outer space matters. All Member States could clearly see the advantage to use space exploration and its application as a tool for societal development, in particular of developing countries. The foundation for that is that fair conditions for the use of outer space must be available for all nations. The prevention of the militarisation of space is an imperative.

By giving their statements, the Member States used the opportunity to talk about the focus of their respective national programmes and their work and projects in support of the SDGs.

Developing countries and non-space faring countries showed confidence in requesting fair conditions in the conquest of outer space. A criticised principle was the first-come-first-serve practice in the distribution of GEO slots. This excludes non-space fairing nations by default.

Here are some details from a small selection of statements:

UNOOSA Director **Simonetta DiPippo**, sees UNISPACE+50 as a starting point for broader space activities with more players. She reflected on her office as a type of "broker" to bring different interests together, and also stressed that UNOOSA has entered into many innovative partnerships which cover the full spectrum of space activities. (When looking at this portfolio, an outside observer could conclude that those activities might enable UNOOSA to set up a space programme - including an UN astronaut corps.) Director Di Pippo continued by pointing out that UNOOSA currently comprises of 87 Member States with 5 pending applications. She said that the commitment to the SDGs made it possible to "think outside the box" and involve also other UN entities in the work of UNOOSA and to offer services for the whole UN community. UNOOSA gave institutional support for nations which intended to set up national activities.

The representative of **The Netherlands, Mr. Eelco van der Eijk**, National Coordinator for Space Policy of the Ministry of Economic Affairs came with a concrete idea of how to solve one of the pressing problems in space utilisation. He proposed to use LEO instead of GEO for space newcomers to overcome the problem with limited GEO slots. He said: "Madame Chair, your excellencies, ladies and gentlemen, let me also take this opportunity to ask your attention to the specific matter of getting access to the Geostationary Orbit (GEO), in particular for the developing world. It is nowadays very difficult for newcomers to obtain proper orbit and frequency rights to geostationary locations since the GEO orbit has become highly saturated.

The full speech by the representative of The Netherlands can be read here:

However, the Netherlands has the view that there is another way to get access to space for developing countries and that is by obtaining international rights on Low Earth Orbits and frequencies, and to operationalise satellites in this area of space. The costs of satellites in a LEO orbit is only a fraction of the costs of satellites in GEO orbit and therefore operating satellites in LEO orbit might be a much better way to obtain access to space for developing countries. The Netherlands, in cooperation with other member states, is working towards a proposal in this respect for the next meeting of the Scientific and Technical Subcommittee Committee in 2019."

Dmitry Rogozin, President of the State Space Corporation **Roscosmos**, criticised the blockage of regulations on the space environment by some Member States. He urged that national regulations are not sufficient for outer space activities and therefore international rules and laws must govern activities in that environment.

The full text of the speech by Dmitry Rogozin (in Russian) can be found here:

For the full statement by the Head of the Chinese delegation, H. E. Ambassador Shi Zhongjun, follow the link in the QR code or see the textbox on pages 23/24.

H.E. Mr. Shi Zhongjun, Ambassador of the People's Republic of China and Permanent Representative to the United Nations in Vienna sees UNISPACE+50 as the start of future governance of space activities. The Asian nations want to see the role of the UN strengthened. He proposed to apply the principle of a shared future and a shared vision for the future of all mankind into space activities. China is already supporting important UNOOSA programmes and will continue to do so. Among those programmes are the utilisation of the future Chinese Space Station for UNOOSA Member States; meteorological service for SCO countries; UN Spider in Beijing; and the Belt-and-Road-Initiative.

On behalf of **The Republic of Iraq, H.E. Mr. Abdulrazzaq Abduljaleel Essa Alhajessa**, Minister of Higher Education, Scientific Research, Science and Technology, reaffirmed its support for UNOOSA. Moreover, the Republic of Iraq asked to close the space divide, not only in the access to space but also the divide in the availability of space technologies. The speaker called for developed countries to engage in technology transfer and build-up of space capacities in developing countries. Specifically, he proposed the free exchange of space data.

Full text of the statement (in Arabic) by the Delegation of Iraq:

Further, he thanked the UN for the approval of the satellite launch by the Iraqi nation.

He stressed, that Iraq favours the use of outer space for peaceful purposes and strongly rejects any militarisation of outer space. To that end, Iraq favours relying on the UN law for outer space.

Statement by **H.E. Mr. Kim Kwang Sop, the Ambassador Extraordinary and Plenipotentiary of the Democratic People's Republic of Korea**: The DPRK is fully supportive to UNOOSA, the SDG and the peaceful exploration of outer space. The North Korean Nation has a Space Policy in place which outlines the use of outer space for the benefit of the people and recognises the principles of independence and self-reliance. Also, since 2013 there is a law on space development in place. The DPRK recognises the use of space as a measure of the overall strength of a country and stressed the legitimate right of any nation for the exploration of space.

Full text of the statement by H.E. Mr. Kim Kwang Sop:

Full text of the statement by the Delegation of the Islamic Republic of Iran:

Mr. **Morteza Barari, Deputy Minister of Information and Communication Technology and President of the Iranian Space Agency**, speaking for The Islamic Republic of Iran, conveyed a clear message for cooperation. The speaker called for non-discrimination and open access to data and technologies and the use of small sats. Iran assured its full support to the work of UNOOSA.

From the statement, made by Mr. **Li Xinjun, Secretary General of APSCO – Asia-Pacific Space Cooperation Organisation**

"APSCO strives to provide a regional mechanism for co-operation through resource-sharing, critical capacity-building and jointly space-developing programs as we have a shared vision. Integration of resources mitigates costs and risks, and brings tangible benefits and outcomes for Member States. Our cooperative activities are enabling to the use of spatial data for the socio-economic development in the Asia-Pacific region, and contributing directly to the Sustainable Development Goals and SPACE2030.

APSCO believes in strengthening the global governance of outer space to engage all countries, especially the needs and requirements of developing countries. APSCO attaches great importance to its international cooperation, with UN-OOSA, UNESCAP, UNSPIDER, IAF, ESA and other international space-related organizations and institutions. ...

APSCO is contributing to critical capacity-building in its members through need-based short and intensive trainings, and degree education. The trainees and graduates are all making valuable contributions in the Member States. APSCO Space Science Schools and Space Innovation Contests have encouraged new generation to explore space science and develop the idea of future universe.

The advantage of vast geographic displacement of APSCO Member States offers opportunities for connecting the "Ground Stations" at different places to maximize the efficiency of space activities. So far, 6 networks have been initially established among APSCO Member States. Our Data Sharing Service Platform provides Member States with free Earth-observation images for research and disaster management. A Global Earthquake Monitoring and Prediction Platform is under establishment by using the ground ionospheric monitoring conditions and Seismo-Electromagnetic Satellite. Based on three in-orbit remote sensing satellites, APSCO joint Small Multi-Mission Satellite Constellation is under design phase.

Space is not only a driver of sustainable development, but a growth multiplier, a vehicle of progress for social well-being. APSCO will continue to play its vital role in bringing socio-economic benefits of space to developing countries in the Asia-Pacific region."

Full text of the statement by APSCO:

Tian Yulong in casual talks. credit: GoTaikonauts!

From the statement by the PR China:

"Now I'd like to state further China's following three propositions:

First, we should foster a sense of shared future to promote the sustainable development of outer space. The UNISPACE+50 outcome document points out the need to realize a shared vision for the future in the exploration and use of outer space for peaceful purposes and for the benefit and in the interest of all humankind. This agreement is a core concept of the outcome document and also an important contribution of UNISPACE+50 to the development of future outer space governance policy.

A shared vision for the future in space exploration and use is not only consistent with the objectives and purposes established in the Outer Space Treaty that the exploration and use of outer space should be for the benefit and in the interest of all countries but also in line with current needs to protect the outer space environment and promote sustainability both for outer space activities and socioeconomic development; it reflects the common aspiration of the international community and points the clear direction for strengthening the global governance of and international cooperation in outer space in the new era, as well as addressing various challenges in the peaceful uses of outer space.

China has always strived to uphold that vision in strengthening international cooperation in the peaceful uses of outer space. Yesterday, the side event themed "China's Space Cooperation: Towards a Shared Future and Benefits for All" showcased the practical initiatives taken by China to promote, through open cooperation, the realization of a shared vision for future space exploration and use. China stands ready to work tirelessly with other countries to this end.

Second, we should follow the principle of wide consultation, joint construction and shared benefits in taking the global space governance to a new level. Currently, space congestion highlights the difficulties of governance, the emergence of a commercial space industry calls for regulatory reform, and large numbers of developing countries have yet to benefit fully from space technology. Meeting these challenges requires the pooling of wisdom and efforts from various stakeholders. The governance framework built on the UN treaties, principles and resolutions on outer space with COPUOS as its main platform has, by and large, worked and should continue to be maintained and strengthened in the future. At the same time, the specific mechanisms and rules of the framework should be continuously improved on the basis of equal participation of and discussion among states so as to grasp and respond to in a keen and timely manner the various needs and challenges of current activities in the peaceful uses of outer space. These include planning and optimizing the working mechanism as well as enhancing the efficiency and role of COPUOS through developing a space2030 agenda and its implementation plan; allowing UNOOSA to play its role fully and effectively by making full use of available resources; promoting the universalization and more equal, full and effective application of the relevant outer space treaties; and responding to emerging issues timely and effectively using the COPUOS platform by complementing and developing the rules governing outer space, as appropriate.

As a party to the main treaties on outer space, China has supported and participated in the consultations on the relevant UN principles and guidelines, including consultations on the guidelines for the long-term sustainability of outer space activities as well as discussions on emerging issues such as the exploration and exploitation of outer space resources and management of small satellites, among others. At home, China has faithfully fulfilled its treaty obligations by improving relevant

legislation and implementing it in space activity planning and regulation. China will continue, via COPUOS, its in-depth engagement with the international community in efforts to improve the global governance of outer space.

Third, we should adhere to the principle of cooperation and mutual benefit in deepening cooperation in the various areas of outer space. Cooperation is the eternal theme of the peaceful use of outer space and key to improving space capacity, meeting common challenges and achieving sustainable development driven by space technology. The UNISPACE+50 outcome document reconfirms the importance of and points out the specific direction for international cooperation, including taking into account the special needs of the developing countries. Consensus on these issues should be implemented fully and effectively. China welcomes COPUOS and UNOOSA to continue playing their coordinating and promotional role in this regard.

China has been promoting cooperation with various parties under the principle of openness, inclusiveness and mutual benefit, paying particular attention to supporting the applications requirements of and capacity building in developing countries. Addressing the 18th Meeting of the Council of Heads of Member States of The Shanghai Cooperation Organization on 10 June, President Xi Jinping announced that China is ready to offer meteorological services using the Fengyun-2 meteorological satellite. On 28th May, China and the UN put out an announcement on first-round cooperation opportunities for experiments on-board the China Space Station (CSS), inviting other countries to do experiments on-board the CSS using their own experimental payloads or those provided by China and do extra-vehicular experiments using their own EV payloads. Astronauts or payload specialists will be given opportunities for orbital flight in the future. China provided 18 million RMB for the UN-SPIDER Beijing office in support of disaster prevention and management in regional countries. The UN-affiliated Regional Centre for Space Science and Technology Education in Asia and the Pacific (China), located in Beihang University, has trained nearly 800 space science and law specialists from regional countries. The Chinese government has always supported and will continue to support the work of the Asia Pacific Space Cooperation Organization and expand exchanges and cooperation among countries in the Asia Pacific region in the peaceful use of outer space.

The Belt and Road initiative has also brought strong impetus to space cooperation. With multiple countries and regions along the Belt and Road, China has established mechanisms of cooperation in the satellite navigation area and will jointly build a Belt and Road space information corridor to promote information connectivity in the regions concerned.

Madam Chair,

The cause of space exploration and use is going strong. China stands ready to work with other countries to implement the outcome of UNISPACE+50 and contribute to realizing the shared vision for the future in the peaceful uses of outer space for the benefit of all humankind."

Full text of the statement by China:

All audio recordings of the statements given during the Plenum of the 61st COPUOS can be found on this website (search for: 61st COPUOS): http://www.unoosa.org/oosa/audio/v2/meetings.jsp?lng=en

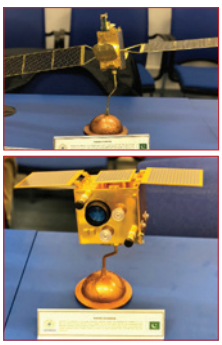
right: Dmitry Rogozin, President of the State Space Corporation Roscosmos gives the statement for Russia.
far right: Pakistan's SUPARCO donated several satellite models to UNOOSA.
credits: GoTaikonauts!

All statements made at the UNISPACE+50 High-level Segment, 20-21 June (20 = Wednesday, 21 Thursday) can be found under the bullet point "Statements made at the UNISPACE+50 High-level Segment, 20-21 June", following this link:

UNISPACE+50 showed that it was high time to come together again. The whole space community has changed significantly since 1999. Not only the diversity of stakeholders is new, but also pressing issues such as space law and the utilisation and exploitation of space resources need a review. At the same time our home planet needs more than ever protection. The importance lies also in the fact that nations express their different or converging viewpoints and debate the way forward. Many answers and solutions can be found by or with space applications. And many answers could be found while cooperating internationally or globally. 2018 was a good beginning for that.

Group photo with Heads of Space Agencies. credit: UNIS

Yang Liwei and Simonetta Di Pippo reveal a model of the CSS which was donated by China to UNOOSA for its space exhibition. credit: GoTaikonauts!



Following Yuanwang tracking ships

by Brian Harvey

China has, since the 1980s, developed a fleet of ocean-going tracking ships, now supplemented by a range of overseas land stations, such as Swakopmund, Dongara, Malindi and Neuquen. As was the case with the Soviet Union's fleet of tracking ships, sadly disbanded in the 1990s, the location and activities of the tracking ships can tell us much about present and planned space activities.

China's current tracking fleet comprises the Yuanwang 3, 5, 6 and 7. This is an account of the movements of these Chinese tracking ships from mid-June to mid-September 2019 and their implications. This report is based on the automatic identification system carried on all ships. This provides periodic - often frequent, but not always so - identification signals of location, speed and direction and also notices of arrivals and departures, actual or intended. Speed is given in traditional units, nautical miles per hour, or knots.

At the opening of the quarter, 16 June 2019:

- Yuanwang 3 was in Micronesia heading south east (101˚) at 16.2 knots, the only one on a voyage.
- Yuanwang 5 and 7 were moored at the Jiangyin base on the Yangtze, upriver from Shanghai.
- Yuanwang 6 was heading westward (263˚) from Haikou, capital of Hainan island at 12.8 knots and the next day arrived at Tieshan on the mainland near Beihai where it stayed until 24 June, before heading south, turning and moving up the coast northward to the west of Taiwan, where it passed Fuzhou on 7 July and then stopped in Luoyuan Bay.

Yuanwang 3 slowed on the 20 June near Baker island, periodically continuing east in the direction 101˚, stopping early July just south of the equator. It appears to have returned quite quickly after that and was back in Shanghai on 7 July.

By 8 July all ships were stopped: 3, 5 and 7 in Shanghai and 6 in Luoyuan Bay. It is also the case that there were frequent small movements between anchorages in Shanghai itself, which may have been due to the availability of individual anchorages, repairs, loading or fittings.

On 9 July, Yuanwang 5 left Shanghai and headed east, 91˚ at 17 knots into the East China Sea, the second voyage in this story. By 11 July, Yuanwang 5 was in the Philippine Sea, heading 145˚ south east at 19 knots. It passed Guam on the 13 July, the equator on the 17, Vanuatu on the 19, Fiji on the 20, Tonga on the 22, was 23˚ south on the 23 and almost reached the international date line before turning around and passing Fiji again on the 28 where it loitered, before entering port at Suva, Fiji on 31 July where it stayed for nine days before heading north. On the 15 August, Yuanwang 5 was almost stationary near Roreti island, which is about half way between Hawaii and Australia, north of Tuvalu island, staying there until 20 August, on which date it announced its return to Shanghai, where it arrived at Jiangyin on 3 September after almost two months at sea.

Meantime, Yuanwang 6 headed back down the coast again through the Straits of Taiwan, eventually heading far upriver to Zhongshan port, near Macao and Hong Kong where it arrived on 12 July. Yuanwang 6 stayed there until 3 August, travelled to Shanghai on the 4 but was back in Zhongshan by the 8, leaving on the 12 when it again passed Hong Kong, reaching Fuzhou on the 15 and then its former mooring in Luoyuan Bay, returning to Zhongshan on the 20.

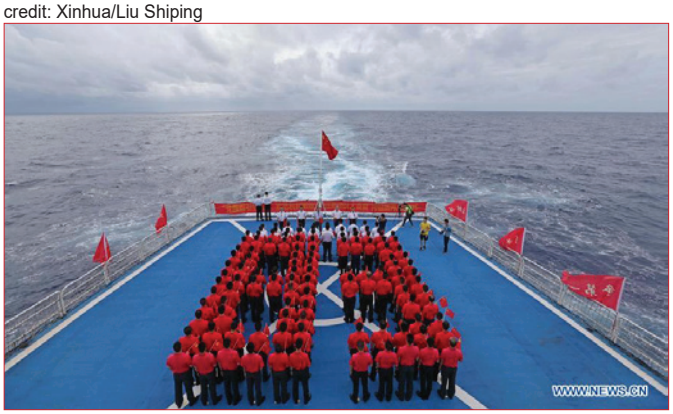
All ships were in port until 12 September when Yuanwang 7 departed for the high seas.

During this period, there were two voyages:

- Yuanwang 3, which concluded its mission on 7 July (there is

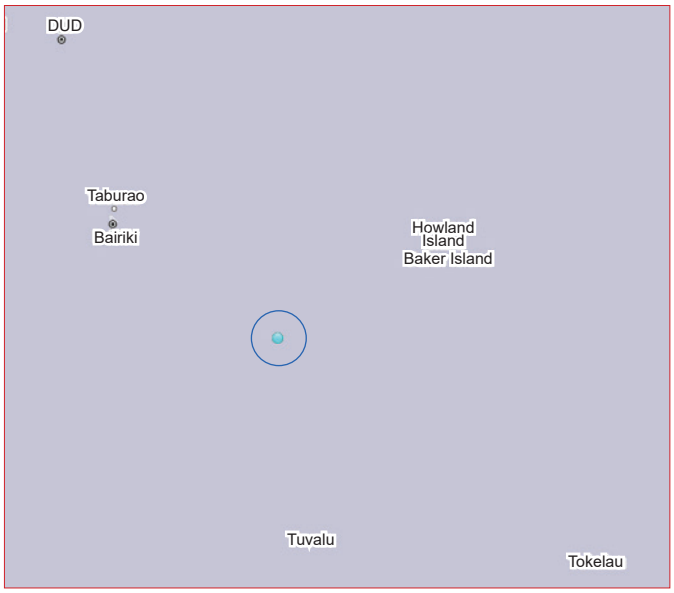
This photo shows the Yuanwang 3 sailing at the mouth of the Yangtze River, on 5 July 2019 returning from a one-month long tracking mission in the Pacific Ocean for the launch of the 46th Beidou satellite on 25 June. It arrived at its home port on 8 July. credit: Xinhua/Li Yuze

A close-up view of the Yuanwang 3 antennas. The photo was taken on 23 June 2019. credit: Xinhua/Liu Shiping

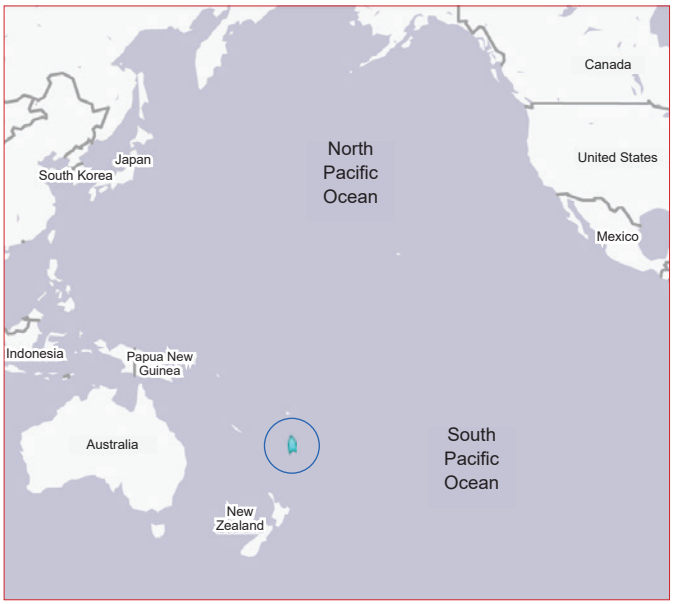


Yuanwang 3 sailing in the open ocean on 10 June. It is heading to the Southern Pacific Ocean to support the launch of the 46th Beidou satellite on 25 June. credit: Xinhua/Li Shiping

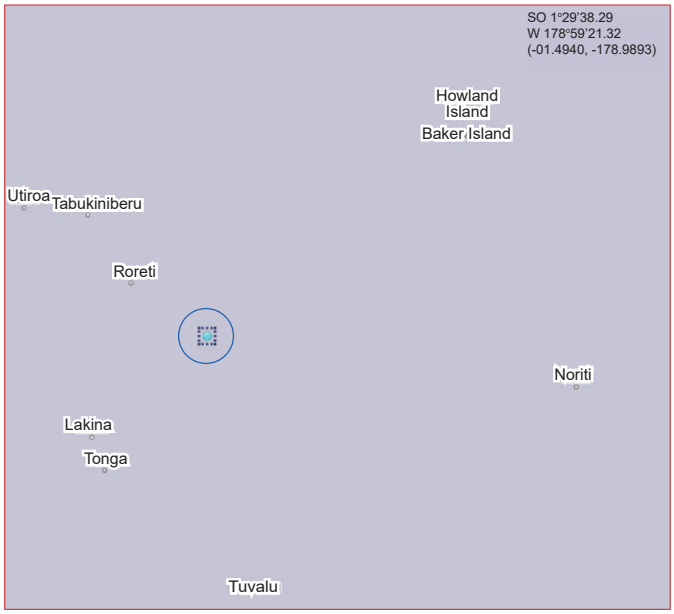
View of the Yuanwang 3 bridge on 8 July 2019 with the captain Ni Liuguo in the front left of the photo. Yuanwang 3 was returning from its one month long mission to the Southern Pacific Ocean. credit: Xinhua/Li Yuze



Yuanwang 3's position in early July 2019 (blue dot in blue circle).
credit: MarineTraffic



Yuanwang 5's most extreme position, July 2019 (blue arrow in blue circle).
credit: MarineTraffic



Yuanwang 5 near near Roreti, August 2019 (blue dot in blue circle).
credit: MarineTraffic

no information here on when it started; approx. one month)
- Yuanwang 5, which made a two-month expedition beyond Fiji, slowing at two locations.

Yuanwang 7 remained in port throughout the period. Yuanwang 6 moved frequently between ports and bays on the south-east coast. It is not clear why, but it may be for outfitting of equipment or possibly the lack of a settled anchorage.

When ships are on station, they cruise at a low speed (e.g. two knots). Soviet recovery ships during the Zond programme used to stop DIW (Dead In the Water) but that is not the case here. Presumably the big tracking ships need electrical power, so the engines are kept turning.

The issue of interpretation concerns the missions of Yuanwang 3 (mid-June to early July) and Yuanwang 5 (9 July to 3 September). The Yuanwang 3 voyage fits in well with the launch on 24 June from Xichang of Beidou DW46 to inclined geostationary orbit at 105°E and it is reasonable to presume that its flight path would have taken it over the vessel. Yuanwang 3 stayed on station for two weeks after the launch, presumably for additional tracking as the Beidou reached a 24 h orbit.

Yuanwang 5 reached the date line at 23°S on 23 July. Three days later, a CZ-2C launched from Xichang the Yaogan 30-05 series of military observation satellites and it is reasonable to presume that its purpose was to track this launch. Yuanwang 5 did not return to port immediately, but lingered in the area, putting into Suva, Fiji for almost ten days, presumably for supplies or rest between assignments. Yuanwang 5 was near Roreti on 19 August at the time of the launch of Zhongxing 18, which appears to have failed shortly after entering orbit, attributed to a solar panel not opening. Yuanwang 5 began to return to port the next day, 20 August, so it appears that the failure was immediate, obvious and irremediable.

Suva has frequently been used as a stopping point for Yuanwang tracking ships, several times sparking diplomatic rows, the most recent being early June. Then, Australia's ABC News called Yuanwang 7 a high-tech surveillance ship which followed Chinese army satellites and intercontinental ballistic missiles. When it docked close to HMAS Adelaide, with US Marines on board, it ran a story that it might be snooping on Australia's military and reported that security measures had been taken. The Royal Australian Navy suspected that it was a spy ship deliberately arriving at the same time to carry out surveillance, it said (Greene, Andrew: Chinese vessel believed to be spy ship docks next to HMAS Adelaide in Fiji. ABC News, 9 June 2019).

At time of writing, a Beidou was scheduled for launch on 24 September, so it is likely that this is the purpose of the voyage of Yuanwang 7. Tracking the tracking ships enables us to make a link between missions and voyages. No ships ventured further than the South Pacific. It will be instructive to follow the tracking ships as the CZ-5 rocket is prepared for test launch in the next number of months. These were not the only Chinese launches during this period (CZ-11 sea launch on 5 June; Hyperbola on 25 July) but presumably these did not have nor need access to the tracking ship system.

My thanks for MarineTraffic for supplying raw data.

Aerial photo of Yuanwang 3 sailing at the mouth of the Yangtze River, on 5 July 2019 returning from a one-month long tracking mission in the Pacific Ocean for the launch of the 46th Beidou satellite on 25 June. It arrived at its home port on 08 July. credit: Xinhua/Li Yuze

Yuanwang 7 departs from its home port on 26 November 2018 to carry out maritime space monitoring and communication missions. credit: Chinanews.com

View of the bridge of Yuanwang 7 during its departure from its home port on 26 November 2018 to carry out maritime space monitoring and communication missions. credit: Chinanews.com

A close-up of the antenna facilities on Yuanwang 7 while departing from its home port on 26 November 2018 to carry out maritime space monitoring and communication missions. credit: Chinanews.com

A photo from 08 July 2019 was taken while Yuanwang 3 was sailing back to its home port in Jiangsu Province. credit: Xinhua/Li Yuze

A photo from 28 June 2019, taken inside the Yuanwang 3 shows a crew member watering vegetables growing soil-free. credit: Xinhua/Li Yuze

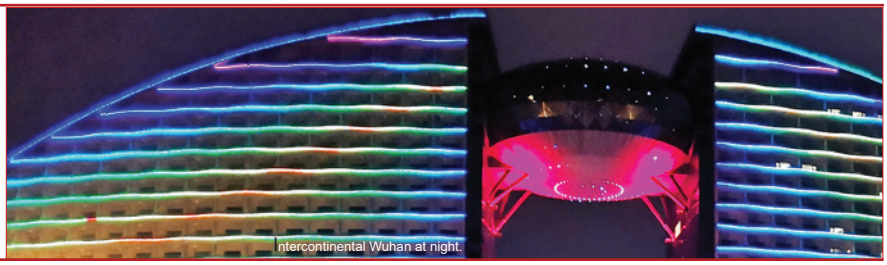
Yuanwang 3 sailing on the southern Pacific Ocean, on 21 June 2019. credit: Xinhua/Li Yuze

A close-up view of the Yuanwang 3 antennas. The photo was taken on 23 June 2019. credit: Xinhua/Liu Shiping

An earlier photo from before 2014 of the Yuanwang 5. credit: Chinese internet

4th China (International) Commercial Aerospace Forum Wuhan 2018: Full speed ahead!

by Jacqueline Myrrhe


Intercontinental Wuhan at night.

Once again: Wuhan! From 26 to 28 September 2018, the 11 million inhabitants' capital of central Chinese Hubei Province hosted the 4th edition of the China (International) Commercial Aerospace Forum (4th CCAF). In 2015 and 2016, the event was centred around the emerging national commercial space efforts. But just as in 2017, when the conference was for the first time international, a wide range of space companies from China but also from Europe, Asia and the US, presented their activities in 2018. Realising the importance of international exchange, this annual event in Wuhan seems to have become the focal point of commercial space activities not only in China but also in Asia. It remains to be seen in the near future whether the CCAF Wuhan can establish itself as meeting place of the global private space community.

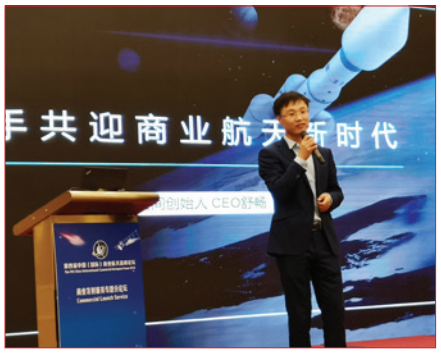
China however, has in 2018 seen the most intense year to date for the Chinese commercial space sector. The four commercial sub-orbital launches (*see text box on page 31*) were just one aspect of it. To mirror this dynamic, the motto "Lead commercial aerospace, explore industrial development" was selected. The forum comprised two days, densely packed with presentations and talks, presenting the latest commercial developments. Among them were many of the really famous commercial space start-ups like SpaceTY, OneSpace, Landspace, Expace but also the big state-owned companies CAST (China Academy of Space Technology), CALT (China Academy of Launch Vehicle Technology), SAST (Shanghai Academy of Spaceflight Technology), CASC (China Aerospace Science and Technology Corporation), CASIC (China Aerospace Science and Industry Cooperation) – the so-called "national team". For the non-Chinese visitor, it was useful and interesting to experience those people about whom one normally reads in the media. In particular in the exhibition area of the accompanying 5,000 m^2 space achievement exhibition which went one for one more day after the conference, visitors could get in direct contact with the nearly 70 companies from China and abroad, covering commercial launcher development, satellite design and manufacturing, space information applications, finances and other fields. Open and direct talks with these business people were easily possible. For that purpose, also the conference coffee breaks and evening dinners were highly useful to start lively in-depth discussions and exchange of views. In contrast to 2017, the Chinese companies were more interested in getting in contact with foreigners. While in 2017, there was still this invisible barrier letting the Chinese participants remain among themselves and the foreigners gathering separately. In 2018, even the dinner and lunch tables were naturally mixed and Chinese would open a conversation with you without hesitation - a really nice experience. Also, maybe only in China will you find that the Vice-Chair of the Board of CASIC is sitting among the "normal" conference participants – without any VIP fuss. You only notice who your dining neighbour is, once you have exchanged business cards.

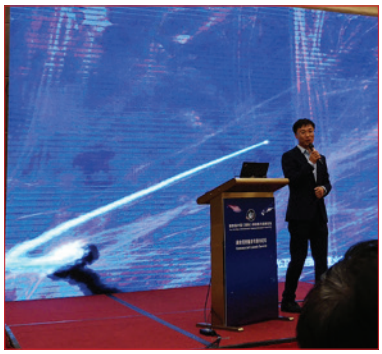
Overall, the number of participants increased compared to 2017. An estimated 500 space experts participated in the 4th CCAF. Despite the clear focus on international involvement, the number of foreign participants remained more or less the same: around 40 participants from France, the UK, Germany, Russia, the US, Singapore, Japan, Italy, Australia and Sweden. Certainly, there is room for improvement in the level of international participation in the conference. Despite that, 30 % of the presentations within the conference programme were given by foreign space experts. Also, more and more international speakers are able to understand and speak Chinese.

The hallmark of CCAF Wuhan is the dedication and commitment of the main organiser CASIC to the rise of the commercial space sector in China. CASIC was able to form a strong alliance between private and governmental space industry, politicians, government and non-space actors. With the establishment of the National Aerospace Industry Base in Wuhan, the first national and commercially important space industry park is in the making. This base is characterised by CASIC's investment into the manufacturing facilities for the Kuaizhou solid-fuel rocket and the serial production of small satellites. No need to say that CASIC occupied the central area of the exhibition area and was highly visible in the keynote speeches during the forum.

The first talk however, was given by the Mayor of Wuhan, Zhou Xianwang. He, together with the Vice Governor of Hubei Province, Cao Guangjing and representatives of the central government from Beijing opened the exhibition. Both arrived with a big media crowd which got even bigger when staff with mobile phone cameras joined in and kept buzzing around. The politicians received an introduction to the potential that commercial space has to create high-tech and high quality jobs in Wuhan and the

22 contracts with a financial volume of 50.6 billion RMB were signed at the end of the opening session. credit all photos: GoTaikonauts!


Shu Chang, CEO of OneSpace spoke fully without script and notes. "We hope that we can become one of the biggest launch service providers for small satellites in the world." credit: GoTaikonauts!


Shu Chang, CEO of OneSpace expressed his opinion: "It doesn't make sense to fight for the biggest piece of the cake. We are interested in making the cake bigger for all."

Already during the conference programme participants started their exchange of ideas and drafted new concepts. When both partners agreed on the draft details, a handshake sealed the deal.

Conference atmosphere: the exchange of business cards is important and the first step for making contact. credit all photos: GoTaikonauts!

Instead of paper business cards, entrepreneurs in China scan their QR codes in the profile of their mobile phone app WeChat. And promptly both persons are connected.

region. This blends perfectly with the aim of the municipality and provincial administration to strengthen the economic foundation of the region and diversify economic growth. The city of Wuhan alone is contributing 180 billion USD to the GDP of the Hubei Province, which is 540 billion USD. The National Aerospace Industry Base in Wuhan has full political support.

The Chairman of the Board of Directors of CASIC, Gao Hongwei, explained in his opening speech: "CASIC, as a state-owned strategic high-tech innovative enterprise, seeks transformation and upgrading through innovations in technology, in the business model and management; it integrates domestic and international resources with the development philosophy of "Information Exchange, Resources Sharing, Capacity Collaboration, Open Cooperation and Win-Win Outcome", and vigorously implements the development plan of commercial aerospace industry; it actively promotes the major commercial aerospace projects such as "*Feiyun*", "*Kuaiyun*", "*Xingyun*", "*Hongyun*", "*Tengyun*" and "*T-Flight*" [author: supersonic train system] projects, and has received various phase achievements and great progress in the fields of commercial carrier launch service, commercial application satellite development and space information application."

Gao Hongwei said that in the next three to five years, China's commercial aerospace industry will achieve significant results that will have attracted worldwide attention. The global commercial aerospace industry will form a new pattern, and the multilateral cooperation and globalisation of the aerospace industry will become the new normal.

"This forum will serve as a platform to enable domestic and foreign enterprises to show their commercial aerospace development capabilities and get the overview of global commercial aerospace development."

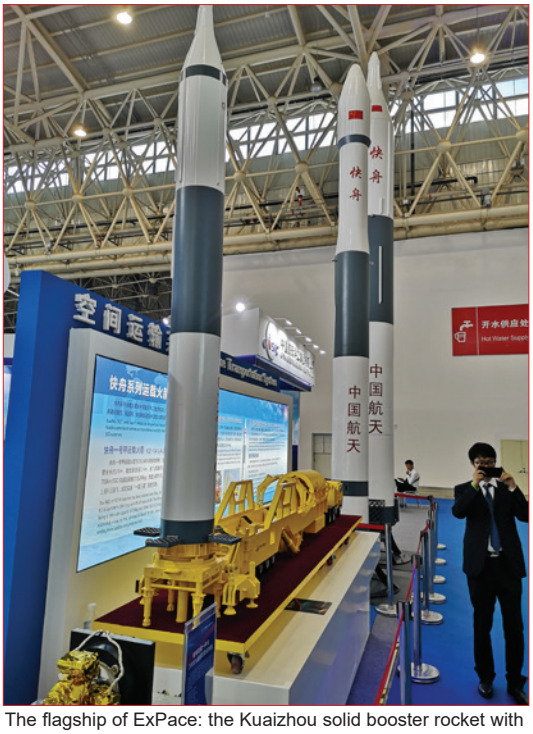
The political representatives praised the potential of aerospace and its importance for Wuhan and the nation. They reiterated their support and efforts in lowering the barriers for the development of the commercial space sector and their determination in working out policies aimed at the levelling of the playing field for private aerospace companies as well as strategic initiatives to help spur the industry.

After the official opening speeches, a perfectly prepared signature ceremony was held at the centre stage. In a record time of three minutes, 22 contracts with a total financial volume of 50,6 billion RMB (6.4 billion Euro/7.4 billion USD) were signed.

After that, the regular two-days conference programme began.

Fu Zhimin, CASIC's Chief Engineer emphasised that cooperation will definitely exceed competition between the state-owned enterprises and private start-ups. The two sectors are complimentary. Compared with private players, companies of the national team like CASIC are taking a long-term view and systematically expanding along the space industrial chain. Private companies have more flexibility, flat hierarchies – they are quicker to apply innovation and modern management or production mechanisms. It will be a win-win situation to combine the technological base of governmental companies with their flexibility and the lower costs of the private sector.

Industrial policies, development models and financial support will be improved to speed up the development of the domestic commercial space sector, said Zhao Jian, Deputy Director of the Department of Systems Engineering of the China National Space Administration, during the forum. And indeed, just a few days after the conference, the Chinese central government announced that a harmonised, national management system for the private space sector will be introduced to deepen the partnership between public and private space industries.



The flagship of ExPace: the Kuaizhou solid booster rocket with its mobile transport and launch facility. credit: GoTaikonauts!

Former French astronaut Jean-Jacques Favier and now professor at the Institut Supérieur de l'Aéronautique et de l'Espace - ISAE (National Higher French Institute of Aeronautics and Space) in Toulouse, stressed that international collaboration is important for the global space industry, in particular for new space-based platforms like space stations or lunar habitats and for new exploration technologies. "It's easier to collaborate in a field where nothing exists and everyone can bring something, for example for the exploration of Moon and Mars," he said.

Many presentations were related to the "commercial" spin-offs of the state-owned space giants like CASIC and CASC – meaning that those companies are not entirely "private" companies. A significant amount of presentations were given by the "real" commercial space actors. Their activities and successes were very prominent in 2018. In early

The concept of the Wuhan National Aerospace Industry Base with the manufacturing facilities for the production of the Kuaizhou small launcher and the serial production of small satellites. credit: CASIC/GoTaikonauts!

The service profile of satellite manufacturer SpaceTY. credit: SpaceTY/GoTaikonauts!

September, Beijing-based iSpace Science & Technology Co., Ltd., (iSpace) and OneSpace Science & Technology Co., Ltd., (OneSpace) launched their rockets within 48 hours of each other from the Jiuquan Satellite Launch Centre, marking the opening of a state-owned, military space launch site to the private sector. Still earlier on 5 April 2018, iSpace tested its sub-orbital Hyperbola 1S rocket from Hainan island and OneSpace launched its sub-orbital rocket on 17 May 2018 from a test field in the Inner Mongolia Autonomous Region.

Currently, China is the fourth biggest investment market for private space, after the U.S., the UK and France. Although China has seen only 3 % of the total global financial investment since 2009, it shows the strongest growth world-wide. From January to September 2018, 217 million USD had been invested in Chinese space companies. In 2017 it has been 230 million USD. Still, governmental space industry employs staff in the range of 100.000s, while private companies employ personell at the magnitude of thousands.

In Wuhan the differences between the private spin-offs of public companies and the “real” commercial actors were visible as well. The representatives of CAST, CALT, SAST, CASIC presented their semi-private programmes in the classic style with static power point presentations but they occupied the most space in the space exhibition. With one exception: CASIC showed fancy animations of its reusable space shuttle project “Tengyun” and incorporated into its exhibits a lot of interactive displays, modern audio-visual material and eye-catching models of ExPace’s Kuiazhou launcher.

The young start-ups, like SpaceTY, OneSpace, LandSpace, Expace, MinoSpace held fresh, self-confident presentations, often even without power point slides, just free-style without or with only very few notes on the mobile phone. This young generation of entrepreneurs took the audience by storm. The speakers were able to transmit their own passion and excitement to the listeners in the room. They were literally radiating optimism and dynamism. They are moving fast and they love moving fast because their ambitions are as high as the sky. In contrast to that, their presence in the exhibition area was less dominant than that of the established state-owned companies. All space start-ups stressed unanimously that they are ready to take-up the competition with “old space” or even other newcomers.

One of those dynamic youngsters is Shu Chang, founder and CEO of One Space. He pointed out that his company was one of the first to take advantage of the opportunity to enter the space sector as a private player. In 2012, President Xi Jinping highlighted the importance for China to become a space superpower and formally allowed in 2014 the establishment of privately-owned space companies. One year later, OneSpace Technologies was on the market and is now determined to establish its niche in the small satellite launcher market.

Shu Chang spoke about CASIC and CAST as a “closed club“ and expressed his satisfaction that this club has been opened for new entrants. Of course, as a young entrepreneur he feels the pressure of responsibility. He is convinced that he will be able to turn his business idea into reality because in particular in the area of launch services for small satellites, the sector OneSpace is targeting, demand can be generated by offering all-round solutions to customers. China is expected to produce 1,000 cubesats over the next five years, and OneSpace is hoping to ride on this demand. “What commercial aerospace companies have to think about now is not how the existing pie is divided? Instead, through cooperation, sharing, and differentiated development, we will make the pie bigger and achieve a win-win situation!”

Openly, he criticised the business model of SpaceX, operating with prices on the market which are not covering the costs. Although competition is motivating, OneSpace is not protected and can fail, Shu reminded the audience. The current business development strategy is resting on three pillars: technology development, cooperation, and applications.

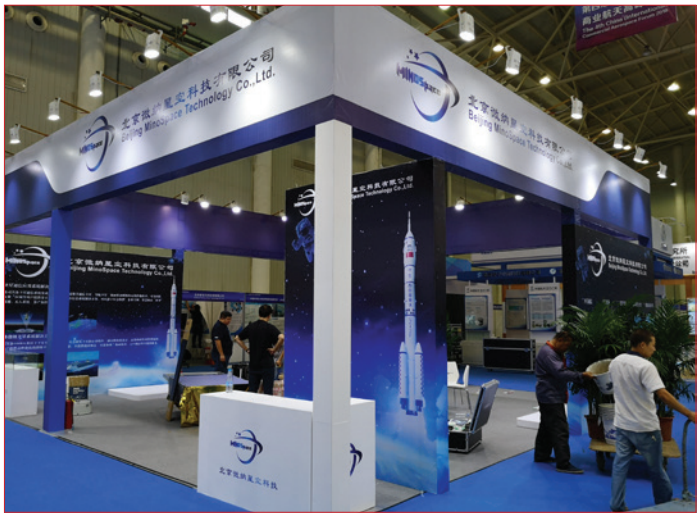
With respect to technology, he sees many things that can be achieved by either specialising in certain developments or by controlled investment.

Cooperation can be useful when a key technology is too demanding for a single company and by cooperation or by sharing the development phases among several interested parties a break-through could be made possible.

Regarding applications, he referred to his own experience when he is flying on the airplane and cannot get access to the internet. He knows that technically this can be solved and the demand is big. So, the solution provider for this demand will have the full advantage on the market. With this portfolio resting on those three pillars, the road into the future should be paved.

Shu also recalled that OneSpace was the first Chinese privately owned company which accomplished a sub-orbital launch on 17 May 2018. The OS-X rocket travelled a total distance of 273.5 km up to an altitude of 38 km before falling back to Earth. (The earlier sounding rocket flight by iSpace was a test flight.)

On 7 September, short before the 4th CCAF, OneSpace launched its “Chongqing Liangjiang Star“ OS-X1 rocket from Jiuquan for a 200-second long sub-orbital flight, achieving 15 km height. The Jilin 1 video satellite recorded the launch and early flight phase from its 535 km orbit. This video sequence went viral on the internet, where the netizens praised more the capabilities



The exhibition booth of the small satellite manufacturer MinoSpace. credit: GT!

of the video satellite than the remarkable launch from a military launch site.

Shu Chang played the video taken by Chang Guang Satellite Company, the owner and builder of Jilin 1, at the 4th CCAF and explained for the first time publicly the story behind the making-of the video.

Originally the launch was scheduled for 13:00 BJT. However, Chang Guang Satellite Company notified Shu Chang that the Jiuquan launch site would not be covered by that time due to limited numbers of satellites. In order to ensure high resolution video quality, it was recommended that the launch should be rescheduled to 12:00 BJT. Thanks to the flexibility and cooperation by the ground staff at Jiuquan, the earlier launch time was made possible. Moreover, the personnel arranged a live broadcast over "Douyin", a short video social software in China. Shu Chang emphasised that he made a very positive experience in the cooperation with the national launch site, what is of great significance and is appreciated by all private space companies.

The same positive impressions were shared by Zhang Qi, the Vice Technology President of space start-up iSpace - Beijing Interstellar Glory Space Technology Corporation Ltd., also: Space Honor. He confirmed: "The Chinese government is pouring tremendous efforts to advance the military-civilian integration and by doing so, support the commercial space sector. Our Hyperbola 1Z (SQX-1Z) rocket launch on 5 September this year received significant support from the State Administration of Science, Technology and Industry for National Defense (SASTIND) and the Jiuquan Satellite Launch Centre."

Zhang Qi took part in several launch campaigns before when he still served for a governmental space organisation. From that time he remembered that the ground staff in Jiuquan had to obey strict rules and regulations and had to supervise the launch support crew without any pardon. But in September 2018, things were relaxed: "To our surprise, our commercial rocket launch received extra attention and excellent cooperation in many aspects." said Zhang Qi, speaking highly of the openness and support of related government agencies.

The 4th CCAF coincided with the public discussion of a classic conflict between a state-owned company which was challenged by a private start-up. Within the Chinese internet community, a wave of outrage propagated about a court case which CASC initiated against its former employee Zhang Xiaoping. Zhang is an experienced rocket engine engineer with expertise in liquid fuelled engines. He left CASC to take up a job at LandSpace. CASC argued that this change is a violation of business rules, even leading to serious damage of China's national space efforts for lunar exploration. This issue was not pleasant for LandSpace. However, it turned out that the accusations had been exaggerated and public opinion took the side of the rocket scientist, blaming the governmental company for not fairly paying its talents. There were even reports that President Xi Jinping was quoted as saying: as long as Zhang stays in China, he can do what he wants.

For the GoTaikonauts! team, a valuable outcome of the 4th CCAF was that we received an invitation to attend the first launch attempt of the commercial launch provider LandSpace at the end of October. (*see our report on that launch in GoTaikonauts! no 23, page 20 to 23*)

During the 4th CCAF 2018 in Wuhan, the first Chinese magazine on commercial space was established. It is bilingual. The editors are looking for contributions from all over the world.

On a last note: The conference venue was absolutely amazing! The Intercontinental Hotel Wuhan with the adjunct Expo Centre is an architectural highlight. The hotel facade re-assembles a UFO hanging in its suspension at the launch tower before take-off – agreed, this is just one possible interpretation of the futuristic shape of the conference hotel.

In the long run, the CCAF might find its permanent location in the Wuhan Aerospace Industrial Base where a conference centre is planned. There, not only an associated conference exhibition on the big scale is possible, but also tours of the manufacturing facilities could become part of the conference programme. That shall be highly interesting.

Sub-orbital launches of Chinese private companies in 2018

05 April 2018 - iSpace

On 4 April, 18:00 UTC (5 April 02:00 BJT), iSpace launched its single-stage solid motor Hyperbola 1S (SQX-1S) rocket for the first time. SQX-1S took off from Hainan island, reaching a peak height of 100 km with a maximum flight speed of 1,200 m/s. The flight verified key technologies and launch procedures. Hyperbola 1S is a technology demonstration model of the first solid launch vehicle Hyperbola 1.

17 May 2018 - OneSpace

On 16 May at 23:33 UTC (17 May, 07:33 BJT) OneSpace' sub-orbital rocket OS-X0 "Chongqing Liangjiang Star" was launched from a test field in the Inner Mongolia Autonomous Region (Alxa). Chongqing Liangjiang Star is named after the state-owned Chongqing Liangjiang Aviation Industry Investment Group, which co-invested in OneSpace's manufacturing facility in Chongqing. The 9 m-long, single-stage, solid-fuel rocket of 7,200 kg mass reached a height of 38.742 km and a maximum speed of approximately 5.7 times the speed of sound. The launcher was equipped with a wireless communication system for on-board sensors and a low-cost and light-weight energy system. The main objective of the mission was to collect data. Nevertheless, a payload for customer Shenyang Aircraft Design Institute under Aviation Industry Corporation of China, Ltd., was hosted.
OneSpace plans 10 annual orbital launches for the OS-X launcher once the rocket is fully operational.

05 September 2018 - iSpace

After its first sub-orbital launch on 4 April/5 April with Hyperbola 1S from Hainan, iSpace conducted its second test flight with its single-staged Hyperbola 1Z (SQX-1Z - Shuang Quxian 1Z) on 5 September at 05:00 UTC (13:00 BJT) from Jiuquan Satellite Launch Centre. At the peak height of 108 km, the rocket released three cube satellites: TFJR 1 for Zero-g-Lab in Beijing and CDGX 1 and EREBus for ADA-Space in Chengdu. A first orbital test flight with enlarged first stage and the SQX upper stage is planned for the first half of 2019. iSpace said that four launches are on its commercial manifest for 2019.

07 September 2018 - OneSpace

OneSpace launched on 7 September at 04:10 UTC (12:10 BJT) for the second time its solid-fuel OS rocket - this time in the version OS-X1 (Chongqing Liangjiang Star-X1) and from Jiuquan Satellite Launch Centre. OneSpace aims for its first orbital launch in 2019.

The 2018 China Commercial Aerospace Forum

Blaine Curcio, founder of Orbital Gateway Consulting and a Senior Affiliate Consultant at Euroconsult, has given account about his impressions from the 4th CCAF. He was one of the speakers on the first conference day where he presented in the Sub-Forum 2 "Aerospace Ecosphere" an overview on "The Low Earth Orbit (LEO) Constellation Industry".