



Issue 10

December 2013

All About The Chinese Space Programme

# Go TAIKONAUTS!

龙腾太空



## Welcome to China for Space

Report from the 64th International Astronautical Congress





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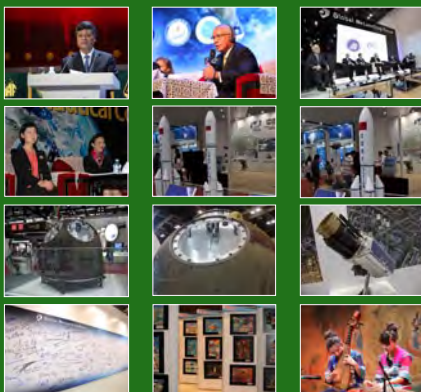
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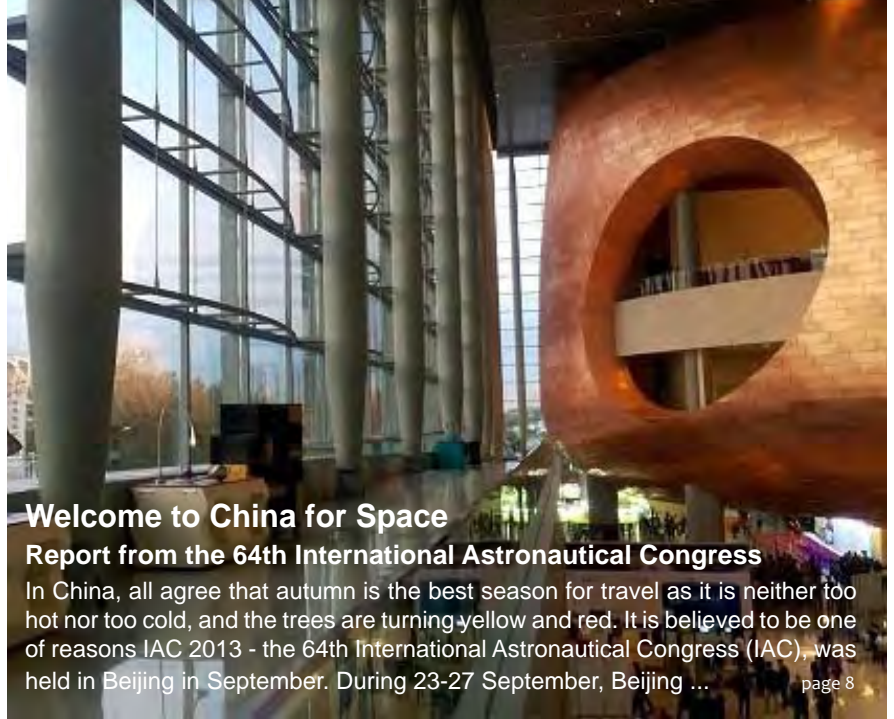
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### Welcome to China for Space Report from the 64th International Astronautical Congress

In China, all agree that autumn is the best season for travel as it is neither too hot nor too cold, and the trees are turning yellow and red. It is believed to be one of reasons IAC 2013 - the 64th International Astronautical Congress (IAC), was held in Beijing in September. During 23-27 September, Beijing ... page 8

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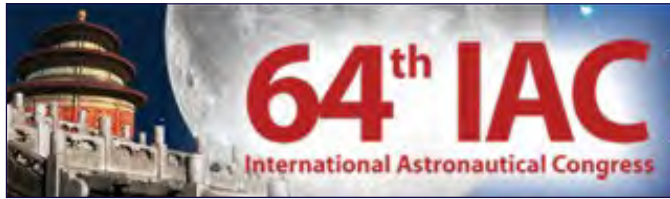
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## Editor's Note

Between 23 – 27 September, the 64th International Astronautical Congress (IAC 2013) was held in Beijing. It was not only a grand gathering of the world space community, but also a big event for China. The Go Taikonauts! Team participated in the Congress. This issue of Go Taikonauts! is a special issue dedicated to the IAC 2013 with reports, interviews and images brought from Beijing. The enormous amount of material we could collect in Beijing made it hard for us to keep up with digesting and processing it. This is the reason why the current newsletter did not follow the usual quarterly rhythm for publishing. However, the volume of articles we can provide now will make up for the long waiting time.

The cover story is an overview report of IAC 2013. During this Congress, China opened a small window on its space programme. In plenary speeches, papers and during the exhibition and face-to-face talks, Chinese officials, engineers and scientists provided comprehensive information in various areas including human space flight, lunar and deep-space exploration, space transportation systems, space applications and advanced technologies, etc., some of which are extremely interesting. We have tried to summarise all the key information in this report, so as to give our readers a clear picture of the future Chinese space programme. On the other hand, a major objective of IAC is to promote international space cooperation. The cover report also discusses particularly the United Nations's role in cooperation on the future Chinese Space Station (CSS). This is actually a new development worthy of special and close attention!

The Congress also gave us an opportunity to have direct contact with several Chinese space personnel. We interviewed officials from APSCO (Asia-Pacific Space Cooperation Organisation), China Great Wall Industries Corporation, and Head Aerospace Ltd, as well as people from other countries. You can read three interview articles in this issue. And we will publish more in the next issue. You will find that topics in all these interviews are also closely related to international space cooperation or commercial activities. Under the same theme of international space cooperation, we have another article on the history of the UK-China space cooperation. We hope that it may leave you thinking.

Just one week before IAC 2013, the United Nations Office for Outer Space Affairs (UNOOSA) and China jointly hosted the Workshop on Human Space Technology in Beijing with a focus on international cooperation. Go Taikonauts! obtained complete presentations of the workshop, which included a lot of interesting information on the future Chinese human space programme. There is an article devoted to this and it can be a very good supplement to the IAC 2013 reports.

On 2 December, China launched the Chang'e 3 Moon lander along with the Yutu rover. It was the first soft-landing on the lunar surface since the Soviet's Luna 24 in 1976. So, it was definitely a big event and a very important milestone in China's lunar exploration programme that lays the foundations for the later sample return mission and eventually the manned lunar landing. We will not miss it. So, stay tuned!

(Chen Lan)

## Imprint

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## Quarterly Report on the Chinese Space Programme

July - September 2013

by Chen Lan

### Highlights

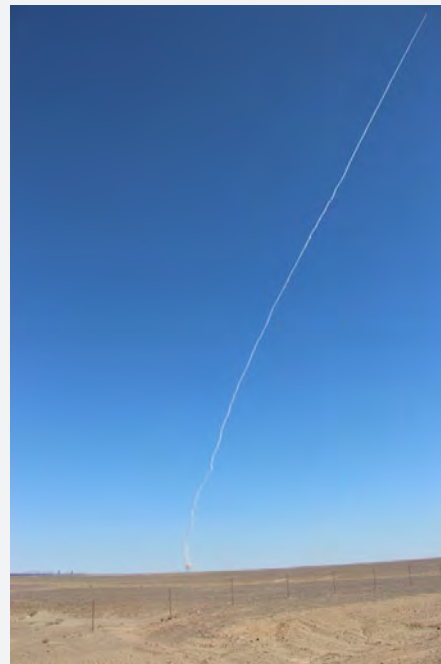
- Qinzhou small launch vehicle made an unexpected debut.
- Long March 5 development back on track. Major progress made.
- China's manned lunar landing plan rumoured to be halted, at same time more details revealed.
- IAC 2013 held in Beijing. More details of the Chinese Space Station disclosed.
- Chang'e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

### Launch Event

From July to September, China made five space launches:

- On 15 July, at 17:27, the SJ-11-05 satellite was successfully launched from the Jiuquan Satellite Launch Centre by a CZ-2C. It was thought to be the replacement of the SJ-11-04 that was lost in a launch failure on 17 September 2011. The failure was caused by a structural failure of the servomechanism of the vernier engine on the second stage, leading to attitude loss of the rocket. The CZ-2C used in this launch is the first one equipped with the dual inertial unit to increase reliability. It also created a Chinese record, the shortest launch preparation time of 30 days from the satellite's arrival at the launch site to launch.
- On 20 July, at 7:37, a CZ-4C lifted-off from Taiyuan Satellite Launch Centre, putting three satellites, the CX-3 (Chuangxin 3), SY-7 (Shiyang 7) and SJ-15 (Shijian 15), into orbit. They were reportedly to perform "space debris observation" and space robotic arm test.
- On 2 September, at 3:16, another CZ-4C took off from Taiyuan and sent the three YG-17 satellites into space. YG-17 is thought to be China's ocean surveillance satellite and the follow-on of YG-9 and YG-16.
- On 23 September, at 11:07, China launched the FY-3C polar orbit weather satellite from Taiyuan using a CZ-4C rocket. It was the first time that three consecutive CZ-4C launches occurred in just a little more than two months. FY-3C was the third of the second generation polar orbit weather satellite, and will join the FY-3B to form a morning - afternoon satellite system. Interestingly, the launch happened just moments after the opening ceremony of the 64th International Astronautics Congress (IAC 2013) being held in Beijing, and seen as a gift to the Congress.
- The most surprising launch happened two days later on 25 September. China suddenly announced the successful launch of the Quaizhou 1 satellite by a Quaizhou launch vehicle (Quaizhou means Fast Vessel or Fast Ship) in Jiuquan at 13:04 the same day. The satellite was developed by Harbin Institute of Technology and the launch vehicle by the China Aerospace Science and Industry Corporation (CASIC). CASIC

had two unsuccessful launch attempts in 2002 and 2003 with its KT-1 (Kaituozhe 1) small launch vehicle. This launch makes CASIC the first Chinese organisation outside of CASC (or CALT and SAST) capable of developing a space launch vehicle and making a successful space launch. There were no further details or any launch images revealed through the official media. The Quaizhou 1 rocket is believed to be a small solid-fuelled, responsive mobile launch vehicle. The Quaizhou 1 satellite is also rumoured to be a satellite integrated with the upper stage. A satellite photo shows its possible launch site is about 6 km east of the existing pad 921 and 603 in Jiuquan.



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

### Space Transportation

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

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

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

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

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

There was also an unofficial message circulating on the internet, stating that the human lunar landing project had failed to be approved in a recent Chinese government decision-making process. But it is believed that pre-studies on the 500 t kerosene/LOX engine and the 220 t cryogenic engine still continue. During the 64th International Astronautics Congress (IAC 2013) held in Beijing, Chinese officials, in plenary speeches, still listed the manned lunar mission and the super heavy launch vehicle as future objectives. One presentation slide showed a moon

landing flight profile using two cargo launches and one manned launch, a newly designed Apollo-like manned spacecraft, and two dockings using both Earth Orbit Rendezvous (EOR) and Lunar Orbit Rendezvous (LOR) approaches. Another slide showed that the super heavy rocket (aka. Long March 9) will have a launch mass of around 3,000 tonnes, and LEO/LTO capability of 100 and 35 tonnes respectively. It will be a three-and-a-half stage launcher. There are eight 500 t thrust LOX/kerosene engines on its first stage and four strap-on boosters. While its second and third stages use cryogenic engines.

## Satellites

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

Development of new civil satellites also made progress:

- It was reported in early July that China's next generation geostationary meteorological satellite FY-4 has completed reviews on the status of all sub-system development and acceptance reviews for all single units. Development of the electrical test model had also been started.
- In August, the DFH-4E comsat bus completed its design review. The enhanced satellite bus will increase the payload mass to 1,000 kg and total mass to 6,000 kg. An electrical propulsion system will also be installed on the DFH-4E.
- In mid-August, the project of ground integration and verification for the satellite electrical propulsion system was approved, paving the way for development of the DFH-3B, DFH-4E and DFH-5 new generation communication satellites.

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

- In early August, a test to verify command uploading to the HXMT (Hard-X Ray Modulation Telescope) was successfully completed in CAST.
- Development of the Shijian 10 engineering model was approved in late September and would start immediately. SJ-10 is a recoverable satellite designed to carry-out microgravity experiments.
- The Institute of Atmospheric Physics, Chinese Academy of Sciences made a breakthrough on the inversion algorithm for China's first carbon-sniffing satellite, TanSat. At the same time, simultaneous carbon dioxide observations on the ground and by JAXA's GOSAT satellite was performed in August, paving the way for the TanSat onboard equipment



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



development.

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

## Manned Space Flight

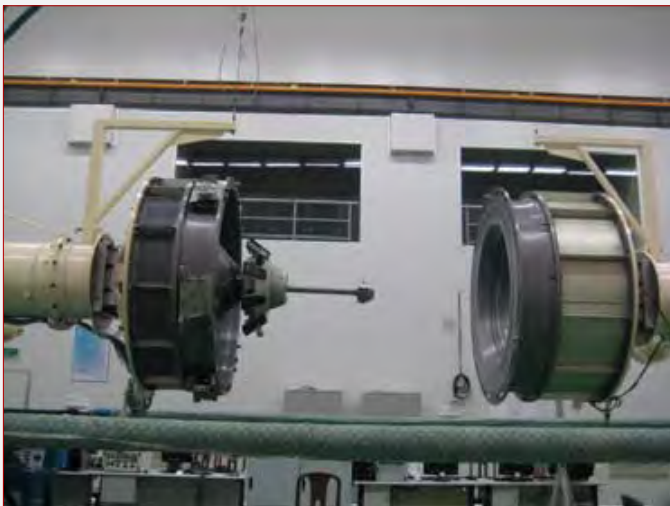
During the IAC 2013 in September, China disclosed more details of its space station plan through plenary speeches and technical papers. Here is a summary of some interesting new information:

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

special customised payloads (like the proposed telescope at CSS) and exposed payloads (i.e. on the outside of the CSS). The former will be arranged in standard scientific racks similar to those on the ISS (the so-called International Standard Payload Racks – ISPRs). 12 racks have been planned:

- Ecology Science Experiment Rack (ESER)
  - Biotechnology Experiment Rack (BER)
  - Science Glove-box and Cryogenic Storage Rack (SGCSR)
  - Fluids Physics Experiment Rack (FPER)
  - Two-phase System Experiment Rack (TPSER)
  - High-Temperature Material Science Experiment Rack (HTMSER)
  - Container-less Processing Experiment Rack (CLPER)
  - Varying-Gravity Experiment Rack (VGER)
  - Low Micro-gravity Level Rack (LMGLR)
  - Payload on Orbit Service Support Rack (POSSR)
  - Two racks for fundamental physics
- There will be eight or more 0.6 x 0.6 m exposed platforms on the CSS. The experimental payload separation facility includes an eject launch system and manipulator (robotic arm) launch system.
  - The interface standard of both the pressurised payloads and exposed payloads is planned to be released to the international space community for international cooperation.
  - Microwave power transmission is proposed to be demonstrated on the CSS. The proposed test will incorporate a 2.4 x 0.6 m transmission panel and will be supplied by the station with 5 kW of power. It is anticipated to transmit 2.5 kW power from LEO to the ground with footprint of 55 km diameter. The Qian Xuesen Laboratory of Space Technology, CAST proposed this demonstration that has already been tested in ground development in the laboratory.

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



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



Lunar rover in testing (credit: CCTV)

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

## Lunar and Deep-Space Exploration

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

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

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

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

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

## Advanced Technology

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

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

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

## International Cooperation

During 23 to 27 September, the 64th International Astronautical Congress (IAC 2013) was held in Beijing. It had been 17 years since the last time the IAC was held in Beijing in 1996. The Congress received 3,675 papers and attracted about 3,700 participants from all over the world. The Heads of Space Agencies of the United States, Russia, Europe, Japan, India and China also attended the Congress and met with the media and students. Seven plenary, 170 technical sessions and 300 other activities, including a technical exhibition, technical visits, student forum, art exhibition and cultural events, etc., were held during the Congress.

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

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

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



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

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

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

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

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

Other developments on international cooperation between China and other countries:

- It was reported that Poland is discussing with China to launch a Polish smallsat Hevelius on a Chinese rocket CZ-4.

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

## Commercial Space

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

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

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

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

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

## Miscellaneous

### Ground Facility

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



## Welcome to Beijing for Space

Report from the 64th International Astronautical Congress

by Chen Lan, Bill Carey, Theo Pirard



### Gathering in Beijing

In China, all agree that autumn is the best season for travel as it is neither too hot nor too cold, and the trees are turning yellow and red. It is believed to be one of reasons IAC 2013, or the 64th International Astronautical Congress (IAC), was held in Beijing in September. During 23-27 September, Beijing welcomed more than 3,700 people from all over the world, including space leaders of major countries, space professionals, students and journalists. Fortunately, during the week the conference was held, Beijing's weather performed at its best with a clear and blue autumnal sky. The notorious haze of Beijing waited for closure of the event and came just after the closing ceremony.

It had been 17 years since the last time the IAC was held in Beijing, back in 1996. China, and also its space programme, has progressed a lot in that time. In 1996, China experienced a string of launch failures leading to the loss of its international commercial market share, and there were only a few working Chinese satellites in space. In 2013 however, China has a mini manned space station in orbit, accompanied by more than 100 operational satellites servicing Earth observation, communication, navigation, and deep-space exploration, etc. China is now undoubtedly one of the most important players in space. The congress provided a good opportunity to show China's capability and position in space. In fact, the Chinese authorities made a great effort to make it a successful gathering. For example, the Chinese co-organiser selected as the venue of IAC 2013, the National Convention Centre that is thought to be the best place in Beijing for such a conference. The centre was built in 2008 for the Olympic Games held that year. It is located in the Olympic Park, and is nearby the well-known Bird's Nest and the Water Cube. The place is thought to be very lucky, as it has joined the Forbidden City and other imperial buildings on the North-South axis of Beijing, formed about one thousand years ago. In ancient times, the location of imperial buildings had to be carefully planned according to Feng Shui theory.

The conference received a total of 3,675 papers. Seven plenary, 170 technical sessions and 300 other activities, including a technical exhibition, technical visits, student forum, art exhibition and cultural events, etc., were held during the week.

China showed a high level of openness during the conference. Chinese authors contributed more than 200 papers, and two plenary sessions specifically on Chinese space development were held, revealing significant details of its space programme, many of which were disclosed for the first time, and sent important messages for cooperation in space to the whole world. The following sections of this report will cover all these in more detail.

### Grand Opening

The Opening Ceremony of the congress themed "Promoting Space Development for the Benefit of Mankind" began on the morning of the first day, with welcoming speeches to the congress attendees, including a speech by the Chinese Vice-President Li Yuanchao. Two highly-prestigious awards were then made. The IAF President, Kiyoshi Higuchi, presented the (first ever) IAF World Space Award to Dr. Edward Stone (for an outstanding contribution to space science), and the Allan D Emil Memorial Award, to Dr. Ma Xingrui (for his foundational work in the Chinese space programme). Then followed a visually striking display of Chinese dancing, acrobatics, and music, presented with exceptional creativity. All was impressive, with an outstanding performance of sand painting, which caught the full attention of the audience.

In the afternoon, the first plenary session "Heads of Agencies" brought together the leaders of seven space agencies: the United States, Russia, Europe, Japan, India, Canada and China. Although with such a distinguished group this should have been one of the highlights of the congress, it failed to live up to its billing, consisting primarily of short statements by each head of agency on the major events which have occurred at their agency during the last year. Noting the level of expertise in the audience, this event was a wasted opportunity by the IAF to really set the bar high for the rest of the conference. Hopefully for next year's congress, a more innovative format will be considered for this plenary session. Fortunately, for the rest of the congress, the bar was very high indeed.

### Chinese Station Hit the Road

One of the most frequently mentioned topics of the congress was China's modular manned space station to be built around 2020. After about 10 years of planning and pre-development, the Chinese government approved the station project on 25 September 2010. The successful Tiangong 1 mission, as a pilot project of the station, further cleared the way for its full-swing development. In technical papers and speeches in the congress, the Chinese not only outlined the latest plan of the station project, but also disclosed more details of its design.

China National Convention Centre (CNCC) where IAC 2013 was held. (credit: Go Taikonauts!)



Performance at the opening ceremony. (credit: Go Taikonauts!)



The main auditorium of the CNCC used for the IAC Opening Ceremony and some plenary sessions. (credit: IAF)



Signing ceremony of the cooperation agreement for a Sino-Italy Joint Laboratory on Electric Propulsion. The document was signed by Professor Zhang Weiwen (Director of the Lanzhou Institute of Physics), Jason Chou (CEO of China HEAD Aerospace), and Professor Mariano Andrenucci (Chairman of Alta). Also attending were the Italian Consul in Beijing, Mr. Giuseppe Rao, the Science and Technology Consul for the Italian Consulate in Beijing, Professor Plinio Innocenzi, and Mr. Enrico Saggese, Chairman of the Italian Space Agency. (credit: Go Taikonauts!)

Here is a summary of some interesting new information:

- The first block of the Chinese Space Station (CSS), an experimental core module, will be launched in 2018. If it works well, the experiment modules 1 and 2 will be launched two years later. If the former does not meet its design requirements, an improved core module will be launched. Wu Ping, Spokeswomen of CMA, stated in a special IAC session on 27 September, that the CSS will be completed by 2022, two years later than previously reported. The construction plan is consistent with a paper published earlier this year by Zhou Jianping, Chief Designer of the CSS.
- The extension plan of the CSS, firstly revealed by Zhou Jianping, was also further confirmed. It includes three additional modules purposely reserved for international cooperation.
- In the future, on the active part of the docking mechanism, three additional electromagnetic brakes (dampers) will be added to enhance the energy-buffering capacity in order to

support the large mass docking conditions. A probe-cone docking mechanism and low-impact docking system are also under study and in testing. China is also closely following the International Docking System Standard (IDSS).

- The CSS scientific utilisation plan has been preliminarily established through work performed since 2006 involving 70 universities and institutes. There are now 200 projects on the candidate list.
- The CSS is able to support 17 tonnes of research facilities and provides 12 kW of power to them. The research facilities of the CSS will be deployed in all of the modules. The racks for microgravity science experiments are arranged in the core module and in experiment module 1.
- Scientific payloads include standard pressurised payloads, special customised payloads (like the proposed solar telescope on CSS) and exposed payloads (i.e. on the outside of the CSS). The former will be arranged in standard scientific racks similar to those on the ISS (the so-called



International Standard Payload Racks – ISPRs). In total, 12 racks have been planned:

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

- There will be eight or more 0.6 x 0.6 m exposed platforms

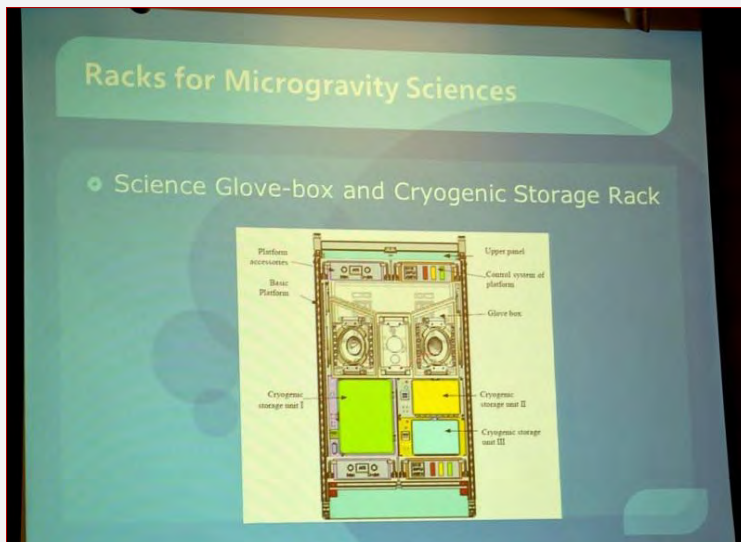
on the CSS. The experimental payload separation facility includes an ejection launch system and manipulator (robotic arm) launch system.

- The interface standard of both the pressurised payloads and exposed payloads is planned for release to the international space community for international cooperation.

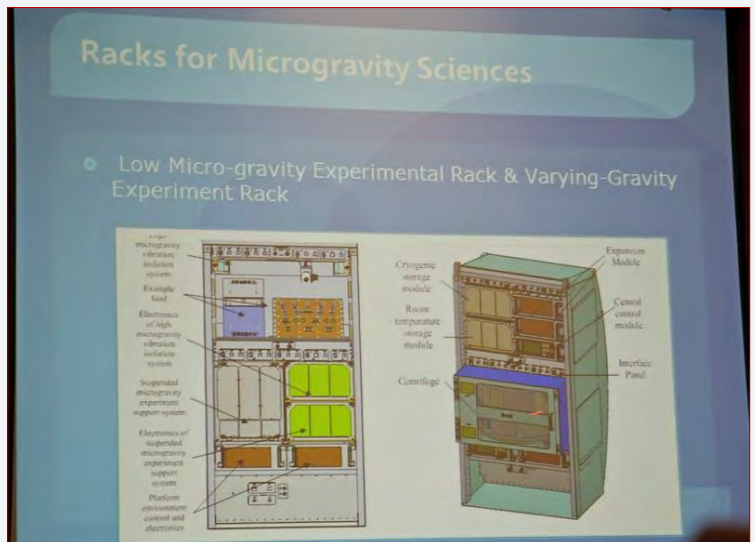
A noticeable development in the space station programme is China's announcement for international cooperation at IAC 2013. We will discuss it more in a later section in this article.

### Exploration Plan Updated

The manned lunar landing project is what most people are interested in. Although there was a rumour circulating on the internet that the project had failed to be approved in a recent Chinese government decision-making process, Chinese officials still listed the manned lunar mission and the super-heavy launch vehicle as future objectives. One presentation slide showed a Moon landing flight profile using two cargo launches and one manned launch, a newly designed Apollo-like manned capsule,



One of 12 racks designed for the CSS, the Science Glove-box and Cryogenic Storage Rack. (credit: CAS/Go Taikonauts!)



Another two racks for microgravity studies on the CSS. (credit: CAS/Go Taikonauts!)



Flight profile of the future manned lunar mission. (credit: CASC/Go Taikonauts!)



Concept of the super-heavy launch vehicle (credit: CASC/Go Taikonauts!)



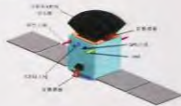


## Einstein-Probe (EP)

- **Science Objectives:** Time-domain census of soft X-ray transient and variable sources in the universe
  - Discover quiescent black holes over all astrophysical mass range and other compact objects via high-energy transients
  - Discover and locate electromagnetic-wave sources of gravitational-wave events by synergy with new GW detectors
  - Systematic census of soft X-ray transients and variability of known X-ray sources over wide time-scales at high cadence

### • Satellite Specifications / Payloads:

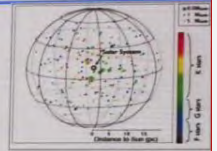
- Orbit: 600km, circular, 30° inclination
- Mass: 380 kg
- Life time: 5 year
- Payloads: a wide-field (60° x60°) monitor based on established multi-pole optics (MPO) technology, with fast alerting capability



## Search for Terrestrial Exo-Planets (STEP)

### • Satellite Specifications / Payloads:

- Orbit: Solar-earth L2 Halo
- Mass: 500 kg    Life time: 5 year
- Payloads: Cassegrain Astrometric Telescope (Primary Aperture: 1.2m, f=50m, FOV: 0.44°)



### > Highlights

- ✓ Extremely-high-precision(0.5uas) astrometric space mission
- ✓ Able to detect the habitable planets at earth criterion
- ✓ Get the actual planetary masses and the full orbital geometry for all components of the detected planetary system

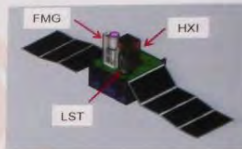


Four candidates selected for the 3rd batch of the Space Science Pioneer Programme. Clockwise: Einstein-Probe (EP), Search for Terrestrial Exo-Planets (STEP), Advanced Space-Borne Solar Observatory (ASO-S) and Water Cycle Observation Mission (WCOM). (credit: CAS/Go Taikonauts!)

## Advanced Space-borne Solar Observatory (ASO-S)

### > Science Objectives:

- ✓ Simultaneously observe the full disc vector magnetic field, non-thermal images of hard X-rays, and initiation of CME
- ✓ Understand the causality between magnetic field and flares, magnetic field and CMEs, flares and CMEs



### > Payloads:

Payload	Objective
Full-disc vector MagnetoGraph (FMG)	Magnetic field
Lyman-alpha Solar Telescope (LST)	CMEs
Hard X-ray Imager (HXI)	Solar flares

## Water Cycle Observation Mission (WCOM)

### • Science Objectives:

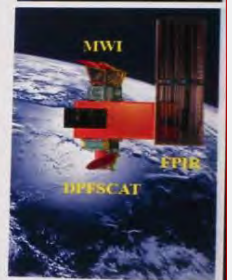
- Better understanding status and process of the Earth's water cycle system under the global change environment, by simultaneous and fast measurement of a set of water cycle key parameters (soil moisture, ocean salinity, ocean surface evaporation, snow water equivalent, frozen/thaw, atmospheric vapor...)

### • Approach:

- Combination of multi-frequency (6.6-90GHz), full-polarized, and passive-active microwave measurements

### • Highlights/Advantages

- Simultaneous acquisition of multiple key parameters for synergistic understanding of water cycle status and process
- Simultaneous measurement of main and ancillary variables to support more accurate retrieval of the target parameters



and two dockings using both Earth Orbit Rendezvous (EOR) and Lunar Orbit Rendezvous (LOR) approaches. Another slide showed that the super-heavy rocket (aka. Long March 9 or CZ-9) will have a launch mass of around 3,000 tonnes, and a LEO/LTO capability of 100 and 35 tonnes respectively. However, an otherwise credible paper from CALT on CZ-9 was obviously outdated. Not only CZ-9's launch mass has been reduced from more than 4,000 tonnes, as stated in this paper, to the current 3,000 tonnes, but the thrust of the main engine has also been cut to 500 tonnes. Still, some other papers published at IAC 2013 are highly interesting. A paper from CALT discussed a docking mechanism for an Earth departure stage assembled in Earth orbit by three launches. The conclusion is that the androgynous peripheral docking mechanism, used on Tiangong 1 and Shenzhou, is still the best choice. Another paper studied seven different flight profiles for the future manned lunar landing, including single launch, multiple launch EOR, LOR, EOR+LOR, and even an Earth-Moon Lagrange Point based approach. And also, there was a paper detailing the in-orbit calculation for a future mission to land a crew at the far side of the Moon using a relay satellite at the Earth-Moon L2 point. It is most likely in the distant future, but it more or less shows China's ambitions.

On 23 September, at the plenary specifically on Chinese

space progress, Xu Dazhe has shown an updated roadmap of planetary exploration up to 2030. A Mars orbiter and rover mission is scheduled in 2018, confirming rumours that the previously planned separate orbiter and rover missions have been merged and moved forward. Four other missions to Mars (sample return), Venus, Jupiter and an asteroid (orbiting and landing) are planned for the 2020 to 2030 timeframe.

Chinese papers at IAC 2013 also covered planetary exploration. One paper proposed a main-sub satellite mission to Mars. The main satellite is a 300 kg small satellite that is supposed to release three subsats once in Mars orbit. The subsats could be micro or nanosats based on a CubeSat or even a mobile phone. The paper proposed to invite universities and institutes in other countries and in Hong Kong, Macau and Taiwan to develop these subsats. Another paper studied a Mars global navigation system. The conclusion is that a constellation consisting of six inclined geosynchronous orbit satellites would be able to provide a positioning precision of less than 50 metres. A paper by the Qian Xuesen Laboratory of CAST, presented an innovative design called the Heat Engine Aerobot (balloon) to perform a long-duration mission in a planetary atmosphere using its temperature gradient as energy. Finally, a paper by SAST showed that it is studying an all-purpose lightweight



propulsion module for planetary missions, and serious work has already been performed. The module will carry 1,300-1,700 kg of propellant, provide a thrust of 490 N to 2,500 N, and is able to restart more than 20 times.

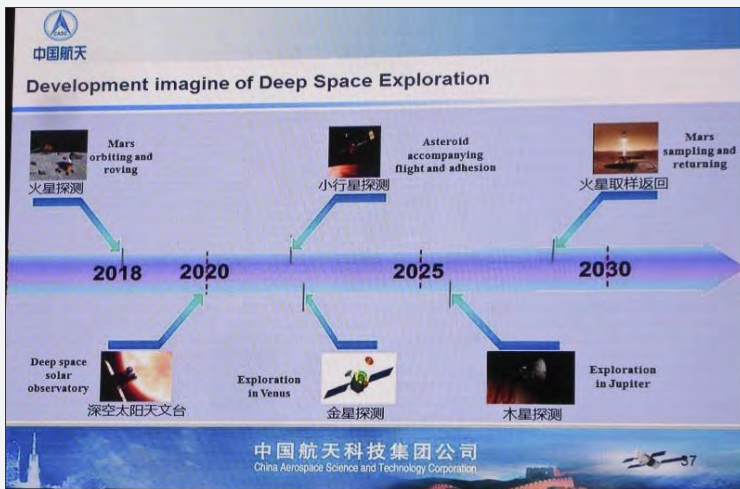
### Glimpse of the Future

In the week of the IAC 2013, China made two space launches. Regardless of whether they were planned or just a coincidence, they were seen as China showing its power, and also as a greeting to the event. The second launch was particularly interesting. Unlike many other Chinese space projects, before its maiden flight on 25 September, almost nothing about the Kuaizhou 1 (KZ-1) small launcher was known to outsiders. It is believed that KZ-1 is a solid propelled, mobile and responsive launch vehicle developed by CASIC, and one of a few of such kind of launch vehicles in the world, if not the only one. This unexpected launch makes people wonder how many hidden advanced space projects are in progress that will give us surprises some day.

The IAC 2013 opened a small window to that. Besides

information revealed by speakers in plenary sessions, many of the 200 Chinese papers submitted to the congress are highly interesting and show that China has invested in a wide variety of advanced space technologies for future projects.

There were two papers, both by the CAST subsidiary, Aerospace Dongfanghong Development Ltd, Shenzhen, about on-orbit servicing and space robots. In the first paper, it proposed a dual-arm robot system designed to capture non-cooperative GEO satellites for taking control or repairing. A special docking mechanism is designed for inserting and locking the nozzle of the satellite's apogee engine. The second paper was about a so-called "the micro-swarm on-orbit servicing system" consisting of five space robots based on a small satellite platform. The system includes one communication robot, two servicing robots (two robot arms), and two monitor robots with the ability to track, rendezvous, capture and take control of non-cooperative targets, and to perform maintenance and repair tasks. These small satellite-robots work in a collaborated way and a single satellite could be easily replaced to make its operational cost lower. These papers are particularly interesting, as on-orbit servicing with non-cooperative target implies potential military use, or anti-satellite (ASAT) operation. In July this year, China



Roadmap of China's planetary exploration until 2030. (credit: CAS/Go Taikonauts!)



Plan of China's civil high resolution imaging satellites - the Gaofeng (GF) programme. (credit: CASC/Go Taikonauts!)



Solid space launcher developed by CASIC, the alleged Kuaizhou small launcher. (credit: CASIC/Go Taikonauts!)



Concept of a Reusable Launch Vehicle. (credit: CASIC/Go Taikonauts!)

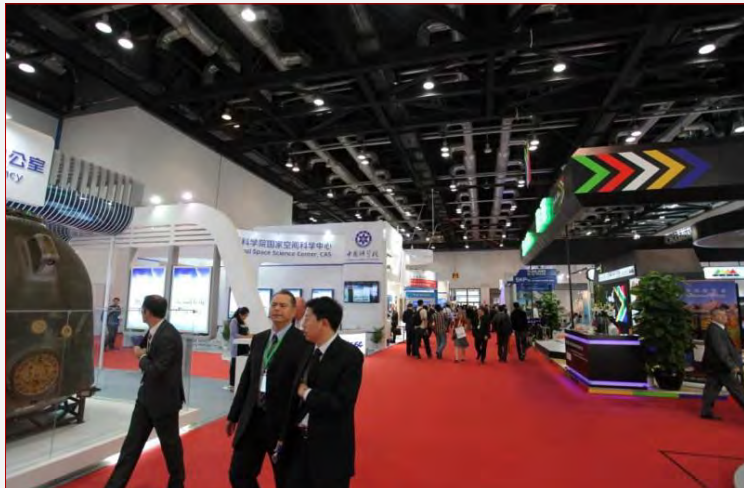


launched three satellites carrying a space robotic arm. Later, one of the satellites made a rendezvous with an earlier-launched satellite and even made a capture test. However, there was no evidence showing the above two papers have connection with this year's mission.

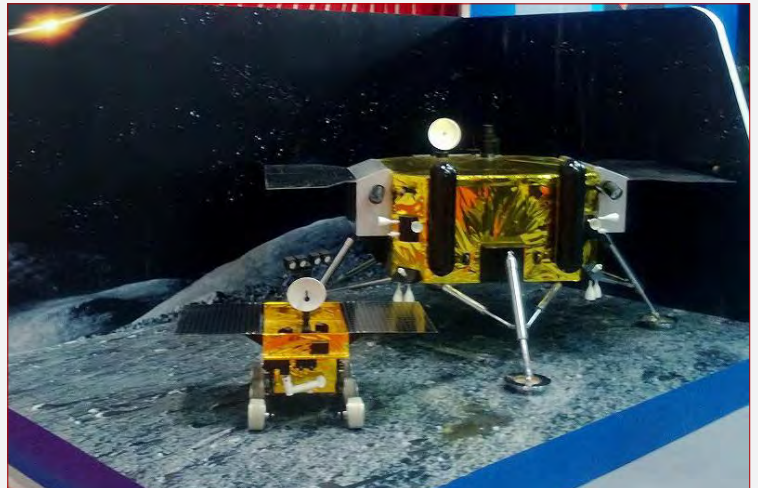
Li Ming, Vice-Director of CAST, revealed during IAC 2013 to the Chinese media, that CAST is studying a space solar power station with a focus on its assembly and attitude control. An IAC 2013 paper supported this report that China is really doing serious work on such a futuristic project. The paper proposed a microwave power transmission demonstration on the CSS. The test will incorporate a 2.4 m x 0.6 m transmission panel and will be supplied by the station with 5 kW of power. It is anticipated to transmit 2.5 kW power from LEO to the ground with a footprint of 55 km diameter. The Qian Xuesen Laboratory of Space Technology, CAST proposed this demonstration, which has already been tested in ground development in the laboratory.

A representation slide from CASIC, seen at the Chinese Space Progress plenary session on 23 September, showed the concept of a re-usable space transportation system. It looks like an air-breathing, horizontal take-off and landing, two-stage-to-space system. There was no detailed description about this

concept. But there were a few papers that give us a glimpse of the Chinese research and development on an air-breathing propulsion system and the space transportation system based on it. One paper analysed factors influencing mode transition in a (ramjet and scramjet) dual-mode engine, based on an experiment using the facility in Beihang University. In the experiment, air was heated up to 1,500 K with a velocity of Mach 2 at the inlet. This is believed to be quite preliminary research and does not represent the highest level of scramjet study in China. Another paper, also from Beihang University, proposed an innovative RBCC (Rocket-Based Combined-Cycle) engine using hybrid rocket (solid fuel and liquid oxidiser), and as a result it was named HRBCC. In this design, the hybrid rocket engine works from take-off to Mach 3, and Mach 6 thereafter. In between, the engine works in the mode of a scramjet. The author believes it will be structurally simpler, lower cost and safer. The third paper proposed a single-stage-to-space system using the conventional RBCC engine, but relies on Maglev technology for take-off. The spacecraft will have a launch mass of 200 tonnes, a dry mass of 43 tonnes, and is able to send 6 tonnes of payload into a 350 km circular orbit. The Maglev track will be 9 km long (3 km for launch and 6 km for abort) with an inclined angle of 2 degrees on which the vehicle will be accelerated to Mach 1.5 with 3 g of overload. The author made a comparison with



The IAC 2013 exhibition area. (credit: Go Taikonauts!)



Scale model of the Chang'e 3 lander and rover. (credit: Go Taikonauts!)



Scale model of the advanced upper stage in development by CAST. (credit: Go Taikonauts!)



The printed edition of Go Taikonauts! Issue 9, distributed free in IAC 2013. (credit: Go Taikonauts!)





## IAC 2013 – BEIJING REPORT - CALT VISIT ON 25 SEPTEMBER 2013

by Theo Pirard

The author at the CALT Headquarters. credit: Theo Pirard



In the programme of technical tours which were organised during the 64th International Astronautical Congress (IAC), there was an interesting visit of CALT (China Academy of Launch Vehicle Technology) headquarters in the Southern part of Beijing. CALT, inside the powerful CASC (\*), means the independent access of China to the new world of space. It is headquartered in a large industrial complex located South of the Fourth Ring Road, some 15 km from the Tiananmen Square, not far away from Beijing Nanyuan Airport. Some 22,000 people are working at CALT manufacturing facilities and launch complexes (\*\*). No indication was given about the employment in Beijing.

The infrastructure consists of modern buildings - which include a historical museum - and common facilities made of enormous halls. It is connected by railway to the launch centres of Jiuquan and Xichang. Its access at the end of a road is severely restricted. No photographs are allowed beyond the entrance barrier. Inside, CALT is equipped to manufacture and test rocket/missile components, and to assemble and integrate CZ-2C and CZ-3 versions of the launch vehicles. This Chinese site has some aspects that remind one of the Soviet production facilities in Moscow, such as the Khrunichev Space Centre. Along the wall which surrounds the governmental 'secret' complex, we discover some poor houses in crowded quarters.

At the entrance, during the welcome process to verify the passports with the list of registered IAC 2013 delegates, we

can see a panel with photographs showing the historical role of Dr. Tsian Hsue-shen, the "father" of liquid rocketry in China. A few sensitive people of the scientific community were not allowed to enter the Long March integration facility.

We got the opportunity to see three large "clean rooms" through a long corridor with windows, and received some explanation about the activities in progress from a specialised guide. In one hall, a CZ-2C launcher was nearly completed, but it was not possible to know its use. It looked like a tool for training. In another, the main elements of two CZ-3B vehicles were in the integration phase. Our guide stated without precisely naming the missions: *"We plan to launch these versions of CZ-3B during December for a spacecraft to the Moon [Chang'E-3] and for a commercial customer [Tupac Katari comsat for Bolivia]"*.

During the session of IAC 2013 about launch services, Si Yuan from the management team of CGWIC (China Great Wall Industry Corporation) made an excellent presentation of the Chinese Launch Services. She insisted on the growing reliability of the CZ launchers with a total success rate of 98.1 % (152/155) for the in-service versions. If all CZ launches since April 1970 are taken into account, the reliability rate will come down to 95 %. The production capability, in Beijing (for CZ-2C and CZ-3 versions) and in Shanghai (for CZ-2D and CZ-4 models), is around 20 units per year. No indication about the partition between Beijing and Shanghai (made by SAST - Shanghai Academy of Spaceflight Technology) was provided. The normal delivery cycle is 24 months, but, with the increasing number of GTO missions, it is possible to shorten the delivery period to 18 months. Questioned about the price for a GTO launch with a CZ-3B, Si Yuan showed some embarrassment, but gave the reference of \$ 70 million (52 million €) that makes CZ-3B greatly competitive with Falcon 9 of SpaceX.

Near the main offices of the CALT administration, there is a nice building which houses the historical museum with old-style content. Our group of visitors got

the permission to take pictures. It is not really an educational exhibition. This kind of interesting bric-a-brac is made of:

- the upper parts of CZ-1D, CZ-2C and CZ-3;
- some liquid rocket engines using the toxic nitric acid and UDMH propellants;
- an impressive mock-up of the Shenzhou spaceship;
- a recovered Shenzhou capsule;
- the presentation of CZ-2F/Shenzhou launch complex,
- satellites of the 1970s and 1980's...

A real model of the CZ-4 launcher - made in Shanghai and not in Beijing! - was the centre-piece of the CALT museum. In an isolated part, there were small mock-ups of the next CZ-5, CZ-7 and CZ-11, although not at the same scale.

At the entrance-exit of the museum, an attractive shop is selling books, stamps, DVDs concerning manned spaceflight in China, as well as the metallic mock-ups of CZ-2F, CZ-3B and CZ-5 launchers... All the material to meet the interest of any fan for the Chinese space programme.

(\* CASC (China Aerospace Science & Technology Corp) is the main player to produce launch vehicles, satellites and manned spacecraft, deep space probes, strategic and tactical missiles... In 2012 - following a poster at IAC 2013 Space Expo, it has generated revenues up to some 15 billion €.

(\*\*) CALT has three manufacturing sites for the Long March versions: Beijing for CZ-2C and CZ-3B models, Shanghai for CZ-2D, CZ-4B and CZ-4C, Tianjin with a new complex to produce the launchers of the new generation using semi-cryogenic and cryogenic rocket engines, CZ-5, CZ-5B, CZ-6 and CZ-7. It operates three launch centres: Jiuquan (for the manned spaceflights and military spacecraft), Xichang (for GTO, MEO and interplanetary missions), Taiyuan for CZ rockets manufactured by SAST. A fourth centre is in construction at Wenchang, on Hainan Island: the maiden flight of a CZ-7 launch vehicle is planned not earlier than 2015.

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Top Left: Scale models of the CZ-7 and CZ-11 new launchers. credit: Theo Pirard

Top Right: The CALT museum. credit: Theo Pirard

Bottom Right: The CZ-4 rocket in display. credit: Theo Pirard

other proposals including VentureStar/X-33 and Skylon, which showed that the system will have a better orbit insertion mass - launch mass ratio (28.82) than the Skylon (21.225).

Of course, it is still a big question of how many of these research activities will lead to actual space missions. But we have seen China's efforts on advanced technologies, and the innovative capability of Chinese space scientists and engineers, mostly young professionals with pride and confidence, which is more important.

### United Nations Joins the Game

China showed great openness during the congress. Not only did the Chinese provide many details of their space plans in speeches and papers, but also they provided many opportunities for participants from other countries to communicate with Chinese space officials, engineers and scientists face-to-face. China was also actively promoting international cooperation. A few cooperation agreements were signed during the congress. For example, China and Italy signed on 24 September, an agreement to establish a Sino-Italy Joint Laboratory of Electric Propulsion. There was even a "Global Networking Forum: Working with Chinese partners - How to get the most".

The discussion led by Dr. Ruan Zongze – Vice-President of China Institute of International Studies brought the panellists

Fu Zhiheng – Vice-President of China Great Wall Industry Corporation (CGWIC); Dr. Wu Ji - Director General of the National Space Science Center (NSSC), China Academy of Science; Dr. Zhang Wei - Secretary-General APSCO; Dr. Gerd Gruppe - Member of the Executive Board of German Aerospace Centre (DLR); René Oosterlinck - Chairman of the Board of the International Space University, and Ghislain Ruy - Chief Systems Manager of LuxSpace Sarl, Luxembourg, together. They all gave an insight into their personal experience of cooperation with China, which was based on quiet different grounds. But all agreed that cooperation must lead to a win-win situation for all involved partners. Also, all panellists appreciated the Chinese intention to open the future Chinese Space Station – CSS, for international cooperation. Dr. Zu Zhiheng from CGWIC pointed out that he would like to see that the ISS would also open the door to Chinese scientists. By stating that, he had the audience on his side.

He also found strong words about the ITAR restrictions in place, which make it harder to initiate cooperation without artificial limitations, but in particular, his business is affected by that US-construct. Dr. Zu reminded the audience that the fate of the ISS for the time after 2020 is not yet determined, and that the CSS might become the only orbital laboratory for all human beings. René Osterlinck and also Dr. Gruppe tried to smoothen the discussion, by clarifying that ITAR is not only a hurdle for China but also for Europe. But that argument played into Dr.



Zu's hands who recommended to get rid of ITAR and then one would be free.

Dr. Gerd Gruppe gave an extensive overview on the work with China on the SIMBOX project. He did admit that it was a cultural challenge for the German scientists, but they really made big efforts to already prepare beforehand for the intercultural barriers, and he hopes that the same is true for the Chinese side. The SIMBOX project was so successful that there is a follow-up project in the pipeline. As an example of other areas of potential cooperation with China, he identified life support on the space station: "What concerns the future of space cooperation between Germany and China? I think we have very good experience in the fields of microgravity life sciences, common research in the area of medical treatment. We will continue that. We have meetings with our Chinese partners during this congress. We can build on a good foundation for those talks. I personally would very much like that we could be a partner in the Chinese Space Station, with German instruments, and for scientific exploitation. Sportsmen and scientists can be the pacemaker for international cooperation, even for political cooperation. This is somehow as we see our role." He finished by emphasising: "I dare to say there are no ITAR problems involved."

Space cooperation between China and the United States always draws the most attention. NASA Administrator Charles Bolden went to Beijing for the second time (the first visit was three years ago in October 2010). In IAC 2013, Bolden and the CNSA Administrator Ma Xingrui had at least two occasions of sitting closely together (at the Heads of Agencies session and the Press Conference on 23 September). But they did not talk to each other at all. Ma met with the heads of several space agencies in Beijing. For Bolden, apart from IAC 2013, the only official activity during his stay in Beijing was the visit to CAS, and a meeting with its President Bai Chunli. No intersection of the paths of the two Administrators shows that there was still no breakthrough in Sino-American space cooperation. It's unfortunate, as IAC 2013 provided a good opportunity for the space leaders of the two countries to have direct contact in order to improve their relationship.

In contrast, another development was more interesting. It was about the international cooperation on the Chinese Space Station (CSS). During the congress, China reiterated its willingness to open the CSS to international partners for cooperation, including joint experiments, joint manned missions, the docking of foreign visiting vehicles, and additional pressurised modules built and launched by the future partners. Nearly one year ago, there was news about ESA's interest in cooperating with China on human space flight. Now, it's the United Nations. According to the document released by the UNOOSA (United Nations Office for Outer Space Affairs) in June, China offered the utilisation of the facilities on its planned manned space station to the world during the 55th session of COPUOS (United Nations Committee on the Peaceful Uses of Outer Space). The document shows that the HSTI (the Human Space Technology Initiative), launched by UNOOSA in 2010, will work with the China Manned Space Agency to review a possible collaboration in utilising the Chinese Space Station. It became reality in September. During the IAC 2013, an UNOOSA representative made a speech revealing that the international cooperation on CSS has been included in the framework of HSTI, and that UNOOSA will invite international partners to join the cooperation programme on CSS. (also compare: GoTaikonauts! no. 09)

China's new strategy on CSS cooperation is significant and will have a long-term impact on a possible new world order in space.

During the last decade, China had expressed several times its willingness to participate in the ISS programme, but all requests remained unheard. U.S. domestic politics and concerns on technology transfer and leakage of sensitive technologies have been the major obstacle that is very difficult to overcome in the short-term. Sino-European cooperation has fewer obstacles. But there may still be some kind of resistance from inside ESA originating from pressure from its US-American partner, which was possibly the reason for slow progress on human space flight cooperation in the past years. The UN does not have to cope with these issues. It has little to no involvement in the ISS programme. It has enough incentive, capability and influence to play a major role in a large international space project like this. The fact is, UNOOSA is very active in CSS cooperation. China has made a clever and wise decision. There is a chance that the CSS will become the second ISS.

## Impression at the Scene

Other than plenary speeches and professional papers, Chinese presence was seen on many other occasions at IAC 2013. At least three taikonauts attended IAC activities. Liu Yang and Wang Yaping, the only two female taikonauts who have flown in space, appeared at the "Women in Space - A 50-Year Success Story" plenary in the afternoon of 24 September, together with US-American and Japanese women astronauts, and Prof. Mazlan Othman, Director of UNOOSA. It was the first time Liu Yang and Wang Yaping have appeared publicly together. Both of them made emotional speeches looking back at their orbital flights and foreseeing international cooperation in space. At the end of the event, the audience rushed up to the stage and asked for their autographs, turning a serious forum into an exciting pop concert. Nie Haisheng, Commander of Shenzhou 10, together with CMSA Spokeswoman Wu Ping attended a special session on the progress of China's human space programme on 27 September. Nie made a report summarising the Shenzhou 10 mission, although without any fresh information.

In the space exhibition of IAC 2013, Chinese exhibitors occupied about one quarter of the hall. CASC, CASIC, CMSA and NSSC of CAS set up their booths. But it was still quite disappointing, as major players like CAST, CALT and SAST did not have their own booths, and all were under the name of CASC. CMSA displayed the Shenzhou 10 capsule that was the only spectacular item in the exhibition. It also displayed a set of Long March scale models, in which the CZ-7 model made its first public appearance. A poster of the CSS in its latest configuration with a set of large flexible solar arrays, was also seen at the booth of CMSA. In addition, some smaller Chinese space organisations in the exhibition provided hardly noticeable, but interesting information. For example, for the first time, details of the camera on the civil GF-1 high-resolution imaging satellite were given at the booth of the Office of China High-Resolution Earth Observation System Major Project. The satellite, developed by DFH Satellite Ltd., carries a 2 m resolution panchromatic camera and two 8/16 m resolution multispectral cameras. It is obviously falling behind China's military imaging satellites with the name of Yangan (YG).

Chinese organisers arranged two technical visits to CALT and CAST respectively. There is a special report with more details about the visit in this article (see above) of Go Taikonauts!. In addition, there were also cultural activities like the Beijing Night Tour and a Kung Fu performance. After the closing ceremony, the gala dinner was held at the Dazhaimen restaurant (literally the Grand Gate, a style of Chinese traditional gate) accompanied by a Chinese ancient dance performance, which made the event more exotic, or more Chinese, to be precise.



The Go Taikonauts! team participated in the IAC 2013 and attended most of the major events. To promote our magazine, a special printed edition of Go Taikonauts! with the same content as Issue 9, was distributed for free at the congress. The decision to print was made just about ten days ahead of the beginning of the congress, and it seemed a “mission impossible” considering the short time left. But fortunately, with help of a local printing company, 500 copies of the printed edition were delivered to the China National Convention Centre around noon of 23 September, the first day of the congress. The response to the printed edition was amazing. Once a batch of the magazines was put on a desk for free collection, it disappeared very quickly.

During IAC 2013, Go Taikonauts! made some interviews with people and organisations in the Chinese space programme or related to it, including APSCO (Asia-Pacific Space Cooperation Organization), CGWIC and HEAD Aerospace - a Chinese space company focused on international space trade. In the rest of this issue of Go Taikonauts! you can see these interviews in detail. It was a big and pleasant surprise to see that the Chinese officials and leading figures were not only easy to approach, but also willing to give information. In the past, Go Taikonauts! would e-mail the one or the other Chinese institution requesting an interview - but always without success. IAC was a great moment for us, and we are aware of the fact that such a moment will not come so soon again.

IAC is the largest space conference in the world. China has strength, capability and experience of organising large-scale international activities. It is not too difficult for China to make the IAC 2013 very successful, and in fact it was not. However, by observation of the Go Taikonauts! team, there were also some unsatisfactory aspects. Skill in speaking English was one big issue for Chinese participants. On some occasions, the Chinese speaker could barely express themselves in English, and had difficulties to understand questions from the audience, and the audience in turn could hardly understand his/her answer. As

a result of the language barrier, Chinese participants seldom communicated with their international colleagues. You could often see the Chinese gathered in one corner and the foreigners in another corner. Another problem on the Chinese side is still related to a long-term culture of the Chinese space industry, which is that the officially released information about the Chinese space programme is unnecessarily blurred, or outdated, or even misleading. For example, as mentioned in an earlier section of this report, the design of the super rocket for the manned Moon landing presented in a CALT paper was an old design of at least two years ago. It was obviously inconsistent with the new design presented in the plenary at the same time. What confusing information! In fact, a serious problem for the Chinese space programme is that information is usually from different channels: sometimes it originates from a scientist or an engineer speaking to the media, sometimes it is from an academic paper published in a journal or presented at an international conference. While the most reliable sources like the official web sites and official news released to the press provide the latest information, the content is mostly very simple and brief, or full of propaganda. It is of no help at all either for further international communication and cooperation, or for improving the image of China's space programme.

What also caused some difficulties was the travel office, in charge of the accompanying sightseeing programme and additional travel requests. It was not clear whether the poor service for non-standard requests was caused by unprofessionalism or unwillingness to put in the extra effort. The result for the customer was that they had to find their own way to get things done. This was in stark contrast to previous conferences in Beijing, such as the 16th IAA Humans in Space Symposium in 2007.

During the Closing Ceremony on the last day, many awards were given to many people – it was easy to lose overview on what was awarded to whom and for what. However, something what should not be accepted by the IAF is that young people



**‘NO SPACE BETWEEN US’**  
 PHOTO BY ZHANG WEI / CHINA DAILY  
 Chinese astronaut Liu Yang talks with her US counterpart Sandra Magnus in the first meeting between female astronauts from the two countries at Beihang University in Beijing on Thursday. Both also shared their experiences in space with students from universities, and middle and primary schools. See story on page 2.

The best photo of the IAC 2013 in Beijing! China Daily titled this photo “No space between us” It was taken during a public event at Beihang University with Liu Yang and Sandra Magnus. Sandra Magnus commented on that event one day later: “We had a wonderful time sharing our experiences. I had an opportunity to spend more time with Liu Yang at the Beihang University. We spend a few hours talking with students and sharing our stories. It was a real delight and I know we look forward to interacting more in the future.” credit: China Daily

# GO TAIKONAUTS!

honoured by the IAF with a high-level award were not present and therefore not able to take the decoration, because they went sightseeing in Beijing!

And simply forgotten was the official expression of thanks to the numerous and extremely passionate volunteers supporting the congress, starting from the registration desk, up to accompanying the technical visits where they had to fight against wrong participant lists, and incomplete information given to them, up to the Beijing Night Tour, where they made sure that nobody got lost during the excursion. It was simply nice to see that a young generation of Chinese professionals is willing to welcome guests from all over the world and do their best to make them comfortable. Well done!

## Last But Not Least – The Political Environment

It went without notice that four days after the closure of the 64th

IAC, China celebrated the 64th anniversary of the foundation of the People's Republic of China on 1 October. The preparations for the event were already visible during the congress.

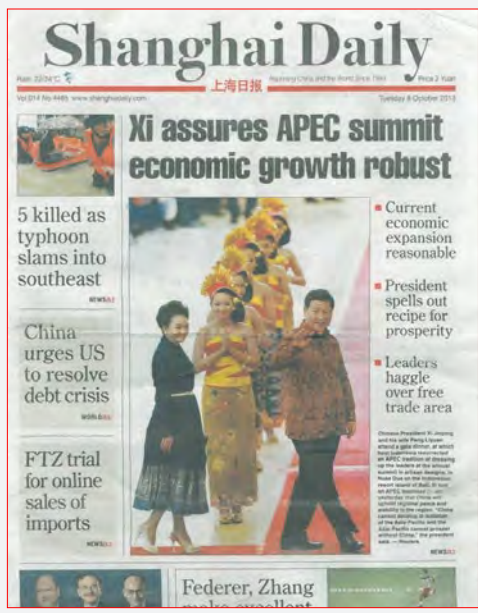
IAC 2013 was flanked by several other political events, worth mentioning. Shortly after the National Celebration, China's leaders participated from 5–7 October in the APEC Summit on Bali in Indonesia. The annual APEC - Asia-Pacific Economic Cooperation - Summit is the most important business event in the Asia-Pacific region. The Summit theme "Towards Resilience and Growth: Reshaping Priorities for Global Economy" matched with the growing self-confidence of Chinese representatives which was also observable during the IAC. Initially, US-President Barack Obama was to have participated in the Summit, but because of the US-Government shutdown, he did not manage to make it. China's President Xi Jinping was there, however. Moreover: The next Summit will take place in Beijing.

Again a few days later from 9 to 10 October 2013, the 23rd ASEAN - Association of Southeast Asian Nations - Summit, and on the sidelines, the 16th ASEAN-China Summit took place in Brunei Darussalam, located on the north coast of the island of Borneo. Here, China's Premier Li Keqiang commemorated with his colleagues, the 10th Anniversary of the ASEAN-China Strategic Partnership and made clear that ASEAN is a priority in Beijing.

China's visibility at those strategically important events stood in stark contrast to the absence of the US and left the floor to the representatives of the Middle Kingdom - a feeling that also was omnipresent during the IAC 2013.

Compared with 17 years ago, there has been tremendous change in China and in its space programme. The successful closure of the IAC 2013 has indicated again that China is a major player in space. How will it be if the IAC is back in China after another 17 years? Will there be greetings to the congress from Chinese on the Moon? Maybe not. Most likely it will be from the Chinese Space Station in orbit.

IAF published some videos of the IAC2013 and a summary newsletter. Follow this link for viewing both materials:  
[http://www.iafastro.org/uploads/PDF/Newsletters/IAF\\_NL\\_Dec2013\(17\)\\_FINAL\\_mail\\_1.pdf](http://www.iafastro.org/uploads/PDF/Newsletters/IAF_NL_Dec2013(17)_FINAL_mail_1.pdf)



Chinese President Xi Jinping and his wife in traditional Indonesian dresses. President Xi stated: "China cannot develop in isolation of the Asia-Pacific and the Asia-Pacific cannot prosper without China." And the APEC Communique reinforced that view: "As our region increasingly becomes the main engine of global growth, we are called... to look ahead, to adapt to our changing needs, and to reinvigorate the path toward progress." credit: Shanghai Daily



China's Premier Li Keqiang, Thailand's Prime Minister Yingluck Shinawatra and Brunei's Sultan Hassanal Bolkiah share the cake. For the moment it is just the celebration cake for the 10th Anniversary of the ASEAN-China Strategic Partnership on the sidelines of the 23rd ASEAN-Summit mid-October in Brunei. But in the future, the cake might take on a strategic meaning. credit: Shanghai Daily



Left: Family atmosphere: Indonesia's President Susilo Bambang Yudhoyono plays on the guitar a birthday song for the Russian President Vladimir Putin who celebrated his 61st birthday during the APEC Summit beginning of October in Indonesia. credit: Shanghai Daily





## Voices From The IAC 2013

Collected by Jacqueline Myrrhe

IAC 2013 was not only a party for the world space community but also a showcase for the Chinese space programme. What was the impression of people from other countries? What were their thoughts about the Chinese space programme and cooperation with China? Some expressed their views at public forums, and in interviews with Go Taikonauts!

**Romain Charles, European Mars500 participant, now working for the European Astronaut Centre in Cologne, as an Astronaut Support Engineer**

**GoTaikonauts!: What was the purpose of your participation in the IAC2013 in September in Beijing?**

**Romain Charles:** For this IAC, I was invited by the ACC (Astronaut Centre of China) as a Mars 500 crewmember. All the 6 crewmembers were invited, but only 4 could make it to Beijing. We were asked to participate in several events (like the Global Networking Forum) to show the international cooperation with China.

**GoTaikonauts!: Did you give a talk? How were your explanations and your ideas perceived?**

**Romain Charles:** With the other crewmembers, we were cited during the Global Networking Forum about Life Science, and we said a few words. Later during the day, I gave a presentation at the Beijing Institute of Technology with my Mars500 Commander Alexey Sitev.

**GoTaikonauts!: What was your general impression of the IAC?**

**Romain Charles:** At first, I was quite impressed by the venue of this IAC. The Congress Centre is huge and it's in the middle of the Olympic Park. It was nice to be surrounded by these world famous buildings! Later on, I really enjoyed meeting with all the people who worked on Mars 500. The feedback from the scientists who studied us for so long is very important to me.

**GoTaikonauts!: What was your personal highlight of the Congress?**

**Romain Charles:** My personal highlight was to meet with Wang Yue, the Chinese participant for Mars 500. I didn't see him for more than one year and I was really happy to discover his home country after hearing so much about it!

**GoTaikonauts!: What did you gain from your participation in the IAC?**

**Romain Charles:** I think that the strong "cooperation" message which was repeatedly given by the Chinese organisers, will stay with me. Other than that, I gained a lot of new contacts during the IAC in Beijing. It's always a good place to get in touch with old friends from the space field and to meet new ones.



European Mars 500 participant Romain Charles was in Beijing on invitation by the China Astronaut Centre. This photo shows him during the IAC 2012, one year ago. Credit: iafastro.org

***During the Astronaut Outreach Event on the last day of the IAC, Romanian cosmonaut and President of the ASE - Association of Space Explorers, Dumitru Dorin Prunariu commented:***

"International cooperation is very much facilitated by the mutual knowledge of each other. This Congress opens the door to so many new cooperation with China and with other countries. The better we know each other, the better we start to work together. If we have suspicions about each others programmes, of course we will become closed, we will become like a black box and we don't leave the cooperation to be developed. Yes, the space programmes may belong to the space agencies – it exists a European Space Agency which has unified the space interests of Europe and the 20 Member States of the European Space Agency. For instance, the European Space Agency has very good cooperation with Russia, has a lot of negotiations with China, they even intend to send some experiments to the future space station, if the agreement will be signed. We are on the way to negotiate many things. During my stay here in Beijing, for the first time I had the opportunity to visit the space centre, to visit some facilities, to see what is inside and not to have doubts about different sides of the programme. Each nation has its own national interests and national security issues, that are solved through the space programme. But if we are open with the civilian programmes, if we try to know each other much better, than we know each other now, then we sign cooperation agreement and go for new types of cooperation. If you take the International Space Station, which was made by 16 countries, including Russia and the United States – former enemies. But now they have an incredible cooperation in space."



NASA astronaut Sandra Magnus could hardly get away from the space enthusiasts who were asking for an autograph and for a photo with her. credit: GoTaikonauts!

*NASA astronaut Sandra Magnus, a three-times space flyer and Mission Specialist on the last-ever Space Shuttle mission in July 2011, has been present during the week of IAC 2013. Not only did she have a full schedule of activities, but she also was a true and honourable representative of the most important space nation of the world. Wherever and whenever she appeared, she was surrounded by space enthusiasts bombarding her with questions and photo requests. She did not turn down any of those requests and even managed to demonstrate strong multi-tasking skills, by give the following interview to GoTaikonauts! in between photo requests ...*

**GoTaikonauts!: When is your next flight?**

**Sandra Magnus:** Actually I'm retired. I've had three flights. I'm currently the Executive Director of the American Institute of Aeronautics and Astronautics. But I have had three flights and then it was time to retire.

**GoTaikonauts!: Would you like to fly to the Chinese Space Station?**

**Sandra Magnus:** I would like to fly anywhere!

**GoTaikonauts!: What is your opinion about cooperation with China?**

**Sandra Magnus:** I think the more countries that develop space flight, the better we are going to be as human beings. And I think eventually we will all be cooperating, but I don't know how long that will take. India is working on flying humans, China has a very strong programme now. I would like to see some more countries gaining the possibility of flying humans into space, because something like a Mars mission, or to any of the Moons of Jupiter, Saturn, or even putting a permanent base on the Moon for example, where people could live there and live there and live there, it takes more than one country's resources. So I think when more and more countries have experience in space, and develop areas of expertise, we will be able to leverage everyone's experience together. So I think we are moving in that direction.

**GoTaikonauts!: What is the biggest obstacle at the moment not to cooperate worldwide, including China?**

**Sandra Magnus:** You know what I think what the biggest problem is now, and there are people working on this, we need a global coordinated strategic plan, for what human beings should do in space. We have countries that have ideas, of what they want to do in space, we have collections of countries that know what they want to do in space, but we need one coherent, all-inclusive, coordinated plan. And then we need the economic willpower for everybody to fund it appropriately. So I think that's really the starting point. And you see parts of that starting to develop, as China is now having lots of international cooperation. They have opened the possibility to fly other countries to their station, and you can see that there's the global exploration roadmap opportunity going on. So we are slowly moving in that direction.

**GoTaikonauts!: And do you think that you can still contribute to that now that you are in a management function? Maybe you can directly accelerate a little bit international cooperation?**

**Sandra Magnus:** One of the reasons why I took the job that I have at the American Institute of Aeronautics and Astronautics, is that we are the professional technical society for the aerospace industry, so we have a lot of the engineers, scientists and technology people in our organisation. So we are very much involved in what happens in space, and so I am hoping to help in that area. But I think as time goes by, you will see more and more international cooperation. We will get closer and closer to one coherent plan. It just takes time.

**GoTaikonauts!: Thank you for coming to Beijing, that is already a big step forward.**

**Sandra Magnus:** No this is great, I'm really happy to be here.

**GoTaikonauts!: Thanks a lot for that interview opportunity. Much success!**

**Sandra Magnus:** Thank you!



**ESA astronaut Christer Fuglesang, currently assigned to the Stockholm-based KTH - Royal Institute of Technology as Adjunct Professor at the School of Engineering Sciences, said about the IAC 2013:**

"I came to Beijing to give two presentations. One was about my current research work at the Royal Institute of Technology where I am an Adjunct Professor in the research group for particle and astro-particle physics. My second presentation was related to education and public outreach. I could identify many interesting presentations, in particular among the high level plenary sessions, like the Head of Agencies Forum. It was also good to see in the session about

space debris that all parties recognised the danger of space debris, but I also would like to see now that somebody feels responsible for this topic and takes active steps to challenge the problem.

However, looking at the immense number of presentations, I have to admit, by no means it would have been possible to go to all presentations I was interested in. My favourite presentation was the one about the NASA Voyager mission. Voyager is very interesting and exciting. Also, I really liked the impressive Opening Ceremony, which connected Chinese culture and modern space technology in an unusual way.

Apart from presenting to a professional audience, another important reason for

coming to Beijing was to meet people face-to-face. For me personally, this is an important motivation for attending conferences like the annual IAC.

What I found a great pity was that it was not possible to tweet from the conference venue or use Western channels of communication. Chinese officials should have made that possible for an event like this. Since I am involved in the preparation of the coming ASE (Association of Space Explorers) Planetary Congress next year in Beijing, I will address this as a lessons-learned. And after that it is getting serious for me because, after the ASE Planetary Congress in Beijing 2014, Sweden is hosting the ASE Congress 2015 in Stockholm. Wish me good luck!"

**During the Astronaut Outreach Event on the last day of the IAC, the four astronauts were asked by somebody from the audience whether they would like to go back into space and whether they would also like to fly to the Chinese Space Station.**

**Christer Fuglesang:**

I definitely would like to go back into space and I would not mind to fly on a Chinese spacecraft, although the challenge would be to learn Chinese. It was hard enough to learn Russian. But I have a good trust in the Chinese space programme. I think its development is very impressive. I look forward to your next achievements.

**Chiaki Mukai:**

Of course I would like to go back. I love Chinese food and if you extend your invitation I would like to fly on a Chinese rocket. I have always been impressed by the Chinese space programme, because you have a successful Long March rocket with more than 150 launches. Also, I teach to young students at the International Space University. Chinese participants have shiny eyes, they have dreams and a lot of hope for the future. I feel some energy from those young Chinese. I think this is a great power, a great asset, a great resource for this country and not only for the country but also for the success of the space programme.

**Sandra Magnus:**

Yes, of course I would like to go back into space. I think it would be very unusual to find an astronaut who will say 'No' to that question. And you will find that we would go back on any vehicle that you give us to go back on. With respect to the Chinese space programme: it is very impressive how much China has accomplished since 2003 when the first manned launch happened, until today. And I think there is a bright future because China has very strong planning and the national desire and the national ability to do the long-term planning that is required to have a strong space programme. And like Christer, I have to admit that it would be challenging to learn Chinese. I would like to learn Chinese but this would be a barrier. But apart from that, I would love to go back into space again. It is so wonderful to be up there. It is like a home that you can never go to again. I would



On Friday, 27 September, the last day of the IAC 2013, NASA astronaut Sandra Magnus, JAXA astronaut Chiaki Mukai, and ESA astronaut Christer Fuglesang were sharing their experiences and opinions on international space cooperation with the audience during the Astronaut Outreach Event. credit: GoTaikonauts!

definitely go back.

**Dorin Prunariu – celebrating his birthday on that day, the 27 September 2013:**

I fully agree with anything what was said by my colleagues. In addition I want to say, that I had some official discussions during the week with Chinese representatives of the space field. They said that when China will have all infrastructure set up in space, I mean the new big space station, they will definitely look for international cooperation and for having astronauts and cosmonauts from the international community.

So, I wish to fly once again into space. And taking into account that John Glenn when he was flying for the second time into space he was only 16 years older than I am now, this means I still have time to do it. But I don't know exactly who will send me again. Maybe I should start learning Chinese... I think this would be feasible. I remember that my first language at school was French, then my second language was German. My third language was Russian, because I was obliged to learn Russian to fly into space and Russian became my second language. And then I learned English because on the international level you could not do without. So, Chinese could be one more language...

## “We Use Chinese Satellites, Chinese Launchers, and Chinese Ground Infrastructure.”

Interview with Fu Zhiheng, the Vice-President of China Great Wall Industry Corporation

by Jacqueline Myrrhe

“China has the fastest growing economy in the world. But the American free enterprise system, which allows anyone with a better mouse-trap to compete, is what will ensure that the United States remains the world’s greatest superpower of innovation. ... As noted last month by a Chinese government official, SpaceX currently has the best launch prices in the world and they don’t believe they can beat them. This is a clear case of American innovation trumping lower overseas labour rates.” This strong statement belongs to a post entitled “Why the US Can Beat China” from 4 May 2011. The author of those words is Elon Musk, founder and CEO of SpaceX, whose company has made dramatic progress in developing commercial space launch services.

Two years on, during the AIAA SPACE 2013 Conference & Exposition in San Diego, California, in September 2013, SpaceX Vice-President Adam Harris dared to take a more cautious outlook. In a panel discussion he admitted: “We really feel at SpaceX that the competition is going to be the Chinese space programme.” He pointed out that the monopoly of the US for commercial launches is over since the 1980s. First Europe’s Arianespace filled the gap, and later on the Russian rocket providers did the rest. With the advent of Chinese capabilities, the launcher market gets far more fragmented than the experts would have ever thought. In 2011 and 2012 the US could only launch 2 out of 38 commercial flights. Adam Harris therefore took the opportunity to call for something not complying with a free-market philosophy, for governmental support: “It takes a government commitment” and added: “The Chinese government is certainly committed to furthering their programme.”

Innovation is not only technical sophistication, it is also finding modern business models, creating win-win situations and procedures, and establishing long-term relationships. China can present impressive examples for this approach, such as offering its future Space Station to international partners, or the support for the Asia-Pacific Space Cooperation Organisation (APSCO) or joining the United Nations Office for Outer Space Affairs (UNOOSA) Human Space Technology Initiative. See our interviews and articles on those topics in this issue

Yes, ITAR is in place, but it has not delivered the wished-for effect of preventing China’s rise as a serious space power. China is using its space programme as a joker-in-the-pack for gaining global influence and to attract international cooperation with nations that the US has left aside. With the China Great Wall Industry Corporation, the Chinese government established a commercial entity responsible not only for launch services, but also for the support of new projects like the International Cooperation and Exchange Centre of CMSA, inaugurated in April 2013.

During the IAC2013 in Beijing, GoTaikonauts! had the opportunity to talk to Fu Zhiheng, the Vice-President of China Great Wall Industry Corporation.



During the interview with Fu Zhiheng on the exhibition booth of China Great Wall Industry Corporation at IAC 2013 in Beijing in September 2013. credit: GoTaikonauts!

### GoTaikonauts!: Could you please, describe the scope of activities of your company?

**Fu Zhiheng:** China Great Wall Industry Corporation is the commercial arm for China’s space industry with respect to international business. Our main business comprises launch services, commercial satellites, including telecommunication and remote-sensing satellites. Also, we are engaged in promoting international collaboration in the space area not only for commercial reasons, but because we are authorised by the Chinese government to do this kind of activity. Indeed, we are the only commercial organisation in China to do that.

You might know that we have a long history when it comes to launch services. We started in the mid-1980s. Our first commercial launch was in 1990. That year we launched an US-built satellite for an Asian customer, and in the 1990s we had a very good business in launch services. We had customers mainly from the US, like the major US satellite manufacturers Hughes (now Boeing), Loral, and Lockheed Martin. Since 1999, due to the ITAR restrictions, we are not able to continue this kind of business with US companies anymore. At that time programmes like Motorola, Iridium were outstanding programmes with a significant influence on the market.

People in the space industry consider the Long March launch vehicle as a reliable launcher, and that it is technically and commercially very competitive. But due to the ITAR restrictions we are not able to offer these kind of services to US-American customers, and also not to most European customers. In the current technological environment, many of the satellites contain ITAR-controlled components. So with this configuration they cannot be launched from China, because the US insists that this would be a kind of export.

During the whole process within our service chain we really commit ourselves to safeguarding the technical security of the customer. There is no possibility for technology leakage or something like that to be considered. But it is that man in the U.S. Congress who has a different point of view. Due to political reasons, they say China has stolen US technical secrets during the course of launch activities. We do not believe that, and do



not agree at all. But since the early 2000, we began to work with European companies, in particular Thales Alenia Space. They deliver the unrestricted satellite product line. So we have done some successful cooperation with them. Currently, I would say that the US keeps introducing procedures that makes our work very difficult. Now we have some difficulties to continue the work with Thales.

**GoTaikonauts!: We are aware of the fact and therefore we wanted to ask you about those ITAR-free satellites which are not really ITAR-free. So, how do you want to overcome that hurdle in the future, because if you are limited by the ITAR regulations, how can you make progress?**

**Fu Zhiheng:** Currently, our priority is to promote a package solution to the customer. We use Chinese satellites, Chinese launchers, and Chinese ground infrastructure. We put it all together into a package and promote it to our potential customers. In this way there is no ITAR issue. All is Chinese technology, all are Chinese products. This is possible, because the Chinese satellite technology is also becoming more and more competitive. You can see - and in this conference you can even experience - the development of China. And the same is true for the Chinese space industry. So I would say that we will continue this kind of business strategy and we will put more effort into that.

In the meantime we also have our eye on the small satellite market. Nowadays there are more and more countries which are capable of developing small satellites, mini or micro-satellites. But access to space is the big obstacle for them, so we believe we can use the capability of the Chinese launchers. As a consequence, our launch activities are quite intensive these days. In the past two years, the number of launches in China ranked number two in the world, just next to Russia. Last year we had even more launches than the US. This means, there are more piggy-back opportunities we can offer to the customer.

**GoTaikonauts!: But why should a customer fly with you? Piggy-back opportunities are also offered by other launch companies.**

**Fu Zhiheng:** I would say that if you observe the market, there are not too many opportunities available for customers who have a small satellite. For example, if we look at major launch service providers, they are too commercial. This is a too tiny a business for them, they are not so interested in that. In the US there is NASA promoting a programme to universities and institutions, offering them even a free ride. But there are still some customers they are not able to find their opportunity. Maybe the best option is currently with the Russian ISC Kosmotras launch service provider on their Dnepr rocket. They offer cluster launches. But the problem here is that the number of Dnepr launches per year is limited. Dnepr is a missile-converted launcher, what means their product may be limited. There is a concern about the future supply in the market.

The recent failures of the Russian launchers has also raised some concern about the reliability of Russian products. Not about the technology, the technology is very mature, they have used it for so many years, there is no problem with the technology. But it seems as if there is a systematic quality-control issue. This is one thing. And also we heard customers complaining about the delivery schedule. One customer mentioned that they signed a contract with the Russians and had a programme delay of over one year. For us, I think our credibility in the launcher market

is good, we keep our commitments, no matter whether it is for the big GEO satellites or the small piggyback payloads. We always launch on time. This is really an attractive criteria for the customer.

**GoTaikonauts!: So you use the complete family of Long March launchers?**

**Fu Zhiheng:** Out of the Long March family of rockets, we use different rockets for different missions. Our advantage is that for GEO orbit we have GEO launchers, for LEO orbit we have LEO launchers. Each rocket of the Long March family uses some similar technology for the first two stages, but for the third stage it is a bit different. This way we can be quite cost-effective for different missions. Currently for LEO we use launchers like Long March 2C and Long March 2D, this is really helpful.

**GoTaikonauts!: When do you expect the Long March 5 or 7 to become available for the commercial market?**

**Fu Zhiheng:** We have not done any commercial flight yet. I am not so sure how quickly the two versions can become available for commercial flights. It really depends on several factors. We will look and see when these kind of launchers have finished their maiden flights, and when they are qualified. After that, I think, they will be available to commercial customers.

**GoTaikonauts!: So if I want to launch I come to you?**

**Fu Zhiheng:** Of course, we welcome that.

**GoTaikonauts!: Will CGWIC be involved in human spaceflight or commercial tourist flights?**

**Fu Zhiheng:** I would like to say that our company is authorised by the China Manned Space Agency CMSA to be an international cooperation and communication centre. So we are now trying to promote China's cooperation with foreign countries in the human space exploration area, so we have a role in this process. Just last week, China's CMSA announced the intention to train international astronauts. If China wants to have cooperation at the Chinese Space Station, this gives us another opportunity. I say, we are a commercial company, but sometimes we do also business, which is not really commercial.



The "Global Networking Forum: Working with Chinese partners - How to get the most" at IAC 2013. On the photo to be seen are the panellists: Fu Zhiheng - Vice President of China Great Wall Industry Corporation, Dr. Wu Ji - Director General of the National Space Science Center NSSC, China Academy of Science, Dr. Zhang Wei - Secretary-General APSCO, the moderator of the panel: Dr. Ruan Zongze (partly covered by the TV camera). credit: GoTaikonauts!

## Shaking the Space World – Epicentre: Asia-Pacific

Interview with Dr. Zhang Wei, Secretary-General and CEO of APSCO

by Jacqueline Myrrhe

At least since the famous Apollo lunar landing, NASA can be considered to have become a household name. NASA's colleagues across the Atlantic, working for the European Space Agency ESA, do not share the same fame as their "big brother" organisation. Even worse when people use the trick to make ESA more popular, by referring to it as Europe's NASA.

However, ESA's unique feature since its foundation on 30 May 1975, has been to be the first intergovernmental space organisation worldwide. A, so far small, dwarf organisation on the other side of the globe, covering the Asia-Pacific region is about to dispute ESA's right of being unique, as the second intergovernmental space organisation in the world. Its name is APSCO - Asia-Pacific Space Cooperation Organisation, and one can bet that hardly anybody has ever heard about that organisation, although the chances have been there.

Already as long ago as November 1992, the first Asia-Pacific Workshop on Multilateral Cooperation in Space Technology and Applications took place in Beijing, and can be considered as the very beginning of a new multilateral space cooperation among Asia-Pacific countries. Representatives from 16 countries of that region concluded to set-up an institution for the promotion of multilateral cooperation in space technology and its applications in the Asia-Pacific region.

During the next decade seven follow-up workshops were organised in Thailand, Pakistan, Republic of (South) Korea, Bahrain, Iran and China, and the Secretariat for the organisation of the workshops took up office in 2001 in Beijing. Consequently, China, Pakistan and Thailand proposed to go for a permanent organisation with the aim to facilitate programmes of multilateral space cooperation in the Asia-Pacific region. On 28 October 2005, Bangladesh, China, Indonesia, Iran, Mongolia, Pakistan, Peru and Thailand – in total eight countries - signed the APSCO Convention during a Signing Ceremony in the Great Hall of Beijing, witnessed by then Chinese Vice-Premier Huang Ju. Also, representatives from Russia, Ukraine, the Philippines, Chile and Brazil observed the Ceremony.

Half a year later, on 1 June 2006, the Republic of Turkey joined the organisation in Beijing, making Turkey the ninth Signatory Country of the APSCO Convention. The Signing Ceremony was attended not only by representatives from the original eight Member States, but also by delegates from Malaysia, and Argentina, and again: Ukraine. Dr. Sun Laiyan, Administrator of CNSA, also followed the Ceremony and met with all participating representatives, a fact showing the importance that China attaches to this process.

But it was not until 16 December 2008, that the official inauguration ceremony of APSCO was celebrated in Beijing, formally establishing APSCO. The following year, another milestone was achieved. On 12 June 2009, during the 52nd Session of the UN Committee on the Peaceful Use of Outer Space (COPUOS) in Vienna, APSCO applied to become a Permanent Observer to the UN-COPUOS. That status was granted by the 64th Session on the UN General Assembly in New York. APSCO achieved fully operational status when the staff moved into its new Headquarters office building in Beijing's Fengtai District, on the South West Fourth Ring no 188 in November 2009 – a building that was donated by the Chinese Government.

Looking at that development one cannot really say that things were happening behind closed doors or only occurred recently. Nevertheless, in Europe and the US, the rise of APSCO went with little notice. And this is even more surprising, since there are APSCO features which should be familiar to the space community. For example, joining forces to achieve bigger programmes or to contribute resources. One is tempted to say, that APSCO's structure is reminiscent somehow of ESA's. The APSCO Convention reads: "The Council, headed by the Chairman of the Council is the highest decision-making body. The Council shall consist of ministers or ministerial representatives of the national space agencies of the Member States of the Organization. Each Member State shall nominate one minister or ministerial representative for representation at the Council; the Council shall elect a Chairman and two Vice-



On 28 October 2005 the representatives of Bangladesh, China, Indonesia, Iran, Mongolia, Pakistan, Peru and Thailand – in total eight countries - signed the APSCO Convention during a Signing Ceremony in the Great Hall of Beijing, witnessed by then Chinese Vice-Premier, Huang Ju. Also, representatives from Russia, Ukraine, the Philippines, Chile and Brazil observed the ceremony. credit: APSCO



APSCO logo. credit: APSCO



Chairmen whose term of office shall be two years.”

The current Chair of the APSCO-Council is Ma Xingrui from China. During IAC 2013 he received one of the most prestigious IAF awards, the Allan D. Emil Memorial Award for his “important contributions to the remarkable progress of China’s space programme and his leading role in promoting international space cooperation.” But not only that, Ma Xingrui unites quite a range of important functions in his person: he is a Member of the 18th Central Committee of the Communist Party of China; Vice-Minister of the Ministry of Industry and Information Technology; Director of the State Administration for Science, Technology and Industry for National Defense (SASTIND); Director of the China National Space Administration (CNSA); and Director of the China Atomic Energy Authority. One should not forget the Honorary Presidency of the Chinese Society of Astronautics.

The executive organ of APSCO is The Secretariat, headed by the Secretary-General. Does it ring a bell? But unlike ESA, the Secretary-General is leading a lean administration - just four departments. The Department for External Relations and Legal Affairs; the Department of Strategic Planning and Programme Management; the Department of Education/Training & Database Management; and the Department of Administration & Finances. The current Secretary-General and CEO is Dr. Zhang Wei, also from China. During IAC 2013, Dr. Zhang attended the “Global Networking Forum: Working with Chinese partners - How to get the most” where he presented his organisation. Dr. Zhang was easily approachable for an interview with GoTaikonauts!, and he was highly passionate about introducing his organisation (see final part of this article).

Just out of curiosity, it does make sense to take a look at APSCO’s Convention to compare it with ESA’s. There are certain similarities such as: Article 1, which reads in the APSCO Convention:

*“1. An Asia-Pacific Space Cooperation Organization (hereinafter referred to as “the Organization”) is hereby established.”*

and in the ESA Convention:

*“1. A European organisation, called the ‘European Space Agency’, hereinafter referred to as ‘the Agency’, is hereby established.”*

But other articles address the different nature and different requirements of the two organisations. When ESA is talking about “geo-return”, APSCO calls it “fair-return”. Also, APSCO’s industrial policy as articulated in Article 5, focuses just on two main goals:

- “a) Development of competitive Asia-Pacific industry by resorting to free competitive bidding;*
- b) Spreading of the relevant technologies among the Member States in order to create the specializations necessary for the Organization’s programs and activities.”*

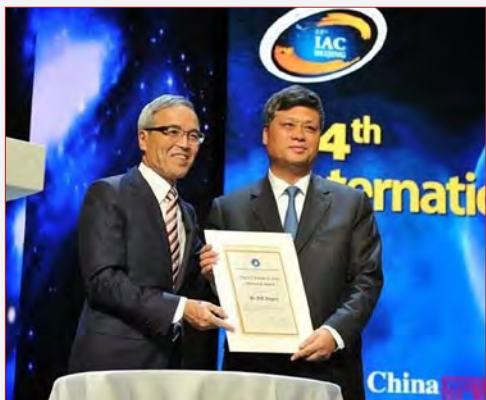
The same sharp focus applies to the defined Fields of Cooperation in Article 6:

- “1. Space technology and programs of its applications;*
- 2. Earth observation, disaster management, environmental protection, satellite communications and satellite navigation and positioning;*
- 3. Space science research;*
- 4. Education, training and exchange of scientists/technologists;*
- 5. Establishment of a central data bank for development of programs of the Organization and dissemination of technical and other information relating to the programs and activities of the Organization.*
- 6. Other cooperative programs agreed upon by the Member States.”*

When it comes to the programmatic, comparable to ESA’s mandatory activities, APSCO has also identified basic activities in Article 7, which are listed as follows:

- “1. Basic Activities*
  - a) Establishing of the Organization’s plans for space activities and development;*
  - b) Carrying out fundamental research concerning space technology and its applications;*
  - c) Extending the applications of matured space technology;*
  - d) Conducting education and training activities concerning space science and technology and their applications;*
  - e) Managing and maintaining the branch offices and the relevant facilities as well as the network system of the Organization;*
  - f) Undertaking other necessary activities to achieve the objectives of the Organization.*

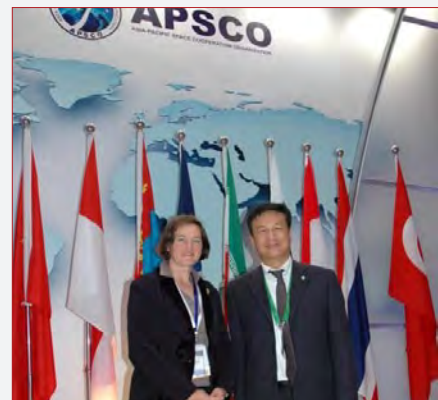
*2. All Member States shall participate in the basic activities in paragraph 1 of this Article.”*



During the IAC 2013, the Allan D. Emil Memorial Award was given to Dr. Ma Xingrui, who is (among other roles), the current Chair of the APSCO-Council, for his foundational work in the Chinese space programme over three decades. credit: iafastro.org



The Secretary-General and CEO Dr. Zhang Wei is presenting his organisation during the “Global Networking Forum: Working with Chinese partners - How to get the most” at IAC 2013. credit: GoTaikonauts!



Dr. Zhang Wei and Go Taikonauts! team member Jacqueline Myrrhe. credit: GoTaikonauts!

Interesting is that, in contrast to the basic activities, APSCO applies to its optional activities the principle of return of investment:

*“1. In addition to its basic activities under Article 7, the Organization shall recommend and organize suitable space science, technology and their applications programs for joint implementation by its Member States, which choose to participate in such programs.  
2. Such a program shall be carried out following the principle of return on investment. The return from an optional activity shall be obtained in proportion to their investment by the Member States participating in it.”*

While the APSCO Convention says in Article 9 that the Organization is open to all Members of the United Nations in the Asia-Pacific Region, this article might currently experience a very generous interpretation. During the discussion of the IAC 2013 event “Global Networking Forum: Working with Chinese partners - How to get the most”, even the moderator summed up the presentation by Dr. Zhang by stating that APSCO is an organisation which is Asia-Pacific based, but with a global vision in mind. And indeed, Dr. Zhang confirmed that his organisation is open to any country: “There is only one frontier for mankind and this is space.”

While it is theoretically the same with ESA, the goals and objectives, clearly directed to European needs, are not really tempting non-European countries to join the organisation. For APSCO this might be easier, since in a way this organisation is taking it from scratch and this is the attraction, in particular to non space-faring countries. On top, every APSCO Member State is granted full voting rights – no matter whether the country is a space-faring nation or not. That principle is also applicable to the decision-making processes in ESA, but more and more this procedure is under debate. The growing number of Member States, ESA at the moment has 20 Member States, and rather small countries are now joining the organisation, makes it harder and harder to find agreement among all. But APSCO is not yet troubled by this situation. Currently, applications from Malaysia and Tajikistan are being processed for becoming observers.

The key message that not only APSCO conveyed, but which was echoed along all corridors of the China National Convention Centre (the venue of IAC 2013), was the imperative for international cooperation. Even Dr. Gerd Gruppe from the German Aerospace Centre DLR came to the conclusion during the “Global Networking Forum: Working with Chinese partners - How to get the most”: “One reason why ESA and APSCO are existing is that everybody sees the necessity for close cooperation. Maybe in the far future we will be cooperating between ESA and APSCO.”

The more flexible and the more pragmatic the approach to that, the better it can be turned into reality. In this respect, APSCO is more than just fractionally ahead of any other space organisation in the world.

Also, the list of Member States reads a bit like a list of “outlaws”, i.e. countries that nobody really wants to work with or that are ignored for the one or other reason. But by giving a home for space activities to countries such as Iran, Pakistan, and Turkey, APSCO shows demonstratively, that talking to each other is the only way forward. APSCO, go! Jiā Yóu! 加油!

**Interview with Dr. Zhang Wei,  
Secretary-General and CEO of APSCO**

**GoTaikonauts!:** From the discussion yesterday during the ‘Global Networking Forum: How to work with Chinese partners’ we understood that APSCO is mainly an organisation for Asian countries. Taking this into consideration, do you think there is a dominance by China since APSCO’s headquarters is situated in Beijing, and because the experience of China is so enormous, that it might become a forum where China would control or steer space projects? Do you think this is a danger or a possibility or a potential?

**Dr. Zhang Wei:** I think China is not controlling anything. Actually we get strong support from the Chinese government. Our convention and also the mechanisms in place make sure that each of our Member States has an equal position and an equal right to contribute its resources and to share them. That also



The “Global Networking Forum: Working with Chinese partners - How to get the most” at IAC 2013. On the photo to be seen are the panelists: Dr. Wu Ji - Director General of the National Space Science Centre (NSSC), China Academy of Science (partly covered by the TV camera), Dr. Zhang Wei - Secretary-General APSCO, the moderator of the panel: Dr. Ruan Zongze, Dr. Gerd Gruppe - Member of the Executive Board of German Aerospace Centre (DLR), and Ghislain Ruy – Chief Systems Manager of LuxSpace Sarl, Luxembourg. Fu Zhiheng is out of the picture, and René Oosterlinck had to leave earlier. credit: GoTaikonauts!



The summary slide from Dr. Zhang Wei’s presentation during IAC2013. credit: GoTaikonauts!



applies to any financial membership fee or financial contribution, where we have minimum and ceiling limitations for any country, even for space-faring countries like China.

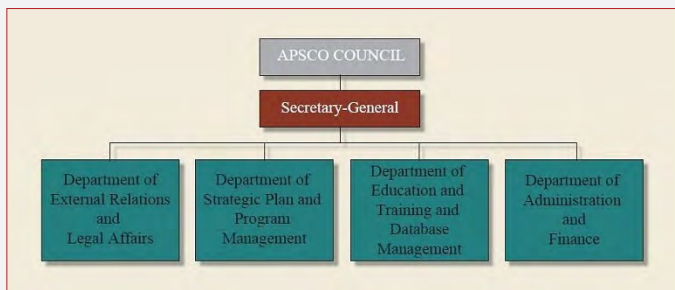
APSCO was founded to share the resources among the Member States. China, nor any other Member State, is controlled by any one country. I can confirm that at the beginning, we were getting support from the Chinese government. China contributed the headquarters building and gave donations for the start-up. But meanwhile, we are working with the resources from all Member States. Not only that, also the programmes and ideas are input from all APSCO members.

Up to now we have 10 projects, some of them are led by China, but others are led by other Member States, like Pakistan, Turkey, and Thailand, who have a different goal.

We hope that more countries will become interested in our network, because our main purpose and function is to encourage all Member States to contribute their ideas and to share them by using the APSCO platform.

**GoTaikonauts!: How do you see your role compared with ESA and NASA on the one side, and now with this new organisation on the other side?**

**Dr. Zhang Wei:** Interesting question! We have very good and friendly discussions with the ESA Director General Mr. Jean-



The APSCO structure. credit: APSCO



Although APSCO is not yet managing any programme related to manned space flight, the desire for extending its envelope to scientific research might be the reason that Xu Yansong, Spokesperson from the Asia-Pacific Space Cooperation Organization, was in the CCTV studio on 14 December to comment on the Chang'e 3 landing. Credit: CCTV

Jacques Dordain. We are good friends and he is sometimes joking that, okay, your convention is copied from ESA but ESA has 35 years of experience, so we are your uncle now. ESA is mainly in Europe, and you are in the Asian Pacific, what implies there could be a good opportunity in the future for cooperation, Mr. Dordain stated. But to be serious again: we think the two organisations are on a different stage, have different areas to cover and master different missions. Both APSCO and ESA could develop very dynamically in the future. True, cooperation is our main concern, but we can also learn a lot from ESA's experiences.

**GoTaikonauts!: Exactly, you said in the discussion that you are open to any country in the world, and you did not really say it directly but we do see a clear opportunity or potential for a global platform which you could provide. ESA is Western Europe, but it is not a leader. The leading agency in the West used to be NASA, but we do see here is now a new forum developing which could lead, maybe not only here in the Eastern hemisphere of the globe, but worldwide. Is that an option? Is it a vision?**

**Dr. Zhang Wei:** We are named 'Asia-Pacific', but it is difficult to say what is clearly our border. Even when we are discussing with ESA they say, yes, we have some business cooperation outside of Europe, like Canada. But you know that it is difficult in space to define territories. On Earth we can say, okay, that is Asia, but this is not possible in space. Space does not have borders. Our Member States are mainly interested in and focused on the projects we are doing. That has not much to do with areas or regions. Our APSCO is new. We show that we are completely open to any country, worldwide, as long as they are interested in our programmes. For example, we are talking about some programmes with Brazil, they are not Asian, neither a Pacific country. But Brazil is interested in our projects, and they also have a traditional cooperation with China, especially in the area of remote sensing. If Brazil says we are interested in your remote sensing programme, or any other kind of project, we are willing to involve them in this project, even in any type of cooperation.

So that is mainly our approach. If we can find a good project, interesting enough for many Member States, we can create any type of cooperation. APSCO is a platform - so let's see how to promote and make cooperation on and with this platform. Any mechanism and model should be tried on our platform. That is what we believe.

**GoTaikonauts!: Which of your projects you are currently doing do you consider as the most important one at this moment in time?**

**Dr. Zhang Wei:** In our scope, we have mainly three kinds of project. First we promote space technology applications, infrastructure applications, or sharing of resources. This is a major requirement from our Member States, like e.g. sharing remote sensing data. Some countries cannot build a new satellite or do not have their own satellite programme, but they urgently need satellite data, maybe tomorrow or immediately. So in this way, we just collect existing Member States resources and share them. It is easy, quick and efficient. This is how we look at space application areas.

A second, further step is technology market sharing. We are discussing and also organising how to create a common interest programme from the beginning, like a satellite. Such a process

starts with studying the available facilities, the manufacturing capabilities and also the launch options and later applications of the space project. That is a long-term programme. We have already started with feasibility studies on remote sensing and communication.

The third area, science, is more long-term and bigger. We have already started with some research projects in science. For example, we talk about KA-band signal transmission in the atmosphere and the related water-effect. That is potentially useful for later communication satellites, and also other research projects. But this area is not so urgent for all Member States, since only China has some space science planning. Other Member States have not yet started these type of activities, since this would require funding and long-term commitment. But what they urgently need are application technologies. But in principle we cover these three areas.

Up to now we have 10 projects. But the other most important thing is the talent and capacity-building programme. I talked about it during the Global Networking Forum yesterday. Here I would like to point to our short training course, our Master's Programme and our Doctor's Programme. That activity is more and more interesting for our Member States, as they have to prepare good personnel, which then can take over further planning and further involvement on the project side. This is another fundamental work for APSCO.

**GoTaikonauts!: Manned spaceflight is not on the agenda yet?**

**Dr. Zhang Wei:** Not yet, but since China is very successful and advancing in this area they call for requirements through the APSCO platform. If our Member States identify an opportunity they are interested in, we will get involved in that. But first they want to obtain some training from the Chinese side, like astronaut knowledge training for example. Maybe in the future our Member States will also have interest in experiments, like microgravity research and aim for some testing in low Earth orbit, to increase their expertise. So these are mainly the areas for the near-term. China can offer very good opportunities for all Member States now.

**GoTaikonauts!: China is also supporting the United Nations with opportunities for the future Chinese Space Station. Is that something that runs in parallel or is it merged together?**

**Dr. Zhang Wei:** I think any opportunity is welcomed by our Member States, like the United States or the UN platform, and the Russian platform. We get more and more involved in positive

discussions. We are already observers with the COPUOS, so we expect more opportunities from different channels, which would benefit our Member States. Also important to mention is that nearly all of the Member States are COPUOS members.

**GoTaikonauts!: Last question. You are now the Head of the organisation. What is your personal vision, what is your wish for the future, how should it evolve?**

**Dr. Zhang Wei:** Currently, we are already in the fifth year for APSCO, and I am the first Secretary-General of this organisation as well as the Head of the Council and the Chairman. Our expectation for the first five years has been to aim at a very stable development of the programmes, and most importantly, of our long-term planning. Nevertheless, we are already planning for changes, but I hope it will be a step-by-step process. Of course the future also depends on the interest of the Member States.

Just an example: An increasing budget will make it more and more possible to implement more interesting projects. My expectation is that in the near future APSCO will have its own satellite, and also its own network of ground equipment, like our optical observation system. Hopefully we can also set-up other science projects and in this way, we can occupy all of the space areas for the benefit of the Member States. But that depends on the situation. Another important point is that in our mechanisms, in the leadership of the Council, the post of the Chairman and also of the Secretary-General, we are getting the Member States more and more involved. So this year and next year we are changing our organisation, including the Secretary-General, which will then come from a different Member State. It is good practice for international cooperation, and we expect that more and more it will become the normal way.

**GoTaikonauts!: Much success! This sounds really interesting.**

**Dr. Zhang Wei:** We hope so! Thank you for the interview and for introducing APSCO to your audience. This might increase the support and understanding of what we do.

**GoTaikonauts!: We are a niche publication, but with a worldwide distribution. So from that point of view, we are happy to spread the message.**

**Dr. Zhang Wei:** In the space area, anything that happens is worldwide, not regional nor local. Therefore we hope that the understanding for space is going around the globe and becomes a worldwide endeavour.



## IAC 2013 – But There Was Also Something Else

### United Nations-China Workshop on Human Space Technology

by Jacqueline Myrrhe

#### Gathering in Beijing

Without doubt, the 64th International Astronautical Congress from 23 to 27 September in Beijing, China has been the ultimate meeting place for the astronautical community in 2013. However, numerous events, workshops, and meetings organised either by the International Astronautical Federation (IAF), or the International Academy of Astronautics (IAA), were held in conjunction with the 64th IAC. Just to name a few:

- 23rd United Nations-International Astronautical Federation Workshop on “Space Technology for Economic Development” from 20 to 22 September 2013;
- the IAC Student Programme from 21 to 28 September 2013;
- the Young Professionals International Project Management Committee (IPMC) Workshop on 20 September 2013;
- the IISL Moot Court Competition on 26 September 2013;
- the Tsinghua University IAF-SUAC International Student Workshop on the 28 September 2013, and just alone on the 22 September 2013, the 5th International Meeting for Members of Parliaments; the IAA Academy Day; the Educators Professional Development Workshop, and the Cross-Cultural Presentation Workshop.

Another workshop bloomed a little bit like a violet in secret, but might be considered as the event with the biggest impact on the future Chinese manned space programme. From 16 to 20 September 2013 the United Nations-China Workshop on Human Space Technology, took place in the Landmark Convention Centre in the Chaoyang District of Beijing’s East. The working meeting was co-organised by the United Nations Office for Outer Space Affairs (UNOOSA), China Manned Space Agency (CMSA), and the International Academy of Astronautics (IAA).

Mazlan Othman, the Director of UNOOSA in Vienna, is the initiator of the “Human Space Technology Initiative – HSTI”, a project dedicated to technology development in the area of manned space programmes. At the core of this programme is to build space skills in countries currently without a space programme – which means in the majority of the current 74 UNOOSA Member States. (compare: GoTaikonauts! no. 09; p. 21-23) Prof. Othman explained in a video interview, posted on the CMSA website dedicated to the workshop what the main purpose of the meeting was: “The fact that more and more countries are getting involved in space is a good thing. It means that space is definitely very, very important in the context of development, not only in global development but also national development. ... China is a good example of how space can become a vital, crucial aspect of development. ... So the significance is that these emerging countries will come this week to speak about what are their thoughts, what are their visions, and then create synergies of cooperation with other countries. Of course, we hope a country like China will lead some of these cooperative initiatives.” She went on by giving the reasons why the workshop was held in China: “China is one

of the most powerful countries in terms of its space research, space development, and especially in terms of developing a manned space programme. And on top of that, China is a still developing country, and I think the Chinese have an idea about the struggles and yet the aspirations, the ambitions, of a developing country. And since the United Nations exists in order for nations to speak together, and for nations to bring up their capacities and capabilities as good as other countries, China is in the position to assist other developing countries in building their capacities and capabilities. China has now the scientific, technological, as well as political will, to build that capability and is still a developing country at heart. This makes China feel more responsible to assist the other developing countries.”

These ideas were strongly echoed by the Chinese space officials during their welcoming notes to the workshop participants. Niu Hongguang, First Deputy Commander of the Joint Committee of China’s Human Space Programme, spelt it out like this: “... we have to be aware that cooperation and innovation will be the two themes of human space exploration. The only way for future development is to strengthen international cooperation and exchange and accomplish more revolutionary innovation in concept, technology and application, to better serve global economic and social development. ... On the basis of equality and mutual benefit, peaceful utilisation and common development, China is willing to strengthen international cooperation and communication, to make more contributions to the sustainable development of human space exploration, to the peace, prosperity and progress of the whole world.”

Wang Zhaoyao, Director-General of China Manned Space Agency CMSA reiterated this concept when he stressed: “The China Manned Space Agency is in full support of promoting international cooperation and exchanges under the framework of the Human Space Technology Initiative, and has made positive efforts to this programme. ... In regards of the channel for cooperation, bilateral and multilateral cooperation are both adoptable to which the United Nations’ Human Space Technology Initiative is an ideal one. As for the cooperation mode, on the basis of peaceful development and win-win cooperation, we can find out the flexible modes for cooperation through discussions and negotiations.”

Dr. Giuseppe Reibaldi, Director Human Spaceflight for the International Academy of Astronautics, was so kind to explain us on behalf of the IAA, the motivation for co-organising this workshop in China.

#### **GoTaikonauts!: What was the intention of your participation in the UN-China Workshop on Human Space Technology in September in Beijing?**

**Giuseppe Reibaldi:** The International Academy of Astronautics (IAA) was founded in Stockholm in 1960 and is an NGO. The main purposes of the Academy are to foster the development of astronautics for peaceful purposes, to recognise individuals



who have distinguished themselves in the field of astronautics, and to foster international cooperation. Academy members are from all over the world, including approximately 65 countries.

The International Academy of Astronautics has been very active in the field of Human Spaceflight by organising thematic symposia and publishing Cosmic Studies. In 2010, on the occasion of the 50th anniversary of its foundation, the Academy organised the first Head of Space Agency Summit in Washington, gathering 30 Heads of Space Agencies. At that time, the Academy published the report: "Future Human Spaceflight: the need for international cooperation", which explained the need for global cooperation in human exploration in Low Earth Orbit, and beyond. The Academy is now preparing a follow-up on the Head of Space Agencies Summit, dedicated to robotics and human space exploration, planned in January 2014 in which several projects fostering global cooperation, especially with new and developing countries, will be proposed for implementation.

The United Nations Office for Outer Space Affairs initiated the Human Space Technology Initiative (HSTI) in 2010, within the frame of the Programme on Space Application, with the aim of involving more countries in activities related to human spaceflight and space exploration, and of increasing the benefit from the outcomes of such activities through international cooperation, which would make space exploration a truly international effort.

In 2012, considering the goals of HSTI and IAA's human spaceflight activities, cooperation was initiated between the two organisations to complement each other, exploiting the skills available in each organisation.

The first joint activity was IAA participation in co-organising the United Nations-China Workshop on Human Space Technology, which took place in China from 16-20 September.

IAA was part of the Programme Committee and provided several Academicians to act as Chair of Sessions and Working Groups.

**GoTaikonauts!: How were your presentation and your ideas perceived?**

**Giuseppe Reibaldi:** The meeting was attended by 31 countries and 150 professionals. 42 presentations were made by the

participants during plenary and technical sessions. I presented, as IAA Director of Human Spaceflight, the activities that the Academy is carrying-out in human spaceflight. The Academy has many Study Groups that deal with topics from space mineral resources to global human Mars system mission, space solar power and many others. These projects are open to participation of the new and developing countries to engage them in a concrete way.

The content of my presentation was well received and we hope to have participants, from experts of the countries attending the workshop, joining our Study Groups.

**GoTaikonauts!: What was your general impression of the workshop?**

**Giuseppe Reibaldi:** The workshop was very well organised, by the local committee of the Chinese Manned Space Agency, and the participants were able to discuss between themselves topics of common interest. Beside the technical sessions there were poster sessions, as well as working groups. The technical tour of Chinese human spaceflight infrastructure was of extreme interest, showing the high level of technical competence reached by CMSA.

**GoTaikonauts!: What did you gain from your participation in the workshop?**

**Giuseppe Reibaldi:** The participants, mainly coming from new and developing countries, expressed their problems in getting involved in human spaceflight activities, and indicated areas of possible cooperation with space-faring nations like China.

China in particular, did offer the possibility to fly experiments on their Chinese Space Station as from 2018, for the new and developing countries via the HSTI programme, and possibly with the support of IAA.

**GoTaikonauts!: What do you think will be the way forward?**

**Giuseppe Reibaldi:** The Workshop has made several recommendations on fostering the involvement of new and developing countries. IAA and HSTI have identified actions, related to the recommendations that we will implement in the future, in a complementary way.

## THE SPIRIT OF BEIJING

**Wang Zhaoyao**, Director-General of China Manned Space Agency (CMSA): "Dear friends, at present, the human society is a community of interdependence. Inclusiveness is listed as one of the United Nations Millennium Development Goals. Human civilization is in more need of inclusiveness, cooperation and innovation than any other time. No country can stand aloof from others. As the host of this Workshop, we want to take this opportunity to make the following proposals: all the countries in the world should strengthen cooperation in human space exploration, enhance the awareness of the common destiny of whole mankind, and promote the inclusive development of all the countries and to create a new era of human space technology."

*For more information on the workshop, please, consult the following websites:*  
<http://www.unoosa.org/oosa/en/SAP/act2013/China/index.html>  
and  
<http://en.cmse.gov.cn/ChinaWS>

*For downloading all the presentations, given during the workshop, please, go to:*  
<http://unoosa.org/oosa/en/SAP/hsti/china2013.html>



## CHINESE SPACE STATION CSS More Technical Details Than Ever Before

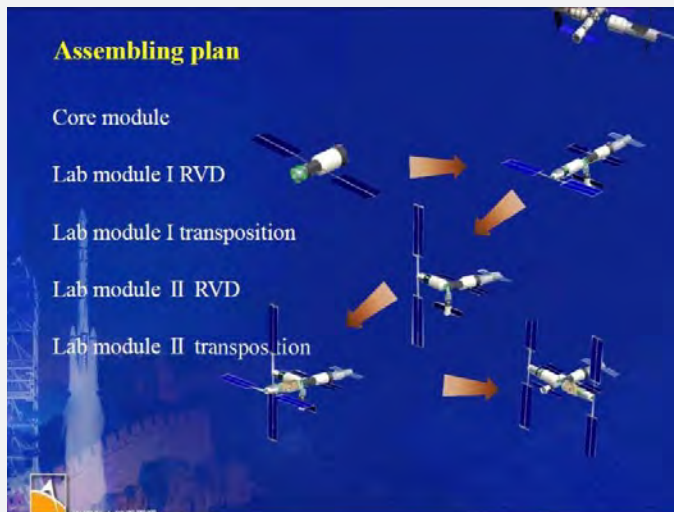
The presentations, given by Chinese space experts have provided the (so far) most comprehensive information on the CSS design. Although an overview of the CSS was given earlier this year in Chief Designer Zhou Jianping's paper, there was a lot detailed and novel information in the presentations.

For example, **Zhou Jianping**, Chief Designer of China Manned Space Programme, reported in great detail on the history, the status quo of the space station programme, and the aims of the CSS project. He introduced technical details, the utilisation areas, as well as the options for international cooperation.

The concept of the CSS is to perceive an orbital outpost under Chinese conditions, of moderate scale, but with the potential for further sustainable development. Additionally, China's intention is to pursue technology progress, make use of modern advanced technology, with full abilities of building large-scale space facilities and on-orbit operations. There is clearly a focus on applications benefits, and innovation progress of space applications and on economical operation of the Station.

Zhou defined the aims of the Chinese space station project as:

- Build and operate a space station;
- Build a national space laboratory;
- Carry out international (regional) cooperation.



Assembly plan of the CSS. credit: Zhou Jianping/CMSA

His presentation contained a detailed description of the different elements of the future Chinese Space Station, along with the assembly plan and the means of space transport for crew and cargo.

Zhou also named the areas of utilisation, and laid-out the next milestones until accomplishment of the CSS final configuration and identified the options for international cooperation.

International cooperation is encouraged in aspects of laboratory modules, space utilisation, astronauts, crew rescue and other possible options.

Worth mentioning are the unique features of the CSS which were listed by Zhou. The most interesting might be the following:

- Expandable and reconfigurable capability upgrades;
- Modularised and maintainable for life extension;
- Modularised cargo spaceship;
- Automated on-board management;
- High data-rate transmission and nearly 100% coverage;
- Internal and external payload support;
- Regenerative life support and environment control;
- Electric propulsion.

For downloading the presentations, given during the workshop, please, go to:  
<http://unoosa.org/oosa/en/SAP/hsti/china2013.html>



International Cooperation on CSS. credit: Zhou Jianping/CMSA

## INTERNATIONAL COOPERATION ON THE CSS Concrete Ideas For An International Future

In his keynote speech, **Wang Zhaoyao**, Head of CMSA, clearly reaffirmed China's willingness to promote international cooperation on the CSS. It can be seen as an official invitation for partnership on the CSS. He also pointed out that working with UNOOSA within the framework of HSTI can be an ideal approach. At the same time, UNOOSA representatives also officially included the CSS, in parallel with ISS, in the HSTI plan. It may be the first time that the plan by China and the UN on the CSS international cooperation

was officially confirmed, one week earlier than the same information was disclosed at the IAC 2013.

The presentation by **Yang Hong** - China Academy of Space Technology, was entitled "Discussion on the Technical Approach and Models of Chinese Space Station International Collaboration" Starting with an historical review of international space station cooperation and analysing those past models, **Yang** comes to the conclusion:

## INTERNATIONAL COOPERATION ON THE CSS

### Concrete Ideas For An International Future

"The models of international cooperation are various." He went on by outlining the technical conditions that enable international collaboration, and are needed to make the involvement of global partners feasible. Here are some excerpts from his slides.

#### Space Station Module Collaboration

USA, Russia, Europe, Japan have the ability to develop experiment modules and take module collaboration with the Chinese Space Station.

#### Feasible Docking Approaches

- Rendezvous and docking independently;
- Independent rendezvous and robotic arm-assisted docking;
- Transported by unpressurised cargo spacecraft and robotic arm-assisted docking.

The latitude of Russia's launch site is higher than the orbit inclination of the Chinese Space Station. Therefore, a module provided by international partners cannot be launched from a Russian launch site. The latitude of the USA, European and Japanese launch sites are smaller than the orbit inclination of the future Chinese Space Station, what makes them suitable for launches to the future CSS.

#### Transport and Supply

The Russian Progress cargo ship, the European ATV, and the Japanese HTV may be used to set-up transport and supply collaboration with the Chinese Space Station. Because of the orbital inclination of the Chinese Space Station, which is lower than that of the ISS, the carrying capacity of the ATV and the HTV could

be increased. The Progress cargo ship would need to change its launch site for the collaboration.

#### Cosmonaut and Engineers

Astronauts and engineers can be transported by a Chinese Shenzhou spaceship to the Chinese Space Station. Astronauts can be transported to the Chinese Space Station by Russian Soyuz spaceship, and USA Dragon spaceship. The Soyuz spaceship would need to change its launch site for the collaboration.

#### Docking Ports, Space Manipulator and Standard Interfaces

There will be 2 docking ports reserved for module extension and international module collaboration. The Space Manipulator can support docking operations.

The inside or external experiment platform provides **standard mechanical, electrical and thermal interface**.

#### Mutual visits or international assistance between space stations in LEO

In the future there might be more than one space station in orbit. Cooperation between space stations can be carried out by astronauts and experimental payload exchange.

An international mutual rescue system (save and rescue) should be established.

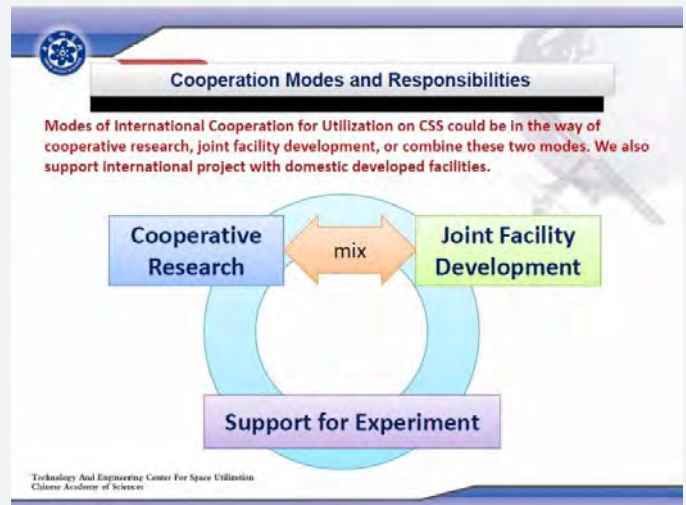
The design of mutual rescue should take into consideration the previously mentioned conditions and constraints of the rendezvous and docking to develop a viable rescue plan.



Basic ideas for the technical cooperation approach for the CSS credit: Yang Hong/CAST, CASC

**M. Gao** from the Centre for Space Utilisation of CAS, made projections for cooperation models in the utilisation of the CSS. The presentation was entitled: "International Collaboration of Space Science and Application in Chinese Manned Space Programme"

He explained that the CSU (once called GESSA, Technology and Engineering Centre for Space Utilisation, Chinese Academy of Sciences) is in charge of the Space Utility System of China's Manned Space Programme. He started by giving an overview on past microgravity research projects which were implemented by CSU. He referred to the implementation of balloon research in 1998, parabolic flights in cooperation with the Russian Gaga-



Cooperation models for the utilisation of the CSS credit: M.Gao/CAS

rin Cosmonaut Training Centre in "Star City", the flight of protein crystallisation samples from Canada on the SZ-3 mission, and the SIMBOX project with DLR. Then, he went on to describe which type of research is assigned to which CSS module, and he gave an overview on the research facilities on the future CSS as well as the utilisation plan.

According to Gao, the modes of international cooperation for the utilisation on the CSS could be in the way of cooperative research, joint facility development, or combine these two modes. He said, that his organisation also supports international projects with domestically developed facilities.

For downloading the presentations, given during the workshop, please, go to:  
<http://unoosa.org/oosa/en/SAP/hsti/china2013.html>



## UTILISATION OF CSS

### A Big Promise For A Wide-Spectrum Of Research

With respect to the utilisation and research facilities on the CSS, **M. Gao** from the Centre for Space Utilisation of CAS, described not only the cooperation options, but also gave a detailed description of the planned racks dedicated to space life science and biotechnology, microgravity fluid physics, material science, and fundamental physics.

A complete workshop presentation dealt with microgravity research on two-phase fluid systems and heat transfer. **Liu Qiu-Sheng** from the Institute of Mechanics of the Chinese Academy of Science, presented under the topic: "Microgravity Research Planning of Two-Phase Fluids System in China". The speaker started off with explaining the history and status of microgravity sciences research in China. Also, the current microgravity research platforms, drop tower, automated satellites, and Tiangong space lab, were introduced. It was interesting to see that GESSA began to organise the planning for the utilisation of the CSS already back in 2009. "Hundreds of space utilisation proposals, suggested by more than 70 universities and institutes were received. After the CSS Mission Planning Committee's review, nearly 200 research projects are now on the candidate list. A series of facilities and platforms were considered as the infrastructure to support the experiments in different disciplines of space utilisation." The actual focus of the talk, however, was on the Two-Phase Fluids Research Programme. Therefore, the preliminary design of the Two-Phase System Rack on the CSS, including its modules and the intended experimental research were described in depth. The presentation also contained some interesting information about specific cooperation projects with ESA (ELIPS-CIMEX, ESA-ARLES Programme), DLR (Mo-FluMa Programme) and CNES (IMPACT Programme) within the framework of the Two-Phase Fluids Research Programme planned for the CCS.

Another noteworthy presentation from the Chinese side was the speech entitled "Researches in Life Sciences and Microgravity Sciences of Chinese Manned Space Program - Past, Present and Future", given by **Liu Yingchun** from the Technology and Engineering Centre for Space Utilisation of the Chinese Acad-

emy of Sciences.

The speaker outlined not only the past research projects within the Chinese manned space programme, but also noted: "The main fields of space science research of the Chinese manned space programme are still space life science, fluid physics, fundamental physics and space materials science, taking advantage of space particular environment, especially for microgravity." In the course of the talk, all those areas were explained and the intended research introduced.

A very comprehensive presentation was shown by **Li Yinghui** from the Astronaut Centre of China (ACC), on "China Space Medicine - Progress and Prospects".

The slides provided a summary of the work of the ACC, and in particular the involved physiology and space medicine research work.

The insight into the experiments done so far during the Chinese manned space mission was highly interesting. The presenter then gave an overview on the facilities and equipment available in the ACC.

For China, 5 key research directions are of importance for the medical research on the future CSS:

- effects of long-term weightlessness on astronaut's health and the protective techniques;
- influence of space radiation on astronaut's health and the protective techniques;
- behaviour and performance of astronauts;
- advanced on-orbit medical monitoring and treatment;
- applicable techniques of traditional medicine in space.

In total, three racks are allocated for space medicine and human physiology research: the Human Research Facility Rack, the Medical Samples Analysis and Treatment Rack, and the Sample Storage and Rodents Experiment Rack. International cooperation in this field will be conducted under the umbrella of the "Nü Wa Project".

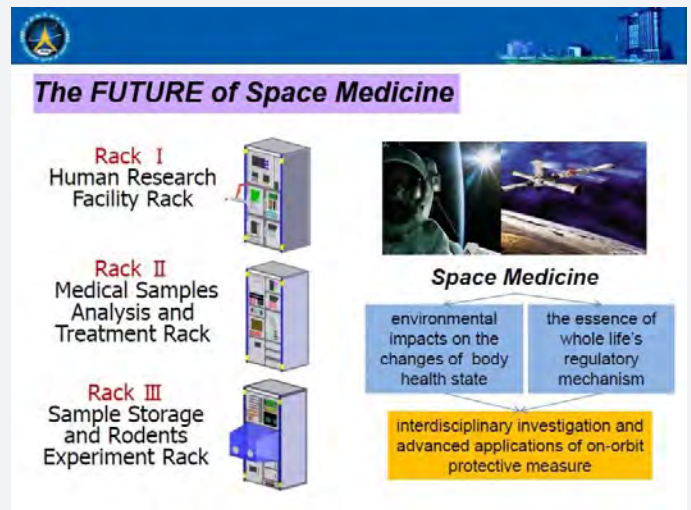


**The FUTURE of Space Medicine**

**5 key research directions**

- effects of long-term weightlessness on astronaut's health and the protective techniques
- influence of space radiation on astronaut's health and the protective techniques
- behavior and performance of astronauts
- advanced on-orbit medical monitoring and treatment
- applicable techniques of traditional medicine in space

The five key research directions of Chinese space medicine. credit: Li Yinghui/ACC



**The FUTURE of Space Medicine**

**Rack I Human Research Facility Rack**

**Rack II Medical Samples Analysis and Treatment Rack**

**Rack III Sample Storage and Rodents Experiment Rack**

**Space Medicine**

environmental impacts on the changes of body health state

the essence of whole life's regulatory mechanism

interdisciplinary investigation and advanced applications of on-orbit protective measure

The three research racks planned for the Chinese Space Station. credit: Li Yinghui/ACC

For downloading the presentations, given during the workshop, please, go to:  
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## UK-China Cooperation in Space: Two Perspectives With the Same Objective

by Dr. William Carey

Depending on whom you are talking to, people use the terms “cooperation” and “collaboration” interchangeably. But both terms refer to essentially the same thing, i.e. individuals or countries working together to achieve a shared objective that they could otherwise not achieve by working alone. Clearly, great achievements can be made without cooperation, the “space race” between the United States and Russia is a classic example of such achievement. So competition can be equally as productive as cooperation, and it still has a role to play, as the age of commercial spaceflight is dawning, or may even have dawned already, and this by its nature, is competitive. As always, there is no fundamental law dictating which is the “best” approach. It very much depends on the technical/political context and level of difficulty and required resources of the particular activity. In the space domain at the global level however, the context appears to be changing, and is continuing to change from one of competition to one of cooperation. The shrinking space budgets of the major space-faring nations such as the US, Russia and Europe are encouraging this transition, as nations see the importance of partnering in order to achieve their objectives. In 2007, the International Space Exploration Coordination Group (ISECG) was established as a response to a document entitled “The Global Exploration Strategy: The Framework for Coordination” published earlier that same year. This “GES” vision document was developed by a total of fourteen space agencies, among which were the UK (at that time represented through the British National Space Agency – BNSC, now the UK Space Agency - UKSA) and the China National Space Agency (CNSA), which defined a voluntary, non-binding framework through which nations could collaborate to strengthen both individual projects and collective effort. China is probably the only nation in the current climate that could in principle, “go it alone”. However, it has clearly stated that it is actively seeking cooperation with nations, in many areas of space, but specifically in respect to its planned space station to be built around 2020.

### The Chinese Perspective

#### History

China established the “Fifth Academy of the National Defence Ministry” in 1956, and appointed Qian Xuesen as its Chief Designer. Qian Xuesen had been deported from the US the previous year, and was a natural choice for this role due to his pioneering work in the early US rocket programme, and his being a co-founder and first Director of Caltech’s Jet Propulsion Laboratory (JPL). Qian is now widely recognised as the founding father of the Chinese space programme. China’s first sounding rocket, the T-7, was successfully launched in 1960. Forty-three years later, in 2003, Yang Liwei became the first Chinese taikonaut with his flight on the Shenzhou 5 mission. As of the time of writing, a total of ten Chinese taikonauts have flown to space, two of them twice. The China National Space Administration (CNSA) was established in 1993, following approval by the Eighth National People’s Congress (NPC) in the same year. The Ninth NPC assigned CNSA as an internal structure of the Commission of Science, Technology and Industry for National Defence (COSTIND).

#### White Papers

A good overview of the development of the Chinese space

programme, especially in the last decade, is reflected in the three White Papers that have been issued in the 2000-2011 time frame. The first White Paper on Chinese Space Activities was published by the Chinese Government in 2000, and since that time, there have been two others, one in 2006 and one in 2011. The content of each these papers essentially covers ten years of activities, as they review the activities of the previous five years and provide the goals and objectives of the upcoming five years. A silken-thread that may be seen running through all of these papers is the strong commitment by China to build its strategy on a foundation of clearly-defined principles. The strategic objectives at the highest level remain consistent, in the sense that progress is envisioned and implemented in a well-structured step-by-step manner, and although the relative prioritisation of specific activities may alter, e.g. the conducting of studies on a preliminary plan for a human lunar landing, the overall direction is maintained. In other words, there are no “giant leaps”. So, the three main characteristics of China’s strategy are: consistency, consistency and consistency. It is also very clear from these papers, and from numerous other fora, that China is actively seeking international cooperation through various organisations, such as the United Nations, the Asia-Pacific Space Cooperation Organisation (APSCO), the International Space Exploration Coordination Group (ISECG), the International Committee on Global Navigation Satellite Systems (ICG), the International Academy of Astronautics (IAA), and the International Astronautical Federation (IAF) amongst others. It is however, noticeable, that although China has made considerable progress with some outstanding achievements, both in general and particularly in the space domain, it still modestly refers to itself as a “developing country”. An attitude that can only continue to drive it towards greater success in the long-term. In the 2011 White Paper, it was noted that China and the UK “have established a joint laboratory on space science and technology, jointly organised a seminar on space science and technology, and conducted exchanges on lunar exploration, Earth observation, space science research and experiment, personnel training and other areas.” Looking to the upcoming five years, the 2011 White Paper identified that China will focus its international space exchanges and cooperation efforts mainly in the areas of:

- Scientific research in space astronomy, space physics, microgravity science, space life science, deep-space exploration and space debris.
- Applications of Earth Observation (EO) satellites in environment and disaster monitoring, global climate change monitoring and forecasting, and marine monitoring.
- Applications of communications satellites in broadcasting and television, long-distance education, and telemedicine.
- Applied technological cooperation, including research and development of terminal equipment, reinforced facility building, specific industrial services, and other areas of satellite navigation systems.
- Technological cooperation on a space laboratory and a space station, in China’s human space flight programme; space science research and experiments.
- Space Telemetry Tracking and Commanding (TT&C) cooperation and support.
- Commercial satellite launch services including, the import and export of complete satellites, satellite parts and compo-



nents, import and export of ground test equipment, and the building and servicing of satellite ground TT&C and satellite application facilities, as well as related service.

- Personnel exchanges and training in the field of space.

The UK could in principle cooperate with China in any of the areas from this quite extensive list of potential activities, but there are strong possibilities in the areas of scientific research, EO satellites, human space flight and personnel exchanges/training.

### Thousand Talents Programme

The so-called “Thousand Talents Programme” was first introduced by China in 2008, with the initial objective to attract 2,000 experts and scholars (of any nationality) over a period of five to ten years, to work in China. The maximum age limit was initially 55 years of age, but has now been extended to 65 years of age. In 2011, a “Thousand Youths Talents Programme for Distinguished Young Scholars” was also introduced to attract around 2,000 young overseas scholars, under the age of 40 by 2015 to China. Both of these programmes have been highly successful, as by mid-2012, they had attracted 1,902 and 361 talents respectively. Evidently, the social progress and development progress brought about by China’s continuous economic growth has played a significant role in this success, but both programmes can only serve to accelerate and enhance China’s capacity for innovation in science and technology, including the space domain, leading eventually to further economic development.

### National Key Universities

Project 211 was an initiative introduced by China in 1995 that identified a number of national key universities with the intention of raising the research standards of high-level universities through special funding. In 1998, this idea was consolidated when Project 985 was introduced with the objective to elevate a small group of higher education establishments to “world-class” excellence level. In the first phase of this project, a total of nine universities were selected, i.e.:

- Fudan University.
- Harbin Institute of Technology.
- Nanjing University.
- Peking University.
- Shanghai Jiao Tong University.

- Tsinghua University.
- University of Science & Technology of China.
- Xi’an Jiao Tong University.
- Zhejiang University.

The White Papers, Thousand Talents Programme and focus on the identification of National Key Universities all demonstrate the intention of China to become a strong knowledge-based society and technology leader. In this endeavour however, the societal benefits are always heavily stressed.

### **The UK Perspective**

#### Space Science and Technology MoU

The Space Science and Technology Memorandum of Understanding (MoU) between BNSC and CNSA, was signed in January 2005, by Lord David Sainsbury of the Department of Trade and Industry, and CNSA Administrator Dr. Sun Laiyan, in Beijing. Lord Sainsbury stated at this meeting, “I am delighted to sign an agreement which marks a new stage in cooperation between the UK and China in civil space activity”, and continued, “Space assists governments to improve the lives of their peoples and it offers novel commercial opportunities. It is a truly global activity and one where it is right that we should work together.” Dr. Sun highlighted the fact that China considers the development of their space industry an important part of their national development strategy, as this development will improve Chinese science, technology and capacity for innovation. He stressed that China’s purpose in developing space technology was mainly to serve the development of the national economy, technical advancement and national security, and to use outer space peacefully for the benefit of all mankind.

Already, at this time, the UK and China had a successful cooperation behind them, as UK scientists had contributed three payloads and six instruments to the Double Star Programme (DSP), a cooperation between China and the European Space Agency (ESA) in 2003. A meeting was held later in 2005 between officials to develop specific actions, and to prepare a series of Space Science and Technology (SS&T) workshops, the first of which was held in March 2006 in Beijing, with BNSC coordinating this activity and involving industry and academia. Since this time, there have been a total of six other workshops,



Yang Liwei, China’s first taikonaut, and now Deputy Director of CMSA (credit: BBC)



Lord Sainsbury and Dr. Sun Laiyan signing the MoU – the framework for UK-China cooperation in Space Science and Technology (credit: Foreign & Commonwealth Office Annual Report 2004-2005)



held in Harwell, Shanghai, Changsha, Oxford, Wuhan, and the last in Milton Keynes in August 2011. It was through the dialog facilitated by these workshops that, in October 2007, China and the UK established the Sino-UK Joint Space Science and Technology Laboratory at the Beijing University of Aeronautics and Astronautics (now known as Beihang University) and Rutherford Appleton Laboratory.

Go Taikonauts! had the opportunity to talk to Mr. Pat Norris of CGI (previously Logica, which was acquired by CGI in August 2012) who has attended most of these SS&T workshops. He had a first contact with the Chinese through participation in a trade mission in the late 1990's, and was present at the signing of the MoU in 2005. The initial focus of the workshops was on Earth Observation and small satellites. They were exploratory, but had a strong science flavour. There were mainly scientists on the Chinese side coming from the China National Space Administration and Ministry. The MoU's related to space were coordinated by BNSC, and were intended to lead to self-supporting/joint activities, commercial and scientific, and identified funding for workshop meetings, to take place alternately between the two countries, one to two per year. Mr. Norris attended some of the workshops in China, and all of those held in the UK.

**Go-Taikonauts!: The last workshop occurred in 2011, what is the present status?**

**Pat Norris:** As far as I understand it, there is no guarantee that they will continue.

**Go-Taikonauts!: Logica is now CGI, will this change your strategy in looking at cooperation with China?**

**Pat Norris:** Well, there has been a change of personality. CGI is committed to growth, achieving a workforce of around 70,000 in 35 years – and this looks as if it will continue. In the space area, we want to grow, and this would include China, but in the short term our eyes are likely to be more to North America, i.e. the US and Canada, and less towards China and India. This is primarily because of the fact that China, and India for that matter, both like to develop their own software, and as we are a system integration software company, this represents a difficult market for us.

**Go-Taikonauts!: Are there any notable success stories of UK-China cooperation in space?**

**Pat Norris:** Certainly SSTL had success in China some years ago, and recently achieved a highly successful cooperation with China only last year, through the selling of services instead of a system. SSTL provides the satellite, and China receives the data. This avoids any issues related to technology transfer. Concerning CGI, we are leading an ESA project called GlobWave, which involves collaboration with marine organisations worldwide. The idea is to create new services to monitor “sea state”. The ESA GlobWave project is a three-year initiative funded by the European Space Agency (and subsidised by the French Space Agency, CNES) to service the needs of satellite wave product users across the globe. At the last SS&T workshop we presented this to the Chinese, and proposed to work together on two main areas:

1. Data from China surface sensors (buoy networks); and merge with data from other satellites.
2. Data from Chinese Ocean Satellites to look at sea condition.

**Go-Taikonauts!: Would there be any sensitivities involved in such a cooperation?**

**Pat Norris:** There are two important aspects here, one is that the

cooperation is not commercial, it is primarily about forging links; and two, the data would be of low-resolution ( $\pm 1\text{km}$  per pixel), and therefore not sensitive.

An Individual Scientist Experience – Prof. J.C. Zarnecki

Prof. John Zarnecki of the Open University (OU) was the Principal Investigator for the Surface Science Package (SSP) onboard the Huygens probe which descended to the surface of Titan in early 2005, and retired from the OU this year. Go Taikonauts! recently had an opportunity to talk to him. He became involved with the Chinese when he was invited to the early SS&T workshops, and in particular with Beihang University, through the “Thousand Talents Programme” which requires that he spends time in China each year to teach and pursue research.

Prof. Zarnecki believes that personal contact is very important when dealing with China, and notes that there are of course cultural differences to face, which are different from when working with scientific colleagues in the West, something he has been doing for many years, so there is a better understanding of how to work together right from the beginning. For China, international collaboration is relatively new, and the organisational structure is very complex and hierarchical, with many entities involved in the space domain. It is not always clear to those outside of China how this organisation works.

Prof. Zarnecki is hoping for future collaboration with China on the development of joint instrumentation on forthcoming planetary missions, stating: “My aim is just to see a joint instrument flying on a Chinese space mission, presumably to the Moon. As we know, when you get scientists and engineers really working together, on the shop floor, designing and building things - that's what builds genuine long-term collaboration.” He also observes that the Chang'e 1 to 3 missions have no international collaboration with respect to instrumentation, but appreciates that for such missions it is important that China shows that it can accomplish these on their own, without a significant involvement from Europe or the US. He also recounts that even with the great things they have achieved in recent years, they continuously point out that this or that was accomplished forty years ago by the US-Americans and Russians.

China is also now just beginning to seriously plan a Mars mission, and once the Chinese decide to do something they go full speed ahead! Such opportunities encourage him, and why he will continue his involvement with Beihang on a number of scientific topics, despite being slightly frustrated at the moment, as he states, “I know that if we can make the breakthrough, and something is decided, then it can happen very, very quickly indeed. It takes a long time to build up the collaboration, but once it's established, it's long-lasting.”

The Surrey Satellite Technology Limited (SSTL) Experience

This UK company launched its first micro-satellite, UOSAT-1 in 1981. At that time it was a small group within the University of Surrey Electrical Engineering Department. In 1985, the company, Surrey Satellite Technology Limited (SSTL) was created to commercialise the expertise built up within the University. SSTL's first involvement with China began in 1998, culminating in the launch from Russia's Plesetsk Cosmodrome, of the Tsinghua-1 microsatellite on 28 June 2000 (on a Russian COSMOS-3M launcher). This satellite continued operating until 26 December 2002. The cooperation in this instance was through the establishment of a joint venture between University of Surrey and Tsinghua University in Beijing. During this period a team of ten Chinese researchers from Tsinghua worked closely



alongside the University of Surrey team. From launch through end of life, the satellite was controlled from a ground station located at Tsinghua University. The mission operations lasted a total of 900 days. The mission objectives of this approximately 50 kg satellite, were to demonstrate technology, high-resolution imaging for disaster monitoring and mitigation, and to perform communications research in Low Earth Orbit. The payloads onboard the satellite included a low cost/low power GPS receiver, and an imaging system consisting of three cameras, having a 40 m resolution.

It is interesting to note that the Tsinghua-1 launch offered a dual-launch opportunity. A second smaller (approximately 7 kg) satellite called SNAP, a technology demonstrator built by SSSL and the University of Surrey, was also launched, with the objective of performing a rendezvous experiment with Tsinghua-1. This would have been a world first in demonstrating formation flying and proximity manoeuvring between two satellites in orbit. However, due to differential drift between the two satellites, and exhausting of the propellant on SNAP, although managing to demonstrate formation-flying technologies, close proximity operations were limited to maneuvering into the same orbital plane.

In 2005, SSSL cooperated with China again on the Beijing-1 satellite. As with Tsinghua-1, launched from the Plesetsk Cosmodrome on a COSMOS-3M launch vehicle. This Earth Observation satellite carried two payloads, providing 4 m high-resolution panchromatic images together with 32 m medium resolution, multi-spectral images having a 600 km imaging swath. This satellite provided the Chinese government and commercial users with information on agriculture, water resources, digital mapping and environment and disaster monitoring throughout China, and is at the time of writing, still operational. Beijing-1 is part of the International Disaster Monitoring Constellation, a constellation of low-cost small satellites, which is coordinated by DMC International Imaging Ltd (DMCii) – a subsidiary of SSSL. This group of nine satellites, five of which are still operational, consists of satellites from the UK, China, Nigeria, Spain, Turkey and Algeria, provides commercial imaging, and free satellite imagery for humanitarian use in the event of natural disasters within the “Space and Major Disasters” International Charter. The Disaster Monitoring Constellation is represented by the UK Space Agency (who joined the Charter in 2005) on the Charter Board, and by DMCii in the Executive Secretariat, and each member space agency takes it in turn to lead the Charter for a

period of six months. The China National Space Agency (CNSA) joined the Charter in 2007.

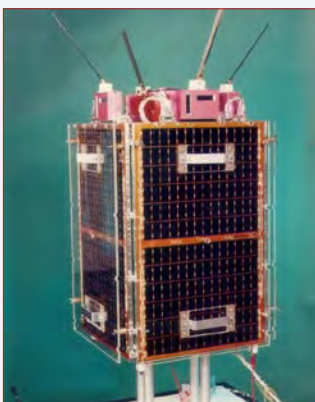
SSSL is currently manufacturing three satellites for DMCii that are due for launch in late 2014 or early 2015, which will form a new constellation, DMC3. This constellation will have daily re-visit times which is crucially important for change detection, disaster monitoring and for the planning of associated responses. Daily re-visits are also essential for the production of cloud-free imagery. In 2011, SSSL made an agreement with a Beijing-based company, 21AT (Twenty First Century Aerospace Technology Company Ltd.), who will lease 100% of the 1 m resolution imaging capacity of the three satellites. A subsidiary of 21AT, the Beijing Landview Mapping Information Technology Co. Ltd. (or BLMIT for short) will be responsible for handling the day-to-day use of the data. There is no technology transfer involved in this cooperation with China, as the DMC3 Constellation is provided as a “turn-key” system, so the three satellites will not be launched onboard a Chinese launcher or be sent to China during development.

In early December this year (2013) SSSL signed an agreement with the China Academy of Space Technology (CAST) under the umbrella of the British Government’s Global Collaborative Space Programme (see below).

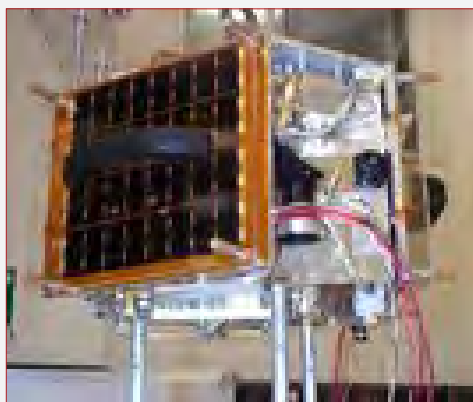
Following the signature of the MoU in 2005, Prof. Sir Martin Sweeting, Chief Executive Officer of SSSL welcomed the MoU with the words, “We are very pleased to see a new close working relationships with China. SSSL sees China as an important member of the space community and is currently manufacturing the next generation Chinese satellite for Earth Observation, which will form part of the Disaster Monitoring Constellation.”

The University of Strathclyde Experience

In February 2012, following the successful conclusion of a collaborative project, the University of Strathclyde signed an agreement with the China Academy of Launch Vehicle Technology (CALT), a subsidiary of China Aerospace Science and Technology Cooperation (CASC), to establish a joint international Space Mechatronic Systems Technology research laboratory. The Dean of Engineering, Professor Scott MacGregor, made a special visit to the company in Beijing at the end of February to sign the agreement, stating, “... given the fact this is the first university collaboration made by CALT outside



The 50 kg demonstrator satellite, Tsinghua-1, developed and built in a joint venture by SSSL and Tsinghua University in Beijing (credit: www.sssl.co.uk)



The SNAP-1 nanosatellite developed and built by SSSL as a testbed for novel microelectronic technologies, and launched together with Tsinghua-1 (credit: www.sssl.co.uk)



Close-up of Beijing-1, a low-cost, high-resolution Earth Observation microsatellite, built by SSSL in cooperation with BLMIT (credit: www.sssl.co.uk)

China, this investment also represents a major recognition of our international research standing.“ This prestigious laboratory will be funded by the Chinese Government for the next five years, with a commitment of a minimum of two million Chinese Yuan per year. CALT will also provide at least two seconded senior engineers from the company to work on the projects within the laboratory at Strathclyde. The laboratory was officially opened in August 2012, and the project is on-going.

Satellite Applications Catapult Initiative

A new initiative, the Technology Strategy Board was originally established by the government in 2004, and is now funded by the Department for Business, Innovation and Skills (BIS), and is the UK’s innovation agency, with the role to stimulate innovation, working primarily with business partners to accelerate economic growth. This organisation is at the same level as the UK Space Agency, and created a seven-strong Catapult network of world-leading technology and innovation centres of excellence – an initiative strongly supported by UK government – set-up to help businesses and to take innovative ideas through to commercialisation. The concept is built along the lines of the Fraunhofer Institutes in Germany. During early 2013, the centre responsible for space, the Satellite Applications Catapult was merged with the International Space Innovation Centre (ISIC) based in Harwell. This centre was created to support UK industry and become a world-class centre for the development and commercial exploitation of space and satellite-based products, services and applications, and has three major thematic areas:

- Market-led programmes.
- Technology-driven programmes.
- Facility development.

Global Collaborative Space Programme

On 5 December this year, the UK Chancellor George Osborne, during the Autumn Statement announced a new five-year Global Collaborative Space Programme (GCSP). This plan will provide the UK Space Agency with funding to extend its cooperation activities with other countries, with the initial focus on using space to support social and economic development. Shortly after the announcement, at the 9th Appleton Space Conference, the Minister for Universities and Science, David Willletts, stated, “Britain’s expertise in space science, applications and training, as well as our technological lead in small satellites, make us the partner of choice for countries looking to develop their national capabilities. We are able, with this programme, to open new

markets around the world for British industry and share British expertise. I am delighted that we are able to deliver something that has been flagged as a priority by our scientific and technology communities.” It was during a UK trade delegation visit to China in early December that David Parker, Chief Executive of the UK Space Agency, signed an MoU with Zhang Jianhua, Vice Administrator of CNSA, and said, “This new funding follows a very successful year of international collaboration by UK industry... The Global Collaborative Space Programme will allow us to build on this success story and its partnerships will play an important role in helping us reach our ambition to capture a £40 billion share of the global space market by 2030.”

The GCSP provides £80 million that would be specifically directed towards developing joint space missions with China, India and other emerging space-faring nations.

Common Objectives

The recently established Satellite Applications Catapult and Global Collaborative Space Programme both demonstrate that the UK consider investing in the space area a priority to encourage economic growth and benefit society. So although culturally and politically, the UK and China are very different, the importance of investing in the space domain is clearly recognised by both countries, as are the benefits brought about through such investment in terms of encouraging innovation and stimulating economic growth. However, as the experiences of both UK companies and individuals also indicate, patience “is a virtue” when cooperating with China, but a virtue that could bring enormous benefits. Time is needed to bring understanding and develop mutual trust, and minimise the differences. As the Chinese Ambassador to the UK, Mr. Liu Xiaoming commented in a speech given in 2012, “... of course, China and the UK differ in history, culture, social systems and values, so one should not be surprised when differences arise. In a mature relationship, some important principles need to be followed – we should respect each other, treat each other as equals and seek common ground while accepting the differences.” Following these principles could lead to a very bright future indeed.

Both nations appear to have common ground concerning the future, as to quote a well-known Chinese proverb:

*When planning for a year, plant corn  
When planning for a decade, plant trees  
When planning for a century, train and educate people*



Philip Davies at the SSTL booth in the Exhibition area at IAC2013 with a model of a Beijing-2 (or DMC3) satellite. (credit: Go Taikonauts!)



Signing of MoU by David Parker and Zhang Jianhua during the UK Trade Delegation visit to China in December 2013. (credit: www.bis.gov.uk)



Liu Xiaoming, Ambassador to the UK (credit: Embassy of the Peoples Republic of China, UK)





## Chinese Space Launch History - Part VI: 2012 - November 2013

#1	#2	Date	Time (UTC)	ID	Model	LV S/N	Launch Site	Lch Pad	Payload		Orbit				Remark
									Name	Weight	Type	Peri.	Apo.	Incl.	
178	167	09/18/2012	19:10:04	12050	CZ-3B/E	Y15	Xichang	2	Beidou-2 M5 Beidou-2 M6		MEO	237 195	21581 21583	54.93 54.98	
179	168	09/29/2012	4:12:00	12052	CZ-2D/2	Y16	Jiuquan	603	VRSS-1	880	LEO	621.9	653.9	98.04	First remote sensing satellite exported
180	169	10/14/2012	3:25:05	12056	CZ-2C/SMA	Y2	Taiyuan	901 (new)	SJ-9 A SJ-9 B		SSO	255	674.2	97.97	
181	170	10/25/2012	15:33:04	12059	CZ-3C	Y10	Xichang	2	Beidou-G6/GR2	3060	GTO	167	34716	20.54	
182	171	11/18/2012	22:53:04	12064	CZ-2C/SMA	Y17	Taiyuan	901 (new)	HJ-1C XY-1 FN-1	890 130 5	SSO	472	489	97.35	
183	172	11/25/2012	4:06:04	12066	CZ-4C	Y9	Jiuquan	603	YG-16		LEO	1103	1084	63.4	
184	173	11/27/2012	10:13:04	12067	CZ-3C	Y24	Xichang	2	ZX-12	5054	GTO	207	50539	26.8	
185	174	12/18/2012	16:13:05	12073	CZ-2D/2	Y22	Jiuquan	603	Gokturk-2	450	LEO	685	685	98	
186	175	04/26/2013	4:13:00	13018	CZ-2D/2	Y18	Jiuquan	603	GF-1 NEE-01 Pegaso Turksat 3USAT Cubebug-1	1.2 4 2	LEO	630 629 629 629	654 653 654 654	98.07 98.08 98.05 98.08	
187	176	05/01/2013	16:06:04	13020	CZ-3B	Y25	Xichang	2	ZX-11	5234	GTO	283	42330	26.73	
188	177	06/11/2013	9:38:00	13029	CZ-2F	Y10	Jiuquan	921	SZ-10		LEO	198	316	42.78	Second manned mission to Tiangong 1
189	178	07/15/2013	9:27:03	13035	CZ-2C/3	Y23	Jiuquan	603	SJ-11 05		LEO	690	704	98.23	

### Note:

- #1 and #2 are flight numbers of all launches and launches per vehicle respectively.
- Last digit in CZ-2C/2, CZ-2C/3, CZ-2D/2 designators is unofficial and refers to "block n".

### Sources:

- CGWIC website: <http://cn.cgwic.com/LaunchServices/LaunchRecord/LongMarch.html>
- Chinese Internet forum: <http://bbs.9ifly.cn/>
- Jonathan McDowell, History of Space Flight, <http://www.planet4589.org/space/book/index.html>
- Wikipedia, <http://zh.wikipedia.org/wiki/中国运载火箭发射列表>



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									Name	Weight	Type	Peri.	Apo.	Incl.	
190	179	07/19/2013	13:37:56	13037	CZ-4C	Y11	Taiyuan	901 (new)	SJ-15 CX-3 SY-7		SSO	666	673	98.1	One of the satellites carried China's first space robotic arm
191	180	09/01/2013	19:16:--	13046	CZ-4C	Y13	Jiuquan	603	YG-17		LEO	1076	1110	63.41	
192	181	09/23/2013	3:07:17	13052	CZ-4C	Y12	Taiyuan	901 (new)	FY-3C	2300	SSO	801	815	98.8	
193	1	09/25/2013	4:37:--	13053	KZ-1		Jiuquan	Mobile	KZ-1		LEO	276	293	96.65	Maiden flight of the KZ-1 small launch vehicle
194	182	10/25/2013	3:50:--	13057	CZ-4B	Y25	Jiuquan	603	SJ-16		LEO	599	616	74.98	
195	183	10/29/2013	2:50:05	13059	CZ-2C/3		Taiyuan	901 (new)	YG-18		SSO	492	512	97.55	
196	184	11/20/2013	3:31:05	13065	CZ-4C		Taiyuan	901 (new)	YG-19		SSO	1201	1207	100.48	
197	185	11/25/2013	2:12:01	13068	CZ-2D/2		Jiuquan	603	SY-5		SSO	739	755	97.99	

### Note:

- #1 and #2 are flight numbers of all launches and launches per vehicle respectively.
- Last digit in CZ-2C/2, CZ-2C/3, CZ-2D/2 designators is unofficial and refers to "block n".

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- Wikipedia, <http://zh.wikipedia.org/wiki/中国运载火箭发射列表>



## China's Yuanwang Fleet

Name	Type	Launched	In Service	Displacement (tonne)	Length (m)	Beam (m)	Height (m)	Depth (m)	Draft (m)	Max. Speed (knots)	Range (nmi)	Note
Yuanwang 1	Tracking & Control	31 Aug 1977	1978-2010	21157	191	22.6	37.2		9	20	18000	
Yuanwang 2	Tracking & Control	Oct 1977	1978-2010	21594	192	22.6	38.5	12.6	9	20	18000	
Yuanwang 3	Tracking & Control	26 Apr 1994	1995-	16792	180	22.2	37.8		8	20	18000	
Yuanwang 4	Tracking & Control	1979	1999-2011	12700	156.2	20.6	39	11.5	7.5	20	18000	Formerly the Xiangyanghong 10 scientific survey ship. It was converted to a tracking ship and delivered for use in July 1999. On 5 August 2007, it was in a collision with a cargo ship at the Jiangyin Base, burnt and damaged.
Yuanwang 5	Tracking & Control	15 Sep 2006	2007-	24966	222.2	25.2						
Yuanwang 6	Tracking & Control	16 Mar 2007	2008-	24966	222.2	25.2						
Yuanwang 21	Rocket transport	29 Nov 2012		9080	130	19		12	5.8			
Yuanwang 22	Rocket transport	24 Jan 2013		9080	130	19		12	5.8			

## Gallery

### IAC 2013 - International Astronautical Congress 2013 in Beijing



Ma Xingrui, the CNSA Administrator, in IAC 2013. (credit: IAF)



Charles Bolden, the NASA Administrator, in IAC 2013. (credit: IAF)



The official press conference on the first day of the IAC 2013. From left to right: JAXA Administrator Naoki Okumura, Canadian Space Agency President Walter Natynczyk, CNSA Administrator Ma Xingrui, the moderator Ulrich Bobinger, ESA's Director General Jean-Jacques Dordain and NASA Administrator Charles Bolden. Representatives from Roskosmos and ISRO were absent in this photo. IAC 2013 provided a rare case of a CNSA Head sitting together with major space leaders of the world. (credit: IAF)



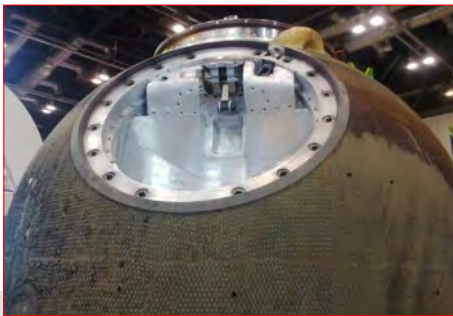
Female taikonauts Liu Yang and Wang Yaping appeared together in public for the first time. (credit: Go Taikonauts!)



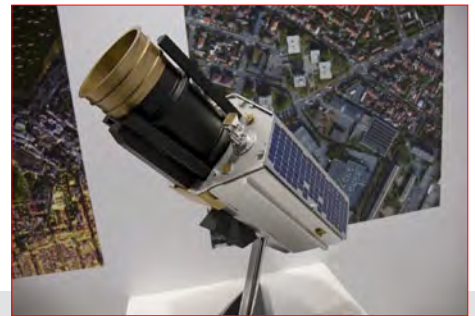
Scale models of the Long March 7 (CZ-7) (left) and Long March 5 (CZ-5) (right) displayed in the IAC 2013 exhibition. (credit: Go Taikonauts!)



Shenzhou 10 re-entry capsule on display in the IAC 2013 exhibition. (credit: Go Taikonauts!)



Close-up view of the Shenzhou 10 capsule. (credit: Go Taikonauts!)



Scale model of Beijing 2 (or DMC 3), a small satellite developed by the UK's Surrey Satellite Technology Limited using its SSTL 300/S1 platform. It will consist of three small satellites and will serve the city administration of Beijing. (credit: Go Taikonauts!)



A wall at the corner of the IAC exhibition is full of signatures by special guests to IAC 2013. (credit: IAF)



Art Exhibition of IAC 2013. (credit: IAF)



Chinese traditional music performance at the gala dinner on the closing day. (credit: IAF)