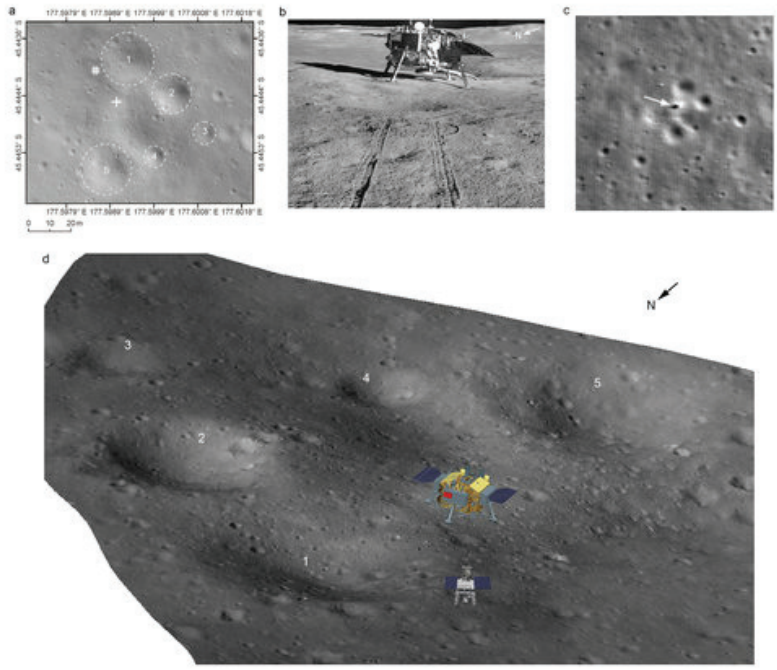
中国科学院
CHINESE ACADEMY OF SCIENCES

CASNewsletter

NO. 156 • October 2019

LEAD ARTICLE



Reconstructing the first successful lunar far-side landing [IMAGE: NATIONAL ASTRONOMICAL OBSERVATORIES OF THE CHINESE ACADEMY OF SCIENCES (NAOC)]

Chinese scientists reconstruct Chang'e-4's landing on moon's far side

Chinese scientists have reconstructed the descent trajectory of the Chang'e-4 lunar probe and determined its precise landing site on the far side of the moon in a move that could bolster further deep space exploration.

China's Chang'e-4, launched on December 8, 2018, made the first-ever soft landing on the moon's far side in the Von Kármán Crater in the South Pole-Aitken area on January 3.

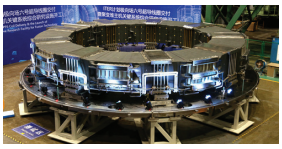
Using high-resolution topographic data obtained by the Chang'e-2 lunar probe and images taken by Chang'e-4 during its descent and exploration, researchers reconstructed the landing process including how it avoided obstacles autonomously.

"Chang'e-4 landed on a gentle slope of a degraded impact crater, and is surrounded by five impact craters. It's only 8.35 meters from the rim of a crater with a diameter of 25 meters to the north," said Li Chunlai, vice director of the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) and research leader.

>> PAGE 7

HOT ISSUE

First ITER poloidal field coil gets ready to be shipped to ITER site



The PF6 coil, the first large superconducting magnet coil of ITER project, has been completed and will be shipped to ITER site in France. >> PAGE 2

RESEARCH PROGRESS

Function of STAT6 acetylation in modulating anti-tumor immunity revealed

Scientists have revealed that the acetylation of signal transducer and activator of transcription 6 (Stat6) could inhibit the polarization of M2-type macrophage, which could be a novel target for tumor immunotherapy. >> PAGE 3

INTERNATIONAL COOPERATION

China's big Earth data efforts to promote UN SDGs: Report

China's research and application of big Earth data will help address challenges in achieving the UN Sustainable Development Goals (SDGs).
>> PAGE 5

SCIENCE STORY

A passion for low temperature thermometry

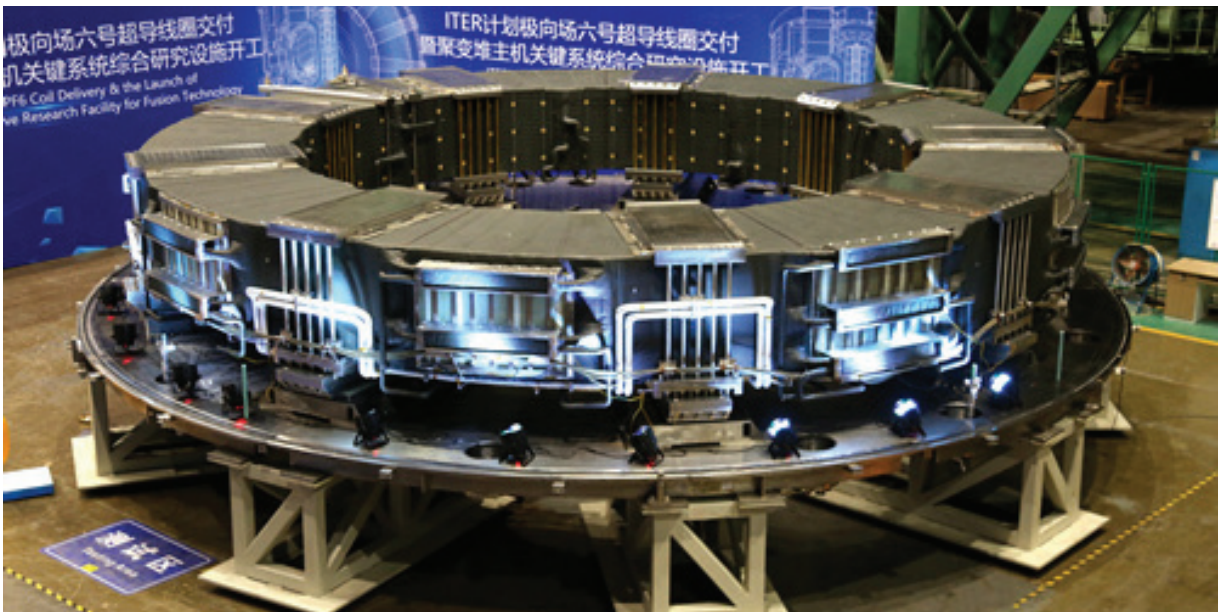
Working with this young and passionate team, I feel that I was getting younger again. >> PAGE 6

NEWS IN BRIEF

China to build National Botanic Museum

China will build National Botanic Museum in Kunming, Southwest China's Yunnan Province.
>> PAGE 8

Edited by Bureau of International Co-operation, Chinese Academy of Sciences
CAS Newsletter – Monthly – Editorial Board: 52, Sanlihe Road, Beijing, 100864, China



The PF6 coil
[IMAGE: WANG TIANHAO]

First ITER poloidal field coil gets ready to be shipped to ITER site

The No. 6 poloidal field superconducting coil (or PF6 coil), the first large superconducting magnet coil of ITER (short for International Thermonuclear Fusion Experimental Reactor) project, has been completed and will be shipped to ITER site in France. A celebration of its delivery was held on September 20 in Hefei, Anhui, China.

PF6, the key component of ITER, will be installed at the bottom of the ITER cryostat. It consists of nine twin-shaped wilding pancakes and a series of supporting accessories, weighing up to 400 tons, even heavier than two Boeing 747 airplanes.

In order to meet the strict requirements for the magnetic field configuration of the ITER device, the profile accuracy of the PF6 coil within ±1.5mm after winding must be strictly controlled. For a superconducting coil with an external diameter of about 11.2 meters and to be wound in a "two-in-hand" configuration, the challenge is incredibly unprecedented. The NbTi superconductor used for winding the coil stretches up to 13.5 kilometers.

Due to its technical complexity, it took six years of the manufacturing team with Institute of Plasma Physics, Hefei Institutes of Physical Science to complete the task.

Facing the huge challenges, the whole team was highly motivated which enabled them to overcome difficulties in "two-in-hand" coil winding by unbelievably less than one year. And particularly worth being highlighted, all the winding equipment was 98% made in China.

In December 2016, the team was pleased to see all the full-size joint sample for the PF6 coil joint qualification had passed the test by ITER organization with fantastic performance, winning it the full praise from Mr Sborchia Carlo, project supervisor for ITER and Fusion for Energy (or F4E) by pointing it as "the best sample both in manufacturing accuracy and appearance" he had ever seen. In fact, It was the ever first joint one in ITER PF coil projects that met ITER's highly strict technical requirements.

To the June this year, the impregnated winding pack that is 1.6 meters in cross section and 1.2 meters in height had been completed from 9 double pancakes with a total of 468 conductor turns, leading the PF6 coil to a perfect ending of vacuum insulation impregnation manufacturing. The specialization of insulation in both design and manufacturing enables the PF6 coil to work for ITER in ultra-low temperatures of minus 269 degrees Celsius and strong radiation of 10 kgy Gamma, as well as to possess tensile strength close to that of stainless steel.

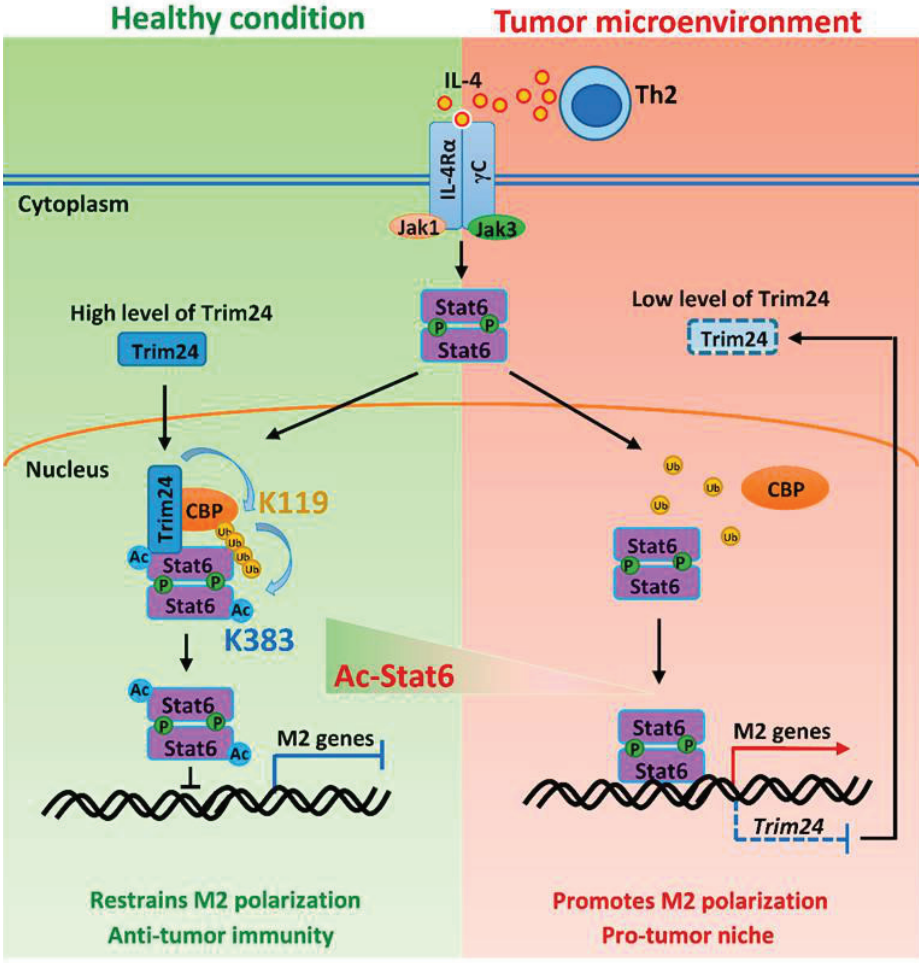
Since ITER is the most ambitious international scientific project, its component PF6 project also sets a good example of collaboration between China and Europe for building a new mode of international fusion collaboration.

Function of STAT6 acetylation in modulating anti-tumor immunity revealed

Scientists have revealed that the acetylation of signal transducer and activator of transcription 6 (Stat6) could inhibit the polarization of M2-type macrophage, thus regulating anti-tumor immune response, which could be a novel target for tumor immunotherapy.

Tumor-associated macrophages (TAMs) are known to exhibit immunosuppressive M2 phenotype and thus inhibit anti-tumor immune responses. Therefore, targeting TAMs inhibits the progression of tumor growth and metastasis and has thus been applied in clinical treatment of many solid tumors. Stat6 is the master transcription factor to control macrophage M2 polarization. However, how macrophage polarization is fine-tuned by Stat6 remains elusive.

A recent work by Dr. Xiao Yichuan's research group at the Shanghai Institute of Nutrition and Health of the Chinese Academy of Sciences reveals that Lys383 of Stat6 is acetylated by the acetyltransferase CREB-binding protein (CBP) during macrophage M2 polarization, which in turn suppresses macrophage M2 polarization. Additionally, Trim24, a CBP-associated E3 ligase, promotes Stat6 acetylation through directly catalyzing CBP ubiquitination at Lys119, which facilitates its recruitment to Stat6. Therefore, the loss of Trim24 dramatically inhibits Stat6 acetylation and thus promotes M2 polarization in both mouse and human macrophages, which consequently compromises the anti-tumor immune responses of the macrophages. More interestingly, Stat6 mediates the direct transcriptional suppression of the Trim24 gene in M2 macrophages, which contributes to the immunosuppressive tumor niche.



The molecular mechanism of Stat6 acetylation in regulating anti-tumor immunity
[IMAGE: DR. XIAO'S GROUP]

These findings establish Stat6 acetylation as an essential negative regulatory mechanism that modulates anti-tumor immunity through regulating macrophage M2 polarization and highlight the first identified acetylation site in Stat6.

This research, entitled "Modulation of M2 macrophage polarization by the crosstalk between Stat6 and Trim24", was published online in *Nature Communications* on September 25, 2019.

For more information, please contact:
Wang Jin (Ms.)
Shanghai Institute of Nutrition and Health,
Chinese Academy of Sciences
Email: sibssc@sibs.ac.cn

Source: Shanghai Institute of Nutrition and Health, Chinese Academy of Sciences

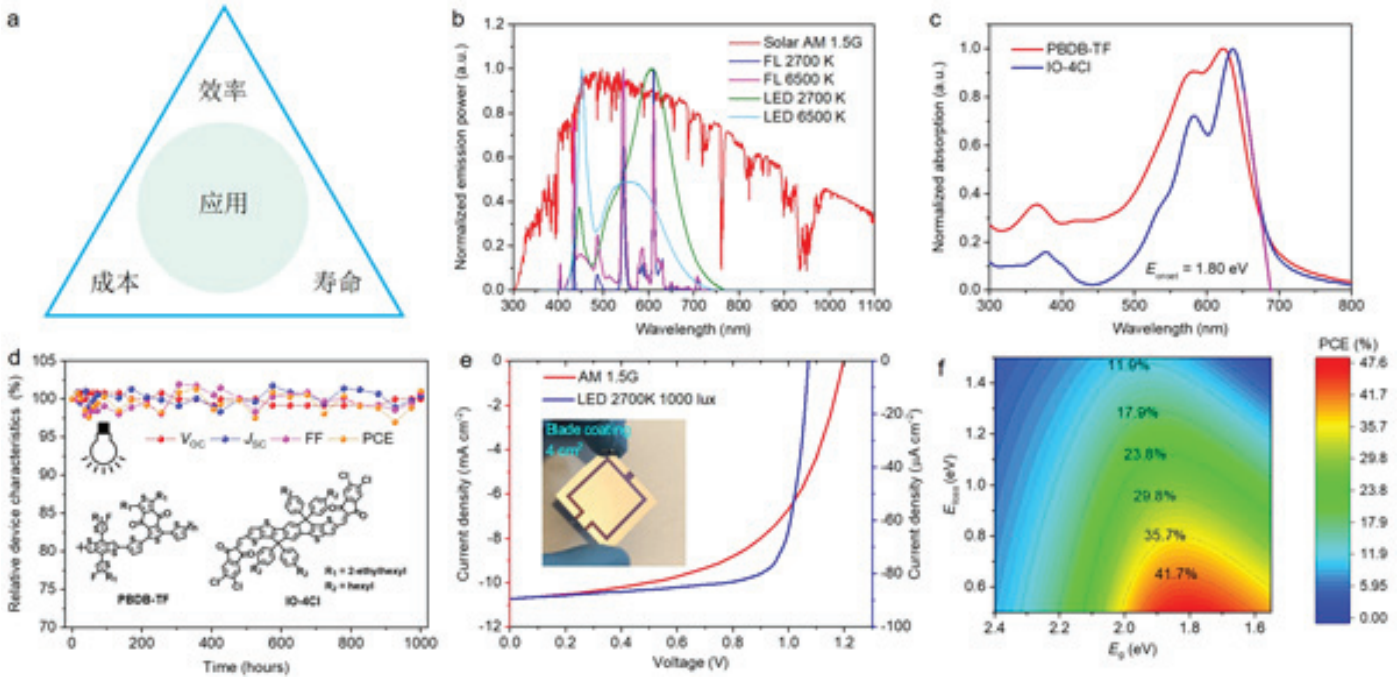


Figure (a) The critical indicators for the practical applications (b) The normalized emission power spectrum of light sources (c) Normalized absorption spectra of PBDB-TF and IO-4Cl as films (d) The curves of the photovoltaic characteristics versus time (e) The J–V curves of a 4 cm2 cell based on a blade-coating method under AM 1.5G and an LED (f) Efficiency prediction of the OPV cells (LED, 2700K) [IMAGE: PROF. HOU JIANHUI]

Organic photovoltaic cell with 26% efficiency for indoor application achieved

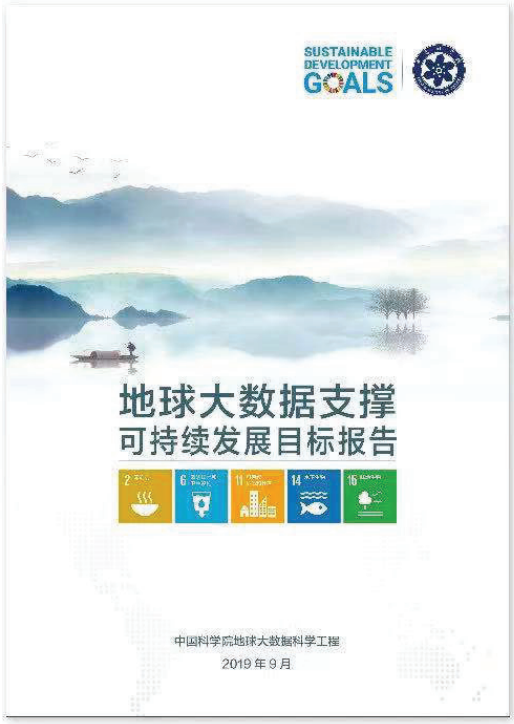
Power conversion efficiency (PCE), lifetime and cost are critical factors in practical applications of photovoltaic cells. With the advent of the Internet of Things, vast numbers of off-grid energy sources are needed to drive low-power-consumption products for indoor applications. However, the mature c-Si cells can't meet the application needs because their PCEs are only 2-6% under the indoor illumination conditions mainly due to the mismatch of absorption spectrum and severe charge recombination at low carrier density. Therefore, development of new photovoltaic cells for indoor applications is urgently needed.

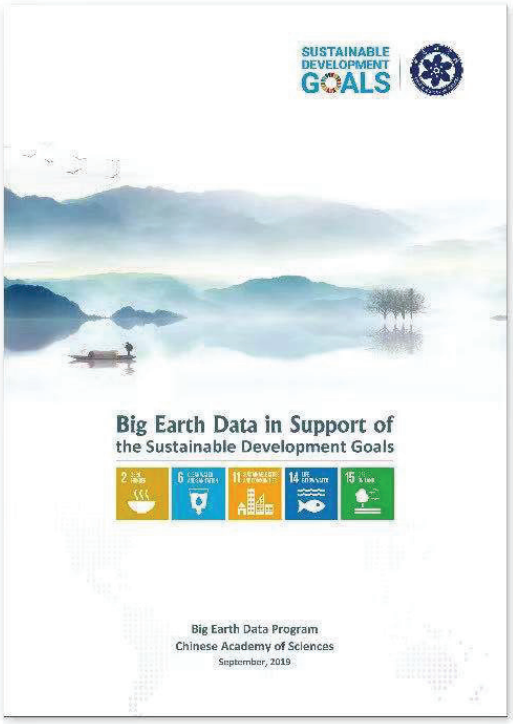
Recently, a research team led by Prof. Hou Jianhui at the Institute of Chemistry, Chinese Academy of Sciences (ICCAS) and Prof. Gao Feng at Linköping University in Sweden, developed an organic photovoltaic (OPV) cell with outstanding efficiency under indoor light conditions. By blending a polymer donor named PBDB-TF and a carefully designed acceptor named IO-4Cl, they made a photoactive layer with an absorption spectrum matching the indoor illumination sources. The 1 cm^2 OPV cell achieved a PCE of 26.1% with an open-circuit voltage of 1.10V under the illumination of 1000 lux (2700 K). Impressively, this work demonstrates this OPV cell not only has high PCE and excellent stability but also can be made with large parameters. For example, the OPV cell almost maintained its initial PCE under continuous illumination after 1000 hours, and a 4cm^2 cell prepared via a blade-coating method realized a PCE of over 23%.

The study, entitled "Wide-gap non-fullerene acceptor enabling high-performance organic photovoltaic cells for indoor applications", was published in *Nat. Energy, 2019, 4, 768*. The work was financially supported by the National Natural Science Foundation of China, the Beijing National Laboratory for Molecular Sciences, the Chinese Academy of Sciences, the Swedish Research Council VR, the Swedish Energy Agency Energimyndigheten and the Swedish Government Strategic Research Area in Materials Science on Functional Materials at Linköping University.

For more information, please contact:
Prof. Hou Jianhui
Institute of Chemistry, Chinese Academy of Sciences
Email: hjhzlz@iccas.ac.cn

Source: State Key Lab of Polymer Physics and Chemistry, Institute of Chemistry, Chinese Academy of Sciences





China's big Earth data efforts to promote UN SDGs: Report

China's research and application of big Earth data will help address challenges in achieving the UN Sustainable Development Goals (SDGs), according to a new report released online by the Ministry of Foreign Affairs.

As the SDGs constitute a vast system that is complicated, diverse, dynamic, and interconnected, effective assessment and monitoring of each and all SDG targets and indicators is essential to the SDGs' being met, according to the report titled "Big Earth Data in Support of the Sustainable Development Goals."

The report, which was created by the Chinese Academy of Sciences (CAS), says that only 45 percent of indicators are currently supported by both methods and data, which will hamper full implementation of the 2030 Agenda for SDGs.

In addressing these challenges CAS concentrates on five SDGs in expectation that its continued effort to develop a big Earth data system will provide robust and complementary data services to support and improve SDG indicators, said the report.

Big Earth data is a new data-intensive research method that consists of big data with a spatial reference, including data related to land, oceans, the atmosphere and human activities.

"The world must achieve the SDGs by 2030, which is extremely challenging in reality. We still face many challenges in leveraging big Earth data to support SDGs," the report said.

Due to the differences in innovative capabilities of information and network technologies as well as big Earth data, there are method gaps for SDG evaluation between different countries and regions.

"Many countries, particularly developing countries, have no roadmap for effectively carrying out scientific evaluation of SDGs," the report said.

Study and development of a methodological system of big Earth data for SDG evaluation can assist UN member states at different developmental stages in reducing the differences in capabilities for SDG evaluation.

"China's effort on big Earth data applications in service of SDGs will likely be of interest to some other developing countries, particularly those lacking technological capabilities," the report said, noting that the research on big Earth data for SDGs is an important contribution of China towards the 2030 Agenda for Sustainable Development.

Source: CAS

A passion for low temperature thermometry

It has been six years since I first met Prof. Gao Bo from the Technical Institute of Physics and Chemistry (TIPC) of the Chinese Academy of Sciences at a Tempmeko conference in Portugal. During the conference we discussed many academic issues and I was impressed by her great passion for low-temperature metrology. That's why I invited her to work in my lab for a few months, which was the beginning of our cooperation. She later participated in research projects measuring the Boltzmann constant and acoustic gas thermometry which have achieved world-leading results. At the same time, we jointly developed a novel primary thermometry at low temperature called single pressure refractive index gas thermometry (SPRIGT). It is expected to become widely used due to its high accuracy and high measurement speeds.

I was very indecisive when Bo first told me she wants to implement this method in China. On the one hand, I believe that the SPRIGT method has great potential and also would promote the entire low-temperature metrology field. On the other hand, the cooperation meant I would have to travel between Paris and Beijing many times which would be a great challenge for me. In addition, at that moment there were no other members on Bo's team and it would be hard for just us two to implement SPRIGT. Finally, I was persuaded by her passion and ambitions, and now two years of cooperation have proved that my decision was right.

The whole research process of SPRIGT was challenging. We started from an empty room in Langfang which is 70 km from Beijing and lacks international accommodation. When I first got there, there were only some equipment boxes in the empty lab. In the past two years, I have been to China 12 times, and eventually received funding from PIFI. Every time I have gone to the lab since then I have found many changes and a lot of progress. The young team works seven days per week and has almost no holidays. Because of jet lag, sometimes I went to the lab at two or three in the morning,

>> **PAGE 7**

>> PAGE 6

and there were always some students there. In the spring of this year, in order to get the data of SPRIGT before the deadline of Tempmeko and to realize China's break-through in this field, they even worked 24 hours per day for four months.

Working with this young and passionate team, I feel that I was getting younger again. With their hard work they completed the whole process of equipment purchase, installation and experiments, with good results. Together we push the instruments to their performance limit and improve our knowledge of low-temperature metrology. Now the team is growing fast and will continue to face and overcome the various unknown difficulties in the future, contributing more to further research.

Laurent Pitre

Laurent Pitre is a Researcher at the French Metrology Organization LNE-CNAM since 2000. He holds a Phd in

Low Temperature Thermometry - below 1 Kelvin (1999), and has started his career with the European project "Ultra Low Temperature". He has worked for 2 years at the National Institute of Standards and Technology (NIST), Washington D.C. as a Guest Researcher, where he has started to conceive and develop a quasi spherical resonator applied for low temperature thermometry (2003-2005). Since his return to France, he has continued the development and the fine-tuning of the quasi spherical resonator. Today he leads a team, which uses this resonator for the re-determination of the Boltzmann constant and the thermometry in the range of 4K to 300K.

Laurent is a very enthusiastic expert in this research field. He has paid a lot of attention to us and to SPRIGT's results. All team members are moved by his professional dedication. Meanwhile, he is a scientist who has long-term vision for the future. We have not only established the TIPC-LNE Joint Laboratory on Cryogenic Metrology Science and Technology but also formulated our research plans for more than ten years. With the redefinition of the new SI, an international system of units, world temperature metrology will open a new door. We look forward to continuing cooperation between China and France to jointly promote the development of the frontier science of metrology.

>> PAGE 1

Scientists calculated the precise location of the landing site at 177.5991 degrees east longitude and 45.4446 degrees south latitude with an elevation of -5,935 meters.

An article reproducing the entire successful landing process, written by the research team, was published in the latest issue of the academic journal *Nature Communications*.

Soft-landing on the lunar surface is a short and fast-moving process, and it is hard to control in real time from the earth. The lunar lander has to land autonomously using on-board sensors.

As a result of the tidal locking effect, the moon's revolution cycle is the same as its rotation cycle, so that the same side always faces the earth.

Before the Chang'e-4 mission, there were 20 successful soft landings on the moon over the past six decades, but all of them were on the near side and the descent trajectories and landing positions of the spacecraft could be measured from the earth.

However, the landing process of Chang'e-4 on the far side of the moon could not be tracked and measured by ground facilities.

The new study not only provides background information and position benchmarks for scientific exploration by the lander and rover of the Chang'e-4 probe, it also gives a basis for high-precision lunar surveying and mapping and provides technological support for China's future deep space exploration, such as landing on asteroids or Mars, said Liu Jianjun, a researcher at NAOC.

The far side of the moon has unique features, and scientists expect Chang'e-4 to make pioneering discoveries.

The scientific tasks of the Chang'e-4 mission include making low-frequency radio astronomical observations, surveying the terrain and landforms, detecting the mineral composition and shallow lunar surface structure, and measuring neutron radiation and neutral atoms.

The mission embodies China's hope to combine capacity in space exploration with four payloads developed by the Netherlands, Germany, Sweden and Saudi Arabia.

Source: Xinhua

China to build National Botanic Museum

China will build National Botanic Museum in Kunming, Southwest China's Yunnan Province, according to the Chinese Academy of Sciences (CAS).

CAS has signed a contract to work together with local governments and offer technological support for the museum.

Zhang Yaping, vice president of CAS, said Yunnan is known as the "kingdom of plants" and boasts rich biodiversity. The museum will make use of this foundation and showcase China's achievements in biodiversity conservation.

The 15th meeting of the Conference of the Parties to the UN Convention on Biological Diversity will be held in Kunming in 2020.

Source: CAS

Signing ceremony [IMAGE: KUNMING INSTITUTE OF BOTANY]

China's first self-developed carbon-ion therapy system gets market access

China's first self-developed carbon-ion therapy system has been approved by the national drug regulator and obtained market access.

This is the first time that the National Medical Products Administration (NMPA) has approved a domestically produced carbon-ion therapy system, according to the official website of the national drug regulator.

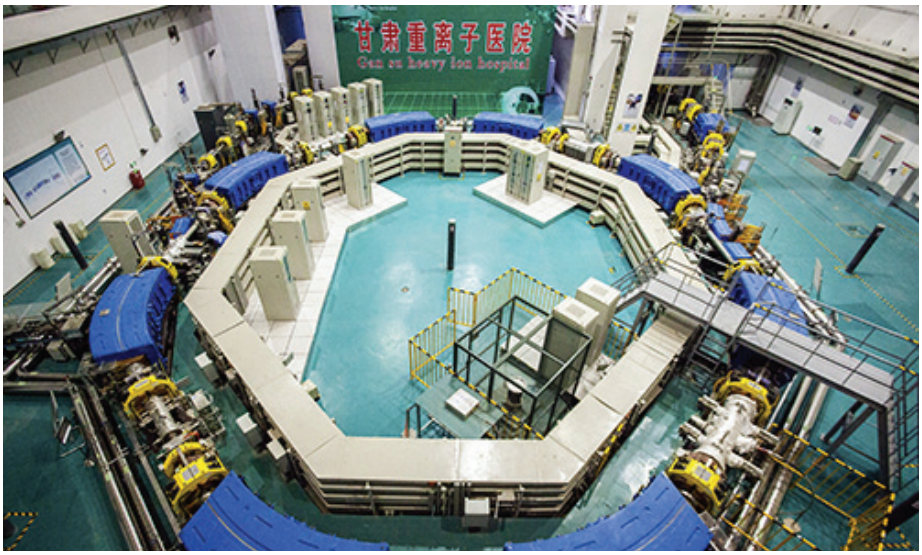
Installed in Wuwei Cancer Hospital in Gansu province, the system was co-developed by the Institute of Modern Physics under the Chinese Academy of Sciences and a subsidiary company.

The product is composed of an accelerator system and a treatment system, and includes two treatment rooms that can provide carbon-ion beams for the treatment of malignant tumors.

The approval of the system marks a new step in the development of high-end medical equipment in China. It will also contribute to the development of cancer diagnosis and treatment in the country, according to the NMPA.

A report published by the National Cancer Center in 2017 showed that China has nearly 25 percent of the world's new cancer cases, with 10,000 cancer patients added per day. Every year, there are 2 million cancer-induced deaths. Lung, breast and stomach cancers are the most common types.

Source: CAS



Synchrotron of Wuwei carbon-ion therapy system
[IMAGE: INSTITUTE OF MODERN PHYSICS OF THE CHINESE ACADEMY OF SCIENCES]