INTERNATIONAL SPACE SCIENCE INSTITUTE - BEIJING

国际空间科学研究所—北京

# ANNUAL REPORT 2017

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# COVER PAGE

**Bubbles composed of seven images (from the lower left to the upper right):**

1. Group picture of the participants of the ISSI-BJ Forum on „Lunar and Planetary Seismology" which took place on January, 11-12, 2017.

2. The far side of the Moon and distant Earth, imaged by the Chang'e-5 T1 mission service module in 2014. Credit: Chinese Academy of Sciences.

3. Prof. David Blair giving an Understanding Science seminar on „Listening to the sounds of the universe: the future of gravitational wave astronomy" on December 12, 2017.

4. Picture painted by Prof. Wing Ip, which was donated by him to ISSI-BJ.

5. Hall of the new ISSI-BJ office space.

6. A reproduction of a composite colour image of the Horsehead Nebula and its immediate surroundings. Credit: ESO.

7. The first Chinese X-ray telescope, HXMT - Insight, launched on June 15, 2017, from the Jiuquan Satellite Launch Center in Jiuquan, Gansu Province, China. Credit: Xinhua.

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# MESSAGE FROM THE CHAIRMAN OF THE BOARD OF TRUSTEES

The past year is encouraging for space science in China. Both DAMPE and QUESS are3 operating normally and continuously getting data back. In June and August, publications from QUESS science team have drawn great attention. One of the papers is even on the front page of Science Magazine. After one and half a year accumulation of the observation data, DAMPE also had its first scientific publication in Nature in November last year. As the leader of the whole science satellite program, I am very happy for them, and believe the success of these scientific missions will also provide great opportunities for the further development and success of ISSI-BJ .

While establishing ISSI-BJ, it was thought that it should be very much related with the new Chinese space science programs. In fact, since 2013, ISSI-BJ has organized 9 forums that are closely related with the scientific topics of the proposed new missions. Up to now, three of them have already been officially selected and approved for engineering phase. They are: Solar Wind and Magnetosphere Ionosphere Coupling Explore (SMILE), Einstein Probe (EP), and Advanced Solar Observatory in Space (ASO-S). The other topics are also under intensive discussion, and have certainly chances to be approved as well. Thank you for all your effort to participate in the forums and giving your suggestions to those new mission concepts.

Looking around the world, exciting missions are also going on. In particular, we have new frontiers, such as gravitational waves detection in space, as a promising area that may have great breakthroughs. Extra solar system planets searching is also an attracting area receiving a lot of funds both in NASA and ESA for new missions. ISSI-BJ has a lot of work to do then to organize exciting forums, workshops and study teams.

During the past year of 2017, all the three workshops of ISSI-BJ had published their book chapters in Space Science Review and the SSSI books will be published soon. ISSI-BJ has 13 active international teams, and had selected and supported 24 teams in total. I am also very happy that the research of one of our teams even led to a book.

On the management side, we have passed through an unstable period last year. I would like to thank Maurizio Falanga for coming back to take care of this difficult situation. I am looking forward to have a more stable management team next year. Hopefully, ISSI-BJ could develop further with the new leadership.

Finally, I thank Michael Blanc for his efforts in trying to plan new activities during the period when he was with us. I thank the excellent staff, Lijuan En, Anna Yang and Ivan Zimovets, for their hard work for the daily operation, and also Xiaolong Dong and Maurizio Falanga for their trustful and efficient management of ISSI-BJ.

Ji Wu

Beijing, May 2018

# ABOUT ISSI-BJ

The International Space Science Institute Beijing (ISSI-BJ) is a non-profit research institute jointly established by the National Space Science Center (NSSC) and the International Space Science Institute (ISSI) with the support of the International Cooperation Bureau and the Strategic Priority Program on Space Science. ISSI-BJ is a close cooperation partner of ISSI in Bern. Both institutes share the same Science Committee, the same study tools, and other information of mutual relevance and interest. However, both use independent operational methods and different funding sources.

The main mission of ISSI-BJ is to contribute to the achievement of a deeper scientific and technological understanding of future space missions as well as of the scientific results from current and past missions through multidisciplinary research, possibly involving whenever appropriate, ground based observations and laboratory experiments. The Program of ISSI-BJ covers a widespread spectrum of space science disciplines, including solar and space physics, planetary science, astrobiology, micro-gravity science and earth observation. It offers a complement to the ISSI program with special emphasis on future scientific opportunities.

## History

In October 2011, Professor Ji Wu, the Director General of the National Space Science Center of Chinese Academy of Sciences (NSSC, CAS), visited the International Space Science Institute (ISSI). He proposed to establish an International Space Science Institute in Beijing (ISSI-BJ) during his visit.

In February 2012, Simon Aegeter, Chairman of ISSI's Board of Trustees and Roger-Maurice Bonnet, Executive Director of ISSI, visited NSSC for further discussion. Both parties exchanged opinions and signed the Memorandum of Understanding which was approved by the ISSI's Board of Trustees (BoT) in June 2012. On April 19, 2013, the BoT of ISSI signed the Agreement of Cooperation with NSSC and approved the implementation plan of cooperation between ISSI and ISSI-BJ. It was decided, for the first time in the history of ISSI, to share the name with another institution. This decision was made because of the conviction that NSSC is an extremely trustworthy partner. Following this decision, ISSI and NSSC moved forward with the implementation plan to establish ISSI-BJ.

The inauguration ceremony of ISSI-BJ was held at the NSSC in Beijing on July 16, 2013. Professor Rafael Rodrigo, Executive Director of the International Space Science Institute, and Professor Ji Wu, Chairman of the BoT of ISSI-BJ and Director General of NSSC, jointly inaugurated the new institute located on the 3rd floor of the NSSC building. In 2013, the ISSI-BJ Board of Trustees elected Professor Maurizio Falanga from Switzerland to head the Institute as its Executive Director.

A brainstorm forum on the strategy of ISSI-BJ was held in November, 2014, and an international visiting assessment committee was established to evaluate the performance of ISSI-BJ. The assessment reports gave ISSI-BJ a very good credit and concluded that ISSI-BJ had a good start and had been gaining excellent reputations from the international science communities. Based on the evaluations, NSSC and ISSI agreed to continue their cooperation on ISSI-BJ. The BoTs of ISSI-BJ and ISSI approved assessment report and the new agreement in April and June, 2015, respectively. Therefore, on October 23, 2015, Professor Ji Wu, director-general of the NSSC and chair of the ISSI-BJ BoT, and Professor Rosine Lallement, representative and vice chair of the ISSI BoT, signed a new agreement, which confirmed the cooperation of two sides on continuation of ISSI-BJ. According to the new agreement, the cooperation will last for at least three years and after the specified period of three years, the agreement can be extended.

# ISSI-BJ'S SCIENTIFIC PROGRAM

ISSI-BJ is an institute with the mission to serve the space science communities in multi-lateral and multi-disciplinary activities. ISSI-BJ is open to support projects from any Asian or international scientists or institutes, encouraging the scientists to work together in Beijing.

## Research Tools

### WORKSHOPS

**Workshops** are study projects on specific scientific themes, selected in consultation with the Science Committee. The duration of a Workshop is typically one week. Workshops are organized by a group of conveners who define the theme, set up the program, and list the group of participants. Participation is by invitation only. The size of any Workshop is usually limited to a maximum participants of 45, including few young scientists.

The results of the Workshops are published as refereed papers in issues of Space Science Reviews and in parallel as volumes of the Space Science Series of ISSI (SSSI).

### FORUMS

**Forums** are informal and free debates among 20-25 high-level participants on open questions of scientific or science policy nature. A Forum may lead to formal recommendations or decisions depending upon the topic or issues addressed in the Forum.

TAIKONG magazines constitute the output of the Forums organized at ISSI-BJ. They report the content of the Forums and reflect in a neutral way the discussions and advises from the participants.

### WORKING GROUPS

**Working Groups** are set up by the Directorate for specific tasks, often of technical nature. Their life time can be of several years. The results of the Working Groups are published as volumes of ISSI-BJ Scientific Report Series (SR) or in the scientific literature.

### INTERNATIONAL TEAMS

**International Teams** follow a strict bottom-up approach whereby in response to a specific call issued every year in January, scientists can propose projects corresponding to the topics broadly identified in the Call. The reviewing and ranking process is the responsibility of the Science Committee.

International Teams are composed of about 5-15 scientists from different institutions, nationalities, and expertise. They meet at ISSI-BJ for one or several periods of time of typically one week. They are active for 12-18 months. IT projects often involve data or modelling work. Their activities is directed and organised by a team leader, generally the initiator of the proposal. Teams are largely independent in the execution of their project, but maintain close contact with ISSI-BJ.

*ISSI-BJ Forum on "Lunar and Planetary Seismology"*

### VISITING SCIENTISTS

**Senior and Junior Visiting Scientists** carry out scientific work in collaboration with, or under the supervision of the ISSI-BJ scientific staff on matters directly or indirectly connected with the ISSI-BJ projects. They contribute to the scientific environment at ISSI-BJ in complement to the ISSI-BJ scientific staff.

## Outreach and Training Tools

### SPACE SCHOOL

**ISSI-BJ Space School** is a biennial Summer School on space sciences and space science missions for international students. The students are provided with the required scientific background relevant to producing a report.

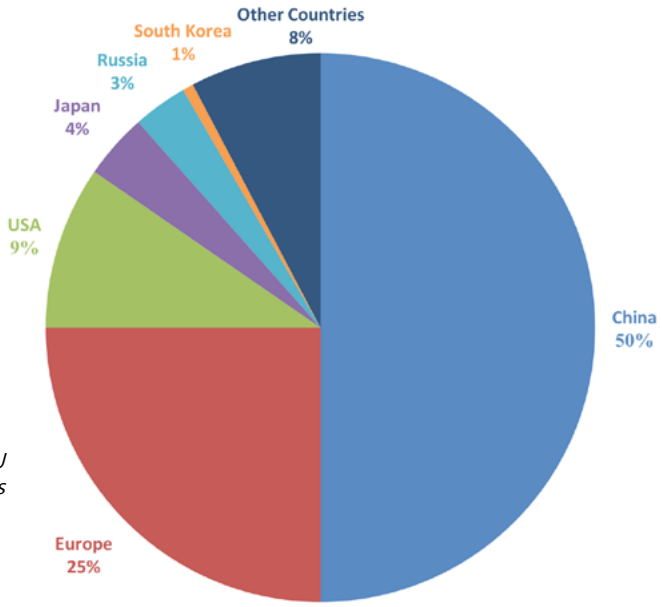
### U.S. SEMINARS

**Understanding Science** is organized by the UK Royal Society of Chemistry, Beijing University of Chemical Technology and ISSI-BJ. Its goal is to make a broader public aware of today's accomplishments in research through short scientific lectures in English (popularization talks), and to give an opportunity to talk with either international or Chinese scientists in a relaxed atmosphere.

## Statistics

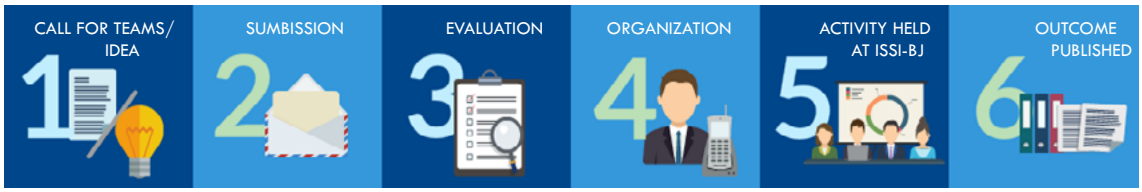
In 2017, ISSI-BJ organized one forum, two Understanding Science public seminars and three scientific seminars. We have 18 active international teams - 4 selected in 2015, 7 selected in 2016, and 7 selected in 2017.

In the course of 2017, a total number of 156 international scientists participated in the scientific activities of ISSI-BJ.




*Pie chart on the right: Geographical distribution of the ISSI-BJ scientific activities participants*

## How to use the ISSI-BJ Tools




**International Team**

1. A joint **call for proposals** is released by ISSI/ISSI-BJ every year in January.
2. Submit your **proposal** corresponding to the topics broadly identified in the Call.
3. The proposals are **evaluated**, prioritized and recommended to ISSI-BJ by the ISSI/ ISS-BJ **Science Committee**.
4. The activity is directed and **organized** by a team leader who is also the initiator of the proposal to ISSI-BJ.
5. The IT holds a series of two to three one-week **meetings** over a period of 12 to 18 months.
6. The **results** of Teams are published in scientific journals.

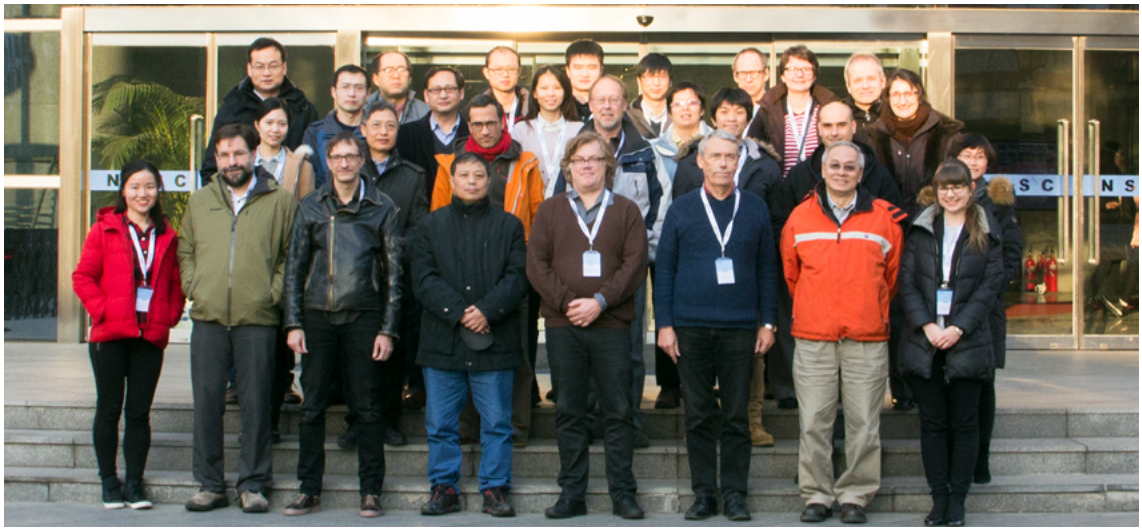
**Workshop, Working Group and Forum**

1. There is no annual call. The scientific community can put forward suggestions **at any time** on future Workshops and Forums.
2. Submit a **summary** of maximum **one page**, explaining the proposal **topic**, the **rationale** to organize the event at ISSI-BJ and the **list of proposers**.
3. The proposals are **evaluated**, prioritized and recommended to ISSI-BJ by the ISSI/ ISS-BJ **Science Committee**.
4. The activity is **organized** by the conveners.
5. The activity is held at **ISSI-BJ**.
6. The activity **outcome** is prepared and published.

## Lunar and Planetary Seismology Forum

**January 11-12, 2017**

*Conveners: Philippe Lognonné (University of Paris Diderot/IPGP, France), Ip Wing Huen (NCU, IANCU, Taiwan), Yosio Nakamura (UT Austin, IG, USA), Mark Wieczorek (CNRS/IPGP, France), Wang Yanbin (SESS, PKU, China), Maurizio Falanga (ISSI-BJ, China), Tilman Spohn (DLR, Berlin, Germany)*



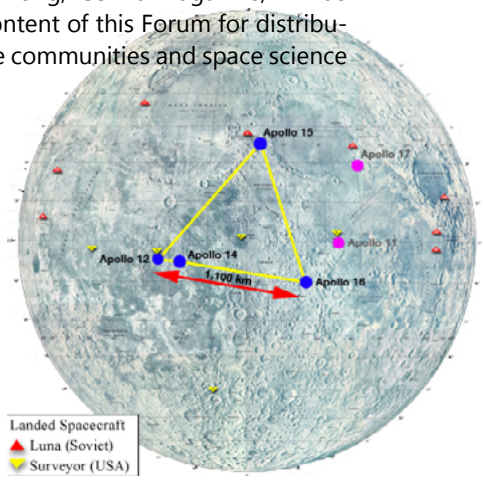
*Participants of the Forum on "Lunar and Planetary Seismology Forum" in Beijing*

The ISSI-BJ forum on Lunar and Planetary Seismology was joined by over 30 leading scientists from 8 countries.

The Forum started with an overview of the Apollo seismic experiment, followed by the outline of the goals and challenges of planetary seismology. Next, the achievements of the Apollo seismic experiment have been reviewed, and the science goals of a new post-Apollo seismic return on the Moon have been identified. The participants then proceeded to review the perspective of planetary seismology on other bodies of the solar system from Mars, where a major seismology mission (INSIGHT) is in preparation, and to the gas giants Jupiter and Saturn, where seismology experiments using astronomical techniques have already been successfully implemented. Finally, the participants discussed the new developments and future projects in Japan, Russia, USA, Europe and China.

The Forum ended with an extensive discussion during which the participants summarized the outcomes of the Forum. All participants shared the vision that future seismology at the moon and further out into the Solar System, will develop on the same foundations which prevailed for terrestrial seismology from its very beginning: a full dedication to open, free, international collaboration and free circulation of data.

An issue of Taikong, ISSI-BJ magazine, will be devoted to the content of this Forum for distribution to the science communities and space science institutions.




*Apollo passive seismic network operating on the Moon from 1972 to 1977*

# INTERNATIONAL TEAMS

Since 2014, every year in January ISSI-BJ and ISSI jointly release the Call for International Teams in Space and Earth Sciences to invite proposals for study projects from internationally collaborating teams of scientists from different institutions.

The Call is open to scientists of any nationality actively involved in the following research fields:

1. Space Sciences (Solar and Heliospheric Physics, Solar-Terrestrial Sciences, Space Plasma and Magnetospheric Physics, Planetary Sciences, Astrobiology, Cosmology, Astrophysics, and Fundamental Physics in Space)

2. Earth Sciences using space data

## Teams selected in 2015

**1. Brasseur G. (DE) & Bouarar I. (DE)**

**Analysis of Persistent Regional Air Pollution in Asia**

Session: February 29-March 4, 2016

Scientific Rationale: We propose to assemble an international and interdisciplinary team of air pollution specialists to address the unresolved problem of the formation of persistent and health-threatening aerosol layers during wintertime in large areas of Asia.

Our objective is to bring together a group of experts representing these different disciplines to address the problem of the formation of large haze episodes in Asia from different perspectives (space observations, surface monitoring, profiling, laboratory approaches, data analysis, modeling and impacts).

The two projected meetings, one in Bern and one in Beijing will provide the opportunity to discuss in detail the different issues related to haze formation and to develop a synthesis that should lead to the production of a proceedings book and to seminal papers that present the state-of-the-art on this issue. Of highest importance is the participation of Asian experts who have collected large datasets and are ready to contribute.

**2. Miyoshi Y. (JP) & Hosokawa K. (JP)**

**Pulsating aurora as a manifestation of non-linear wave particle**

Session: May 30-June 3, 2016 & July 2-6, 2018

Scientific Rationale: The ISSI-BJ Team will understand the causal relationship between the micro-process of the wave-particle interactions in the magnetosphere and pulsating aurora (PsA) in the ionosphere.

We have assembled a team of experts of ground-based observations, satellite observations, and simulations to tackle the focused questions on the pulsating aurora, which is a manifestation of the non-linear wave particle interactions of whistler mode chorus waves.

Besides the experts of the observations, we invite several members from the simulation studies for comprehensive understanding of the physical processes. These members also represent several space missions providing the data that are relevant for our focused research, namely, NASA's Van Allen Probes and THEMIS missions, ESA's Cluster mission, and the upcoming JAXA's ERG mission.

*Note:* *is used to mark the joint ISSI-BJ/ISSI teams*

*Picture of the team work on "Pulsating aurora as a manifestation of non-linear wave particle"*

**3. Nakariakov V. (UK) & Van Doorsselaere T. (BE)**

**Magnetohydrodynamic Seismology of the Solar Corona in the Era of SDO/AIA**

Sessions: December 14-18, 2015 & January 16-20, 2017

Scientific Rationale: We are going to assess in depth, develop and create the basis for full-scale implementation of the magnetohydrodynamic (MHD) seismological methods for the diagnostics of the solar coronal plasmas by MHD waves and oscillations with the use of data obtained with the Atmospheric Imaging Assembly (AIA) on the Solar Dynamics Observatory.

The unique capabilities of the instrument, such as the combination of the high spatial and time resolution, high sensitivity and 24/7 full-disk coverage allows for the confident detection of coronal wave and oscillatory processes, and assessing their key parameters.

These observational findings, in combination with the advanced MHD wave theory and instrumentoriented forward modelling provide us with the ground for the delivery of robust coronal plasma diagnostics of the key coronal plasma parameters, such as the coronal heating function and sub-resolution structuring.

Aims of the proposed activity are: 1. major expansion of the international research collaboration in the field by establishing new research collaborations and enhancing existing links 2. conducting collaborative research on several selected topical problems, 3. performing effective knowledge exchange, and 4. creation of a fertile ground for the joint application for collaborative research grants.

**4. Ouzounov D. (US) & Zhang X. (CN)**

**Validation of Lithosphere-Atmosphere- Ionosphere-Magnetosphere Coupling (LAIMC)**

Sessions: September 21-25, 2015, August 22-26, 2016 & May 7-11, 2018

Scientific Rationale: We propose an investigation of the near-Earth space plasma dynamics and electromagnetic environment by multi-parameter analysis from variety of space-based missions (ESA, NASA, NOAA, JMA and CNSA).

This study aims to advance the physical concept of the coupling mechanism between lithosphere, atmosphere, ionosphere and magnetosphere, which is linked to the chain of processes initiated by atmospheric boundary layer modification associated with major natural disasters: earthquakes, tsunamis, typhoons, dust storms and volcanoes.

Our primary interests for this inter geosphere exploration are to utilize ensemble of space-born observations to verify the geospheres interaction caused by large-scale natural disasters over Taiwan (ROC) and Mainland China. This study is advancing the initial study "Multi-instrument space-borne observations and validation of the physical model of the Lithosphere-Atmosphere-Ionosphere-Magnetosphere Coupling" (Pulinets and Ouzounov, ISSI-Bern, 2013-15).

Team of leading international and Chinese experts from different disciplines of space and Earth sciences will provide an unique opportunity for knowledge fusion to make breakthrough in the holistic understanding the physics of coupling process among different geospheres of our planet.

*A multi-wavelength view of all that remains of RCW 86, the oldest documented example of a supernova (Credit: X-ray: NASA/CXC/SAO & ESA; Infared: NASA/JPL-Caltech/B. Williams (NCSU))*

**5. Tian F. (CN)**

**Astrobiology in the New Age**

Session: April 25-27, 2017

Scientific Rationale: Astrobiology, the quest for life in the universe, is "scientifically" driving most NASA and ESA exploratory missions in the Solar System and beyond. China is developing a solid plan of exploration of the Solar System and construction of new generation scientific satellites. A strong astrobiology community in China will be able to suggest substantial science cases to make its space exploration efforts beneficial.

Here we proposed to organize an ISSI-BJ astrobiology team in order to address some strategic questions important to the development of China's astrobiology community. The team is highly interdisciplinary with a broad expertise to study Astrobiology.

The results of our project will be important for identifying priorities in astrobiology in China and will foster the growth of this discipline in China, which could in turn contribute to relevant researches internationally.

## Teams selected in 2016

**1. Belloni T.(IT) & Dipankar B.(IN)**

**Understanding multi-wavelength rapid variability: accretion and jet ejection in compact objects**

Sessions: March 20-24, 2017 & March 19-23, 2018

Scientific Rationale: The study of fast variability of compact objects, in particular galactic X-ray binaries, has in the past few years shifted in focus and technique. Earlier we had plenty of observational information in the Xrays, thanks to the RossiXTE satellite, but it was a heroic effort to obtain fast timing observations at longer wavelengths, due to the non-availability of suitable instrumentation. The situation has now reversed, as the RossiXTE mission was terminated and more and more fast-timing capabilities are being added to optical and infra-red observatories.

At the same time, the radio coverage that was at best patchy in the past is now easier to obtain. Starting from 2016, fast timing in X-rays will again be possible through the Indian multi wavelength satellite Astrosat, launched in 2015 September. As the recent outburst of a bright peculiar transient, V404 Cyg, has shown, it is now possible to coordinate major facilities throughout the world to obtain multi-wavelength coverage, which is essential to understand the nature of the emission and its variability, and hence the underlying physics.

Our International Team will discuss both existing results and future observational programs in order to summarise the current status of our understanding and devise projects to coordinate observational efforts in a manner to maximise their scientific output.

## 2. Zhang S.(US)

### Climate Change in the Upper Atmosphere

Session: May 7-11, 2018

Scientific Rationale: Climate change is characterized by global surface warming associated with the anthropogenic increase in greenhouse gas concentrations since the start of the industrial era. In the Earth's upper atmosphere where many modern technologies reside, it is now recognized that a long-term cooling has been taking place over the past several solar cycles. Compelling evidence for such cooling comes from direct measurements of the thermospheric density and the ionospheric temperature. A lot more indirect evidence has become available since the 1990s following a seminal modeling study by Roble and Dickinson (1989), suggesting potential effects of increased greenhouse gases on the ionosphere and thermosphere. However, there are several outstanding issues, for example, (1) the very strong ionospheric cooling observed by multiple ionospheric radars that does not fit with the prevailing theory based on the argument of anthropogenic greenhouse gas increases; (2) CO2 trends in the mesopause region observed by satellite missions are about twice of what current general circulation models predict; (3) trends in atmospheric wave activity and their impacts on the atmosphere-ionosphere system are poorly known and unquantified.

Our International Team will be taking on these challenging outstanding topics as our research theme, with the goal to improve the understanding of the long-term trends in the ionosphere and thermosphere.

*Picture of the team work on "Understanding the fate of binary systems in the Gaia era"*

## 3. Mowlavi N.(CH)

### Understanding the fate of binary systems in the Gaia era

Session: November 6-10, 2017

Scientific Rationale: The majority of stars in the Universe are in binary or multiple systems. Yet, the evolution of binary systems is still poorly understood theoretically and poorly constrained observationally. This is especially true for close systems experiencing mass transfer from one companion to the other.

The field will benefit from the exceptional database that is being gathered by ESA's Gaia mission. Launched at the end of 2013, the spacecraft is repeatedly observing several millions of which are expected to be eclipsing binaries. This unprecedented all-sky sample of eclipsing systems can serve as a proxy of the population of binary systems in the Galaxy and in the Magellanic Clouds. This ensemble of data on eclipsing binaries will offer a unique opportunity to analyze binary systems in different states of evolution, and eventually provide more reliable predictions for the occurrence fractions of various binary evolution channels.

The purpose of this team is to clarify and answer questions like: the identification of eclipsing binary parameters that can be extracted from large scale multi-epoch surveys, including Gaia, their link with observable properties of binary systems, and the efficiency of binary population synthesis models to predict various binary evolutionary channels based on eclipsing binary parameters extracted from large-scale multi-epoch surveys.

The study will rely on space- and ground-based multi-epoch surveys of eclipsing binaries such as Kepler and OGLE, and on simulated Gaia-like eclipsing binary time series in advance of, and in preparation for the study of, real Gaia data of eclipsing binaries.

### 4. Zhang Q.H.(CN)

**Multiple-instrument observations and simulations of the dynamical processes associated with polar cap patches/aurora and their associated scintillations**

Session: May 8-12, 2017 & September 17-21, 2018

Scientific Rationale: Polar cap patch/aurora are common in the polar ionosphere where their motion and associated density gradients give variable disturbances to High Frequency (HF) radio communications, over-the-horizon radar location errors, and disruption and errors to satellite navigation and communication. They are also directly subject to space weather disturbances and link to the magnetosphere-ionosphere-thermosphere (M-I-T) coupling processes. However, their formation and evolution under disturbed space weather conditions are poorly understood, and there is no forecasting tool to predict it.

Improved knowledge and modelling efforts in these phenomena is key to make progress toward improved space weather forecasts and correction of global navigation satellite system (GNSS) signals in real-time in the polar cap regions. With the fast developing of the coverage in the polar regions during the recent years from the multiple instruments, such as GNSS ground-based receivers, incoherent scatter radars (ISR), Super Dual Auroral Radar Network (SuperDARN), and all sky imagers as well as space-based measurements, the global distributions of plasma and flows as well as the associated scintillations are well obtained, which offer us a good opportunity to study the polar cap patch/aurora and detailed understand the M-I-T coupling processes in a global view.

The aim of this Team is to organize multiple instruments observing campaigns (including ISRs, SuperDARN, all sky imagers, etc.) through international collaborations for understanding high latitude dynamics processes of the ionosphere, including particularly the polar cap patches and aurora generated by M-I-T coupling in the polar regions.

To enhance our understanding of the basic high-latitude physics, we propose to conduct investigation in three aspects: (1) Observational data taking with ground-based and space-based instruments which involves coordinating international campaigns within high latitudes; (2) Scientific analysis of the observations; (3) model simulation of important high-latitude effects. The conclusion of this team study will involve the drafting of a number of papers on the work carried out.

*Aurora as seen from on board the International Space Station (Credit: ESA/NASA)*

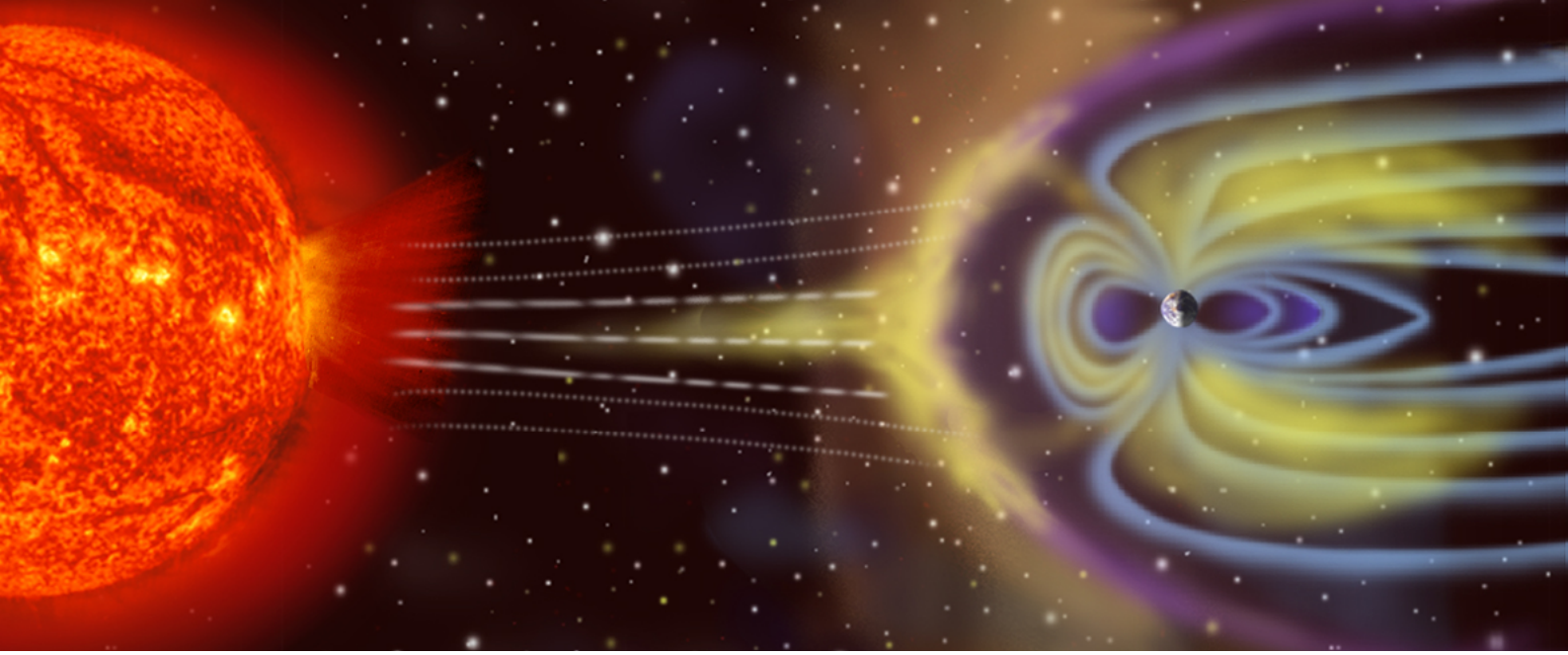
### 5. Orsolini Y.(NO)

**Snow reanalyses over the Himalaya-Tibetan Plateau region and the monsoons**

Session: February 27 - March 3, 2017 & May 14-18, 2018

Scientific Rationale: The aim of this Team is to inter-compare and assess available re-analyses and snow datasets over the Himalaya-Tibetan Plateau region in the satellite era, and the impact of the improved snow re-analyses over that region upon subseasonal-to-seasonal forecasts of the Asian monsoons.

The Asian monsoons are among the climate phenomena that have the strongest social and economic impacts. The types of snow analyses



*Solar wind impact on Earth's magnetosphere (Image Credit: ESA)*

used by operational meteorological centers to initialize subseasonal-to-seasonal forecasts, are now rapidly evolving. Land re-analyses which include assimilated satellite and in-situ observations are currently being tested at operational meteorological centers for the next generation of prediction systems. They harbinger the foreseen development of strongly coupled data assimilation method, involving the different subsystems of the forecast model.

While snow datasets and re-analyses have been compared over hemispheric or continental scales for variability and trends, their quality over the Himalaya-Tibetan Plateau region, sometimes called the Third Pole, is quite uncertain. While complicated by high orography and a paucity of in-situ data, it is nevertheless important for monsoon forecast initialisation.

The aim is to provide a synthesis evaluation paper and, ultimately, recommendation about what is needed to better initialize subseasonal-to-seasonal forecasts.

**6. Tian H.(CN)**

**Diagnosing heating mechanisms in solar flares through spectroscopic observations of flare ribbons**

Session: October 15-19, 2018

Scientific Rationale: Solar flares are one of the most energetic events on the Sun that have profound impacts on the near-Earth space environment and the rest of the heliosphere. Flare ribbons are locations of enhanced line and continuum emissions in broad wavelengths ranges from infrared and white light to extreme ultraviolet (EUV) from the lower solar atmosphere (from the photosphere to the chromosphere and transition region). They consist of footpoints of hot and dense flare loops, locations where most of the flare energy is deposited and dissipated.

With a high cadence up to a few seconds and a resolution of ~0.33 arcsecond (~240 km on the Sun), NASA's Interface Region Imaging Spectrograph (IRIS) mission has revealed unprecedented details of the dynamics in ribbons of hundreds of flares since July 2013. Characteristics of emission line profiles observed at the ribbons, e.g., Doppler shift, line width, asymmetry, central reversal and wing enhancement, are manifestations of various physical processes occurring in these flares. Such observables can be used to help disentangle different chromospheric heating mechanisms, namely thermal conduction, electron beam and Alfvén wave.

Our Team will diagnose flare heating mechanisms through combined efforts of spectroscopic observations of flare ribbons and advanced flare modeling. The team includes observers who will fully characterize the temporal evolution of several

key emission lines, e.g., Mg II, Si IV and Fe XXI lines, at different locations of the ribbons in at least ten IRIS observations of flares. The team also includes modelers who will perform hydrodynamic/radiative-hydrodynamic simulations focusing on different heating mechanisms to reproduce signatures in the observed IRIS line profiles.

**7. Savin S.(RU) & Wang C.(CN)**

**Outer Magnetospheric Resonances: The Role in Ionosphere-Magnetosphere Coupling**

Session: June 12-16, 2017

Scientific Rationale: The key objective of the proposed Team is a new understanding of solar wind dynamic interaction with the Earth's magnetosphere: how surface and cavity resonances of the outer magnetospheric boundary layers can govern the plasma penetration inside and outside magnetosphere.

We propose that the main mechanism is the generation of the coherent plasma jets in magnetosheath, modulated by the resonances, which can be well seen inside the ionosphere. We propose to analyze cross-correlations of all available data from the spacecraft (s/c) in outer magnetosphere and the ionospheric data. Unlike most of the previous studies, we use the dynamic pressure data from the outer s/c and correlate them with energetic particle and magnetic field data, including SYM-H and AE indices.

We plan to simulate the experimental data using the facilities of our Chinese members, to study new features, such as a secondary shock over cusp.

## Teams Selected in 2017

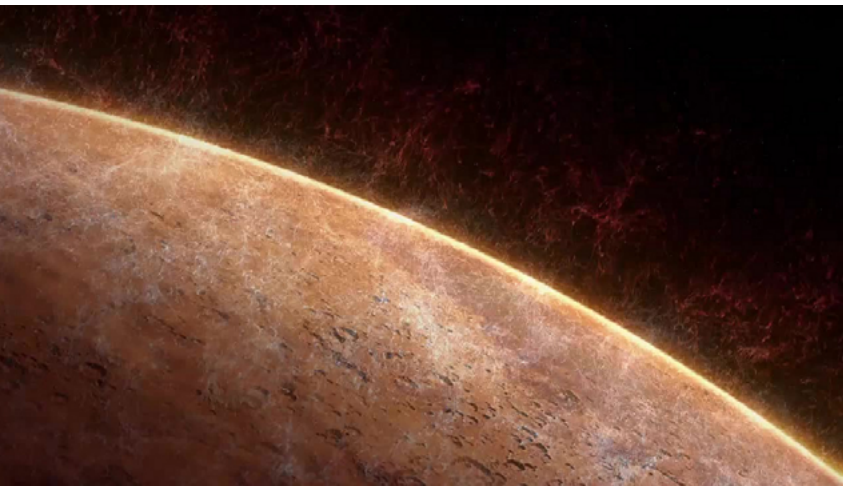
**8. Chaffin M. (US)**

**Hydrogen Escape across the Solar System and Beyond**

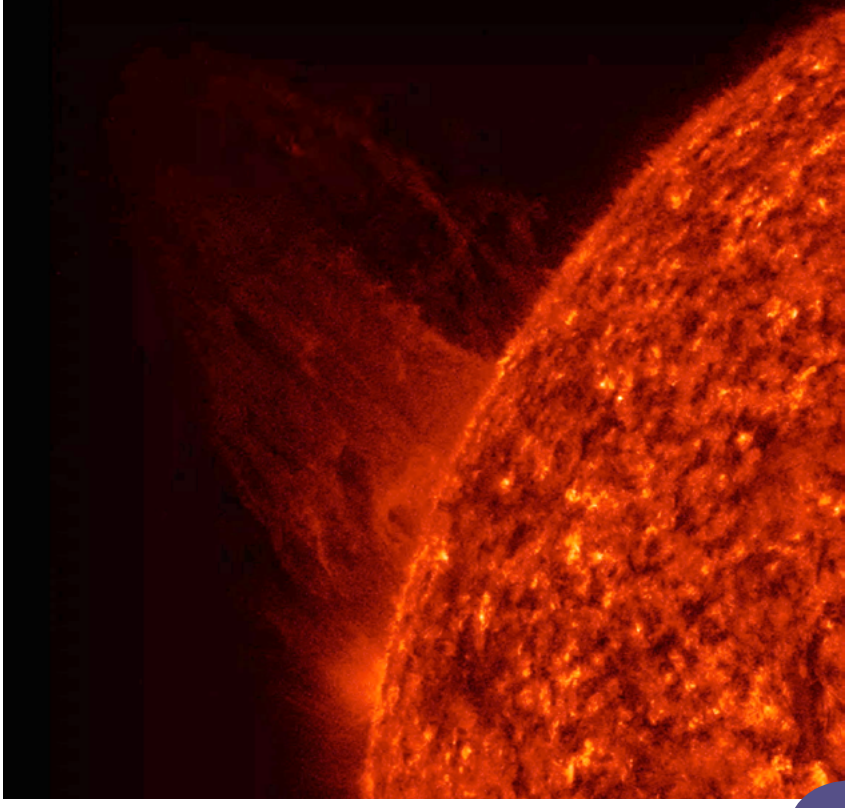
Scientific Rationale: Hydrogen escape has played a major role in sculpting the atmospheres of the terrestrial planets, especially at Venus and Mars. Because of this, it is important to understand the dynamics and escape of hydrogen in general, across solar system objects and exoplanets.

Our team is motivated by new H datasets from NASA's MAVEN mission at Mars and the Earth-observing TWINS spacecraft, the discovery of H coronas around close-in exoplanets, and the complete H escape dataset from Venus Express at Venus. Beyond observations, newly discovered phenomena that may control H escape from Mars and other planets are being explored with models.

Our team will combine experts who study each of these topics, pooling experience to begin assembling a comprehensive framework for understanding H escape. The result of our team's work will be greatly strengthened ties across disciplines and objects, and at least one review article summarizing current knowledge of H escape.



*Hydrogen escape from Mars. Image source: NASA/GSFC; CU/LASP*



*A sheet of plasma blasted out into space from just behind the edge of the sun. Image credit: NASA/GSFC/Solar Dynamics Observatory*

**9. Heger A. (AU) & Lugaro M. (HU)**

**Radioactive Nuclei in the Cosmos and in the Solar System**

Session: April 16-20, 2018

Scientific Rationale: The presence of today extinct radioactivities can be inferred from the analysis of primitive meteoritic inclusions and presolar grains, the former telling us about the formation history of the Solar System, the latter about chemical evolution of the Galaxy, and nucleosynthesis mostly in low-mass stars and supernovae. Key examples of such nuclei include 26 Al, 6 0 Fe, and 2 44 Pu. Our goal is to exploit these nuclei and the information that they carry by combining the most current sophisticated experimental, observational, theoretical, and numerical modelling investigations. We will undertake a unique and complete effort to understand the production of these radionuclei in stars and supernovae, their distribution and history in the Galaxy, and how they ended up in the Solar System.

Our team includes experts on gamma-ray observations, accelerator mass spectrometry, nuclear experiment and theory, and modelling of stars, supernovae, and galactic chemical evolution. We will take advantage of new nuclear research facilities in China (e.g., JUNA), Europe (FAIR) and USA (FRIB) to obtain nuclear data and we will identify uncertainties in key reaction channels that need to be constrained by future experiments, helping to define the future research program. This becomes particularly powerful in combination with data from current and future international and Chinese gamma-ray observatories through which theory and models can be tested.

Our key target is to exploit radioactive nuclei to constrain stellar evolution and nucleosynthesis, the production and propagation of such nuclei, and the timescales of Galactic history and of the origin and history of the matter in our Solar System.

**10. Jofre P. (UK) & Worley C. (UK)**

**Stellar libraries of 2020**

Session: April 23-27, 2018

Scientific Rationale: Libraries of stellar spectra reside at the crossroad of many di erent fields of astrophysics. On the one hand they serve as a basis for the classification and automatic analyses of stellar parameters that are being derived from on-going and future large stellar spectroscopic surveys. On the other hand, they are the fundamental ingredients for models of stellar populations that are used to study the evolution of galaxies in the Universe. We propose to perform a thorough comparative study with the goal to answer two main questions: 1. What is the limit in stellar parameter accuracies that can be derived from current libraries and how do the newest data from astrometric and astroseismic space missions help to improve these accuracies? 2. What are the key gaps in the libraries that need to be filled in


*Group photo of the team on "Pulsations in solar flares: matching observations and models"*

order to increase their impact on the future of Galactic and extragalactic astronomy?

**11. Olshevsky V. (BE) & Valentini F. (IT)**

**Magnetic topology effects on energy dissipation in turbulent plasma**

Session: September 3-7, 2018

Scientific Rationale: Our team will focus on the role played by the magnetic topology in the processes of turbulent energy dissipation in space plasma. The synergy of kinetic, hybrid and magnetohydrodynamic simulations will be used to find out what magnetic topologies allow more efficient energy dissipation and conversion at different scales. These simulations will be directly compared with in situ observations of the MMS mission. Perspective applications for MMS, and for the future THOR missions will be drawn.

**12. Zimovets I. (RU/CN) & Ning Z. (CN)**

**Pulsations in solar flares: matching observations and models**

Session: October 16-20, 2017

Scientific Rationale: Our Team will focus on comprehensive analysis of solar flare space- and ground-based observations and advanced modeling to deepen current knowledge about non-stationary processes of flare energy release manifested as pulsations of flare electromagnetic emission.

The Team is composed of international experts in the relevant areas of solar physics and is aiming to: 1. develop more rigorous criteria of quasi-periodicity for solar flare light curves; 2. utilize new methods of analysis of nonlinear and non-stationary datasets; 3. develop an advanced classification of different types of pulsations in solar flares; 4. perform detailed multi-wavelength spatially-resolved analysis of the sources of pulsations in the large sample of solar flares using modern observational datasets (RHESSI, Fermi, SDO, IRIS, Lomonosov, Vernov, Spectr-R, NoRH/NoRP, SSRT, etc.); 5. assess adequacy and improve the existent flare models; 6. evaluate the possible role of pulsations in solar-terrestrial connections; 7. develop a strategy of exploration of pulsations in solar and stellar flares with space- and ground-based instruments in the coming years.

**13. Garcia R. (FR) & Zhu P. (CN)**

**An international reference for seismological data sets and internal structure models of the Moon**

Session: June 18-22, 2018

Scientific Rationale: The goal of this project is to obtain a consensus at international level on the data analysis of Apollo passive seismic experiments in order to provide both a reference data set with appropriate error bars and an ensemble of 1D seismological reference model of the Moon internal structure. These reference data analysis and 1D seismological models will clarify what we know and what we don't know of the internal structure of the Moon.

In addition, the output of this study will facilitate both the access to Moon seismological data sets and the interpretation of seismological Moon models by the international community. The international team, whose members come from various teams in the world, will conduct the analysis of error of arrival times and location of the moonquakes, build a reference data set with error bars and construct an ensemble of 1D seismological reference models of the Moon internal structure through Bayesian velocity inversion.

**14. Zhang H. (US) & Zong Q. (CN)**

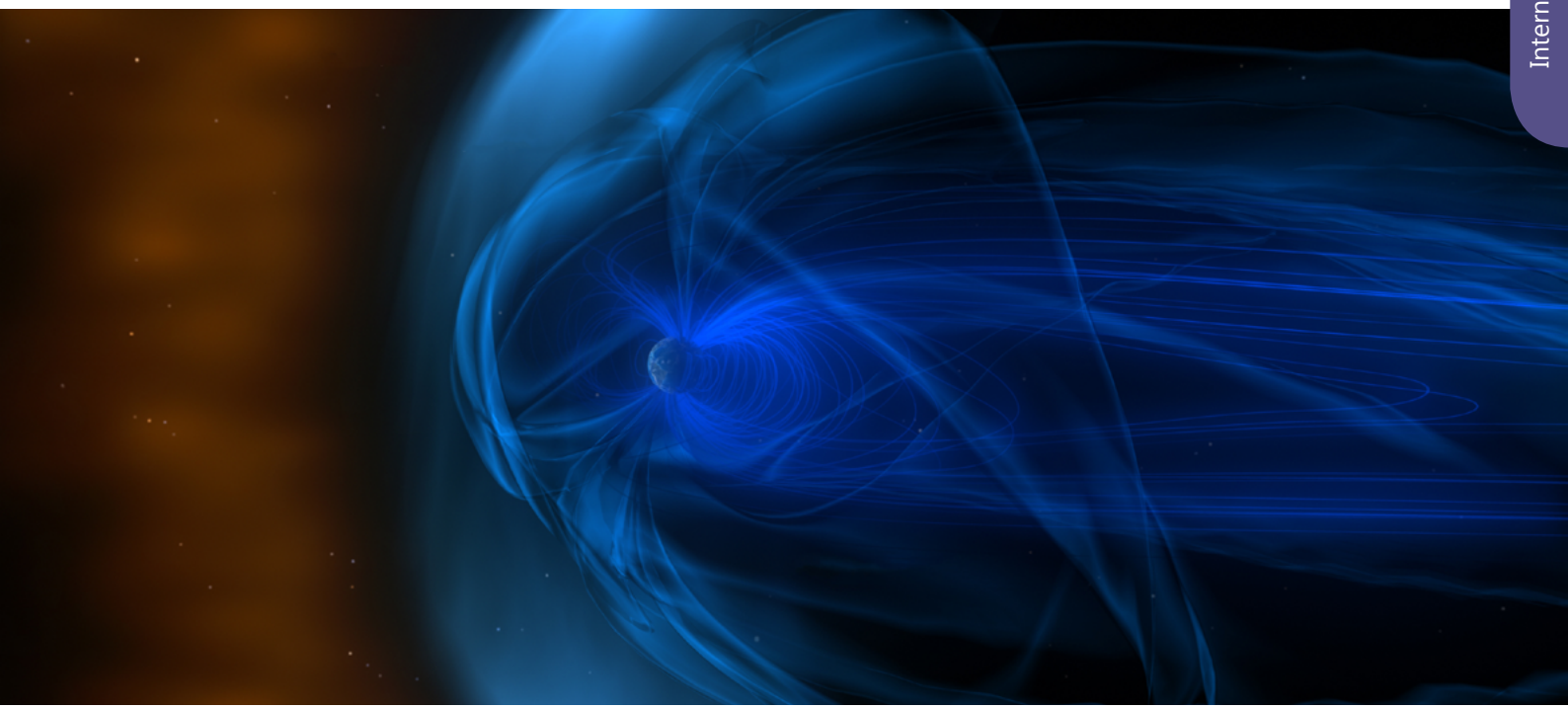
**Dayside Transient Phenomena and Their Impact on the Magnetosphere-Ionosphere**

Session: May 28-June 1, 2018

Scientific Rationale: We propose a team that will employ both observations and simulations to investigate dayside transient phenomena at the magnetopause and bow shock and their impact on the magnetosphere and ionosphere.

Dayside transients are frequently observed upstream from the bow shock (e.g., Hot Flow Anomalies, foreshock cavities, and foreshock bubbles) and at the magnetopause (e.g., flux transfer events and surface waves). They play a significant role in the mass, energy and momentum transport from the solar wind into the magnetosphere and impact the whole magnetosphere-ionosphere system. Foreshock transient phenomena, associated with variations in the solar wind dynamic pressure, deform the magnetopause, which in turn generates field-aligned currents (FACs) connected to the auroral ionosphere. Solar wind pressure variations along with transient phenomena at the dayside magnetopause are also believed to be sources of magnetospheric ULF waves, some of which can play an important role in the dynamics of Earth's radiation belts.

The goal of our team is to provide a fundamental physical understanding of dayside transient phenomena and their impact on the magnetosphere-ionosphere system. Specifically, we will focus on the following key unanswered questions: 1. What are the physical differences and relationships among hot flow anomalies, foreshock cavities, and foreshock bubbles upstream from the bow shock? 2. What are the spatial and temporal variations of the magnetic reconnection at the magnetopause? 3.How do the magnetosphere and ionosphere respond to dayside transient phenomena?



*Magnetosphere of the Earth, with constant stream of particles flowing by from the solar wind. Credit: NASA.*

# SCIENTIFIC SEMINARS GIVEN BY OUR VISITORS

## Stardust: The Cosmic Seeds of Life

**Sun Kwok**

February 27, 2017



*Sun Kwok giving a talk on "Stardust: The Cosmic Seeds of Life"*

On February 27, 2017, Prof. Sun Kwok, Director of the Laboratory for Space Research of the University of Hong Kong and President of Commission F3 Astrobiology of the International Astronomical Union (IAU), visited the International Space Science Institute in Beijing, and gave a talk at the National Space Science Center (NSSC) on "Stardust: The Cosmic Seeds of Life". In his impressive talk, Prof. Sun Kwok explored the question of how life originated on Earth.

For over 50 years, scientists believed that life was the result of chemistry involving simple molecules such as methane and ammonia cooking in a primordial soup. Recent space observations have revealed that old stars are capable of making very complex organic compounds. The stars then ejected the organics and spread them all over the Milky Way Galaxy.

There is evidence that these organic dust particles actually reached the early Solar System. Through bombardments by comets and asteroids, the early Earth inherited significant amounts of star dust. Was the development of life assisted by the arrival of these extraterrestrial materials?

In his seminar, Prof. Sun Kwok described discoveries in astronomy and solar system science over the last 10 years that resulted in a new perspective on the origin of life.

## Science on Space Stations

**Olivier Minster**

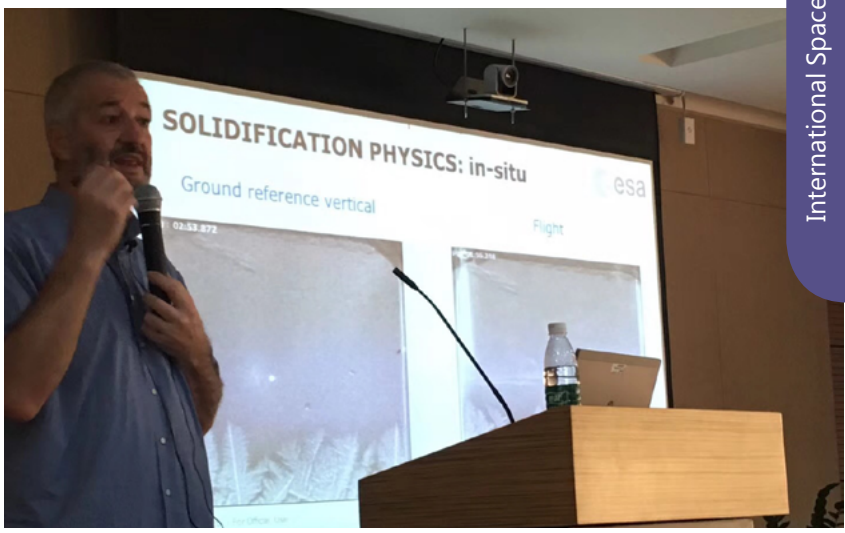
September 6, 2017

Following his visits to the International Space Science Institute - Beijing on June 29 and July 19, a seminar by Dr. Olivier Mister (ESA, currently detached at CSU) on "Science on Space Stations" was jointly organized by ISSI-BJ and NAOC/CAS on September 6, 2017.

The European Space Agency runs a program on Science in the Space Environment (SciSpacE) on behalf of its member states. The program addresses a vast variety of topics in life sciences addressing the behavior of living organisms - from individual cells to astronauts - in the space environment. The program also includes physical sciences, covering solar physics, atmospheric physics, fundamental physics, fluid physics and materials sciences. Gravity has a pervasive effect on a variety of processes and experimenting under reduced gravity conditions enables scientists to do unique experimental research in situations not achievable on Earth.

Dr. Olivier Minster joined the European Space Agency in 1988 to support the scientific coordination of the program of Research in Space. He is currently detached by ESA to the Center for Space Utilisation of the Chinese Academy of Sciences in Beijing to help develop scientific cooperation in the field.

In his talk, Dr. Olivier Minster offered a glimpse into the ISS program and delved into some examples of projects and results in physical sciences and future perspectives in basic and applied research utilising the International Space Station in particular.




*Olivier Minster sharing his knowledge about the European Space Agency's program on Science in the Space Environment*

# Observing the Changing Global Ocean Water Cycle from Satellite: a major scientific, technological and data analysis challenge

**Lisan Yu**

June 22, 2017

*Lisan Yu giving seminar at ISSI-BJ/NSSC*

On Thursday, June 22nd, ISSI-BJ had the pleasure of hosting Dr. Lisan Yu of the Woods Hole Oceanographic Institution (WHOI), one of the leading oceanography institutes in the world, located near Cap Cod in Massachusetts, U.S., as the speaker of its Space Science Seminar Series (4S), organized jointly with the Key Laboratory of Microwave Remote Sensing, NSSC, CAS.

Dr. Yu explained to a fully captivated audience the central role played by our oceans both in the water cycle (the oceans are for sure our main water reservoir) and in the energy cycle of our planet. These two cycles are couples via the evaporation and precipitation fluxes at the ocean surface. The salinity of ocean surface waters, which is highly variable in space, can be partly used as a tracer of the evaporation – precipitation global pattern, but it is also influenced by surface winds.

Retrieving the different fluxes characterizing the exchanges of moisture, energy, etc., between sea and air, which are critical ingredients to understand how the Earth's climate engine works, is therefore a non-trivial problem. It can be addressed more and more accurately with the world fleet of oceanography and weather satellites, using a combination of sensors giving access to the different parameters of the sea-air interface, and sophisticated tools for data assimilation and numerical simulation.

Dr. Yu nicely introduced us to some of them, and emphasized the role that the global Water Cycle Observation Mission (WCOM, see the Taikong magazine #8, May 2016) recently selected by China as part of its program of space science missions, is going to play in the world-wide effort to address this challenge

## Exploring Mars

**Jeremie Lasue**

March 07, 2017

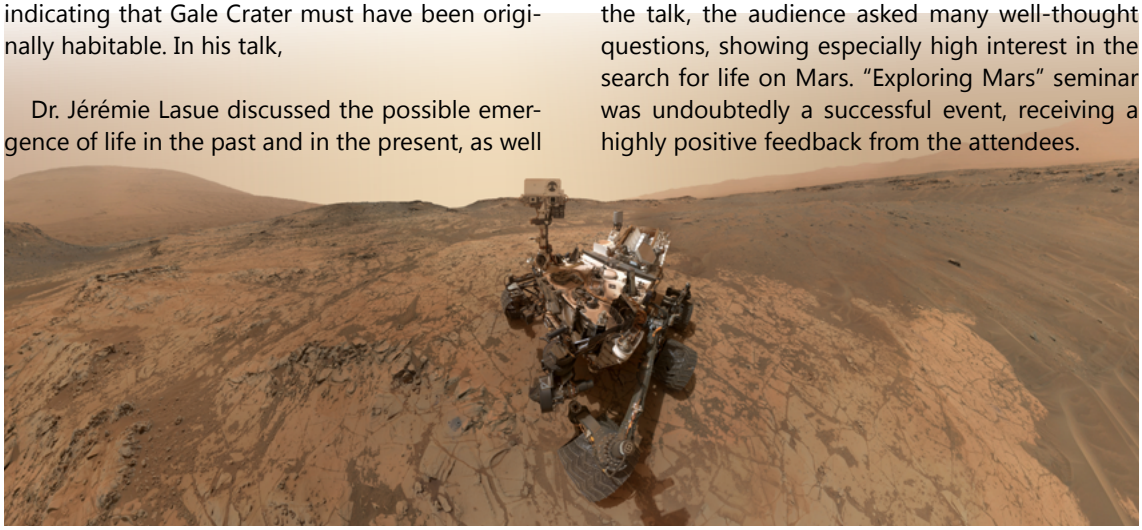
On March 07, 2017, ISSI-BJ organized an Understanding Science seminar on "Exploring Mars". The lecture was held by Dr. Jérémie Lasue of the Institut de Recherche en Astrophysique et Planétologie (IRAP/OMP) in Toulouse, France, a visitor to ISSI-BJ. Dr. Lasue is part of the team working on the ChemCam instrument on the Mars Science Laboratory (Curiosity) rover.

During his talk, Dr. Jérémie Lasue, in a comprehensible manner, reviewed the exploration of Mars and its results. With 6 satellites and 2 rovers operational at Mars, the red planet is currently the most explored object of our planetary system after the Earth. While it is currently mostly a desiccated frozen world, signs of large amounts of water flowing on Mars over long periods of time in the past have triggered the question of its habitability. The NASA Mars Science Laboratory (Curiosity) has found evidence for past liquid water at Gale, and the presence of all the necessary elements for life indicating that Gale Crater must have been originally habitable. In his talk,

Dr. Jérémie Lasue discussed the possible emergence of life in the past and in the present, as well as reviewed the opportunities and challenges for future exploration of the Red Planet by robots and humans.

*Dr. Jérémie Lasue giving an Understanding Science seminar on "Exploring Mars"*

The event was well attended, and the room at the Bridge Café, a coffeehouse in Wudaokou, Beijing, quickly became crowded with scientists, young students and other curious listeners. After the talk, the audience asked many well-thought questions, showing especially high interest in the search for life on Mars. "Exploring Mars" seminar was undoubtedly a successful event, receiving a highly positive feedback from the attendees.

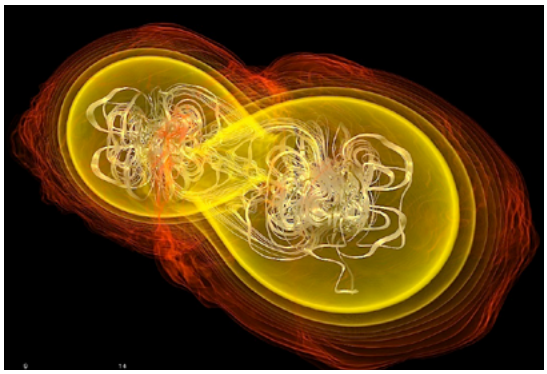


*Self-portrait of NASA's Curiosity Mars rover showing the vehicle at the "Okoruso" drilling site on lower Mount Sharp's "Naukluft Plateau." The scene is a mosaic of multiple images taken with the arm-mounted Mars Hands Lens Imager (MAHLI). Credit: NASA/JPL-Caltech/MSSS*

# Listening to the sounds of the universe: the future of gravitational wave astronomy

**David Blair**

December 12, 2017



*A still from a computer simulation of merging neutron stars, which are thought to power short gamma-ray bursts. Credit: NASA, AEI, ZIB, M. Koppitz and L. Rezzolla*

On December 12, 2017, ISSI-BJ organized an Understanding Science seminar on "Listening to the sounds of the universe: the future of gravitational wave astronomy". The lecture was held by Prof. David Blair of Australian Research Council Centre of Excellence for Gravitational Wave Discovery, a visitor to ISSI-BJ. Prof. Blair is an experimental physicist. He developed the first southern hemisphere gravitational wave detector NIOBE, and the Sapphire Clock.

During his talk, Prof. Blair compared the universe to a forest, which - in order to be fully experienced - should not only be viewed, but also listened to. Gravitational waves have allowed humanity to listen to the universe for the first time. Gravitational wave signals have revealed an unexpectedly large population of large black holes, and coalescing neutron stars that with associated gamma ray, optical and radio observations have provided a glimpse of the extraordinary power of this new type of astronomy.

What we have heard and seen is the tip of the iceberg. New detectors are proposed that will allow us to hear events across most of the visible universe. In real (cosmic) time we will be able to hear the universe winding down as matter exits the universe and black holes grow. In his impressive seminar, Prof. Blair also discussed the new physics and the improved detectors that would make this possible.


*Prof. Blair introducing the concept of the "singing universe" with gravitational waves*

# EVENTS & MEDIA COVERAGE

## Collaboration with APSCO

**June 20 and August 14, 2017**

Following the billateral meeting on June 20, the new Memorandum of Understanding (MoU) was signed by Dr. Li Xunjun, Secretary-General and CEO of the Asia-Pacific Space Cooperation Organization (APSCO) and Prof. Michel Blanc, Executive Director of the International Space Science Institute - Beijing on August 14, 2017.

The renewal of the current cooperation agreement with APSCO was realized with a shared interest for extending the initial object of the cooperation – the Space Science School – to new activities.

## Discussions with CSU

**June 29, July 18 and August 23, 2017**

After the initial meeting on June 29, a half-day brainstorming meeting between ISSI-BJ and Center for Space Utilisation (CSU), CAS, organized around a comprehensive presentation of the research programs on board the ISS and the CSS by Dr. Olivier Minster (ESA, currently detached at CSU), was organized in our premises on July 18, 2017. The following meeting, on August 23, 2017, discussed the way forward towards the inclusion of sciences in space in our program.


*Bilateral meeting between ISSI-BJ and APSCO on June 20, 2017. Image credit: APSCO.*

## ISSI-BJ in Media

**Radio Interview**

"Les Ambitions Spatiales de la Chine" with Michel Blanc

Radio France Inter, January 4, 2017

# INTERVIEW

## Interview with Wing Ip

***Wing Ip is a professor at the National Central University, Taiwan, AGU Fellow, and member of Academia Sinica. Co-investigator in Giotto, Galileo, Space 1, Mars Express, Cassini and Rosetta missions, received NASA distinguished public service medal, Axford prize of AOGS.***

**Could you briefly explain how you were involved with ISSI-BJ?**

I knew of ISSI-Bern since long, actually since its founding in the 90's. At that time I already thought that it was such a brilliant idea, partly to expand the scientific component of European Space Agency and partly to extend the influence of European scientists on the development of space science and astronomy, not to mention its importance in bridging the generation (or rather mission) gap by putting data from all past missions under one roof for in-depth analysis and interpretation. After I returned to Taiwan, I invited Dr. Roger Bonnet who was then both Executive Director of ISSI and COSPAR President to visit Taiwan. Roger was positively impressed by the level of scientific research in Earth and space science we had here and I therefore ventured to float the idea to him about establishing a branch ISSI-office in Taiwan with focus on Earth science. Unfortunately, this conversation was not followed up. So I was pleasantly surprised by the news of the establishment of ISSI-BJ.

My contact with ISSI-BJ came about after an inter-agency meeting between CNSA and ESA on the possible cooperation of a joint lunar seismometer experiment on the Chang'E 4 mission. For some technical (and financial) reasons, this interesting idea was not realized. But Dr. Philippe Lognonne and I decided to continue this discussion using ISSI-BJ as the platform. This is the origin of the lunar and planetary seismology forum. In the meantime, Prof. Maurizio Falanga, the first Executive Director of ISSI-BJ, also discussed with me several times about the desirability of getting Taiwan's scientific community more involved in the activity of ISSI-BJ. When Dr. Michel Blanc took up the Executive Directorship at ISSI-BJ, we had chances to discuss his view and experience often because we are old acquaintances since the Cassini days.

**How was your experience of working at ISSI-BJ?**

ISSI-BJ gives people the feeling of being familiar but also strange at the same time. From the organizational point of view, I think there is still a lack of the presence of senior scientists and scientific staff when compared with ISSI-Bern. For example, I used to consider going to Bern a kind of pilgrimage with the hope of being able to meet Prof. Johannes Geiss who is a symbolic figure and inspiration in planetary science. The next thing is, of course, the space science groups at the University of Bern next door appear to have taken full advantage of ISSI-Bern's scientific activity. This academic connection to the local community has

now emerged slowly. I believe this situation will be significantly improved as China and other Asian countries move into high gear in space exploration. The ground work laid by ISSI-BJ now will be very much appreciated.

For a long-term strategy, it might be worthwhile to consider the scheme of supporting a visiting scientist program complementary to what is current in place. The idea is to have agreements with a number of leading research institutes in China, Japan, India, Korea, etc. to support the stationing of postdoctoral fellows for a period of six months to a year, with a view to share a (small) part of the scientific administration. The main task and benefits for the visiting fellows are, however, to carry out scientific research of interest to both ISSI-BJ and its host institution (e.g., NSSC) in an international setting. Some of them could even be detailed to ISSI-Bern, and vice versa. This might be too idealistic. But you know me.

**What do you think is special about ISSI-BJ and how do you see its future development?**

ISSI-BJ is providing a unique bridge between Asia, Europe and the US using scientific workshops and teamwork as building stones. It provides access for scientists from the western world to the exciting developments in astronomy, space and planetary sciences and Earth observation in China and other Asian countries. It serves as an invaluable tool for fostering cooperation in solving some of the most fundamental questions of humankind.

**Can you say a few words about the painting you donated to ISSI-BJ?**

When I was attending a science team meeting of the OSIRIS camera experiment on Rosetta in January, 2016 in Paris, I was called home because my mother, Mei-Tao Lee, was gravely ill. I took the earliest possible flight from CDG international Airport to Hong Kong. On the way, I looked out the window and took pictures of the clouds thinking of my mother's courage in life. My mother passed away in February, 2017. I then painted a series of pictures after those photos with the title of "On both sides of the clouds". The one now exhibited in ISSI-BJ is from one of them with the additional touch of an arc with a rocket on its way to Mars. My mother would have been mightily pleased if she knew that the picture in memory of her will be viewed by space scientists from all over the world.

**You have visited Beijing a number of times. Is there any place where you particularly enjoyed spending time?**

One place I recommend is the Yonghegong Lama Temple (雍和宫) that can be easily reached by subways. It used to be the place for the Imperial College of the Ching Dynasty. There are many things to see including the records of the top scholars over many generations. There is a small building displaying the learned sayings of some legendary figures and philosophers in Chinese history. I particularly like what was written by Master Han-Fei-Zi (韓非子) in the Warring State Period. It says: A nation cannot always be strong, or always be weak. A nation will be strong when law-abiding people are strong. A nation will be weak when law-abiding people are weak (國無常強，無常弱。奉法者強則強。奉法者弱則弱). How true!

*Painting donated by Prof. Wing Ip to ISSI-BJ*

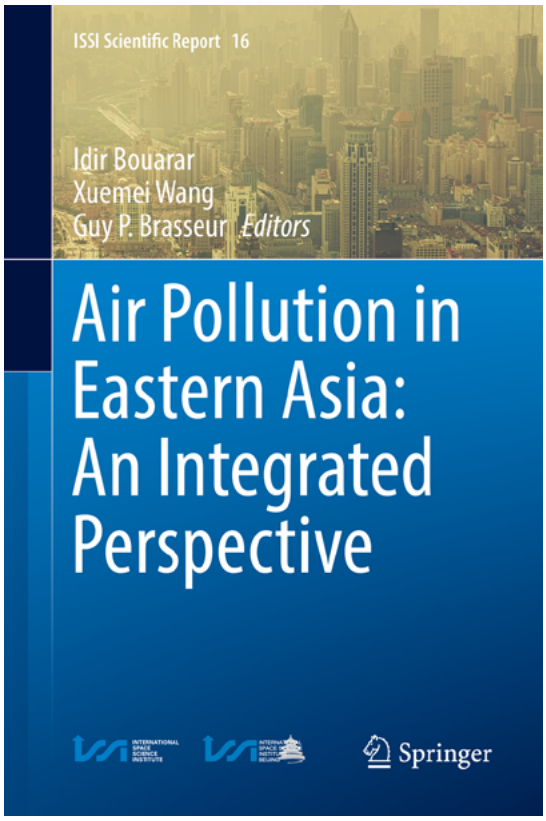
# PUBLICATIONS

## ISSI Scientific Report Series

**Volume 16, 2017**

**Air Pollution in Eastern Asia: An Integrated Perspective**

*Book Editors: Bouarar, Idir, Wang, Xuemei, Brasseur, Guy P.*




This book is, written by an international group of experts from China, Europe and the USA, presents a broad and comprehensive analysis of the chemical and meteorological processes responsible for the formation of air pollutants in eastern Asia, and in particular for the development of severe pollution episodes observed primarily during winter in the northeastern part of China, as they were addressed and debated during the joint ISSI-BJ/ISSI International Team meetings.

With the rapid population growth, economic development and urbanization occurring in Asia, air pollution has become a major environmental problem in this part of the world. The book is organized around six distinct parts. The first part of the volume offers a general perspective on issues related to air pollution including persistent haze events in eastern and southern Asia. The second part presents an overview of air pollution sources (i.e., anthropogenic and biomass burning sources). The third part analyzes in-situ observations of chemical species in China, while the fourth part focuses on space observations of gas-phase and aerosol species. The modeling aspects are treated in the fifth part of the volume, which includes a presentation of several air quality forecast systems and an assessment of the role of urbanization on air pollution levels. Finally, the effects of air pollution on health and crop productivity in China are discussed in the last part of the book. The book also presents an integrated view of past and present situations in Asia and provides the scientific basis from which mitigation policies can be established and air quality can be improved.

Audience: This book is written for scientists, educators, students, environmental managers, policy-makers and leaders in public administration and private corporations who wish to use science-based information to mitigate air pollution. The book should help decision-makers to design effective policies for air quality improvement and to successfully manage short-term air pollution episodes that substantially affect people's quality of life and strongly impact the economy.

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# FORTHCOMING FORUMS

## Roads towards Sample Return from Comets and Asteroids

**January 17-18, 2018**

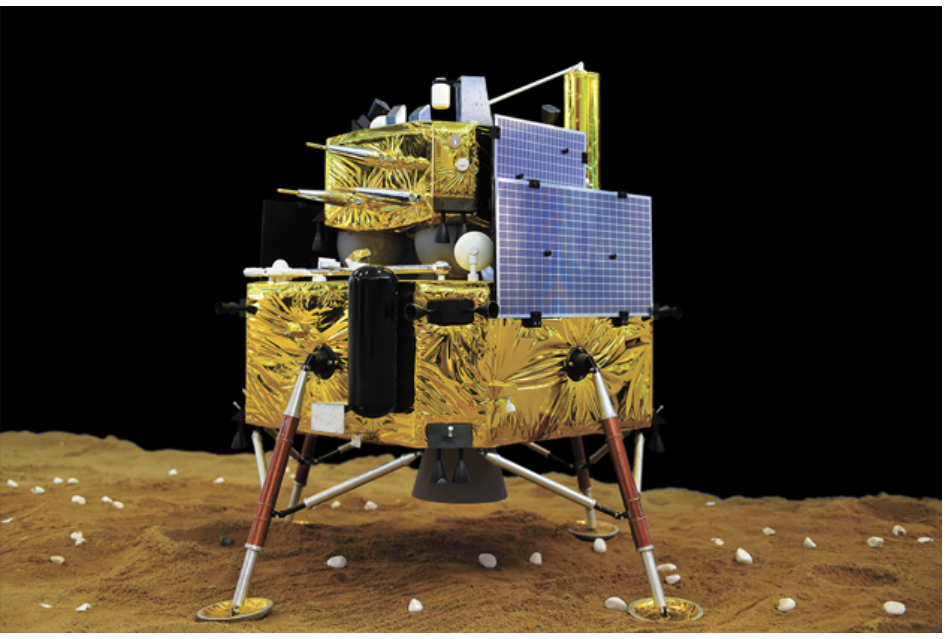
Conveners:

- Antonella BARUCCI, Observatoire de Paris, Paris, France
- John BRUCATO, Arcetri Observatory, Florence, Italy
- Humberto CAMPINS, University of Central Florida, USA
- Ian FRANCHI, Open University, Milton Keynes, UK
- HUANG Jiang-chuan, CAST, Beijing, China
- Jeremie LASUE, IRAP, Toulouse, France
- LIN Yangting, IGG, CAS, Beijing, China
- Holger SIERKS, MPS, Goettingen, Germany
- Shogo TACHIBANA, Department of Natural History Sciences, Hokkaido University, Japan
- Michael ZOLENSKY, NASA, Johnson Space Center, USA
- WU Ji, NSSC/CAS, Beijing, China
- Michel BLANC, ISSI-Beijing, Beijing, China

The populations of Small Bodies, in particular comets and asteroids, are the last witnesses of the origin and early evolution of the Solar System and of the formation scenarios of its planets. Collecting samples from these objects to analyse them using the powerful analytic tools available in our Earth-based laboratories is one of the most promising ways of reading the early History of our Solar System to learn about our own origins.

This is the reason why several space agencies have programmed sample return missions from these bodies, in addition to remote sensing and in situ analysis missions.

At a time when China considers flying a full-scale sample return mission as a component of its 14th five-year plan for priority space science missions, this ISSI-Beijing FORUM will discuss in an international context the science drivers and key sample collection objectives of such missions and will explore the possible mission scenarios with the objective of identifying the most promising ones.



*Left:*
*The model of Chang'e-5 lunar probe, to be launched by China in 2019 to bring lunar samples back to Earth (credit: Xinhua/ Liang Xu).*

# Discovering Sky at Longest Wavelength

**October/November 2018**

Conveners:

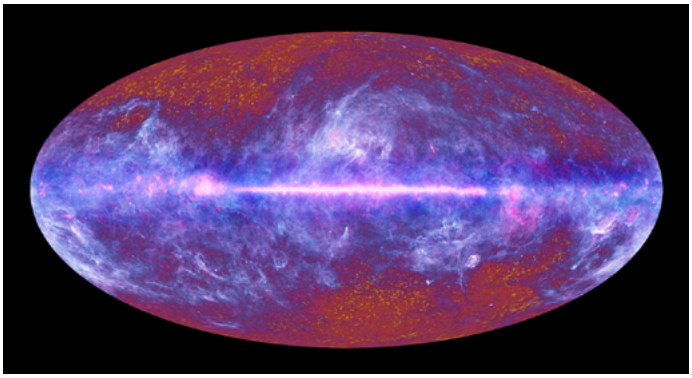
- Xuelei Chen, National Astronomical Observatory of China, Beijing, China
- Ji Wu, National Space Science Center, CAS, Beijing, China
- Jack O. Burns, Colorado University, USA
- Joe Silk, University of Oxford, UK & Institut d'Astrophysique de Paris, FR & Johns Hopkins University, USA
- Leon Koopmans, Kapteyn Astronomical Institute, University of Groningen, NL
- Hanna Rothkaehl, Space Research Center of Polish Academy of Science, PL
- Maurizio Falanga, ISSI-BJ, China

Over the last century, astronomical observation has expanded from the optical to radio, infrared, ultraviolet, X-ray and gamma-ray, as well as cosmic ray, neutrino, and gravitational wave. These new observational windows brought many unexpected discoveries, which greatly changed our view of the Universe, and gave deep insight on the fundamental laws of Nature. However, at the longest wavelength of the electromagnetic spectrum, our view is still incomplete, as the observation at frequencies below 30 MHz is strongly hampered by the ionosphere and man-made radio frequency interferences, and even at 100 MHz the observations are still affected significantly. The low frequency radio observation may provide a unique probe for the dark age after the Big Bang, and the cosmic dawn when the first stars, galaxies and black holes formed, as well as shedding light on many astrophysical problems, from the active Sun and planets, through exoplanents, interstellar medium and galactic structure, to radio galaxies, quasars, clusters and intergalactic medium, and may even reveal previously unknown objects or phenomenon.

The Chinese Academy of Sciences (CAS) in collaboration with domestic and international partners, is preparing to carry out a few pilot experiments during the Chang'e-4 (CE-4) lunar mission to be launched this year (2018), and is carrying out intensive studies for a possible future lunar orbit array mission. The lunar orbit array is made up of satellites flying in linear formation on the same orbit, which make both interferometric and single unit observations of the sky on the part of orbit where the Earth is shielded from the view by the Moon.

The first goal of the Forum is to review our current understanding on the various science subjects, which may be related to the low frequency radio window, previous and ongoing observations and progress, and the key science problems to be solved.

The second goal of the Forum is to review the concepts and technologies related of space-based low frequency radio observation and data processing, with a special focus on a possible mission for the lunar orbit.



*This image of the microwave sky was synthesized using data spanning the range of light frequencies detected by Planck. These low frequencies, which cannot be seen with the human eye, cover the range of 30 to 857 gigahertz. Image credit: ESA, HFI & LFI consortia (2010)*

## Next Scientific Program of SCOSTEP

**November 14-16, 2018**

SCOSTEP

Scientific Committee on Solar-Terrestrial Physics

The objective of the ISSI Fora is to bring community leaders together to define the next scientific program of SCOSTEP for the period 2019-2024. SCOSTEP is tasked by the International Council for Science (ICSU) with running long-term scientific programs in solar terrestrial physics (STP). SCOSTEP has formed a committee for the next scientific program (NSP) and the committee has been gathering input from the community.

During the Fora, the committee will meet with experts from the community in discussing the current inputs and develop a document that identifies the projects that can be carried out over a period of 4-5 years with participation from the widest possible cross section of the STP community.

The projects need to be international and interdisciplinary in nature addressing the objectives of a plurality of the constituent organizations (COSPAR, IAGA/IUGG, IAMAS, IAU, IUPAP, SCAR, URSI, and WDS). The Fora will also identify the modus operandi for the projects including metrics for the progress and means for disseminating results.

These Fora will be modelled after the previous ISSI Forum held in 2012 in Bern, which defined the highly successful Variability of the Sun and Its Terrestrial Impact (VarSITI) program. To minimize the cost and enhancing the input from the community, it has been decided that there will be two Fora, one in Beijing (ISSI-BJ) and the other in Bern (ISSI). The rationale for the ISSI-BJ Forum is to get the input from the large STP communities in China and other Asian countries. Experts from these countries may not be able travel the long distance to Bern for a three-day meeting.

The proposed dates are November 14-16, 2018 (Beijing) and February 25-27, 2019 (Bern). The Bern Forum in 2019 will represent the culmination of the NSP committee activities and draft the final report for NSP to be submitted to the SCOSTEP Bureau for further action.

# FORTHCOMING WORKSHOPS

## Tropical and Sub-Tropical Cyclones from Space

**May 2018**

Conveners:

- Lennart Bengtsson (University of Reading, UK/Max Plank Institute of Meteorology)
- Wu Ji (National Space Science Center, CAS, Beijing, China)
- Xiaolong Dong (National Space Science Center, CAS & ISSI-BJ, Beijing, China)
- Mark Bourassa (Center for Ocean-Atmospheric Prediction Studies, Florida State University)
- Hui Yu (Shanghai Typhoon Institute, CMA, Shanghai, China)
- Anny Cazenave (ISSI, Bern, Switzerland)

Tropical cyclones and extreme convective weather events have significant impacts on lives, properties and global and regional hydrological and energy cycles. Satellite observations can provide atmospheric and surface information over ocean and land, which is important for the forecast and nowcast for these meteorological processes.

The goal of this workshop is to review the achievement, development and perspective of satellite observations for tropical cyclones and extreme convective weather events. The workshop will also discuss the gaps between the current observation capabilities and the requirements from assimilation, forecast and assessment of the impacts, which would contribute to the formulation of future development of both the satellite observations and research on the tropical cyclones and extreme convective weather events.

*Hurricane Isabel (2003) as seen from orbit during Expedition 7 of the International Space Station. Credit: ISS*

# FORTHCOMING SUMMER SCHOOL

## The 2nd APSCO & ISSI-BJ Space Science School with EISCAT on "Study Space Weather Effects From the Sun to the Ground"

**October 10-19, 2018**


This is the second joint space science school organized between the Asia-Pacific Space Cooperation Organization (APSCO) and the International Space Science Institute in Beijing (ISSI-BJ). The 2018 school is also co-organized with the EISCAT Scientific Association (EISCAT). It is intended to promote a biennial School on space sciences for Master's and Ph.D. students, as well as post-doctoral and early career scientists or engineers.

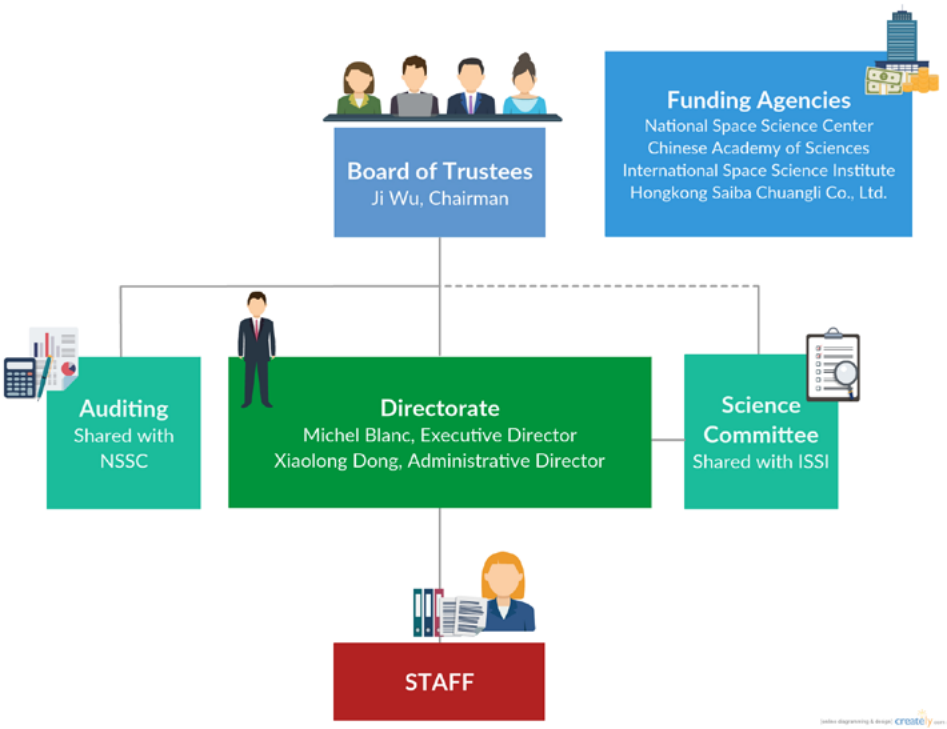
This school will provide the participants with the in-depth knowledge of the science of Space Weather, observational methods and its relevance to applications from the Sun to the ground. While there are many different ground-based measurements of space weather and its effects, in this school we will focus on the use of incoherent scatter radars as operated by EISCAT. The school will build links between participants, and between teachers and participants in order to facilitate future collaboration in Space Weather.

The School will teach the students to work on observational Space Weather space and ground data, theory and modelling. Ionosphere / Incoherent Scatter Radars group will be organized on the model of an EISCAT school to give an introduction to and a practice of the ground-based facilities (principally the incoherent scatter radar systems) to observe and study space-weather effects. It will also introduce the International Meridian Circle Project (IMCP), to which several APSCO member states participate, and the different generic categories of instruments used to monitor space weather from the ground. The School will also facilitate and initiate different discussions in an international and multi-disciplinary way; it will encourage creativity and provide the contacts for the participants to develop a professional network. International collaboration will also be an important theme at the school.

The School is open to 60 selected science and engineering participants. The participants are requested in the registration form, to select the working group they wish to join.

The registration form and more information available on the School's official website: http://www.apsco.int/2nd_space_science_school

# ISSI-BJ'S ORGANIZATIONAL STRUCTURE




## Board of Trustees

The Board of Trustees supervises the work accomplished at the Institute, exerts financial control and appoints the Directors. It consists of representatives of the Founder and of the funding agencies. The Board of Trustees is presided over by Ji Wu.

## Directorate

The Directorate is in charge of the scientific, operational and administrative management of the Institute. It interacts with the Funding Agencies, the Board of Trustees and the Science Committee.

The Directorate consists of Executive Director (Michel Blanc) and Administrative Director (Xiaolong Dong).

## Science Committee

The Science Committee is shared with ISSI and is made up of internationally known scientists active in the field covered by ISSI-BJ and ISSI.

Chaired by Mioara Mandea, the Science Committee advises and supports the Directorate in the establishment of the scientific agenda providing a proper equilibrium among the activities and reviews and grades the International Team proposals in response to the annual call.

Science Committee members serve a three year term with a possible extension of one year.

# BOARD OF TRUSTEES & ISSI-BJ STAFF

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- **Chair**: WU Ji, Director-General, NSSC, CAS, China
- Michel Blanc, Executive Director, ISSI-BJ, Chin
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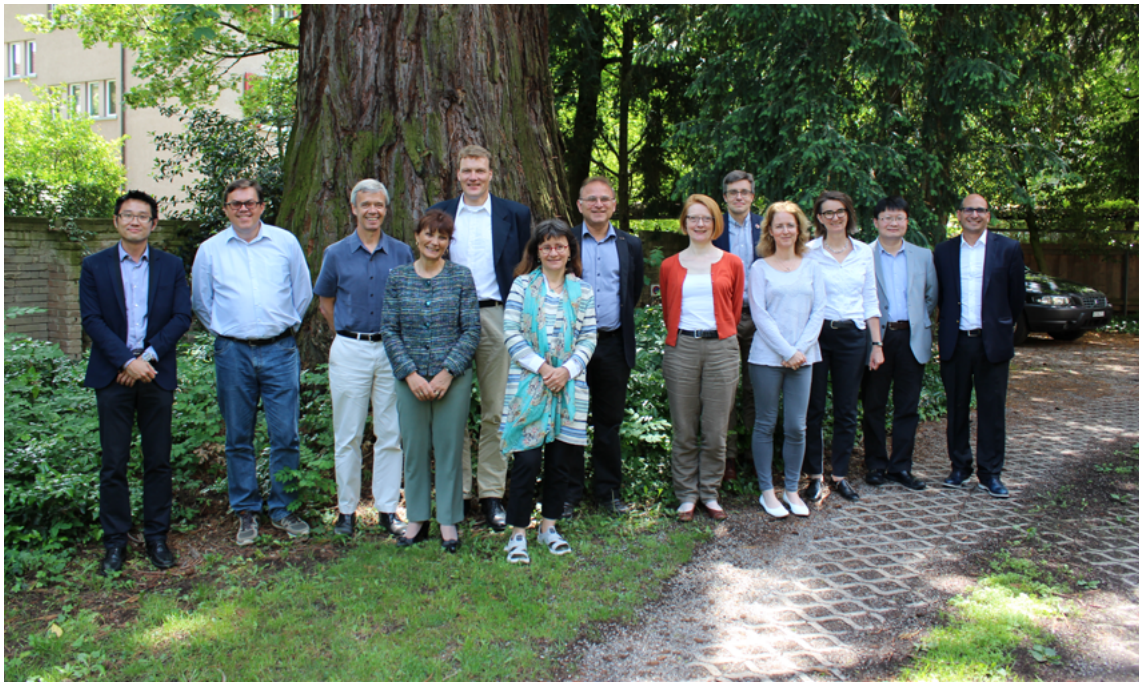
# SCIENCE COMMITTEE



## Members of the Science Committee:

**Chair:** Mioara Mandea, CNES, Paris, France

- Daniel Baker, University of Colorado, USA
- Corinne Charbonnel, Department of Astronomy, University of Geneva, Switzerland
- Xiaolong Dong, International Space Science Institute Beijing, Beijing, China (ex officio)
- Lyndsay Fletcher, University of Glasgow, Scotland
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- Sami Solanki, MPI for Solar System Research, Göttingen, Germany
- Christophe Sotin, NASA Jet Propulsion Laboratory (JPL/Caltech), Pasadena, USA
- Frances Westall, CNRS Orleans Campus, Orleans, France

# FINANCIAL OVERVIEW

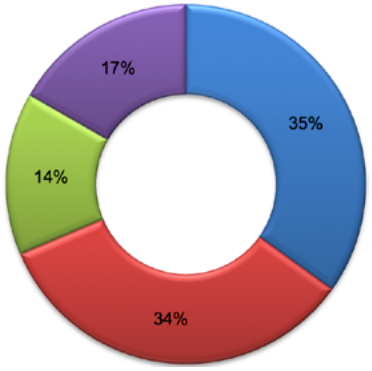
In the 2017 fiscal year, from January 1 to December 31 of 2017, ISSI-BJ was operated with the total revenue of 2,400,065.06 RMB, and the total expenses were 2,358,003.06 RMB. The surplus is 42,062 RMB, which will be transferred to the 2018 budget, and used for the cross-year activities.

The funding revenues include: direct financial support of 350,000.00 RMB from the Bureau of International Cooperation of Chinese Academy of Sciences (CAS) as international organization project for ISSI-BJ operation and activities, and 488,000.00 RMB as project funding supporting the executive director as CAS PIFI professor; project support of 809,099.08 RMB from the Bureau of Major Research and Development Programs of CAS for activities; 401533.14 RMB transferred from 2017 budget for the relocation and decoration of ISSI-BJ premises; and the direct support of 351,432.84 RMB from the National Space Science Center (NSSC) of CAS for expenses on premises, facilities, half salary of one staff member, and the international travel costs of the administrative director for the ISSI/ISSI-BJ activities. The NSSC in-kind support, including the use of the premises, visa and finance management, IT support and support for the administrative director, is not included in the statistics.

The expenses include: expenses on the scientific activities including 1 forum, and 8 team meetings; the salary of the executive director and 2 staff; domestic and international traveling expenses of the executive director and staff; and other daily operating and maintaining expenses. The expenses of the premises use and administrative expenses, and salary of the administrative director, which are in-kind support from NSSC, are not included.

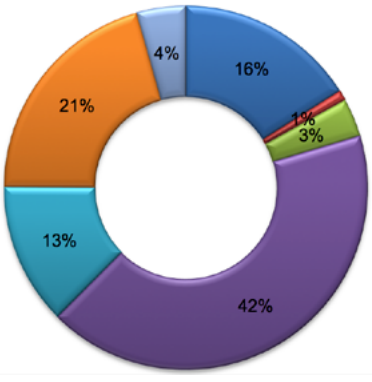
**Total Revenues in RMB for 2017 Fiscal Year (1 January, 2017 – 31 December, 2017)**

| Funding Sources | Amount | |
|---|---|---|
| Bureau of International Cooperation, CAS | 838,000.00 | Project for ED and operating |
| Bureau of Major R & D Projects, CAS | 809,099.08 | Strategic priority program on space science for ISSI-BJ activities |
| NSSC Direct Support | 351,432.84 | 1/2 staff's half salary, premises and other direct supporting |
| Budget transferred from 2016 | 401,533.14 | Budget arranged for ISSI-BJ office relocating and decoration |
| **Total:** | **2,400,065.06** | |




**Operating Expenses in RMB for 2017 Fiscal Year (1 January, 2017 – 31 December, 2017)**

| Expenses | Amount | |
|---|---|---|
| Scientific Activities | 378,553.92 | 1 forum and 8 team meetings |
| Local Transportation | 21,415.00 | |
| Design, Publications, Printing, Post, Telecommunication | 80,276.73 | Telecommunication, Taikong magzine, Internet, etc |
| Salary | 992,991.12 | Executive Director & 2 staff |
| Travelling | 297,274.74 | International and domestic |
| Premises | 484,425.74 | Daily maintenance, telephone, relocation, etc, |
| Other Reception Expenses | 103,065.81 | BoT & annual dinner, SC meeting, outreach expenses, etc |
| **Total** | **2,358,003.06** | |



# FACILITIES

ISSI-BJ office is located in the Building A at the Zhongguancun campus of the National Space Science Center, Chinese Academy of Sciences (NSSC, CAS).

The new 205 m2 ISSI-BJ facilities include one small meeting room (suitable for up to 12 participants) with a coffee break area, as well as a library with all ISSI-BJ and ISSI publications, and one big meeting room (suitable for up to 36 participants).

The three attached office rooms, equipped with laptops, fast internet connection, printer and paper shredder, offer space for the ISSI-BJ staff members, as well as for the visiting scientists.

*ISSI-BJ main office space with a small meeting room and office rooms attached*

*Big meeting room (Saturn Hall)*

*Coffee break area*

*Small library*

Furthermore, ISSI-BJ shares its conference facilities with the National Space Science Center of the Chinese Academy of Sciences. The facilities are composed of six seminar rooms (20-30 participants each), two lecture halls (up to 100 participants each) and one multimedia conference hall (30 participants).

All rooms are equipped with overhead projectors for large screen presentations and high speed wireless network connection.

# INTERNATIONAL SPACE SCIENCE INSTITUTE IN BERN

## About ISSI

The International Space Science Institute (ISSI) was created by Space Pioneer Professor Johannes Geiss in 1995. Since then, the institute offers scientists from all around the world a forum to work together.

On average, ISSI is now hosting around 950 scientists per year in its activities, in the framework of International Teams, Workshops, Working Groups, or Forums. ISSI is using all these tools to address, in a strict scientific framework, controversial issues and to promote a science program related directly to the most pressing issues raised by space and Earth science missions.

## International Teams

In total 66 Team meetings took place in 2017. On average the teams publish over 200 peer-reviewed papers per year.

Thirty-one new International Teams – approved in 2017 by the Science Committee – started their projects in the twenty-third ISSI business year (July 2017 to June 2018).

## Workshops

In the reported period ISSI organized two Workshops with the following topics:

- Space-Based Measurements of Forest Properties for Carbon Cycle Research (6-9 November 2017)
- Clusters of Galaxies: Physics and Cosmology (20-24 November 2017)

All Workshops activities lead to a topical collection in Spaces Science Reviews or an issue in Surveys in Geophysics and are reprinted as a volume in the Space Science Series of ISSI (SSSI) published by Springer.

## Working Groups

Four Working Groups worked on their projects and two of them met directly at ISSI in 2017: "Designing a Low-Inclined Nanosatellite Mission to Improve the Science Return of the ESA Swarm Constellation" led by G. Hulot (10-13 April 2017) and "Virtual Sea Ice Mission" led by S. Mecklenburg and M. Drusch (22-23 May 2017). Every Working Group work leads to a Scientific Report Volume (SR).

## Forum

A Forum on "Small Satellites for Space Science (4S)" took place (23-24 May 2017). An international study team of scientist and engineering leaders under the auspices of COSPAR is embarking on a 2-year activity to develop an international scientific roadmap on Small Satellites for Space Science (4S), focusing particularly on CubeSats and CubeSat-technology enabled small satellites. CubeSats are small satellites built in increments of 10 cm cubes (1 cube is called 1U or "unit" two 10 cm cubes together are known as 2U, and so on). A second follow-up Forum is planned to take place in 2018

## Publications

Three Space Sciences Series of ISSI books, that resulted from the correspondent ISSI Workshops, were published in the course of 2017:

Volume 58: "Integrative Study of the Mean Sea Level and its Components" edited by A. Cazenave, N. Champollion, F. Paul, J. Benveniste, ISBN 978-3-319-56490-6, reprinted from Surveys in Geophys-

ics, Volume 38, Issue 1, 2017.

Volume 59: "Dust Devils" edited by D. Reiss, R. Lorenz, M. Balme, L. Neakrase, A.P. Rossi, A. Spiga, J. Zarnecki, ISBN 978-94-024-1133-1, reprinted from Space Science Reviews, Volume 203, 1-4, 2016.

Volume 60: "Earth's Magnetic Field: Understanding Geomagnetic Sources from the Earth's Interior and its Environment" edited by C. Stolle, N. Olsen, A.D. Richmond, H. Opgenoorth, ISBN 978-94-024-1224-6, reprinted from Space Science Reviews, Volume 206, 1-4, 2017.

Furthermore, two Scientific Reports appeared in 2017:

Volume 14: "Inventing a Space Mission - The Story of the Herschel Space Observatory" by V. Minier, R.M. Bonnet, V. Bontems, T. de Graauw, M. Griffin, F. Helmich, G. Pilbratt, S. Volonte, Results of an ISSI Working Group.

Volume 16: "Air Pollution in Eastern Asia: An Integrated Perspective" edited by I. Bouarar, X. Wang, G.P. Brasseur, Results of an ISSI Team.

The Working Group "Carbon cycle Data Assimilation" led by M. Scholze and M. Heimann published all their results in an interactive open-access journal of the European Geosciences Union: https://www.atmos-chem-phys.net/special_issue11_192.html.

## Operation

Three statutory bodies interact regularly in matters of strategy, operation, finance or public relations: the Board of Trustees, the ISSI Directorate and the Science Committee. The latter gives also scientific advice to ISSI-BJ. Rafael Rodrigo is ISSI's Executive Director. Together with the other directors Rudolf von Steiger, Anny Cazenave and Joachim Wambsganss, the directorate is in charge of the scientific, operational and administrative management of the institute. The complete ISSI staff (scientists and administration) counts 16 members.

The European Space Agency (ESA), the Swiss Confederation, the Swiss Academy of Sciences (SCNAT) provide the financial resources for ISSI's operation. The University of Bern contributes through a grant to a Director and in-kind facilities. The Space Research Institute (IKI, Moscow, Russia) and the Institute of Space and Astronautical Science (Japan Aerospace Exploration Agency, JAXA, Japan) are supporting ISSI with an annual financial contribution.

The complete information about the Institute, its present and near term program and its publications can be found on the web page www.issi-bern.ch.


*ISSI Scientific Reports on "Inventing a Space Mission".*

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