INTERNATIONAL
SPACE
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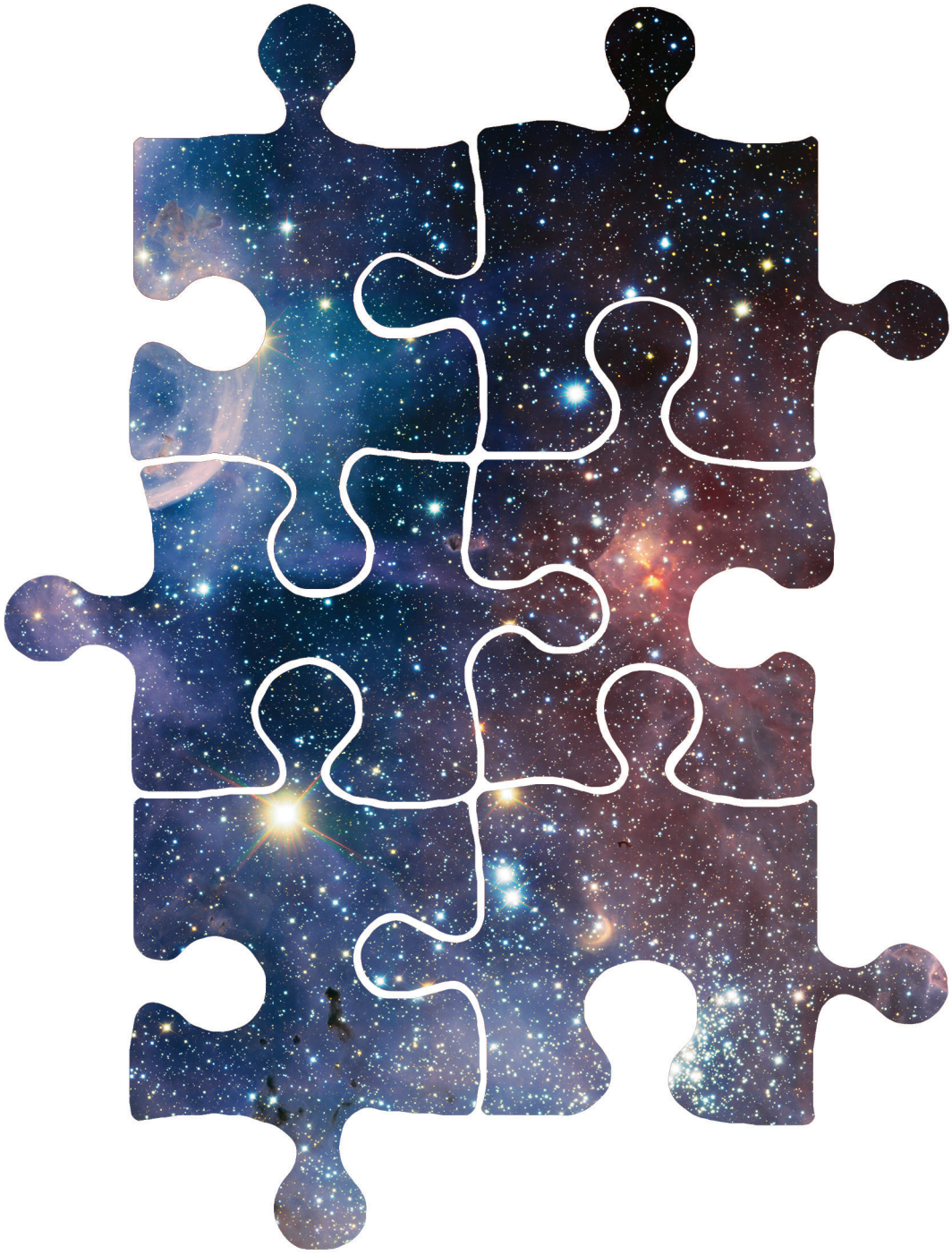
INSTITUTE



2017
2018

Annual Report

Imprint

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Cover Page

The puzzle is composed of the following picture:
Image of Carina Nebula, a region of massive star formation in the southern skies, was taken in infrared light using the HAWK-I camera on ESO's Very Large Telescope. Many previously hidden features, scattered across a spectacular celestial landscape of gas, dust and young stars, have emerged. (Image Credit: ESO/ T. Preibisch)

Table of Contents

The International Space Science Institute (ISSI) is an Institute of Advanced Studies where scientists from all over the world meet in a multi- and interdisciplinary setting to reach out for new scientific horizons. The main function is to contribute to the achievement of a deeper understanding of the results from different space missions, ground based observations and laboratory experiments, and adding value to those results through multidisciplinary research. The program of ISSI covers a widespread spectrum of disciplines from the physics of the solar system and planetary sciences to astrophysics and cosmology, and from Earth sciences to astrobiology.

From the Chairman of the Board of Trustees

During this 23rd business year of our International Space Science Institute (ISSI), from July 1, 2017 to June 30, 2018, we have again witnessed an outstanding amount of scientific activities and a world-wide visibility through a record number of International Teams, Workshops, Working Groups, Forums, and individual Visiting Scientists. This is, for a large part, the direct result of the constant dedication and efficiency of its directorate and staff. They are a small group of individuals working pleasantly as a united team.

During the same period, two major events took place, related both to the ISSI directorate.

First, on October 1, 2017, Joachim Wambsganss took up his duties as new ISSI Director for Astrophysics and Cosmology, the consequence of a unanimous decision taken by the Board of Trustees (BoT) during its June 15, 2017 meeting.

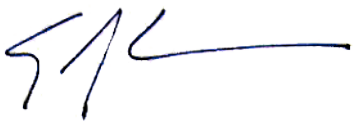
Joachim Wambsganss is full professor at the Department of Physics and Astronomy of the Heidelberg University and Director of its Zentrum für Astronomie, with outstanding scientific, administrative, and public-outreach skills. His wide research interests range from the search for extrasolar planets with the technique of gravitational microlensing, through the study of quasars to the investigation of the dark matter distribution in galaxy clusters via the analysis of giant gravitational arcs.

We warmly welcome Joachim Wambsganss and look forward to collaborating with him for the benefit of astrophysics and cosmology at ISSI.

Second, on June 23, 2018, Rafael Rodrigo wrote me a letter, announcing his resignation, with immediate effect, from his position as ISSI Executive Director, a position he occupied since February 1, 2013. This obvious loss for ISSI comes from the fact that Rafael Rodrigo has been offered a very high position in the new Spanish government where he is now Secretario General de Coordinación de Política Científica, Ministerio de Ciencia, Innovación y Universidades. This represents for him a rare opportunity to influence, at the highest level of education and research, the scientific policy of his country. We wish him every success in his new responsibilities and are very much grateful for the five and a half fruitful years he spent in Bern as ISSI Executive Director. The ISSI staff and everybody related to ISSI will miss him.

The BoT immediately initiated a search process in order to find Rafael Rodrigo's successor. In the mean time, we are very grateful to Rudolf von Steiger, who has accepted to be Executive Director ad interim.

All ISSI main actors, namely, its directorate and its staff, are congratulated and thanked for their excellent work. We are also grateful to all members of the Science Committee and of the BoT for their continuous dedication. ISSI is very appreciative to all its funding agencies, national and international. The constant aim of all of us remains to enlarge the number and the quality of ISSI scientific activities by further increasing the number of its funding agencies and their financial support.



Georges Meylan
Chairman of the ISSI Board of Trustees
Ecole Polytechnique Fédérale de Lausanne (EPFL)
Lausanne, July 2018

The twenty-third year of ISSI started out in the usual manner, but ended with an unexpected and unforeseeable event.

Thanks to the continued support from our principal funding agencies, ESA (both the Directorate of Science and the Directorate of Earth Observation) and the Swiss Confederation, supplemented by important contributions from the Swiss Academy of Sciences (SCNAT), from the European Commission's H2020 program, and from JAXA/ISAS, ISSI could again host nearly one thousand scientists. Together with the SCNAT, which since 2017 supports ISSI as the Swiss National Science Foundation had done since 1997, ISSI organized a special event on NASA and Swiss Space Science. Thomas Zurbuchen, many times visitor at ISSI and Associated Administrator for the Science Mission Directorate of NASA since October 2016, addressed some one hundred Swiss space professionals from all disciplines in his unmistakable and enthusiastic manner.

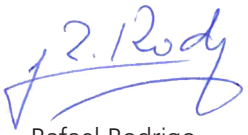
During the twenty-third year, there were six Workshops held, one of which in collaboration with EuroPlanet, the MiARD projects of H2020, and with the European Science Foundation ESF; in addition, there were two Working Group meetings, one Forum meeting, and 65 International Team meetings, all described in more detail in the subsequent pages. Together they brought 964 visitors to ISSI, 44.8% of which were coming for the first time. The publication record has grown by five volumes in the Space Sciences Series of ISSI and one in the ISSI Report Series. The impact factor of Space Science Reviews (from which the SSSI volumes are reprinted) has increased from 7.5 to 9.3, placing the journal in sixth rank of more than 60 astronomy journals evaluated by Thomson Reuter's Web of Science.

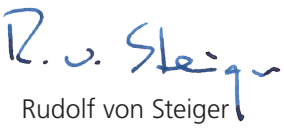
The ISSI Science Committee met for its two regular meetings, reviewing and discussing all future activities. In the Fall 2017 meeting, five Workshops were recommended for implementation in 2018/2019 and several more for updated information to be reconsidered at a future meeting. In the Spring meeting, the Committee primarily reviewed 90 Team proposals and recommended 33 for implementation, four of which are joint with ISSI-Beijing.

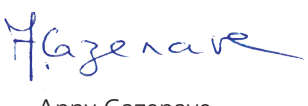
Two members of the ISSI staff could celebrate a work anniversary in the past year: Editorial Assistant Andrea Fischer has been working at ISSI for the past ten years, and Computer and System Administrator Saliba F. Saliba has completed even fifteen years of service. We thank them and all staff members for their continued service; it is a real privilege for ISSI to have such a dedicated workforce. On the other hand, Frederic Effenberger, who had joined ISSI as a postdoc in May 2017, received an offer for a tenure-track position in Potsdam, which he of course could not decline so he left ISSI after only eight months. We thank Frederic for his short but valuable stay at ISSI and we are happy that he will return as a Team leader and a Workshop convenor in the near future. A post doc position was announced in an open call immediately, and in a competition of 43 applicants, four of whom shortlisted, the position was awarded to Julia Venturini from the University of Zurich to work on astrophysics in general and on planet formation in particular, starting in September 2018.

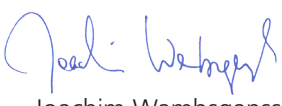
Finally, in June 2018, one of us (RR) was called to the Ministry of Science, Innovation and Universities of Spain after a change of Government, as the Chairman of the BoT mentions in his address. The leaving Executive Director R. Rodrigo stated: *"This was due to very special and recent circumstances in Spain with the establishment of the new Ministry. The Spanish Minister offered me to work at the new Ministry playing a major role as General Secretary of Coordination of the Science Policy, and, after a deep meditation, I accepted this new challenge and responsibility. I would like to add that it has been a real honor for me to work for ISSI since February 2013. Since the very beginning, I felt at ISSI as at home and it was extremely heartwarming to work with all my friends and colleagues at ISSI. ISSI is indeed a unique institution and this is mainly due to the very high efficiency, professionalism, enthusiasm and commitment of its staff. ISSI staff makes it possible to work in a friendly and very positive atmosphere, and I am deeply in debt to all ISSI friends."*

The ISSI Board of Trustees has taken immediate action to fill this important position with the shortest possible delay.

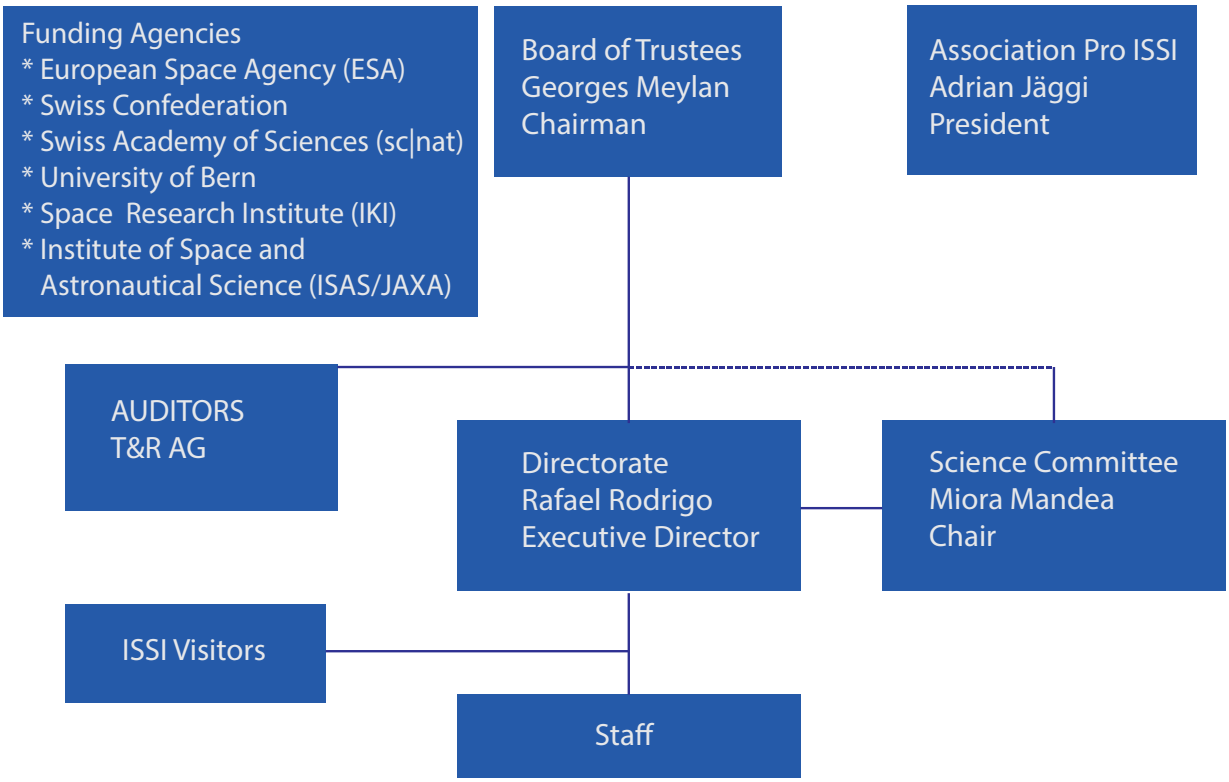

Rafael Rodrigo


Rudolf von Steiger


Anny Cazenave


Joachim Wambsganss

About the International Space Science Institute



The International Space Science Institute (ISSI) is a nonprofit organization set up in Bern in 1995 as a foundation under Swiss law with an endowment by Contraves Space AG, later renamed Oerlikon Space AG and now part of RUAG. Three statutory bodies govern ISSI: the Board of Trustees, the Directorate, and the Science Committee. A fourth important body, the Association Pro ISSI, promotes the idea of ISSI, especially within Switzerland.

The European Space Agency (ESA), the Swiss Confederation, and the Swiss Academy of Sciences (sc|nat) 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) and the Institute of Space and Astronautical Science (ISAS/JAXA) are supporting ISSI with an annual financial contribution. ISSI received tax-exempt status from the Canton of Bern in May 1995.

ISSI's **Board of Trustees** oversees the work accomplished at the Institute, exerts financial control, and appoints the Directors and members of the Science Committee. It consists of representatives of the Founder, and of the funding Institutions. Furthermore the Board of Trustees may nominate up to five personalities representing the national and international science community, space industry and space politics for terms of three years. The Board of Trustees is presided over by Georges Meylan.

The **Science Committee**, chaired by Miora Mandea, is made up of internationally known scientists active in the fields covered by ISSI. 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 Team proposals in response to the annual call. Science Committee members serve a three year term (with a possible extension of one year).

The **Directorate** is in charge of the scientific, operational, and administrative management of the Institute. It interacts with the Funding Agencies, the Swiss authorities, the Board of Trustees, the Science Committee and the Association Pro ISSI. The Directorate consists of Rafael Rodrigo (Executive Director until June 2018), Rudolf von Steiger (University of Bern), Anny Cazenave (CNES, Toulouse, France) and Joachim Wambsganss (Heidelberg University, Germany).

The **Association Pro ISSI** promotes the idea of ISSI by organizing public lectures, where internationally known scientists introduce their results. Summaries of these talks are published in the journal SPATIUM. Member benefits include invitations to lectures and a free subscription to SPATIUM. The Board of the Association Pro ISSI is presided over by Adrian Jäggi.

The 23rd financial year of ISSI resulted in a deficit of nearly 61 kCHF as opposed to a budgeted deficit of 227 kCHF. This much better result is almost entirely due to the increased exchange rate of the Euro to the Swiss Franc. The deficit is still fully covered by positive results from previous years, specifically from an unexpected payment from the Swiss Confederation for helping to compensate the declining exchange rate of the Euro.

On the revenue side the contributions from ESA (Directorates of Science and of Earth Observation) and from the Swiss Confederation were received as budgeted and are gratefully acknowledged, as is the contribution from our Japanese partner, JAXA/ISAS. Contributions from the EU H2020 projects, EuroPlanet and MiARD, are also acknowledged. These programs are now in full operation, but will come to an end in the course of the next business year. Finally, the contribution from the Swiss Academy of Sciences no longer requires a separate audit and therefore has been consolidated with the other ISSI accounts since January 1st, 2018. The accounts were audited by the company T+R AG in Gümligen.

In addition to the direct contributions listed here it is important to note that ISSI also receives indirect contributions that do not appear in the table below: One of the directors is employed directly by the University of Bern, and ISSI also benefits from the University through in-kind contributions such as Internet connectivity etc.

Rudolf von Steiger

Statement of Operations (in CHF) for the 23rd Financial Year (1.7.2017-30.6.2018)

	Expenses	Revenues
ESA Science Directorate		1'397'748.65
ESA Earth Observation Programme		351'166.50
Swiss Confederation		960'000.00
Swiss Academy of Sciences (SCNAT) [1]		121'015.70
EC H2020 Projects: EuroPlanet, MiARD Projects		167'927.80
ISSI Partners: ISAS/JAXA		29'045.00
Other income or cost [2]		76'910.42
Salaries and related costs [3]	1'372'354.10	
Fixed costs	281'366.35	
Operating costs [4]	214'719.08	
Investment (depreciated)	18'739.48	
Workshops, Working Groups, Teams, Visitors [5]	1'277'602.48	
Result of the Year		60'967.42
Total	**3'164'781.49**	**3'164'781.49**

Remarks:

[1] **SCNAT:** The grant from the Swiss Academy of Sciences has been consolidated with the other ISSI accounts since January 1st, 2018.

[2] **Other income** includes extraordinary income, interest income, and exchange gain or loss.

[3] **Salaries:** It should be noted that the majority of the ISSI staff members (including directors) are scientists actively conducting research as well as taking care of organizational, editorial, and administrative tasks.

[4] **Operating costs** include repair and maintenance, insurance, supplies, administration, and public relations.

[5] **Workshops, etc.** also include the balance from income and expenses of guest apartments.

The Board of Trustees

from left to the right:
Rudolf von Steiger, International Space Science Institute, Bern, Switzerland, *Secretary of the Board*
Lennard A. Fisk, University of Michigan, Ann Arbor, USA
Johan A.M. Bleeker, SRON, Utrecht, The Netherlands
Daniel Fürst, RUAG, Zurich, Switzerland
Ji Wu, National Space Science Center (CAS) and International Space Science Institute Beijing, China
André Maeder, Observatoire de Genève Sauverny, Switzerland
Rosine Lallement, Observatoire de Paris-Meudon, France, *Vice Chair*
Georges Meylan, Ecole Polytechnique Fédérale de Lausanne, Switzerland, *Chair*
Renato Krpoun, Swiss Space Office, Bern, Switzerland
Willy Benz, University of Bern, Switzerland
Adrian Jäggi, President of the Pro ISSI Association, Bern, Switzerland

missing from the picture:
Günther Hasinger, ESA, Paris, France
Jean-Pierre Swings, Université de Liège, Belgium
Sergio Volonté, Science and Robotic Exploration Directorate, ESA, Paris, France - retired
Lev M. Zelenyi, Space Research Institute (IKI), Russian Academy of Sciences, Moscow, Russia

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from left to the right:
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Vladislav Izmodenov, IKI, Russian Academy of Sciences, Moscow, Russia (ex officio RAS)
Christophe Sotin, NASA Jet Propulsion Laboratory (JPL/Caltech), Pasadena, USA
Miora Mandea, CNES, Paris, France, *Chair*
Stein Haaland, University of Bergen, Norway
Corinne Charbonnel, Department of Astronomy, University of Geneva, Switzerland
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Louise Harra, University College of London, UK
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Xiaolong Dong, International Space Science Institute Beijing, Beijing, China (ex officio)
Maurizio Falanga, International Space Science Institute, Bern, Switzerland, *Secretary of the Science Committee*

missing from the picture:
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Masaki Fujimoto, Japan Aerospace Exploration Agency, Sagamihara, Japan*
Arvind Parmar, ESTEC ESA, Noordwijk, The Netherlands (ex officio ESA)
Francesca Primas, ESO, Munich, Germany
Michael Rast, ESA ESRIN, Frascati, Italy (ex officio ESA)
Nathan Schwadron, University of New Hampshire, Durham, USA
Frances Westall, CNRS Orleans Campus, Orleans, France

*Membership ended on 30 June 2018

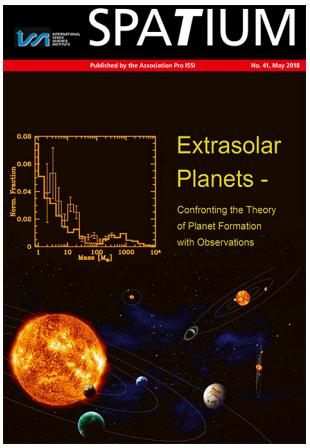
ISSI Staff

from left to the right:
Maurizio Falanga, Science Program Manager
Anny Cazenave, Director
Raphael Marschall, Post Doctoral Scientist
Teodolina Lopez, Post Doctoral Scientist
Rudolf von Steiger, Director
Rafael Rodrigo, Executive Director
Silvia Wenger, Assistant to the Executive Director
Joachim Wambsganss, Director
Saliba F. Saliba, Computer Engineer and System Administrator
Alexandra Lehmann, Secretary
Andrea Fischer, Editorial Assistant

missing from the picture:
Roger-Maurice Bonnet, Senior Discipline Scientist
Andrei Bykov, Discipline Scientist
Johannes Geiss, Honorary Director
Jennifer Fankhauser, Part-Time Secretary
Irmela Schweizer, Librarian

All lists show the status at the end of the 23rd business year on 30 June 2018.

The Pro ISSI Association was founded in 1994 under Swiss law with the goals to create a Space Science Institute in Switzerland, and to communicate the fascinating results of space sciences to the Swiss public. With the creation of the Foundation International Space Science Institute (ISSI) in 1995 the first objective had been reached. Pro ISSI focuses now on providing a bridge between leading space scientists and its members, representing universities, industry, politics and public administration. The Association offers public lectures on new insights in space science, and publishes 2-3 SPATIUM issues per year. The Pro ISSI Association, which counts presently 125 members, meets once per year for its general assembly. The Board of Pro ISSI consists of Adrian Jäggi (President), Hansjörg Schlaepfer (Editor Spatium), Frank Rutschmann (Treasurer) and Silvia Wenger (Secretary).



Covers of the SPATIUM No. 40 and 41 published in the 23rd ISSI Business Year.

Public Lectures

Pro ISSI organized three public lectures in the period of this report:

The General Assembly was held on 1st November 2017 followed by a lecture given by the Director of the International Space Science Institute in Beijing (ISSI-BJ), Michel Blanc. He spoke about "Next Stop Jupiter! Giant Planets Exploration and the Cassini Legacy". Just two months after the end of the NASA-ESA Cassini-Huygens mission to the Saturn System, the presentation elaborated on the unique scientific understanding this outstanding mission has enabled so far and about the expected perspectives from the current Juno mission orbiting Jupiter.

On 4th April 2018, Gary Zank from the University of Alabama at Huntsville (USA), and third Johannes Geiss Fellow, spoke about "Faltering Steps into the Galaxy". The presentation described the very first in situ observations of the interstellar medium made by Voyager 1, as well as some of the puzzles that are emerging from these observations, after the probe has entered the interstellar medium.

On 23rd May 2018, Niels Olsen from the Technical University of Denmark was scheduled to speak about "Exploring Earth's Magnetic Field using the Swarm Satellite Constellation Trio". Unfortunately, the presentation had to be canceled due to health issues of Niels Olsen. The presentation is planned to be rescheduled in 2019.

SPATIUM

The Association's magazine SPATIUM elaborates on selected lectures offered by Pro ISSI. It appears two to three times per year. During the reporting period, issue no. 40 was published in November 2017, reporting on CaSSIS, the Swiss Camera on board of the Trace Gas Orbiter of "ESA's ExoMars programme". Nicolas Thomas from the University of Bern, Switzerland, did not only explain in detail the technical aspects of the CaSSIS instrument but also shared some of the most fascinating first pictures that CaSSIS made from Mars. In contrast, issue no. 41, published in May 2018, reports on extra-solar planets. The author, Christoph Mordasini from the University of Bern, Switzerland, portrayed the now more than 3000 extra-solar planets as ideal testbed to confront the theory of planet formation against and increasingly large set of observations.

These publications together with all previous issues of SPATIUM can be found on Pro ISSI's homepage www.issibern.ch/publications/spatium.html.

Adrian Jäggi

Scientific Activities: The 23rd Year

The Program and the Tools

ISSI's mode of operation is generally fivefold: multi- and interdisciplinary Workshops, Working Groups, International Teams, Forum, and Visiting Scientists. In the 23rd business year a total of 964 international scientists participated in the scientific activities of ISSI.

Workshops consist of up to 50 invited scientists exchanging their views on a scientific theme, typically during a week's duration. Workshops always lead to a volume of the Space Science Series of ISSI and in parallel as issues of Space Science Reviews or Surveys in Geophysics. In the 23rd year, six Workshops were organized, summaries of which can be found on the following pages.

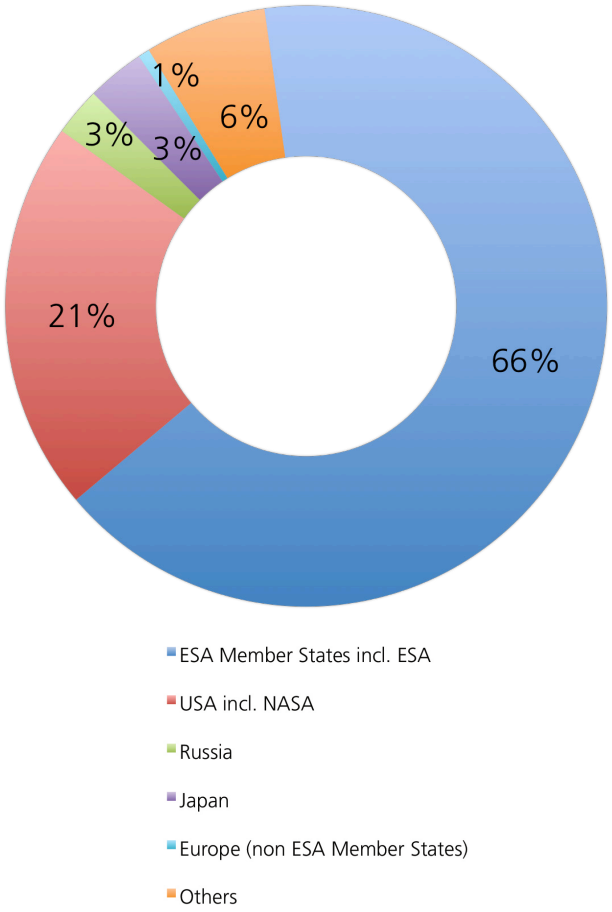
Working Groups have a smaller number of members and meet repeatedly as necessary to achieve the assigned objective. The results of the Working Groups activities are in general published as titles of ISSI Scientific Report Series. In the course of the reported period, two Working Groups met at ISSI. Their objectives can be found in the previous Annual Reports.

International Teams consist of about 15 external scientists, addressing a specific scientific topic in a self-organized fashion. The results of these activities are customarily reported in scientific journals. In total 65 Team meetings took place in the 23rd business year. Details can be found from page 19 on forward.

A Forum is an informal and free-ranging debate consisting of some 25 high-level participants on open questions of a scientific nature or on science policy matters for about two days. A Forum does not necessarily lead to formal recommendations or decisions. In the reported business year, one Forum was held.

Visiting Scientists spend variable periods of scientific activity at ISSI. 18 individual visitors used the ISSI facilities during the year.

The Young Scientists Program is designed to bring PhD students and young post-docs in contact with the community at work. These young scientists are invited by ISSI to complement the membership of Workshops, Working Groups, International Teams and Forums. 99 young scientists participated in the ISSI activities in the course of the year.



Pie chart showing the ISSI visitors countries of origin. A total of 964 scientists worked at ISSI during the 23rd business year, 432 of them were here for the first time.

How to use ISSI tools

As a general rule, participation in ISSI's activities is by invitation only. The financial support for invited scientists covers the local accommodation expenses and a per diem while in Bern.

International Teams: A call for proposals is released every year in January. These proposals are evaluated by the ISSI Science Committee and approved by the Directorate.

Workshops, Working Groups, and Forums: There is no annual call. The scientific community may suggest at any time Workshops, Working Groups, and Forums by submitting an idea on a maximum of one page. The ISSI Science Committee will evaluate these suggestions and the ISSI Directorate will take a final decision.

Forums are informal and free-ranging debates among some twenty-five high-level participants on open questions of a scientific nature or on science policy matters. Forums do not necessarily lead to formal recommendations or decisions.

Small Satellites for Space Science (4S)

10–11 April 2018 Second Forum

In 2016 COSPAR tasked Thomas Zurbuchen and Rudolf von Steiger as co-chairs to assemble an international group of space scientists and engineers and develop a Roadmap document on the use and potential of small satellites for space science. In August, they drafted a document with Terms of Reference and a list of names for the group, which were both approved by COSPAR. When Zurbuchen was appointed Associate Administrator of NASA shortly afterwards his role of co-chair was transferred to Robyn Millan from Dartmouth College, NH.

In the Fall of 2016 the group members were formally appointed by COSPAR and a first in-person meeting was set up to get started. The meeting was held at (and sponsored by) ISSI on May 23–24, 2017, and attended by some 15 of the 21 group members, with two more attending remotely. The meeting was structured along the six themes listed in the annual report last year. During the meeting and when writing up the notes afterwards it became apparent that a truly visionary component was missing. It was thus decided to add to the Roadmap a section with four "Visions for the Future" on a time scale of several decades from now, in addition to the six sections from the themes listed in the ToR.

After the first in-person meeting the group continued to hold regular meetings by video conference on intervals of 2-3 weeks. Thereby, the structure of the Roadmap document was defined and responsibilities were assigned for each section. Gradually the intended content of each section was described in more detail with a list of keywords. It was at this level of detail when the document and the work of the 4S group were presented at the 3rd COSPAR Symposium in Jeju in September 2017. In a subsequent discussion session, the community had the opportunity to comment on and add further points to the Roadmap document.

A second in-person meeting was held on April 10–11, 2018, again sponsored by ISSI. The meeting concentrated on assembling the drafts of all sections into a coherent document and came up with a well-reasoned set of findings and recommendations. Subsequently the document was edited into final form and supplemented with an introduction and an epilogue. It was then officially presented to COSPAR at its 42nd Assembly in Pasadena on July 18, 2018, in a session that was very well attended. After the Assembly it was formally submitted for publication in Advances in Space Research, where it should appear after having been reviewed, hopefully before the end of the year. After publication the Roadmap Committee will continue to advertise and publicize the document. Its main purpose is to encourage the space science community to leverage developments in the small satellite industry in order to increase flight rates, and change the way small science satellites are built and managed. Five recommendations are made; one each to the science community, to space industry, to space agencies, to policy makers, and finally, to COSPAR.

A trio of CubeSats from Spain, Greece and Israel as seen from the ISS. (Image Credit: NASA)

Rudolf von Steiger

Workshops

Space-Based Measurement of Forest Properties for Carbon Cycle Research

6–9 November 2017

Forests are crucial elements of the Earth system and one of Earth's most precious resources. Forests sustain a myriad of ecosystems that provide habitats for many flora and fauna, yielding rich resources for human development and providing an important sink in the global carbon cycle. In response to the need to monitor these ecosystems, ESA, NASA and DLR are developing the BIOMASS, GEDI, NISAR and Tandem-L missions. These missions will use innovative SAR and Lidar technologies to measure forest structure parameters (such as forest height and forest biomass) and their change with time on a global scale with much more precision than possible today. They are expected to be launched between 2018 and 2022, providing a unique and powerful combination of techniques to monitor Earth's forests.

These missions will meet a pressing need for information in the forests globally. Analysis of the global carbon cycle shows that the annual emissions of carbon from fossil fuels and land-use change are larger than the annual accumulations of carbon in the atmosphere and oceans. This suggests a largely unknown terrestrial sink for carbon, which has never been measured. Measurements of the BIOMASS, GEDI, NISAR and Tandem-L missions offer a unique opportunity to reduce the uncertainties in both the global net emissions of carbon from forest cover change and global changes in aboveground forest biomass. This will significantly improve our understanding of the global carbon cycle, which will be of essential value for climate modeling and policy adaptation actions.

The Workshop was organized along the implications of these future missions. The topics covered during this event provided an overview of the related science questions, community needs and Earth observation technologies and capabilities to address these questions and needs. A specific emphasize had been put on the synergies and complementaries between the different observation types and on the potential benefits of a joint exploitation of these data.

Nearly 50 scientists attended this Workshop and agreed on a book outline summarizing all the Workshop results & recommendations planned to be published in autumn 2019. The Workshop was convened by K. Scipal (ESA ESTEC), R. Dubayah (University of Maryland), T. Le Toan (Centre d'Etudes Spatiales de la Biosphère), S. Quegan (University of Sheffield), A. Cazenave and T. Lopez (both ISSI).

Klaus Scipal and Teodolina Lopez

Clusters of Galaxies: Physics and Cosmology

20–24 November 2017

The International Space Science Institute hosted a series of three Workshops on physics of astrophysical objects with extreme energy release ranged from black holes of stellar mass to clusters of galaxies. The first Workshop "Jets and Winds in Pulsar Wind Nebulae, Gamma-Ray Bursts and Blazars" (2014) and the second "Supernovae" (2015) were very successful and resulted in published Space Science Reviews topical collections and books. The third Workshop was devoted to an in-depth examination of clusters of galaxies which are the largest gravitationally bound structures in the Universe. Galaxy clusters are one of the most important cosmological probes to test the cosmological models. Constrains on the Dark Energy equation of state from the cluster number density measurements, deviations from the Gaussian perturbation models, Sunyaev-Zeldovich effect, the dark matter profiles and the cluster outskirts were among the issues discussed at the Workshop. Clusters of galaxies are not isolated entities in the Universe: they are connected through a filamentary cosmic web. ESA's Planck instrument found an extended bridge of hot gas connecting two clusters of galaxies Abell 399 and Abell 401, shedding light on the 'missing baryons' in the cluster vicinity. Multiwavelength views of cluster of galaxies from the radio observations by VLA, GMRT and LOFAR, X-ray satellites XMM-Newton, Chandra, Suzaku and Hitomi and gamma-ray observatory Fermi were reviewed and linked together. The observations and physics of clusters of galaxies were lively discussed at the Workshop "Clusters of Galaxies: Physics and Cosmology", which gathered together more than 40 active researchers over the world, including 6 early career researchers. The Workshop conveners were A.M. Bykov (Ioffe Institute and ISSI), M. Brüggen (Hamburger Sternwarte), J.S. Kaastra (SRON), M. Markevitch (NASA GSFC), M. Falanga (ISSI), F. Paerels (Columbia University), and R. von Steiger (ISSI).

Andrei Bykov

Comets: Post 67P Perspectives (in Collaboration with MiARD)

15–19 January 2018

The Workshop was in collaboration with a Horizon 2020 project of the European Commission called MiARD (Multi-Instrument Analysis of Rosetta Data) and included invitees from both the MiARD project itself and the wider community. Special emphasis was placed on giving younger scientists a visible role in the Workshop.
MiARD was intended to link the results of several instruments by analysis of data using unified self-consistent models. The Workshop focused on several aspects. Specifically
To review the progress made on multi-instrument data analysis. This included
a. Current status of the development of an integrated 3D shape model
b. Current status of the mapping of properties/ measurements to surface facets of the 3D model
c. Current status and results from gas dynamics modeling including activity distributions
d. Current status of dust emission and brightness modeling
e. Current status of analysis of surface physical structure and thermal balance
f. Current understanding of the coma and surface chemical composition

1. To assess and possibly revise current models of nucleus activity (including potential evidence for different mechanisms) and evolution
2. To assess our current understanding of risk from comets (through perturbation of nuclei by non-gravitational forces and particle impact on interplanetary spacecraft).
3. To re-assess the (extensive) study work performed on possible comet nucleus sample return studies and provide guidelines as to how this work should be updated in the light of Rosetta's results.

The Workshop provided a forum for a broad multi-disciplinary discussion of the Rosetta data set but also integrated our knowledge from previous fly-bys, ground-based observation, and laboratory measurements. Controversial topics (including the dust to ice ratio of the nucleus itself) were discussed. A set of review papers are expected to be submitted shortly. The Workshop was convened by N. Thomas (University of Bern), B. Davidsson (Jet Propulsion Laboratory), L. Jorda (Laboratoire d'Astrophysique de Marseille), E. Kuehrt (DLR), C. Snodgrass (The Open University), R. Marschall (ISSI), and R. Rodrigo (ISSI).

Nicolas Thomas

Workshops are selected by the Directorate in consultation with the Science Committee. Proposals or suggestions for Workshops may originate from the external community. The program and speakers are defined by a group of experts serving as conveners. The Workshops can be attended by up to 50 invited scientists. Workshops always lead to a volume of the Space Sciences Series of ISSI (SSSI) published by Springer and in parallel as issues of Space Science Reviews or Surveys in Geophysics.

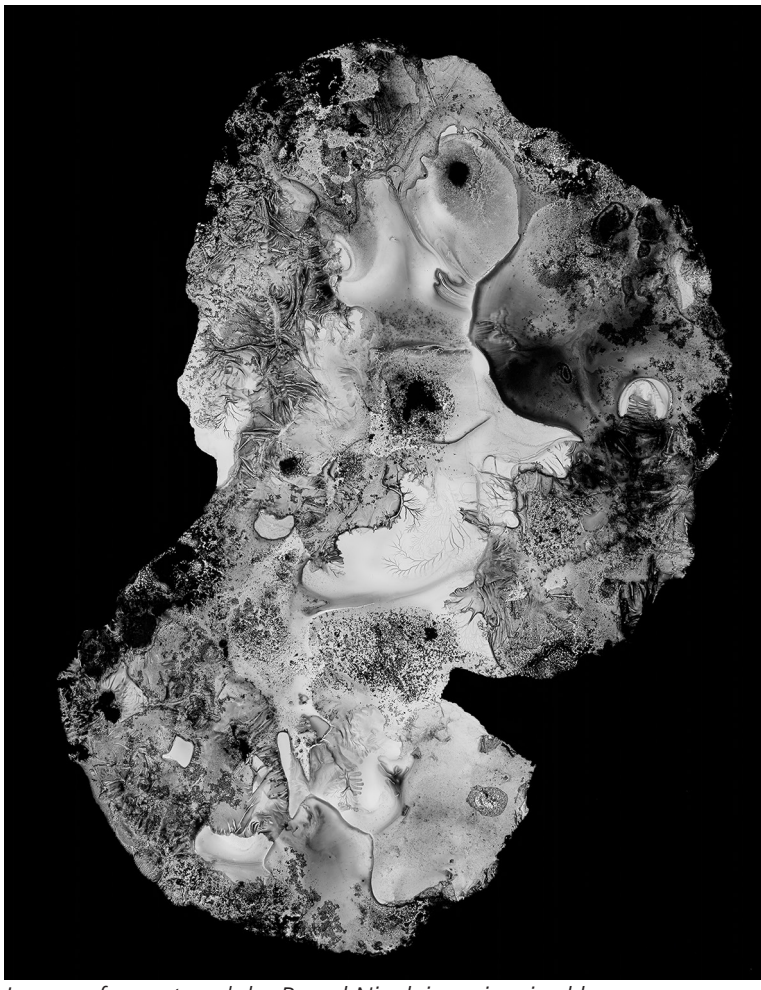


Image of an artwork by Bernd Nicolaisen, inspired by an image of "Chury", taken by the OSIRIS camera. (Copyright: Bernd Nicolaisen based on the Rosetta, OSIRIS cameras, © ESA, Rosetta, MPS for OSIRIS Team MPS, UPD, LAM, IAA, SSO, INTA, UPM, DASP, IDA)

Workshops

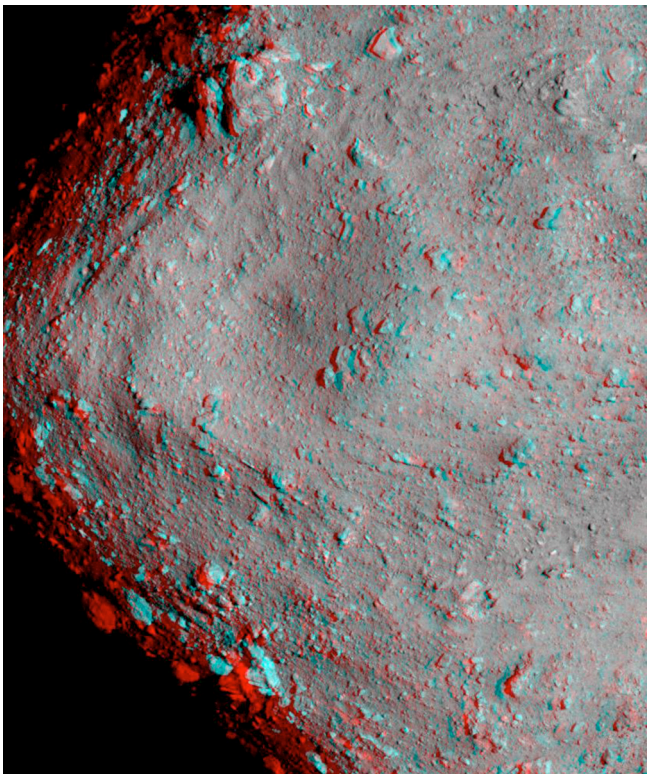
Role of Sample Return in Addressing Major Outstanding Questions in Planetary Sciences (in Collaboration with Europlanet)

5–9 February 2018

Major advances in our understanding of the origin and evolution of the inner Solar System have been made through analyses of returned samples from the Moon by Apollo and Luna missions in 1960s and 1970s. More recently, the Stardust and Genesis missions sampled cometary grains and solar wind particles, respectively, revealing their elemental and isotopic compositions. Similarly, sample return by the Hayabusa-1 mission from asteroid Itokawa revealed greater insights into the makeup and properties influencing the regolith evolution on minor bodies in the Solar System as well the first direct link between meteorites and asteroids. As we write this report, two further asteroidal sample return missions (Hayabusa-2 and OSIRIS-REX) are approaching their targets and a mission in preparation to return new lunar samples to Earth in 2019. The next decade may also witness the first Mars Sample Return (MSR) mission.

Although lacking a parent body context, meteorites research has been invaluable in addressing a number of scientific topics related to the Solar System formation and evolution through studies of pre-solar grains to the fluid-rock interactions on parent bodies during the 4.5 Ga geological history of the Solar System. In addition, there now exist global remote sensing dataset for various planetary bodies that weren't available previously, and these already have and will continue to play a vital role in the selection of targets for sample return missions. As a result, we now have a wealth of remote sensing and cosmochemical data on a number of Solar System objects (e.g., Moon, Mars, asteroids, meteorites) but significant gaps exist for other bodies such as Venus and Mercury.

One of the main aims of this Workshop was to review our current knowledge and understanding of the Solar System formation and evolution and identify major outstanding science questions that remain to be answered through future sample return missions. This joint ISSI-Europlanet Workshop was convened by Mahesh Anand (Open University, UK), Yangting Lin (IGG CAS, China), Kuljeet Marhas (PRL, India), Sara Russell (NHM, UK) Shogo Tachibana (Hokkaido Univ., Japan), Meenakshii Wadhwa (ASU, USA) and Michel Blanc (ISSI, Switzerland) and was attended by 39 invited participants, representing a broad cross section of the international planetary science community. The career stages of attendees ranged from senior researchers to mid-career researchers to early-stage researchers including PhD students.



A red and blue stereoscopic image of asteroid Ryugu, prepared from the images taken by the Optical Navigation Camera - Telescopic (ONC-T) on Hayabusa2 at an altitude of 6km. The images were taken on July 20, 2018. (Image Credit: JAXA, Univ. of Aizu, Univ. of Tokyo, Kochi Univ., Rikkyo Univ., Nagoya Univ., Chiba Inst. of Technology, Meiji Univ. and AIST)

The Workshop was structured around three main themes: (i) Initial conditions and workings of the Solar System (ii) Planetary habitats and (iii) Sample curation. The presentations and associated discussions in these themes were focused to: (1) review major outstanding science questions in Planetary Sciences that can only be answered via Sample Return missions. (2) identify specific target body(ies) for answering specific science question(s). (3) evaluation and considerations for sample curation facilities relevant for such sample return missions. We anticipate that the outputs from the Workshop will directly contribute towards planning of mission concepts for future sample return missions that are currently being developed by various space agencies.

Mahesh Anand

Understanding the Relationship between Coastal Sea Level and Large-Scale Ocean Circulation

5–9 March 2018

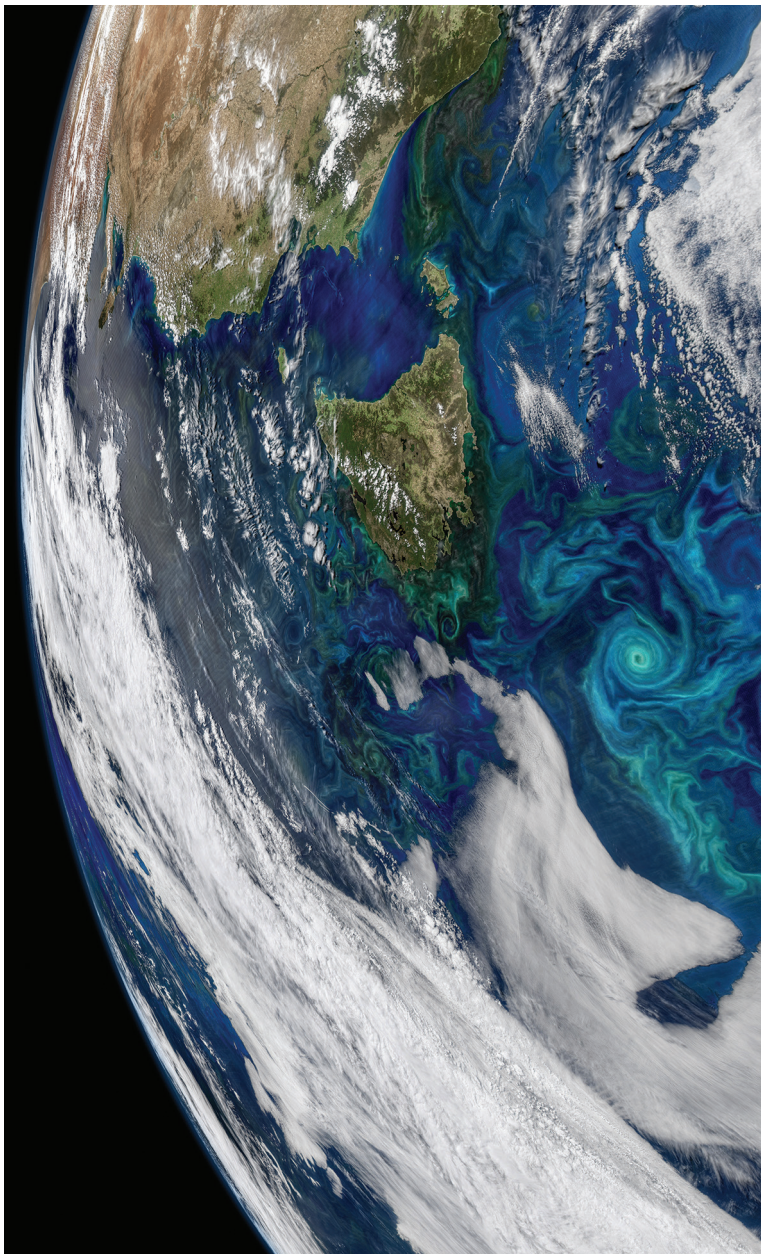
Many atmospheric and oceanographic factors associated with both large-scale and local variability can influence coastal sea level on time scales from hours to decades. Previous studies have pointed out differences between observed sea level behavior at the coast and over adjacent shallow and deep ocean regions. Short spatial structures can arise from coastally trapped waves and currents, localized tidal resonances, bathymetric controls, local atmospheric forcing and other factors, and all of these influences are a function of location and timescale. Identifying these various influences is essential for understanding, simulating, and predicting coastal sea level variability, which remains a key societal concern in the context of a changing climate.

This Workshop had several objectives: (1) review our current understanding of coastal sea level changes and variability, from seasonal to multi-decadal time scales, and characterize the impact of large-scale open ocean processes on coastal sea level; (2) review available observing systems informing on sea level in coastal areas and identify gaps and uncertainties; (3) assess the ability of ocean syntheses in estimating coastal sea level variations and of atmosphere-ocean global coupled models in projecting future changes.

The topics covered during this event will lead to a (1) better understanding of the forcing factors that affect coastal sea level, and of the role of large-scale climate signals, (2) identification of a set of priorities for the development of an optimal and integrated (satellite and ground-based) coastal observing system; and (3) development of strategies to increase model capabilities to forecast short-term processes and project longer-term coastal changes.

Nearly 40 scientists attended this Workshop and agreed on a book outline summarizing all the Workshop results and recommendations, planned for publication in summer/autumn 2019. The Workshop was convened by R. Ponte (Atmospheric and Environmental Research), B. Meyssignac (Laboratoire d'Etudes en Géophysique et Océanographie Spatiales), C. Domingues (University of Tasmania), A. Cazenave (ISSI), T. Lopez (ISSI) and D. Stammer (University of Hamburg).

Rui Ponte, Anny Cazenave and Teodolina Lopez



High pressure over the Tasman Sea in November 2017 clears the cloud cover and provides ample sunlight for the phytoplankton blooming there. The weather system coupled with a warming climate is also sending the region toward a record-setting heat wave. The surface waters in this region have warmed excessively before and are warming at nearly four times the global rate with serious impacts to local ecosystems. (Image Credit: NASA, Gene C. Feldman)

Workshops

ExoOceans: Space Exploration of the Outer Solar System Icy Moons Oceans (in Collaboration with the European Science Foundation ESF)

18–22 June 2018

Workshop Participants (picture taken by S.F. Saliba)

We are at the beginning of a new era in the exploration of the Outer Solar System. Spacecraft have visited each of the giant planets and made detailed observations of their major satellites. It is now well-recognized that several of the icy satellites have the potential to possess subsurface liquid water, are geologically active today and have in some cases organic materials present in considerable abundance, including large and complex molecules. This combination holds promising prospects for the astrobiology research field and further exploration of these objects are likely to provide relevant results to better understand the emergence of life and habitability in the solar system and beyond.

Understanding the astrobiological potential of the icy moons requires thorough investigation of the origin and evolution of these objects, the chemical processing that has occurred, and the potential habitability of their environments. In order to better understand these environments, it is important to bring forward and use our knowledge of the Earth's oceans. To progress investigations on these subjects, space agencies have inserted the possibility for future exoocean exploration in their agendas.

The astrobiological implications of exooceans are now clear and in view of current ESA and NASA future space missions, an interdisciplinary Workshop to address this topic was timely. This Workshop gathered 40 worldwide leading scientists from around 11 countries as well as ISSI and European Space Sciences Committee and European Marine Board staff. The scientists attending were from the planetary field, from the astrobiology domain and experts in terrestrial ocean investigations. Of the attendees, 4 were Young Scientists. The Workshop was structured around 8 themes, namely i) Origin of life ii) Icy moons with core-ocean connection iii) Comparative planetology iv) Habitability of early earth v) Earth analogs vi) Icy moons trapped between two ice layers vii) Experimental and simulation efforts viii) Relevant technologies. A total of nearly 45 presentations were made within this scheme including the ones from participating Young Scientists.

Because this Workshop was unique in bringing together experts from science communities dealing with both Earth and planetary, it is to be hoped that the Space Sciences Series of the ISSI book by Springer will be original and provide a coherent view of the astrobiological knowledge on the outer solar system paving the way for future astrobiological research and space missions. The Workshop was convened by (in alphabetical order) P. Cabezas (ESF, Strasbourg), A. Coustenis (Obs. de Paris-Meudon), J. de Leeuw (Utrecht Univ.), K. Hand (NASA JPL), A. Hayes (Cornell Univ.), K. Olsson-Francis (Open Univ.), F. Postberg (Univ. of Heidelberg), F. Raulins (LISA, Paris-Est Créteil Univ.), R. Rodrigo (ISSI), C. Sotin (NASA JPL), G. Tobie (Univ. de Nantes), and N. Walter (ESF, Strasbourg).

Athena Coustenis, Nicolas Walter and Patricia Cabezas

International Teams consist of about 4-15 external scientists, addressing a specific scientific topic in a self-organized fashion, under the responsibility of a leader in a series of two to three one week meetings over a period of 18 to 24 months. The results of these activities are customarily reported in scientific journals. The selection of International Teams results from an annual call issued in January and from the subsequent review and prioritization done by the Science Committee.

Listed are Teams that had a meeting at ISSI in the period of the 23rd business year. A rationale is given only for the selected teams in 2017; for the others see the previous Annual Reports.

Teams selected in 2015

EuroMoon: Lunar Surface Composition and Processes
Team leader: Manuel Grande, Aberystwyth University, United Kingdom
Sessions: 2–6 October 2017 and 13–15 June 2018

Structure and Dynamics of Jupiter's Magnetosphere and Boundary Regions
Team leaders: Caitriona Jackman, University of Southampton, United Kingdom, and Christopher Paranicas, The Johns Hopkins University, USA
Session: 18–22 September 2017

Polar Stratospheric Cloud initiative (PSCi) Workshops
Team leader: Michael Pitts, NASA Langley Research Center, Hampton, USA
Session: 27 November – 1 December 2017

Galactic Cosmic Ray Origin and Composition
Team leader: Nikos Prantzos, Institut d'Astrophysique de Paris, France
Session: 12–15 February 2018

Physical Properties of Cometary Nuclei Assessed from the Development of 67P CG's Activity
Team leader: Yuri Skorov, Technical University of Braunschweig, Germany
Session: 19–23 February 2018

New Diagnostics of Particle Acceleration in Solar Coronal Nanoflares from Chromospheric Observations and Modeling
Team leader: Paola Testa, Harvard-Smithsonian Center for Astrophysics, Cambridge, USA
Session: 13–15 February 2018

How Does the Solar Wind Influence the Giant Planet Magnetospheres?
Team leaders: Marissa Vogt, Boston University, USA, and Adam Masters, Imperial College London, United Kingdom
Session: 18–22 September 2017

Teams selected in 2016

From Qualitative to Quantitative: Exploring the Early Solar System by Connecting Comet Composition and Protoplanetary Disk Models
Team leader: Boncho Bonev, American University, Washington, USA
Session: 29 January – 2 February 2018

Quasi-periodic Pulsations in Stellar Flares: A Tool for Studying the Solar-Stellar Connection
Team leader: Anne-Marie Broomhall, University of Warwick, United Kingdom
Session: 26 February – 2 March 2018

Investigating the Magnetosphere through Magnetoseismology
Team leader: Peter Chi, UCLA/IGPP, Los Angeles, USA
Session: 14–18 May 2018

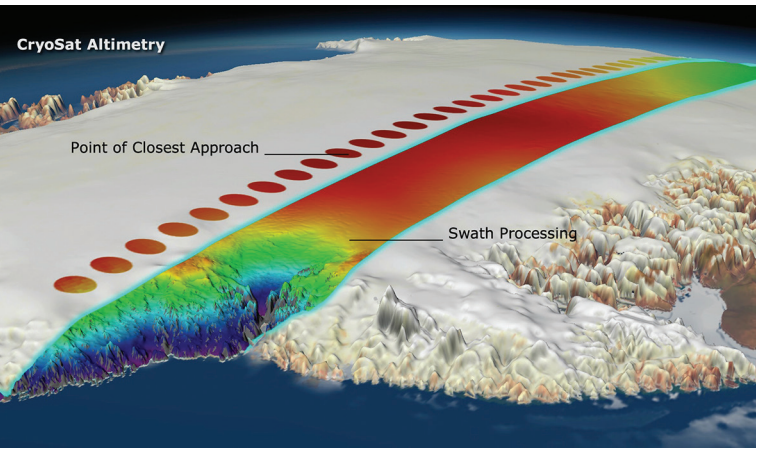
A Tropical Width Diagnostics Intercomparison Project
Team leader: Sean Davis, NOAA ESRL Chemical Science Division, Boulder, USA
Session: 19–22 June 2018

Observation-Driven Modeling of Solar Phenomena
Team leader: Klaus Galsgaard, University of Copenhagen, Denmark
Sessions: 5–8 September 2017 and 7–9 May 2018

MMS and Cluster Observations of Magnetic Reconnection
Team leader: Kyoung-Joo Hwang, NASA Goddard Space Flight Center, Greenbelt, USA
Session: 28 May – 1 June 2018

The Early Evolution of the Atmospheres of Earth, Venus, and Mars
Team leader: Colin Johnstone, University of Vienna, Austria
Session: 5–8 June 2018

International Teams



The technique of swath processing differs from conventional radar altimetry. Using CryoSat's novel interferometric mode, whole swaths, rather than single points, of elevations can be computed. This is yielding more detail that ever before on how glacial ice is changing. (Image Credit: ESA/Planetary Visions)

Strong Gravitational Lensing with Current and Future Space Observations
Team leader: Jean-Paul Kneib, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Session: 21–23 March 2018

Towards a Unified Solar Forcing Input to Climate Studies
Team leader: Natalie Krivova, Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany
Session: 3–6 October 2017

Solving the Prominence Paradox
Team leader: Nicolas Labrosse, University of Glasgow, United Kingdom
Session: 20–23 March 2018

Ionospheric Space Weather Studied by RO and Ground-based GPS TEC Observations
Team leader: Jann-Yenq Liu, National Central University, Taoyuan, Taiwan
Session: 3–6 April 2018

AsteroSTEP - Asteroseismology of STEllar Populations
Team leader: Andrea Miglio, University of Birmingham, United Kingdom
Sessions: 18–22 December 2017 and 4–8 June 2018

Studies of the Deep Solar Meridional Flow
Team leaders: Markus Roth, Kiepenheuer-Institut für Sonnenphysik, Freiburg, Germany and Junwei Zhao, Stanford University, USA
Session: 3–7 July 2017

Explosive Processes in the Magnetotail: Reconnection Onset and Associated Plasma Instabilities
Team leader: Mikhail Sitnov, Johns Hopkins University, Laurel, USA
Session: 23–27 October 2017

Main Belt Comets
Team leader: Colin Snodgrass, The Open University, Milton Keynes, United Kingdom
Session: 26 February – 2 March 2018

The Role of Shallow Circulations in Organizing Convection and Cloudiness in the Tropics
Team leader: Bjorn Stevens, Max Planck Institut für Meteorologie, Hamburg, Germany
Session: 27 November – 1 December 2017

Past, Present, and Future of Active Experiments in Space
Team leader: Anatoly Streltsov, Embry-Riddle Aeronautical University, Daytona Beach, USA
Sessions: 24–28 July 2017 and 12–16 March 2018

Stratospheric Sulfur and its Role in Climate (SSiRC)
Team leader: Larry W. Thomason, NASA Langley Research Center, Hampton, USA
Session: 14–18 May 2018

Exploring the Ultra-Low Surface Brightness Universe
Team leader: David Valls-Gabaud, Observatoire de Paris, France
Session: 13–17 November 2017

The Influence of Io on Jupiter's Magnetosphere
Team leader: Ichiro Yoshikawa, University of Tokyo, Japan
Session: 11–15 September 2017

Teams selected in 2017

SOFAR – Seismology of Fast Rotating Stars

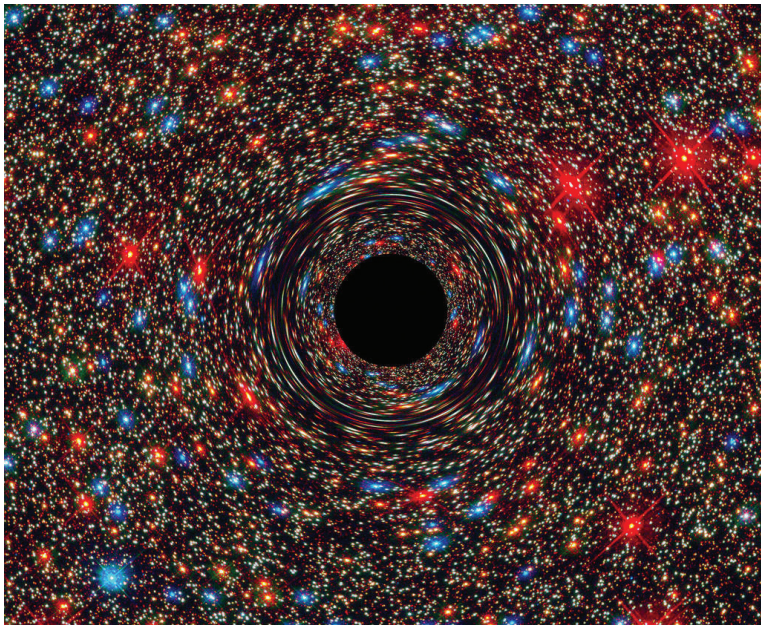
Team leader: Jérôme Ballot, Institut de Recherche en Astrophysique et Planétologie IRAP, Toulouse, France
Session: 29 January – 2 February 2018
Scientific Rationale: The Team gathers observers who have analyzed CoRoT and Kepler data of classical pulsators, and modelers who have developed new 2D codes and theoretical seismic tools. The Team involves up to 14 researchers, including Young Scientists, from Belgium, France, Hungary, and Spain. The scientists aim at providing new seismic diagnosis, especially for stellar rotation so as to obtain new interpretations of CoRoT and Kepler observations of δ Scuti stars, γ Doradus or SPB stars. This work will also help the seismic analyses of future space missions such as TESS and PLATO.

Electrostatic Manipulation of Nano-Scale Objects of Lunar Regolith

Team leader: Elena Besley, University of Nottingham, United Kingdom
Session: 29 January – 2 February 2018
Scientific Rationale: Dusty plasma, widely spread in cosmic space, has been under the spotlight of the space science community for the past few decades as it underpins a wide range of fundamental problems and causes some unresolved practical concerns. In the first lunar missions, it was found that dust from the Moon surface sticks readily to spacesuits and spacecraft surfaces due to electrostatic adhesion. Nano-metre size particles are typically very difficult to detect by standard methods of observation but one of the most relevant properties of lunar dust is its ability to acquire electric charge due to interaction with solar irradiation, solar wind, and earth magnetosphere. Charged micro- and nano-particles, along with the electron and ion environments, form a plasma dust system over the Moon surface. Physical processes, by which particles with a wide range of sizes and composition become electrically charged, have not been yet fully understood.

The Evolution of Rich Stellar Populations & Black Hole Binaries

Team leader: Christian Boily, University of Strasbourg, France
Session: 13–16 November 2017
Scientific Rationale: The evolution of stars is driven by both their internal chemical composition and total mass. A significant fraction of the stars are born in binary- or multiple systems and may evolve to become solar-mass binaries of black holes (BBH's) and other such compact remnants. The detection in late 2015 of gravitational waves (GW) from a coalescing stellar-mass BBH by the



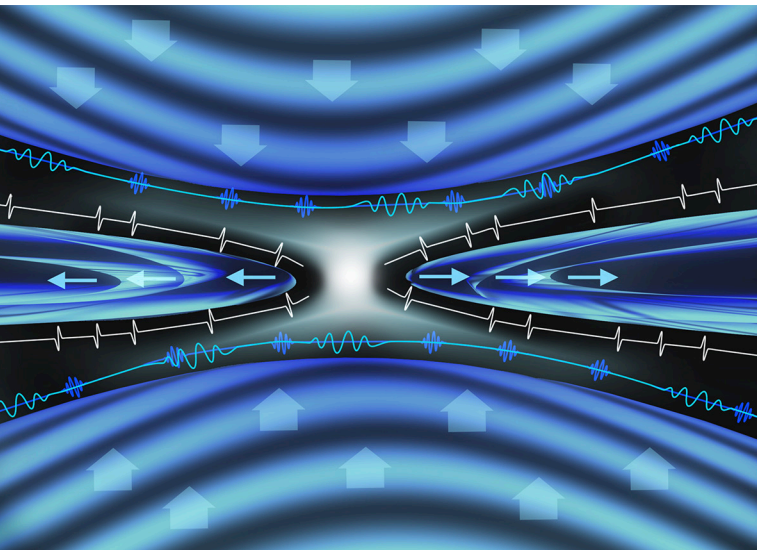
This computer-simulated image shows a supermassive black hole at the core of a galaxy. The black region in the center represents the black hole's event horizon, where no light can escape the massive object's gravitational grip. Light from background stars is stretched and smeared as the stars skim by the black hole. (Image Credit: NASA, ESA, D. Coe, J. Anderson, R. van der Marel (STScI))

LIGO interferometer has opened up a new window for astrophysical research with wide-ranging implications for our understanding of the universe. This collaborative research project focuses on exploring key questions related to the origin of binary stars and BBH's, with the goal to determine their links with high-energy flares and GW's. To that end the Team implements a two-part program. One key objective is to pin down the overall rates and mass distribution of BBHs, so as to put their origin in a clearer perspective with respect to observations.

The Solar and Stellar Wind Connection: Heating Processes and Angular Momentum Loss

Team leaders: Allan Sacha Brun, CEA Saclay, Gif-sur-Yvette, France and Sean Matt, University of Exeter, United Kingdom
Session: 28 May – 1 June 2018
Scientific Rationale: To tackle efficiently the challenging questions of solar and stellar wind heating and angular momentum loss, the "Solar and Stellar Wind Connection" Team gathers known world experts on the theoretical, numerical and observational aspects of dynamo, magnetic activity, wind dynamics, heating mechanism and rotational history of the Sun and solar-like stars in

International Teams



This illustration shows the configuration of a region, in the tail of Earth's magnetosphere, where magnetic reconnection is taking place. Two flows of plasma with anti-parallel magnetic fields are pushed together, flowing in from above and below, and create a thin current sheet. (Image Credit: ESA/ATG medialab)

a coherent group. The tasks of the Team are split into 4 focus groups that will tackle inter-related topics: The Dynamo and Magnetism; Solar and Stellar Winds; Heating Mechanisms; and Angular Momentum Evolution. These groups work to provide theoretical solutions, numerical models and recipes and observational constraints. The Team plans to develop a general understanding of solar/stellar winds, how they shape their surroundings, and impact stars and their magnetism.

Plasma Heating and Particle Acceleration by Collisionless Magnetic Reconnection

Team leaders: Jörg Büchner, Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany and Masahiro Hoshino, University of Tokyo, Japan
Sessions: 23–27 October 2017 and 30 April – 4 May 2018
Scientific Rationale: The goal of the Team is to make a step forward towards the solution of crucial open questions of the physics of magnetic reconnection: the quantification of the efficiency of energy conversion by reconnection in collisionless astrophysical and space plasmas, particle acceleration and plasma heating in dependence on the ambient macroscopic plasma and field configuration and parameters, in particular by processes at the electron scale as they became in situ accessible by MMS space observations. The method to achieve this goal is to use state-of-the-arts high-performance supercomputer numerical simulations in combination with space plasma observations comparing the results also with those of laboratory experiments.

Hydrogen Escape Across the Solar System and Beyond (ISSI – ISSI Beijing Team)

Team leader: Michael Chaffin, University of Colorado, Boulder, USA
Session: 22–25 May 2018
Scientific Rationale: Hydrogen escape has played a major role in sculpting the atmospheres of the terrestrial planets, with the most notable examples being the dessication of Venus and Mars. The Team brings experts together to study and combine experience to begin assembling a comprehensive framework for understanding H dynamics and escape across observed planets. In addition to observers, the Team invites modelers of H escape to understand how the observations in hand should be interpreted, as well as how they can be used to inform studies of early Solar System escape and escape from exoplanets. The result of the work will be a new understanding of hydrogen escape and atmospheric evolution in its cosmic context, at least one review article summarizing current knowledge of H escape, and greatly strengthened ties across disciplines and objects that will be essential to interpreting the planetary and exoplanetary data of tomorrow.

Comet 67P/Churyumov-Gerasimenko Surface Composition as a Playground for Radiative Transfer Modeling and Laboratory Measurements

Team leader: Mauro Ciarniello, INAF-Osservatorio Astronomico di Roma, Italy
Session: 19–23 February 2018
Scientific Rationale: The aim of the Team is twofold: 1. Investigation of 67P/Churyumov-Gerasimenko surface composition from the convergence of results from dedicated laboratory measurements of cometary analogues and radiative transfer models, applied to Rosetta spectrophotometric observations of the nucleus. 2. Test and improvement of widely used radiative transfer models needed for spectral inversion, by comparing their output with laboratory spectrophotometric measurements of materials with known compositions made available for 67P/Churyumov-Gerasimenko spectral unmixing. In this context, the main objectives of the study will concern the capability of the models to constrain composition (endmember abundances and mixing modalities) and physical properties (material grain size distribution and porosity).

Towards a Unified Sea Level Record: Assessing the Performance of Global Mean Sea Level Reconstructions from Satellite Altimetry, Tide Gauges, Paleo-Proxies and Geophysical Models

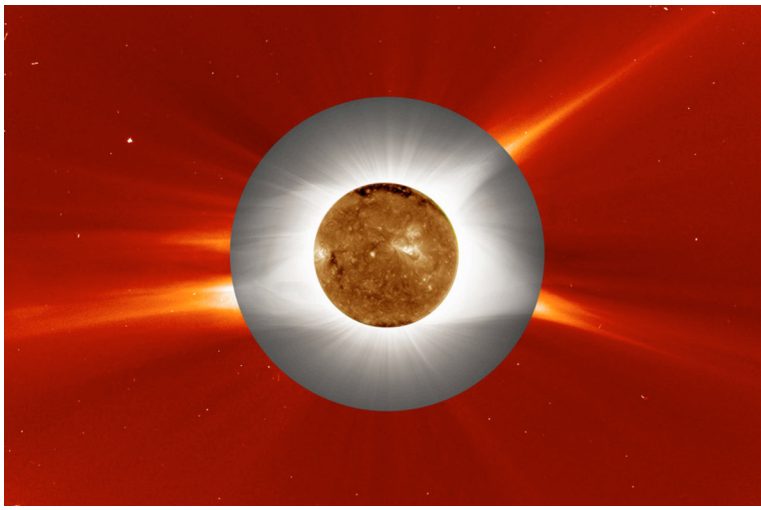
Team leaders: Sönke Dangendorf, Universität Siegen, Germany and Marta Marcos, University of the Balearic Islands, Esporles, Spain
Session: 4–7 December 2017
Scientific Rationale: Sea-level rise is one of the most certain and costly consequences of a warming world with potentially hazardous impacts on coastal infrastructure, property, and the livelihoods of coastal communities. The Team aims to (i) objectively assess the performance of pre-altimetric sea level reconstructions using a consistent and reproducible framework of common datasets, (ii) understand and reduce the wide range of past estimates, and (iii) put the high contemporary GMSL rates obtained from satellite altimeters (~3.4 mm/yr) into a better constrained historical context.

Studying Magnetic-Field-Regulated Heating in the Solar Chromosphere

Team leaders: Jaime De La Cruz Rodriguez and Jorrit Leenaarts, Stockholm University, Sweden
Session: 13–16 March 2018
Scientific Rationale: The Team aims to identify the processes that lead to chromospheric heating in magnetically active regions and flares using observations taken with the foremost space-borne (NASA's Interface Region Imaging Spectrograph, IRIS) and ground based (the Swedish 1-m Solar Telescope, SST and the Atacama Large Millimeter/submillimeter Array, ALMA) telescopes, as well as numerical simulations. To do so the Team members derive time-dependent 3D empirical models from the observations using advanced non-LTE inversion techniques. Then they analyze the spatio-temporal distribution of the physical parameters such as magnetic field, temperature and velocity. This allows the identification and characterization of the heating events. Furthermore, they compare then the signatures of these events with theoretical models and advanced radiative 3D MHD simulations, and so constrain the heating mechanisms that act in the chromosphere.

High-Energy Particles Sources and Powerful VHF Radiations in Electrically Active Atmosphere: Theoretical Models and Space Borne Instruments

Team leader: Maxim Dolgonosov, Russian Academy of Sciences, Moscow, Russia
Session: 29 January – 2 February 2018
Scientific Rationale: The aim of this Team is to advance the fundamental knowledge of the high energy process in the terrestrial atmosphere that are of key importance to the generation of the Terrestrial Gamma-ray Flashes (TGFs) and Compact Intracloud Discharges (CIDs). This will be achieved by the analysis of data collected by Chibis-M, TARANIS, ASIM, and ancillary ground based facilities. This unique set of measurements is required to have a chance to resolve the mystery of explosive processes in the terrestrial atmosphere.



An image of the total solar eclipse on Aug. 21, 2017 (gray, middle ring), is superimposed over an image of the Sun's atmosphere, called the corona (red, outermost ring), as seen by ESA and NASA's Solar and Heliospheric Observatory (SOHO), which watches the Sun from space. At center is an image of the sun's surface as seen by NASA's Solar Dynamics Observatory in extreme ultraviolet wavelengths of light. (Image Credits: ESA, NASA, SDO, SOHO, J. Pasachoff, R. Dantowitz, C. Lockwood, Williams College Eclipse Exp., NSF, National Geographic)

Observed Multi-Scale Variability of Coronal Loops as a Probe of Coronal Heating

Team leaders: Clara Froment, University of Oslo, Norway, and Patrick Antolin, University of St Andrews, United Kingdom
Session: 22–26 January 2018
Scientific Rationale: The Team aims at determining the observational characteristics of the evaporation and condensation cycles, and elucidate the link with the spatial and temporal properties of the heating. This Team consists of experts in the leading theories behind coronal heating and coronal rain, experts in numerical simulations and forward modeling, and experts in multi-wavelength observations and Fourier analysis. The results will help determine key observables needed to properly differentiate between coronal heating theories. Furthermore, impact in future instrument design for solar missions is expected, thanks to the strong involvement of the Team members in currently planned ESA and NASA solar missions.

International Teams

Marina Galand and her Team members working on "Plasma Environment of Comet 67P after Rosetta" at the November '17 meeting. (Image Credit: S.F. Saliba)

Plasma Environment of Comet 67P after Rosetta

Team leader: Marina Galand, Imperial College London, United Kingdom
Sessions: 27 November – 1 December 2017 and 11–15 June 2018
Scientific Rationale: The Team addresses open questions on the plasma environment of comet 67P raised by the Rosetta mission. The Team is composed of multi-disciplinary experts from 8 countries. It includes Rosetta instrument team members from the Rosetta Plasma Consortium (RPC), Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) and Alice (UV spectrometer), as well as modelers with expertise from MHD and multi-fluid, to hybrid and full kinetic approaches applied at different spatial scales around the comet, which would offer a complete self-consistent modeling approach. The Team also facilitates the interactions between observers and modelers, initiates interaction between plasma and UV observational Teams, and enhances the science return from the Rosetta mission.

An International Reference for Seismological Data Sets and Internal Structure Models of the Moon (ISSI – ISSI Beijing Team)

Team leaders: Raphael A. Garcia, CEA Saclay, Gif-sur-Yvette, France and Peimin Zhu, China University of Geosciences, Wuhan, China
Session: 23 – 27 October 2017
Scientific Rationale: The goal 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 clarify what we know and what we don't know of the internal structure of the Moon. In addition, the output of this study facilitates both the access to Moon seismological data sets and the interpretation of seismological Moon models by the international community. The Team conducts 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.

Soft Protons in the Magnetosphere focused by X-ray Telescopes

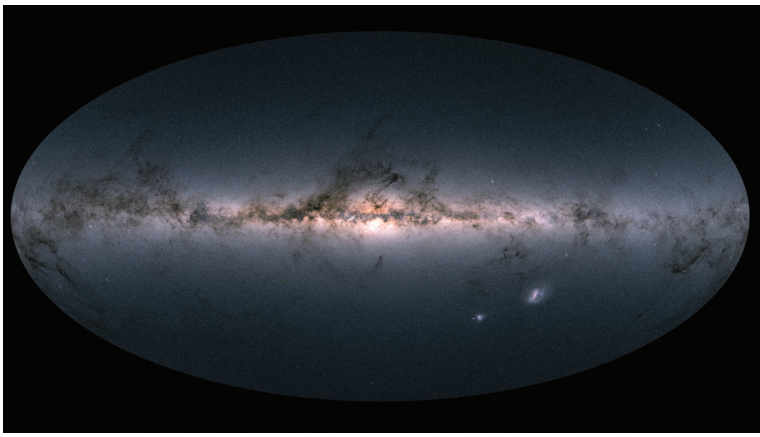
Team leader: Fabio Gastaldello, INAF - IASF Milano, Italy
Session: 16–20 April 2018
Scientific Rationale: The Team members investigate the rich datasets provided by XMM and the ESA magnetospheric mission CLUSTER over more than 15 years with the following objectives: (i) to gauge the flux of soft protons at the XMM satellite location and orientation in the magnetosphere; (ii) to provide a necessary in flight assessment of the physical process complementary to what obtained by laboratory experiments; (iii) to learn lessons to mitigate the impact for future X-ray missions.

Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere

Team leaders: Antonella Greco, Università della Calabria, Arcavacata di Rende, Cosenza, Italy and Olga Khabarova, Institute of Terrestrial Magnetism (IZMIRAN), Troitsk, Russia
Session: 16–20 October 2017
Scientific Rationale: The Team consists of experts in the multiple, often individually addressed, physical processes associated with the proposed project, including expertise in observations, theory and modeling simulations, to synthesize our understanding of magnetic reconnection, turbulence, structures and particle acceleration. Besides being fundamental to virtually every aspect of space science and astrophysics, this synthesis will contribute practically to further Space Weather studies and the origin of high energy particle radiation. Finally, the format and the work will lead to successful and efficient collaboration for a project such as this, that aims to synthesize typically disparate studies of fundamental physical processes.

Satellite-Derived Estimates of Antarctic Snow- and Ice-Thickness

Team leaders: Petra Heil, University of Tasmania, Hobart, Australia and Rachel Tilling, University of Leeds, Leeds, United Kingdom
Session: 25–29 June 2018
Scientific Rationale: Recent changes in the polar cryosphere have been dramatic, and include the well known reduction of the Arctic sea-ice cover during the annual ice mimimum. The Team addresses the following objectives: 1. To compile an updated summary of current and near-term satellite-derived sea-ice products; 2. to investigate the available products with a view to deriving the mean seasonal sea-ice thickness distribution from independent data obtained from satellite-based and aerial (Operation IceBridge) altimeters; 3. to evaluate the derived sea-ice and snow thickness data using independent (remotely-sensed) data sets; 4. and to conduct regional case studies to explore processes, including ice kinematics, that affect the thickness distribution of polar sea ice.



Gaia's all-sky view of our Milky Way Galaxy and neighboring galaxies, based on measurements of nearly 1.7 billion stars. The map shows the total brightness and color of stars observed by the ESA satellite in each portion of the sky between July 2014 and May 2016. (Image Credit: ESA/Gaia/DPAC)

Globular Clusters in the Gaia Era

Team leaders: Vincent Hénault-Brunet, Dominion Astrophysical Observatory, Victoria, Canada and Mark Gieles, University of Surrey, Guildford, United Kingdom
Sessions: 22–26 January 2018 and 28 May – 1 June 2018
Scientific Rationale: The multi-disciplinary Team brings together experts on a range of topics of relevance to the dynamical evolution of GCs and their stellar populations, both from the observational and modeling/theoretical point of view. In the short term, the Team members planned to capitalize on the imminent arrival of the game-changing second Gaia data release (DR2 – April 2018) by delivering science-ready Gaia data products for each Milky Way GC to the scientific community, along with results from dynamical mass models for a large sample of GCs. This project has an invaluable legacy value for a variety of applications by the scientific community. It is an essential step to tightly constrain GC formation models, supply an independent measurement of the mass of the Milky Way, and establish the role of GCs as gravitational wave factories.

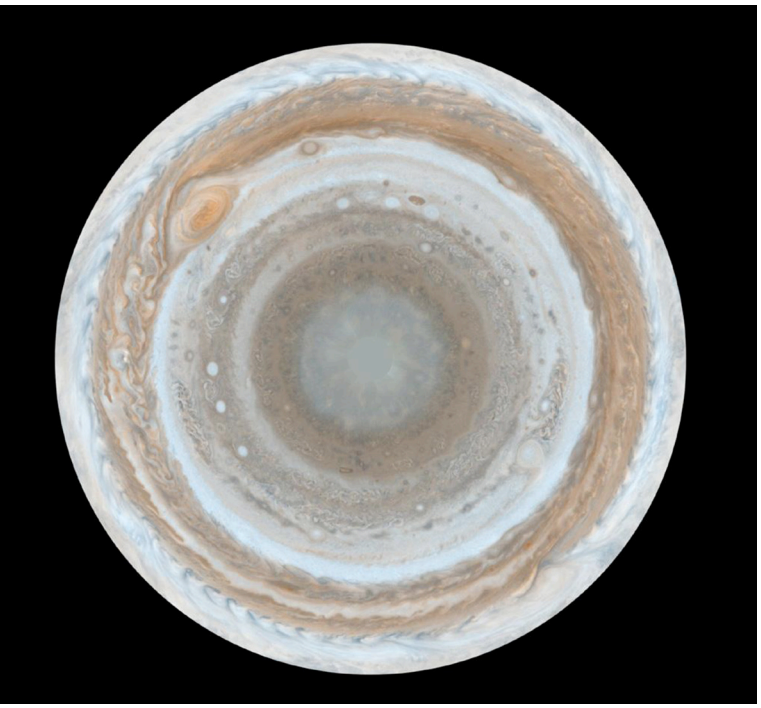
Low Frequency Imaging Spectroscopy with LOFAR – New Look at Non-Thermal Processes in the Outer Corona

Team leader: Eduard P. Kontar, University of Glasgow, United Kingdom
Session: 9–13 October 2017
Scientific Rationale: The Sun via its activity disturbs the heliosphere and affects the Earth. Over the last two years, we obtained a unique set of observations with unprecedented temporal and frequency resolutions using the Low Frequency Array (LOFAR). The new observations at sub-second scales require new models and a re-thinking of the current understanding of the non-thermal processes in the outer corona. In the view of the unprecedented radio data, the Team plans to complement these radio observations with the data from a suite of spacecrafts (RHESSI, SOHO, STEREO, SDO, Fermi) to gain a new level of understanding of the non-thermal processes in the outer corona.

Spacetime Metrology, Clocks and Relativistic Geodesy

Team leaders: Sergei Kopeikin, University of Missouri-Columbia, USA and Jürgen Müller, Leibniz Universität Hannover, Germany
Session: 19–23 March 2018
Scientific Rationale: The goal is to establish a tight connection between the theory and practice of precise space geodesy, spacetime metrology, atomic clocks and optical fibers network. This is a rapidly developing new branch of the fundamental physics of time and space with a wide range of applications from geophysics/geodesy – through realization of the next generation of terrestrial reference frames – to the most fundamental theory of gravity – general relativity. The project catches up the developments of the topics which were intensively discussed at the ISSI/HISPAC Workshop on "High Performance Clocks with Special Emphasis on Geodesy and Geophysics, and Applications to other bodies of the Solar System" (held from 30.11. to 4.12.2015).

International Teams



This Cassini image shows Jupiter from an unusual perspective. If you were to float just beneath the giant planet and look directly up, you would be greeted with this striking sight: red, bronze and white bands encircling a hazy south pole. (Image Credit: NASA/JPL/Space Science Institute)

New Features in the Meteor Radar Observations and Applications for Space Research

Team leader: Alexander Kozlovsky, University of Oulu, Sodankylä, Finland
Session: 8–12 January 2018
Scientific Rationale: Due to the progress of computers and radar technique, the meteor studies have received new breath in the 2000s when the new generation meteor radars were taken in use. Recent investigation has revealed a number of new features related to the mesospheric temperature estimate and composition of meteor streams, the perturbations caused by a rocket explosion in the ionosphere, and signatures of pulsating aurora in the meteor radar data. The studies are multi-disciplinary and the results are applicable in the fields of ionospheric plasma physics, meteor astronomy, radio science, and atmospheric science. Ultimately, the objective is to improve the meteor radar echoes selection algorithms and, respectively to improve the estimations of mesospheric temperature and wind velocity. This is of practical importance for planning space missions, which require knowledge of atmospheric neutral density and variability during geomagnetically disturbed periods for estimating the satellite drag.

The ENCELADE Team: Constraining the Dynamical Timescale and Internal Processes of the Saturn and Jupiter Systems from Astrometry

Team leader: Valéry Lainey, NASA Jet Propulsion Laboratory, Pasadena, USA
Session: 26 February – 1 March 2018
Scientific Rationale: The Team is composed of experts from different fields related to planetary sciences (including astrometry of the Solar system objects, orbital and rotational dynamics, physics of tidal dissipation in planetary and stellar interiors). This association of experts from diverse specialties proved its efficiency with high ranked articles in the past few years. The Cassini mission ended in 2017 and the Juno mission will end in 2021. Hence, it is the perfect time to settle (until the next space mission) scenarios of formation and evolution, while extending our research to the Jovian system to prepare the upcoming missions: EMFM (ex Europa clipper) and JUICE.

Kappa Distributions: From Observational Evidences via Controversial Predictions to a Consistent Theory of Suprathermal Space Plasmas

Team leaders: Marian Lazar, University of Leuven, Belgium and Horst Fichtner, Ruhr-Universität Bochum, Germany
Session: 12–16 February 2018
Scientific Rationale: The Kappa distribution function has already gained a remarkable notoriety as one of the most suitable empirical models capable of describing suprathermal particle populations present in space plasmas, but is still controversial in achieving a statistical characterization of these nonequilibrium plasma systems based on first principles. The intention is to emphasize the importance of these models and to increase their visibility in the space plasma community, where the standard Maxwell (-Boltzmann) distribution function is still preferred for its simplicity, but it is not adequate for nonequilibrium collision-poor plasmas in space. Our new collaboration is therefore expected to provide innovative analytical and numerical tools for kinetic plasma modeling of nonequibrium processes in diverse astrophysical scenarios, as well as universal concepts on their interpretation and fundamental physics to be published and accepted by the community in space sciences.

Large-Amplitude Oscillations as a Probe of Quiescent and Erupting Solar Prominences

Team leader: Manuel Luna Bennasar, Instituto de Astrofisica de Canarias (IAC), La Laguna Tenerife, Spain
Session: 9–13 April 2018
Scientific Rationale: The aim is to advance our understanding of the global structure of prominences and the mechanisms responsible for their destabilization. This project is following up the work from the previous

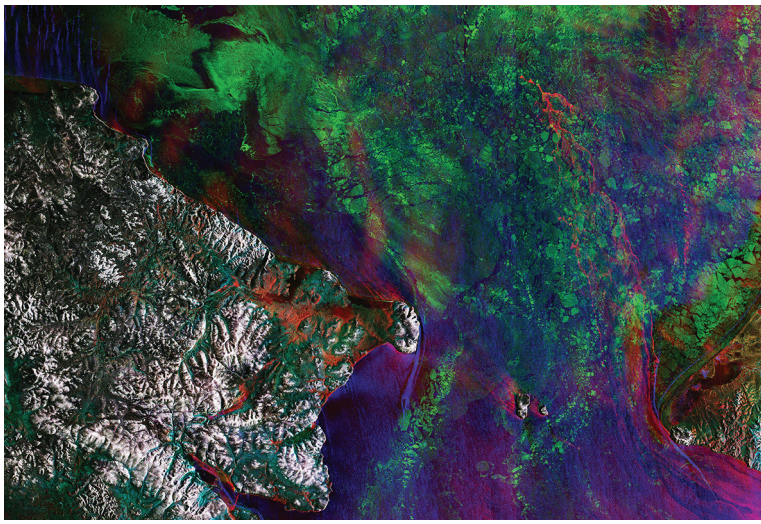
Team #314 "Large-Amplitude Oscillations in Solar Prominences". Recent studies have shown that the very common Large-Amplitude Oscillations (LAOs) in prominences open a new window into prominence structure by means of large-amplitude prominence seismology, which combines observations and theoretical modeling of LAOs. Using this technique, key physical properties of prominences can be inferred that are not accessible through other approaches. In addition, many filament eruptions are observed to be preceded or accompanied by LAOs, for reasons that remain obscure. The expected achievements of this Team are to understand: a) the global evolution of the morphology of solar filaments over the solar cycle, by continuing the in-progress survey and analysis of LAOs in solar cycle 24, b) the mechanisms responsible for triggering LAOs, and c) the internal processes in an eruption, by studying the relation of such processes with LAOs.

Physics of Dust Impacts: Detection of Cosmic Dust by Spacecraft and its Influence on the Plasma Environment

Team leader: Ingrid Mann, The Arctic University of Norway, Tromsø, Norway
Session: 4–8 June 2018
Scientific Rationale: High-velocity impacts of meteoroids, or dust particles on objects in space generate free atoms, molecules and particulate fragments, most of them in a charged state. The generated charge is detectable by instruments on the spacecraft, and the measured signals can be used to characterize the impacting dust. In the hypervelocity speed range, the generated impact charge is substantial and can significantly alter the spacecraft environment. A number of space missions use or plan on using antenna measurements for characterizing dust populations in new, previously unexplored environments. Researchers –active in the field– combine space observations with ongoing laboratory and theoretical/numerical studies, in order to reconcile dust observations from previous missions, and to make recommendations for optimal operations for upcoming space missions with dust detection capabilities.

Understanding the Origins of Problem Geomagnetic Storms

Team leaders: Nariaki Nitta, Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, USA and Tamitha Mulligan Skov, The Aerospace Corporation, Los Angeles, USA
Session: 16–20 April 2018
Scientific Rationale: The existence of the so-called "problem geomagnetic storms" is long known, the progenitors of which, i.e. solar eruptions, are not readily identified in Earth-based remote-sensing observations.



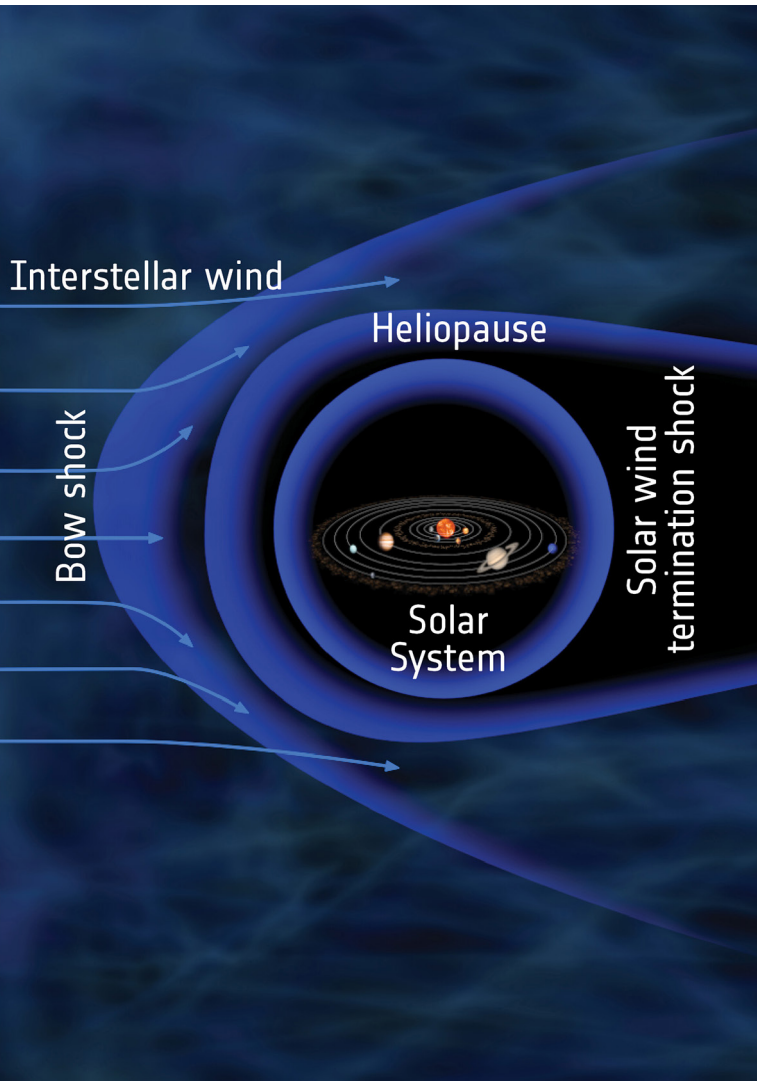
The Copernicus Sentinel-1 mission takes us over the Bering Strait, which connects the Pacific and Arctic Oceans between Russia and Alaska. The image was created by combining three radar scans of 11 December 2017, 23 December 2017 and 4 January 2018. Each image has been assigned a different color: blue, red and green, respectively. This creates a colorful composite that highlights how the sea ice changed over the four weeks. (Image Credit: Copernicus Sentinel data (2017–18), processed by ESA)

The Team investigates the origins of recent problem geomagnetic storms and, more broadly, advances our understanding of the formation and geoeffectiveness of interplanetary CMEs (ICMEs) without clear solar origins. The main goal is to find out if the mechanisms and processes during the eruptions responsible for problem geomagnetic storms are distinct from those associated with more typical CMEs. The Team consists of leading experts in analyzing remote-sensing and in situ data, modeling solar and interplanetary magnetic fields, and simulations of eruptions in the corona and the heliosphere.

Magnetic Topology Effects on Energy Dissipation in Turbulent Plasma (ISSI – ISSI Beijing Team)

Team leaders: Vyacheslav Olshevsky, University of Leuven, Belgium, and Francesco Valentini, University of Calabria, Arcavacata di Rende, Cosenza, Italy
Session: 13–17 November 2017
Scientific Rationale: In order to understand the role of magnetic topology in energy dissipation, it is fundamental to tackle the problem from different perspectives, using different configurations, models and observations. The Team members perform numerical simulations in several carefully chosen plasma configurations that reflect the real space plasmas. These simulations are

International Teams



The heliosphere is a vast magnetic bubble that contains our Solar System, the solar wind and the solar magnetic field. The heliopause marks the boundary between the heliosphere and the interstellar gas outside the Solar System. (Image Credit: ESA)

going to be confronted against observations. Furthermore, they undertake the challenge at all scales, from global (system), to kinetic ones, to reach two main goals: (1) find out what kind of magnetic topologies allow more efficient energy dissipation and conversion at different scales in turbulent plasmas.; and (2) define the indicators classifying and characterizing the regions of intense energy dissipation which could guide the observations of the MMS and future THOR missions. Results of the study produce a major step forward in magnetospheric physics and impact the ongoing and future satellite missions as well as other fields of plasma physics, from astrophysics to laboratory and fusion.

Recalibration of the Sunspot Number Series

Team leaders: Mathew James Owens, University of Reading, United Kingdom and Frédéric Clette, Royal Observatory of Belgium, Brussels, Belgium
Session: 22–26 January 2018
Scientific Rationale: The sunspot number series forms the longest observational dataset in existence and is the primary index of long-term solar variability, used in more than 100 publications each year across the fields of solar, solar-terrestrial, geophysics and statistics. This Team aims to resolve the uncertainties related to the sunspot series and to produce a consensus new-generation series, based on the modern methods and knowledge of physical processes leading to sunspot variability. The ultimate goal is to provide a consensus "best" sunspot number reference(s), including accurate estimates of the uncertainties, for use by the whole scientific community

Linking the Sun to the Heliosphere using Composition Data and Modeling

Team leader: Susanna Parenti, Université de Paris Sud, Orsay, France
Session: 19–23 February 2018
Scientific Rationale: Understanding the formation and evolution of the solar wind and heliosphere is still a priority in the Solar and Heliospheric communities. The plasma composition is considered a good tracer for the plasma propagation in the heliosphere. The main objective is to provide solid diagnostics for linking the in-situ and remote sensing charge-state and elemental composition measurements. The aim is to review what is known today and identify which analysis and modeling elements are needed to move forward. The problem will be tackled through its different faces: solar and in-situ data analysis, modeling the large scale corona and heliosphere, investigating physical process of composition fractionation in various plasma conditions and its eventual release into the solar wind, and revising atomic physics calculations to be used for inferring plasma composition including out-of-equilibrium conditions. The results will be of great benefit for the upcoming Solar Orbiter mission and Parker Probe Plus.

Multi-technique Characterization of Near-Earth Space Environment

Team leader: Ashik Paul, University of Calcutta, India
Session: 14–18 May 2018
Scientific Rationale: The phenomenon of ionospheric scintillations poses a major challenge to the SBAS system designers even after more than six decades of extensive research. Impact of ionospheric irregularities on multiple frequencies and their mutual correlations may provide an idea of the scattering mechanisms and their variabilities even across the same L-band. The spatial diversity

of GNSS constellations (GPS, GLONASS, GALILEO and COMPASS) can address the issue of loss of satellites due to failure of carrier tracking loop and mitigate the impact of ionospheric scintillations on SBAS navigation. Information related to fade durations, correlation of fades across different frequencies and effect of increased satellite links on positioning errors under scintillation conditions will be extremely helpful and provide opportunities to test the principles of spatial and frequency diversity as proposed to be applied to future GNSS under intense scintillation events as expected to be frequently encountered in equatorial and polar latitudes.

Reconstructing Solar and Heliospheric Magnetic Field Evolution Over the Past Century

Team leader: Alexei A. Pevtsov, National Solar Observatory, Sunspot, USA
Session: 8–12 January 2018
Scientific Rationale: This project aims at developing methods to study the evolution of solar and heliospheric magnetic activity over several past solar cycles. The Team creates pseudo-magnetograms using the spectroheliograms taken in Ca II K spectral line at Kodaikanal (India) and Mount Wilson (MWO, USA) observatories and the polarity of sunspot magnetic fields (MWO sunspot field strength measurements, 1917-present). The scientists also use the magnetic field and plage observations from modern spacecraft observations to refine the relationship between brightness of plages and unsigned magnetic flux. The historical data will be used to create a complete set of synoptic (Carrington rotation) pseudo-magnetograms from the early 20th century (start of systematic observations in Kodaikanal in 1907) until present. The magnetic fields outside plages (quiet Sun and high latitude/polar regions) will be modeled using the flux-transport model. Finally, the Team members compare the coronal magnetic field derived from Potential Field Source Surface (PFSS) model, which uses pseudo magnetograms as input , and the satellite observations from 1965 (OMNI data) to evaluate the validity of application of pseudo-magnetograms in representing the interplanetary magnetic field over the last 100 years. The results of this project will be useful to various interdisciplinary studies (e.g., solar physics, space climate, Earth's climate).

Towards Unified Error Reporting (TUNER)

Team leaders: Thomas von Clarmann, Karlsruhe Institute of Technology, Germany and Douglas Degenstein, University of Saskatchewan, Canada
Session: 4–8 December 2017
Scientific Rationale: The project aims at providing consistent and intercomparable error estimates for atmospheric temperature and composition measurements from space. Currently multiple retrieval methods are used by the different instrument groups, and along with this various approaches to error estimation are applied. Resulting errors are not always intercomparable. Some kinds of uncertainties are sometimes not reported at all. The different altitude resolutions and the different content of prior information in the data products is a particular problem.

The complete Galileo constellation will consist of 24 satellites along three orbital planes, plus two spare satellites per orbit. The result will be Europe's largest-ever fleet, providing worldwide navigation coverage. (Image Credit: ESA, P. Carril)

International Teams approved in 2018

The following listed teams have been selected for implementation from the proposals received in response to the 2018 Call for International Teams:

New Quantitative Constraints on Orographic Gravity Wave Stress and Drag: Satisfying Emerging Needs in Seasonal-to-Subseasonal and climate prediction
Team leader: Joan Alexander (US)

Probing the Core of the Sun and the Stars
Team leader: Thierry Appourchaux (FR)

International Combination Service for Time-variable Gravity Field Solutions
Team leaders: Richard Biancale (FR) and Adrian Jäggi (CH)

Origins of 3He-Rich Solar Energetic Particles
Team leaders: Radoslav Bucik (DE) and James Drake (US)

An Exploration of the Valley Region in the Lowlatitude Ionosphere: Response to Forcing from Below and Above and Relevance to Space Weather
Team leader: Jorge Chau (DE)

An Intercomparison of 1D Chemical Kinetics Codes for Exoplanet Atmospheres
Team leader: Benjamin Drummond (UK)

Witnessing the Culmination of Structure Formation in the Universe
Team leader: Stefano Ettori (IT)

Weak Gravitational Lensing Studies from Space Missions (ISSI – ISSI Beijing Team)
Team leader: Zuhui Fan (CN)

Synergy between Satellite and Ground Based Observations for the Study of Middle Atmosphere Dynamics
Team leader: Alain Hauchecorne (FR)

Can Magnetic Reconnection Explain the Discrete Aurora?
Team leader: Michael Hesse (NO)

Pristine
Team leader: Pascale Jablonka (CH)

Solar Flare Acceleration Signatures and their Connection to Solar Energetic Particles
Team leaders: Natasha Jeffrey (UK) and Frederic Effenberger (DE)

First Contact: Making Sense of 1I/'Oumuamua and Its Implications
Team leaders: Matthew Knight (US) and Alan Fitzsimmons (UK)

Are We Doing the Right Satellite Observations and Analyses for Quantifying Cloud-Mediated Aerosol Climate Forcing?
Team leaders: Alexander Kokhanovsky (DE) and Daniel Rosenfeld (IL)

Cross-Calibration of Laser-Induced Breakdown Spectroscopy (LIBS) Instruments for Planetary Exploration (ISSI – ISSI Beijing Team)
Team leaders: Jérémie Lasue (FR) and Roger Wiens (US)

Negative Ions in the Solar System
Team leader: Charles Lue (SE)

Novel Approaches to Multiscale Geospace Particle Transfer: Improved Understanding and Prediction through Uncertainty Quantification and Machine Learning
Team leaders: Ryan McGranaghan (US) and Enrico Camporeale (US)

Relativistic Electron Precipitation and its Atmospheric Effect (ISSI – ISSI Beijing Team)
Team leader: Irina Mironova (RU)

Looking at the Disc-Jet Coupling from Different Angles: Inclination Dependence of Black-Hole Accretion Observables
Team leaders: Sara Elisa Motta (UK) and Piergiorgio Casella (IT)

High EneRgy sOlar partICle Events Analysis (HEROIC)
Team leader: Ahanassios Papaioannou (GR)

Study of the Physical Processes in Magnetopause and Magnetosheath Current Sheets Using a Large MMS Database
Team leaders: Götz Paschmann (DE) and Tai Phan (US)

Gaia-BGM Exploiting Gaia data with the Besançon Population Synthesis Model for Understanding our Galaxy Evolution
Team leader: Annie Robin (FR)

Chemical Abundances in the ISM: The Litmus Test of Stellar IMF Variations in Galaxies Across Cosmic Time (ISSI – ISSI Beijing Team)
Team leaders: Donatella Romano (IT) and Zhi-Yu Zhang (UK)

Picture showing spectacular ribbons of gas and dust wrapping around the pearly center of the barred spiral galaxy NGC 1398. This galaxy is located in the constellation of Fornax (The Furnace), approximately 65 million light-years away. (Image Credit: ESO)

COSWEB: The Cosmic Web and Galaxy Evolution
Team leader: Gregory Rudnick (US)

Linking Solar and Stellar Variabilities
Team leader: Alexander Shapiro (DE)

Cold Plasma of Ionospheric Origin: Implication for Magnetospheric Dynamics
Team leader: Sergio Toledo-Redondo (ES)

Global Study of the Transmission of Foreshock ULF Waves into the Magnetosheath and the Magnetosphere
Team leaders: Lucile Turc (FI) and Minna Palmroth (FI)

The Nature and Physics of Vortex Flows in Solar Plasmas
Team leaders: Kostas Tziotziou (GR) and Eamon Scullion (UK)

Magnetic Helicity in Astrophysical Plasmas
Team leaders: Gherardo Valori (UK) and Etienne Pariat (FR)

Ice Giants: Formation, Internal Structure, and the Link to Exoplanets
Team leaders: Julia Venturini (CH) and Ravit Helled (CH)

Outcome of collisions in the Early Outer Solar System
Team leader: Jean-Baptiste Vincent (DE)

Towards Earth-like Alien Worlds: "Know thy Star, Know thy Planet"
Team leader: Christopher Watson (UK)

Resolving the Microphysics of Collisionless Shock Waves
Team leader: Lynn Wilson (US)

Johannes Geiss Fellow 2017 and Visiting Scientists

The Johannes Geiss Fellowship (JGF) is established to attract to ISSI – for limited duration visits – international scientists of stature, who can make demonstrable contributions to the ISSI mission and increase ISSI's stature by their presence and by doing so will honor Johannes Geiss for his founding of ISSI and his contributions to ISSI, and for his many contributions to a broad range of space science disciplines.

Interview with Johannes Geiss Fellow Gary Zank

Gary Zank, working at the University of Alabama, was elected among 15 applicants as the Johannes Geiss Fellow 2017. In the following paragraphs he answers a few questions asked by Raphael Marschall, ISSI Postdoc, about his scientific work.

Johannes Geiss Fellow Gary Zank during his Pro ISSI talk "Faltering Steps into the Galaxy" on April 4, 2018.

Raphael Marschall: First a general question regarding ISSI. How did you first encounter ISSI and what kind of work did ISSI foster for you personally?
Gary Zank: I was fortunate to be invited to the very first opening ISSI workshop conference in I believe 1996. At the time, I was still a young assistant professor and had begun developing the first models of the interaction of the solar wind with the local interstellar medium along with a post doc of mine. This was beginning to become very vibrant and active field despite Voyager 1 or 2 not having crossed the heliospheric termination shock, it was very exciting to be in the company of many of the people who had laid the foundations of the field. That first meeting was very influential for me in many ways. As a young person, the exposure of some of my ideas to a broader informed audience was extremely valuable, both in terms of defending the ideas and in propelling me to the forefront of the discipline. The general nature of the discussions that revolved around the presentations were of great value since I was able to engage much more broadly than is typical of a regular meeting. It was a great meeting, a great time, and one that fostered my growth in the field immeasurably. As much as I've enjoyed subsequent ISSI meetings, the 1996 meeting will always be my highlight.

Raphael Marschall: Regarding your Pro ISSI talk, what would you say is the most exciting scientific work spurred by the Voyager probes in the past ~decade? And how has Voyager deepened and maybe surprised our understanding of the solar system interaction with the local environment?
Gary Zank: Every scientific discovery that Voyager 1 or 2 makes is always a surprise at some level and with all of them comes considerable excitement. Obviously, the crossings of the boundaries (heliospheric termination shock and heliopause) will always be exciting but to me, it's the enormous body of underlying physics that is the most compelling. So for example, the Voyager 2 observation of the TS-2 HTS crossing, both the magnetometer and plasma data, represent one of the most exciting and profound discoveries. That the shock exhibited the classical structure of a quasi-perpendicular shock but the thermal plasma was hardly heated basically confirmed a 1996 prediction of mine that all the dissipation was due to reflected pickup ions, and that the subsequent proton distribution downstream of the HTS was a complex but most likely kappa-like distribution. This observation in some sense underpins almost all our current understanding of the origin of energetic neutral atoms that are measured by IBEX, and the plasma physics of a non-equilibrated thermal solar wind and suprathermal interstellar pickup ion population. In many respects, from the perspective of a theorist, that Voyager 2 crossing of the HTS has had a profoundly deep impact on the detailed understanding of the basic plasma physics of the solar wind interaction with the LISM. Other examples can be cited, but sometimes the observations leave us with nearly as many questions afterwards as before, the HP crossing being a case in point. It's fascinating, exciting but I don't think anyone claims that we understand quite what happened (or even precisely what or where the HP is). So this set of observations has deepened the puzzle about the boundary region between the solar wind and very local ISM, but has not yet deepened our basic physical understanding to the point where new and apparently unrelated insights can be drawn. Part of the difficulty, at least for me, comes with the pace and scope of the discoveries that Voyager makes

- theoreticians need time to contemplate a problem but if the newest exciting thing keeps changing and diverting our attention, we're far too easily distracted!

Raphael Marschall: As a young cometary scientist I see parallels between the gas/plasma coma interaction of a comet with the solar wind and the interplanetary magnetic field (IMF) and what you are studying on much larger scales with the interaction of our solar system with the local environment around it. Can cometary plasma science inform what you are doing or vice versa?
Gary Zank: Absolutely. In the late 1980s, 1986, the cometary encounter of Giotto with Halley was the news everywhere. I had just graduated with my PhD and was spending time in both Heidelberg and Katlenburg-Lindau Max-Planck Institutes. Since MPIAe (at the time) was the lead organization for Giotto, it was hard to escape cometary physics. So I dabbled a little in that for a few years, nothing very significant or profound since I came to the field too late, but it gave me an opportunity to learn about pickup ion physics. And for me and my post docs, that led to a number of far more profound results about the interaction of interstellar neutrals with the solar wind. So there was a direct informing of the solar wind – VLISM interaction problem by ideas nurtured in the cometary context. The reciprocal feedback has not been so significant and I think an opportunity has not yet been taken. I see several areas where this could fruitfully be followed. For the solar wind – VLISM interaction problem, the nature of the non-equilibrated neutral atom population is profoundly important. I think the codes that we have developed in the solar wind – VLISM interaction context would be of great value to understand the detailed evolution of the expanding neutral gas cloud as the comet approaches the Sun. I don't think we have fully clarified the important role of the pickup ions in mediating or modifying structures such as the many forms of cometary bow shocks that have been observed, the role of PUI excited turbulence and it's back reaction on the thermal plasma, and the corresponding effects on the cometopause as an example of the HP. And I think this is just scratching the surface.

Previous Johannes Geiss Fellows

The Johannes Geiss Fellowship (JGF) started in 2015. George Gloeckler from the University of Michigan, USA has been elected as the first JGF recipient. Followed up by Kurt Lambeck from the Australian National University, Australia in 2016.

Individual Scientists are invited for extended periods to work on scientific subjects at the forefront in areas of interest to ISSI. The results of this research are to be published as books or in major scientific journals, with appropriate acknowledgment to ISSI.

Furthermore the following Visiting Scientists have worked at ISSI in the course of the twenty-third year:

Raphael Antoine, CEREMA, France, working period: 16.-21.4.2018.

Pavel Bakala, Silesian University, Opava, Czech Republic, working period: 11.-17.2.2018.

Yujun Cui, ENPC, France, working period: 16.-21.4.2018.

Katerina Goluchova, Silesian University, Opava, Czech Republic, working period: 11.-17.2.2018.

Bill Hartmann, Planetary Science Institute, Tucson, USA, working periods: 11.-22.9.2017 and 19.6.-10.7.2018.

Konstantin Herbst, University of Kiel, Germany, working period: 7.-18.5.2018.

Peter Hoppe, MPI für Chemie, Mainz, Germany, working period: 28.5.-16.6.2018.

Haijun Hu, ENPC, France, working period: 16.-21.4.2018.

Natasha Jeffrey, University of Glasgow, UK, working period: 22.-24.1.2018.

Debora Lancova, Silesian University, Opava, Czech Republic, working period: 11.-17.2.2018.

Ken McCracken, University of Maryland, College Park, USA, working period: 15.4.-17.6.2018.

Alexander Milovanov, Associazione EURATOM-ENEA sulla Fusione, Frascati-Rome, Italy, working period: 5.6.-14.7.2018.

Eberhard Möbius, University of New Hampshire, USA, working period: 7.1.-2.2.2018.

Götz Paschmann, MPI for Extraterrestrial Physics, Garching, Germany, working period: 28.9.-6.10.2017.

Volodymyr M. Reshetnyk, Shevchenko University, Ukraine, working period: 26.7.-9.8.2017.

Yuri Skorov, University of Braunschweig, Germany, working period: 27.7.-9.8.2017.

Luigi Stella, INAF - Osserv. Astronomico di Roma, Rome, Italy, working period: 11.-17.2.2018.

Gary Zank, JG Fellow 2017, University of Alabama, USA, working periods: 8.10.-4.11.2017 and 22.3.-10.4.2018.

Events

Alpbach Summer School 2017 "The Dusty Universe"

Summer School Jury members. From top left to first-rank right: Hans Sünkel (TU-Graz), Peter Falkner (ESA), Manuel Güdel (Univ. of Vienna), Sergio Volonte (ISSI Board), Hugo Marée (ESA), Andreas Geisler (FFG), Christoffel Waelkens (KU Leuven), Michaela Gitsch (FFG), Roger Bonnet (ISSI) and Silvia Wenger (ISSI). (Image Copyright: MA Jakob, Summer School Alpbach 2017, FFG/ESA)

The Alpbach Summer school is a major European educational yearly event in space sciences. It aims at educating the future space scientists and engineers in developing a space mission from the elaboration of a science objective leading to a concept through to the launch and post-launch activities. The main responsible organization is the Österreichische Forschungsförderungsgesellschaft (FFG), represented by the Director of the Summer School, Mrs Michaela Gitsch with support from ESA, the University of Graz, and ISSI, which offers administrative support to the School and Roger-M. Bonnet chairing the Jury. The School is also supported by Austrospace, the association of Austrian space industries and research institutions. EuroPlanet offers grants for students.

Every year, 60 European students selected by their respective national space organizations do convene in Alpbach (Austria) for 11 days during which they follow scientific and technical lectures adapted to the main topic of the School. The topic in 2017 (in the field of astronomy) was related to the Dusty Universe. Following a more than 40 years-established scenario, four teams of 15 students each, randomly selected by the School's head tutor were setup to define the scientific objectives of their respective project, and propose a preliminary end-to-end mission providing observations that will help resolving the outstanding problems related to the topic. During these challenging 11 days, they had to design the spacecraft, select and define the capabilities of their proposed scientific instruments, as well as mission and science operations that would meet their stated objectives. On the last day of the school the students of each team (identified by 4 different colors) did present a 60 min. PPT description of their proposals to the Alpbach Jury members, who assessed the respective Scientific and Technical value, the competitiveness and the quality of the mission's presentation, and eventually granted an "Oscar" corresponding to these criteria to each of them.

The "Blue Team" Polycyclic Aromatic Hydrocarbons Space Telescope (PAHST) intended to probe star formation in the Early Universe by detecting PAH features and emission lines redshifted between 30 and 200 µm, using an 8m mirror Infrared telescope located at Lagrange point 2, launched by Ariane 6, equipped with a high-sensitivity spectrometer and photometer. The Team was granted a new unforeseen so-called Ambition-Oscar because of their mission's boldness, and their proposed new solutions for deploying large telescopes in space.

The "Green Team" Magnificent Analysis of Grains Research At Tremendously High and Exciting Altitude mission, (Magrathea), a dust-growth experiment (dust sizes between 1 µm and 100 µm) in micro-gravity conditions addressed the formation of planetesimals from molecules and dust in the protoplanetary disks. A Soyuz would launch the mission to a Sun-synchronous orbit at 800 km. The Technical Case Oscar was granted to the Team because of its challenging, highly innovative and engineering approach. The Team was also rewarded with a second Quality of Presentation Oscar.

The "Orange Team" FROST (Far-infrared) Observation Spectroscopy Telescopes) would observe the inner protoplanetary disks of T Tauri and Herbig Ae/Be stars in the far infrared from 40 to 200 µm at distances up to 140 pc at high angular resolution, using a three- part formation flying interferometer with spectroscopic capabilities, launched by Ariane 6 to Lagrange point 2. Because of its boldness, and observing capabilities, the Team was granted the Scientific Case Oscar.

Finally, the "Red Team" EuRopean Extinction BUmp Survey (EREBUS) mission would study how dust does vary in size and composition throughout galaxies using ultra-violet (UV) radiation. The 300kg satellite will be launched on a 1200 km Sun Synchronous orbit with a Vega.C launcher. Because of its originality and genuine potential for new discoveries, the "Red Team" was awarded the Competitiveness Oscar.

Roger-Maurice Bonnet

Space Science Horizon 2000: A Retrospective View Symposium in Honor of Roger-Maurice Bonnet on the Occasion of his 80th Birthday

On 8 and 9 February 2018, some 140 scientists gathered at ESTEC, Noordwijk, The Netherlands for a short symposium in honor of Roger-Maurice Bonnet, ESA Director of Science 1983-2001 and ISSI Executive Director 2001-2012, to reflect on the outcome of the Horizon 2000 missions. The symposium started with a short message from the ESA Director General, Jan Wörner, paying tribute to the true leadership of Roger Bonnet in taking the initiative for setting up the "Horizon 2000 programme" and for guiding its implementation, thereby bringing ESA to the forefront of worldwide space research.

The program consisted of the following contributions:

- The Horizon 2000 Initiative by Johan Bleeker
- Physics of the Sun-Earth system (SOHO/Cluster) by Ester Antonucci
- The Hot and Energetic Universe (XMM- Newton/ INTEGRAL) by Xavier Barcons
- European Landers (Huygens/Philae) by John Zarnecki
- The Molecular and Dusty Universe (Herschel) by Christoffel Waelkens
- Exploration of Planetary Atmospheres in the Solar System by Athena Coustenis/Thérese Encrenaz
- Galactic Dynamics (Hipparcos/Gaia) by Anthony Brown
- Primordial Material in the Solar System (Rosetta) by Kathrin Altwegg
- The Oldest Light (Planck) by Jean Loup Puget

All speakers presented an excellent and comprehensive summary of the results of the Horizon 2000 missions (and more) in a most captivating way. Together with a compilation of the pictures taken during the symposium the presentations are accessible on the symposium website: www.cosmos.esa.int/web/horizon-2000-symposium.

Johann Bleeker and Henk Olthof

The symposium audience at ESTEC, Noordwijk, listening to the many speakers talking about the "Horizon 2000 programme" in February 2018.

Thomas Zurbuchen gave a keynote lecture at the Kuppelsaal (University Bern). This event was organized by the Swiss Academy of Sciences (SCNAT) and ISSI. (Image by M. Friedrich)

Further Events

2 August 2017: "NASA and Swiss Space Science", Keynote lecture talk with Thomas Zurbuchen, Associate Administrator, NASA Science Mission Directorate. Followed by a panel discussion with T. Zurbuchen (NASA), J. Harris (Head of Space Electronics at Astrocast), R. Krpoun, (Swiss Space Office), and N. Thomas (Swiss Academy of Sciences). The recorded event can be found on: https://www.youtube.com/watch?v=E79KRLIi8x0.

1 November 2017: Pro ISSI talk "NEXT STOP JUPITER! Giant Planets Exploration and the Cassini Legacy" with Michel Blanc.

2 November 2017: Meeting of the Science Committee.

3 November 2017: Meeting of the Board of Trustees and ISSI Dinner.

4 April 2018: Pro ISSI talk "Faltering Steps into the Galaxy" with Gary Zank, Johannes Geiss Fellow.

24–25 May 2018: Meeting of the Science Committee.

12 June 2018: Meeting of the Board of Trustees.

International Space Science Institute in Beijing

Activities

Within the reported period, on January 17–18, 2018, ISSI-BJ organized a Forum on "Roads towards Sample Return from Comets and Asteroids". To make the Forum discussions and its conclusions accessible to the broad scientific communities and the public, the insights gained from these Forums will be published in the ISSI-BJ "TAIKONG" magazine.

A joint ISSI-BJ/ISSI Workshop on "Tropical and Subtropical Cyclones with Improved Satellite Observations" took place on May 7–10, 2018. Following the Workshop, its output will be published as a volume in the "Space Science Series of ISSI/ISSI-BJ" by Springer, after publication of the chapters as peer-reviewed papers in the journal of "Surveys in Geophysics".

Between July 2017 and June 2018, 10 International Team meetings took place at ISSI-BJ. At the beginning of 2018, ISSI-BJ and ISSI released a joint Call for Proposals for International Teams in Space and Earth Sciences. Six excellent Teams have been selected by the Science Committee, which will hold a series of meetings at the Institute in Beijing. Four out of six Teams will share the meetings between Beijing and Bern.

ISSI-BJ is promoting outreach and education activities to the general public and to young scientists as a co-organizer of the "Understanding Science" seminars. In the reported period, ISSI-BJ held three of these scientific seminars, namely:

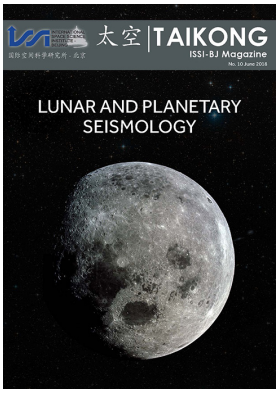
- "Listening to the Sounds of the Universe: The Future of Gravitational Wave Astronomy " in December 2017, given by David Blair from Australian Research Council Centre of Excellence for Gravitational Wave Discovery (ARCC)
- "The Galactic Adventure of the First Interstellar Asteroid - A/2017 U1 'Oumuamua" in January 2018, by Wing Ip from National Central University, Taiwan
- "Gravitational Lenses: Mirages in the Universe" in June 2018, by Georges Meylan from Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland, and Chairman of ISSI's Board of Trustees

On September 6, 2017, a seminar by Olivier Minster (ESA, currently detached at CSU, China) on "Science on Space Stations" was jointly organized by ISSI-BJ and NAOC, CAS.

Publications

In the reported period, ISSI-BJ published one issue of the "TAIKONG" magazine, which constitutes the output of the ISSI-BJ Forums on "Lunar and Planetary Seismology" organized in January 2017. The magazine reports the contents of the forums and reflects in a neutral way the Forum discussions and advises from all the participants:

The International Space Science Institute in Beijing (ISSI-BJ) was jointly established by the International Space Science Institute (ISSI) and the National Space Science Center (NSSC) with the support of the International Cooperation Bureau and the Space Science Strategic Project of the Chinese Academy of Science (CAS). ISSI-BJ is a close cooperation partner of ISSI. Both institutes share the same Scientific Committee, the same study tools, and other information of mutual relevance and interest. However, both use independent operational methods and different funding sources. More information can be found on its website: www.issibj.ac.cn.



Cover of the published TAIKONG magazine on "Lunar and Planetary Seismology". Electronic editions of the published TAIKONGs can be downloaded from www.issibj.ac.cn/publications.

- TAIKONG No. 10 on "Lunar and Planetary Seismology", June 2018. The magazine is available for download at: http://www.issibj.ac.cn/Publications/.

In September 2017, one volume of the ISSI Scientific Reports Series was published as an outcome of the joint ISSI/ISSI-BJ International Team:

- Air Pollution in Eastern Asia: An Integrated Perspective, Bouarar, Idir, Wang, Xuemei, Brasseur, Guy P. (Eds.), ISSI Scientific Report Series, Volume 16, Springer 2017.

As a result of the ISSI-BJ Workshop held in 2014, one volume of the Space Science Series of ISSI was published:

- Gamma Ray Bursts – A Tool to Explore the Young Universe, Götz, D., Falanga, M., Dai, Z., Le Floc'h, E., Tanvir, N., Zhang, B. (Eds.), Space Science Series of ISSI, Volume 61, Springer 2018.

Operation

Maurizio Falanga who served as the International Space Science Institute – Beijing founding Executive Director from 2012-2016, has been appointed ISSI-BJ Executive Director ad interim, effective March 1, 2018. Maurizio Falanga will serve until the appointment of a new Executive Director.

Anna Yang

Listed are activities in which ISSI staff scientists participated between 1 July 2017 and 30 June 2018. This includes presentations given, meetings attended, outreach, honors received, and chairmanships held.

Presentations

14 July 2017 – M. Falanga: Millisecond X-ray pulsars: 15 years of progress, Hong Kong University, China.

28 August 2017 – F. Effenberger: Multi-Instrument analysis of coronal X-ray and temperature signatures in solar limb flares, IAGA Meeting, Cape Town, South Africa.

1 September 2017 – R-M. Bonnet: Cassini, le grand Final, Panel Testimony of 30 years of the Mission, Cité des Sciences, Paris, France.

4 September 2017 – F. Effenberger: Stochastic Acceleration and Transport Processes in Solar Flares and Heliospheric Plasmas, Seminar at North-West University, Potchefstroom, South Africa.

8 September 2017 – R. von Steiger: Introduction to «le noir de l'étoile» by Gérard Grizey Musikfestival Bern, Reithalle Bern, Switzerland.

18–22 September 2017 – R. von Steiger: Small Satellites for Space Science (4S) COSPAR Roadmap, talk at 3rd COSPAR Symposium, Jeju island, Korea.

19 September 2017 – R. Marschall: On causes of deviations from free-radial outflow in the inner dust coma of comet 67P/C-G using OSIRIS data, European Planetary Science Congress 2017, Riga, Latvia.

28 September 2017 – F. Effenberger: Connecting solar flares and in-situ energetic particles: Observations and modeling challenges, Solar Physics Seminar, Glasgow, UK

3 October 2017 – R-M. Bonnet: Space Revolution in Solar Physics, IKI Symposium Sputnik-60: Along the paths of Discoveries, IKI Moscow, Russia.

6 October 2017 – R. Rodrigo: Activities in Earth Science at ISSI, Earth Science Advisory Committee, ESA Directorate of Earth Observation Program, Frascati, Italy.

9 October 2017 – R-M. Bonnet: A Portuguese Scientist, Colloquium in honor, Teresa Lago amongst friends, Centro de Astrofísica da Universidade do Porto (CAUP), Portugal.

9 October 2017 – A. Cazenave: Global Sea Level Budget, State of Climate 2017, World Meteorological Organization, Geneva, Switzerland.

10 October 2017 – F. Effenberger: Current challenges in Solar Energetic Particle Transport, SCOSTEP Workshop, Locarno, Switzerland.

12 October 2017 – R-M. Bonnet: Science Spatiale et Innovation, l'Exemple Européen, Université Populaire, Antony, France.

19 October 2017 – M. Falanga: Type-I X-ray burst spectra affected by accretion, Silesian University, Opava, Czech Republic.

24 October 2017 – F. Effenberger: Solar energetic particle transport with field-line random walk, Arcetri Workshop, Florence, Italy.

5 November 2017 – R-M. Bonnet: From Giotto to Rosetta, Keynote, ISSI Board of Trustees Annual Meeting, Bern, Switzerland.

23 November 2017 – R-M. Bonnet: International Cooperation in Space Science: a 60 years overview, Padova, Italy.

29 November 2017 – R. Rodrigo: The importance to have a good Board and Science Advisory Committee for a National Laboratory, International Forum of National Laboratory for Space Science Center, Opportunities and Lessons learned, Beijing, China.

29–30 November 2017 – R-M. Bonnet: Experiences in managing Space Science Organizations, International Forum of the National Laboratory for Space Science, Opportunities and Lessons learned and Frontiers of Space Science that may Lead to Major breakthrough, National Space Science Center, Huairou Beijing, China.

11–15 December 2017 – T. Lopez: Influence of the surface permeability on the GRACE water mass variations, Case of the Lake Chad basin (Poster), AGU Fall Meeting, New Orleans, USA.

11 December 2017 – A. Cazenave: Monitoring coastal zones from space, AGU Fall Meeting, New Orleans, USA.

13 December 2017 – A.M. Bykov: A decade of Agile: Results, challenges and prospects of gamma-ray astrophysics, Accademia dei Lincei and ASI Headquarters, Rome, Italy.

Staff Activities

15 December 2017 – A. Cazenave: Arctic sea level, AGU Fall Meeting, New Orleans, USA.

14 December 2017 – F. Effenberger: The size of coronal hard X-ray sources in solar flares: How big are they? (Poster), AGU Fall Meeting, New Orleans, USA.

5 January 2018 – R. von Steiger: Bausteine des Universums, Burgerspital Viererfeld, Bern, Switzerland.

6 January 2018 – R. Marschall: A multi-instrument modelling perspective of cometary activity, Rosetta Science workshop and SWT 49, Rhodes, Greece.

1 February 2018 – A. Cazenave: Climate change; ocean warming, land ice melt, sea level rise, CEED, Oslo University, Norway.

9–13 February 2018 – T. Lopez: Space-based study of the mechanisms of surfac fluids exchanges in (semi)-arid regions (PICO presentation), European Geosciences Union (EGU) Conference, Vienna, Austria.

20 February 2018 – R. von Steiger: The Legacy of Two Decades of Observations with SWICS on Ulysses, Talk at the ISSI Team on Linking the Sun to the Heliosphere using Composition Data and Modelling, Bern, Switzerland.

1 March 2018 – M. Falanga: Millisecond X-ray pulsars: 15 years of progress, Beihang University, Beijing, China.

11 April 2018 – A. Cazenave: Women in sciences, EGU, Vienna, Austria.

26 April 2018 – M. Falanga: Millisecond X-ray pulsars: 15 years of progress, Tsinghua University, Beijing, China.

30 April 2018 – R. Marschall: Rosetta: The journey to a relic from the early solar system, Astronomy on Tap Bern, Bern, Switzerland.

3 May 2018 – A. Cazenave: Key Climate Change Indicators from the Ocean; 2017 Update, Subsidiary Body for Scientific and Technological Advice (SBSTA), UNFCCC, Bonn, Germany.

28 May 2018 – A. Cazenave: Climate change and sea level rise, Liege University, Liege, Belgium.

Meetings

3 July 2017 – R. von Steiger: Evaluation Commission of SNSF professorship proposals, Bern, Switzerland.

10–13 July 2017 – M. Falanga: Serendipities in the Solar System and Beyond and Wing Ip's 70th Birthday, National Central University, Taoyuan, Taiwan.

18–27 July 2017 – R-M. Bonnet: Alpbach Summer School 2017, Jury Chair, Alpbach, Austria.

18–27 July 2017 – S. Wenger: Alpbach Summer School 2017, Alpbach, Austria.

25–27 July 2017 – R. Rodrigo: Alpbach Summer School, Alpbach, Austria.

2 August 2017 – R. von Steiger: Symposium on NASA and Swiss Space Science with Thomas H. Zurbuchen, University of Bern, Switzerland.

6 September 2017 – R. Rodrigo: Jury of the Awards Spanish Royal Society of Physics – BBVA Foundation, Madrid, Spain.

15 September 2017 – R-M. Bonnet: Cassini Grand Final, Cité des Sciences, Paris, France.

27–28 September 2017 – R. Rodrigo: Multi-instrument Analysis of Rosetta Data (MiARD) project (H2020 686709) team meeting, Marseille, France.

3–4 October 2017 – R-M. Bonnet: IKI Symposium Sputnik-60: Along the paths of Discoveries, IKI Moscow, Russia.

5–6 October 2017 – M. Falanga: GA meeting "Swiss Society for Astrophysics and Astronomy", Zurich, Switzerland.

6 October 2017 – R. Rodrigo: Earth Science Advisory Committee, ESRIN, Frascati, Italy.

9 October 2017 – R-M. Bonnet: Colloquium in honor of Prof. Teresa Lago, Centro de Astrofísica da Universidade do Porto (CAUP), Portugal.

16–20 October 2017 – M. Falanga: Visiting the "Silesian University, Opava", Czech Republic.

November 2017 – R. von Steiger: Evaluation of Marie Skłodowska-Curie Individual Fellowships.

13–14 November 2017 – R. Rodrigo: ExoOceans Study Core Group, Paris, France

17 November 2017 – R-M. Bonnet: Celebration of the 130th anniversary of the Societé Astronomique de France, Ministry of Research, Paris, France.

23–24 November – R-M. Bonnet: International Cooperation in Space Science: a 60 years overview, Padova, Italy.

24 November 2017 – R. Rodrigo: Plenary Session Acadèmie d l'Air et de l'Espace, Toulouse, France.

28–30 November 2017 – R. Rodrigo: International Forum of National Laboratory for Space Science, Opportunities and Lessons learned, Beijing, China.

29–30 November 2017 – R-M. Bonnet: Experiences in managing Space Science Organizations, International Forum of the National Laboratory for Space Science, Opportunities and Lessons learned and Frontiers of Space Science that may Lead to Major breakthrough, National Space Science Center, Huairou Beijing, China.

14 December 2017 – F. Effenberger: SPA SH005: Multi-wavelength Observations and Modeling of Solar Flares: Magnetic Structures, Particle Acceleration, and Atmospheric Response, Lead session convener/chair, AGU Fall Meeting, New Orleans, USA.

10–12 January 2018 – R. von Steiger: Evaluation Commission of SNSF professorship proposals, Bern, Switzerland.

8–9 February 2018 – R-M. Bonnet, A. Fischer, R. Rodrigo, S. Saliba, and S. Wenger: Space Science Horizon 2000: A retrospective view, ESA/ESTEC, Noordwijk, The Netherlands.

15 February 2018 – R-M. Bonnet: Program Committee of the Alpbach Summer School 2018, Vienna, Austria.

6–8 March 2018 – R-M. Bonnet: Evaluation of the German Aerospace Center, DLR, Oberpfaffenhofen, Germany.

26 March 2018 – R.-M. Bonnet: Meeting with ESA DG, ESA Headquarters, Paris, France.

8 April 2018 – R. von Steiger: Editorial Committee of Space Science Reviews, Vienna, Austria.

1 May 2018 – R. von Steiger: Evaluation Commission of SNSF Eccellenza Grants and Fellowships, Bern, Switzerland.

16 May 2018 – R-M. Bonnet: Ordinary General Assembly of the Institut Français d'Histoire de l'Espace, Paris, France.

23–25 May 2018 – R-M. Bonnet: Exosat Reunion 2018celebrating 50 years after launch, The European Space Astronomy Centre, Madrid, Spain.

7–9 June 2018 – R. Rodrigo: "Selection Committee of the ISSI-BJ Executive director", Beijing, China.

14 June 2018 – R-M. Bonnet, M. Falanga, R.Rodrigo: ISSI-BJ Board of Trustees, ISSI Bern, Switzerland.

19–29 June 2018 – A.M. Bykov: DIAS Summer School in High-Energy Astrophysics 2018, Dublin, Ireland.

Outreach: ISSI Scientists in the Media

13 July 2017 – "Sind Astronauten überflüssig?", Radio Report with R. von Steiger, SRF 2 Kultur.

19 July 2017 – "Satellite Snafu Masked True Sea Level Rise for Decades", Article by J. Tollefson with A. Cazenave, Nature/Scientific American.

26 August 2017 – "Sonnenforschung im Schatten des Mondes", Radio Interview with R. von Steiger, Wissenschaftsmagazin, Radio SRF 2.

15 September 2017 – "Cassini-Huygens - Grande Final", TV and Radio Report with R-M. Bonnet, Cité des Sciences, Paris, France.

9 November 2017 – "The Rise and Fall of Africa's Great Lake - Scientists Try to Understand the Fluctuations of Lake Chad", Article by K. Hansen with T. Lopez, NASA Earth Observatory Blog (https://earthobservatory.nasa.gov/Features/LakeChad).

14 December 2017 – "Wettrennen zum Mond", Radio Interview with R. von Steiger, Wissenschaftsmagazin, Radio SRF 2.

12 February 2018 – "Satellites show warming is accelerating sea level rise", Article by S. Borenstein with A. Cazenave, the Denver Post.

13 February 2018 – "Die ISS zu betreiben ist keine zukunftsträchtige Strategie", Radio Interview with R. von Steiger in "Echo der Zeit", Radio SRF 1.

18 March 2018 – "Sputnik and its national and international impact in science and society at large", Russian TV interview with R-M. Bonnet, to be included in a documentary film.

Staff Activities

Chairman- and Memberships, Honors

R-M. Bonnet:
- President of IFHE's Prix Aubinière Award, France
- President of the Alpbach Summer School Jury 2017 and 2018, Austria
- President of the Space Science Panel of the DLR-Helmhotz Review of the Scientific Evaluation of the German Aerospace Center (DLR)
- Member of the Board of Association Française d'Astronomie, France
- Member of Institut Français d'Histoire de l'Espace, France

A. Cazenave:
- Advisory Committee Member of FUTURE EARTH
- Committee Member "Evolving the geodetic infrastructure to meet new scientific needs", NRC (National Research Council, The National Academies, USA)
- Scientific Advisory Board Member of the Centre for Earth Evolution and Dynamics, University of Oslo

M. Falanga:
- Member of the Astronomy & Astrophysics Journal Board of Directors, Swiss representative since 2011
- Member of the International Astronomical Union (IAU)
- Member of the International Academy of Astronautics (IAA)

R. Rodrigo:
- Member of the Arecibo Observatory Science and Management Advisory Committee
- Member of the International Academy of Astronautics Scientific Activities Committee
- Member of the Editorial Board of Space Science Reviews
- Member of the Scientific Advisory Committee of the BBVA Foundation
- Member of the Scientific Advisory Committee of the General Foundation of the Spanish National Research Council
- Member of the Scientific Organization Committee. 3rd International Symposium on Lunar and Planetary Science, Macau (June 11-14, 2018)
- Elected as Correspondent of the Academie de l'Air et de l'Espace, France
- Co-Investigator of the Instrument "Giada" of the ESA Mission Rosetta for the exploration of minor bodies in the Solar System
- Spanish Lead Scientist of the "Osiris" instrument of the ESA Mission Rosetta for the exploration of minor bodies in the Solar System
- Co-Investigator of the BepiColombo Laser Altimeter of the ESA Mission BepiColombo to planet Mercury
- Co-Investigator of the Instruments Janus and Gala of the ESA Mission JUICE for the exploration of the Jovian system

R. von Steiger:
- Member of the Evaluation Committee for Swiss National Science Foundation Professorships
- Member of the Evaluation Marie Skłodowska-Curie Individual Fellowships
- Co-chair of the Cospar Roadmap Committee on Small Satellites for Space Science (4S)
- Full Member of the International Academy of Astronautics (IAA)
- Editorial Board of Space Science Reviews
- Editorial Board of Frontiers in Space Sciences
- Editorial Board of Living Reviews in Solar Physics

Listed are all papers written or co-authored by ISSI staff that were submitted or that appeared between 1 July 2017 and 30 June 2018. The papers that are published in the Space Science Series of ISSI (SSSI) can be found from page 52 on.

Agarwal, J. et al. (including: R. Rodrigo), Evidence of sub-surface energy storage in comet 67P from the outburst of 2016 July 03, MNARS, 469, S606–S625, 2017.

Antoine, R., T. Lopez, Les températures proches de la surface, In: Gasc, M. et al., Manuel de Mécanique des Roches, Tome V - Thermomécanique des Roches, Presses de Mines, ISBN: 978-2-35671-65-7, 2017.

Attree, N. et al. (including: R. Rodrigo), Tensile strength of 67P/Churyumov-Gerasimenko nucleus material from overhangs, Astron. Astrophys., 611, A33, 2018.

Auger, A.-T. et al. (including: R. Rodrigo), Meter-scale thermal contraction crack polygons on the nucleus of comet 67P/Churyumov-Gerasimenko, Icarus, 301, 173-188, 2018.

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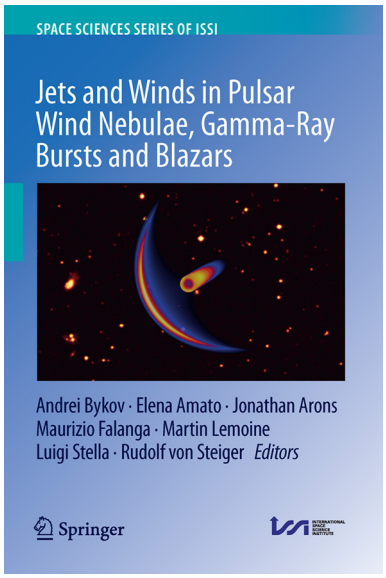

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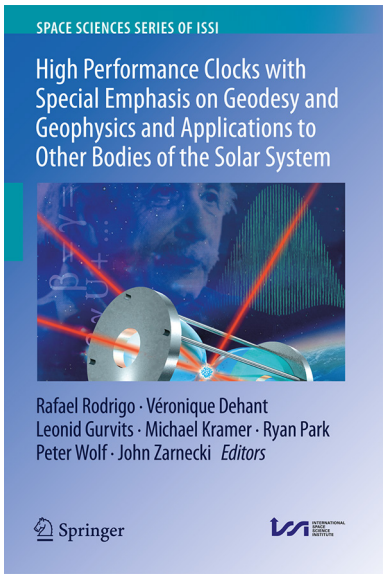

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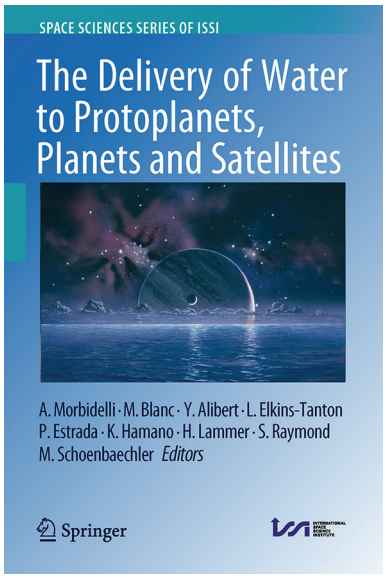

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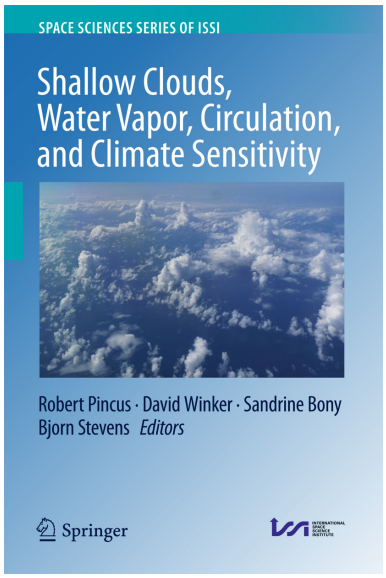

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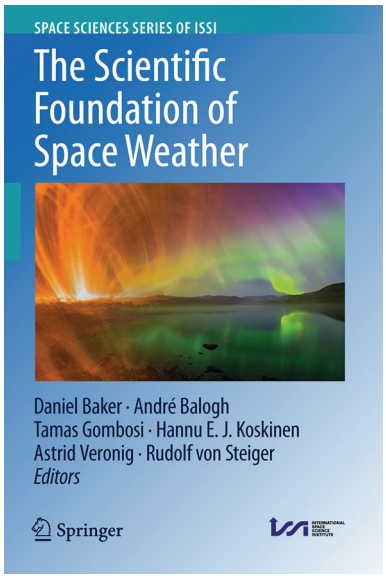

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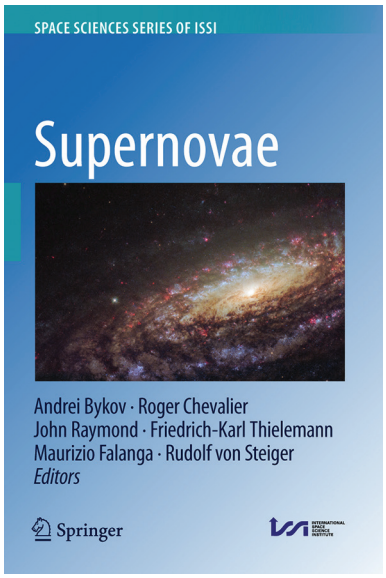

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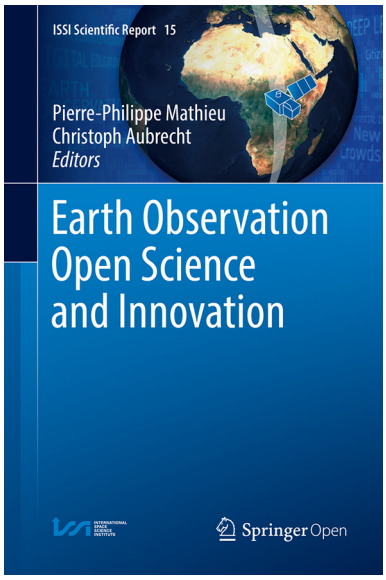

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