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1. Message from the International Astronautical Federation (IAF)

The 73rd International Astronautical Congress — IAC 2022 — will take place in the beautiful city of Paris, France. It will be hosted by the Centre National d’Études Spatiales (CNES), a member of IAF since 1981. Paris hosted the first IAC ever in 1950, then again in 1963 and in 1982. With the congress in 2022, Paris will hold the record for hosting the IAC four times. Exceptionally, the IAC 2022 will be organized from Sunday until Thursday, 18–22 September at the Paris Convention Center.

With the theme Space for All, the IAC 2022 looks forward to reach beyond the space community and bring together all communities that could benefit from space and offer them opportunities for networking and forging new contacts and potential partnerships. Side by side, the IAF and CNES are working intensively to make the IAC the place-to-be for all communities to gather and reflect on the rapidly increasing global ecosystem; and to connect the global space community with flourishing start-ups, entrepreneurs, research organizations and manufacturers from all sectors to exchange ideas and showcase their own achievements.

Special attention will be paid to students and young professionals, who will be closely involved through dedicated events. Of course, the general public will not be forgotten, as space-themed conferences and exhibitions will accompany the congress.

With the dedicated support of our host, our partner organizations as well as all the volunteers involved, I am confident that the IAC 2022 in the historic city of Paris will mark an important step into the expansion of this one-of-a-kind space gathering. On behalf of the International Astronautical Federation, I wish you all a safe and fruitful year 2022 and I look forward to meeting you next year for the IAC 2022 in Paris.

I look forward to seeing you in Dubai, UAE.

Pascale Ehrenfreund
President,
International Astronautical Federation (IAF),
France

2. Message from the Local Organizing Committee

The International Astronautical Congress (IAC) — the world's largest space conference — is coming to Paris, France from Sunday 18 to Thursday 22 September 2022 (please note that the congress will start on a Sunday). It is with great pleasure that we invite you to be a part of this event by submitting your abstracts for the 73rd edition of the IAC. After a few years of limited travel due to restrictions induced by the COVID19 pandemic, the IAC in 2022 will be more than ever the ideal platform to showcase your latest research, your innovations and your vision to the global space community. Each year, the Congress attracts high profile representatives from the global space sector, including top space agency officials, policymakers, scientists, and experts in the space and technology sectors.

The IAC is the place to share information, it facilitates the exchange of insights and ideas, it fosters the creation of new partnerships and collaborations. And for the very first time for an IAC, the Paris edition is intended to be an environmentally responsible event (ISO 20121), in line with CNES sustainable development strategy. We are very much looking forward to welcoming you in Paris.

France is one of the world's most visited countries, it is easily accessible for delegates from all nations, offering an impressive range of opportunities for social and cultural activities and events. Paris has a wealth of world renowned museums and monuments that attracts thousands of international visitors every year.

France is also one of the world's leading countries for space activities. From the first flights of Ariane more than 40 years ago to the recent success of SuperCam on the NASA's Mars Perseverance Rover, the French space community has conceived, designed and developed innovative space solutions, and is supporting the nation's most prestigious missions, notably in the field of Earth science and environment monitoring. The year leading to IAC 2022 will be marked by major milestones such as the end of the Alpha mission of the French space agency CNES on the International Space Station, the launch of the James Webb Space Telescope from Kourou in French Guiana on an Ariane 5 rocket, and the launch of ESA's ExoMars and JUICE missions, respectively to Mars and Jupiter. These and emerging space technologies. This forum will provide participants with a holistic and up-to-date view of science, engineering and space technology and offer an access to space knowledge for professionals and experts from around the world. IAC 2022 presents an opportunity to highlight the evolutionary role of international partnerships in exploration, research, and development. It is a time when participants will envision the discoveries to be made and the knowledge to be gained by preparing the future together. Participating in the IAC 2022 will enrich the youth’s knowledge in space science and technology. It will act as an accelerator for STEM education and will be a source of enormous pride and inspiration for the ambitious younger generations.

In addition to the more than 5,000 leading figures in the international space industry from 70 countries, the Paris IAC 2022 will encourage participation from users and partners from other sectors not belonging to the space community, according to the motto “Space for All”. The year 2022 will be a significant symbol for France as it is both the year of the celebrations of the 60th anniversary of CNES and the year it hosts the International Astronautical Congress (IAC), the largest specialized gathering in the space sector worldwide. Space has become an essential asset for society. Major topics such as the evolution of access to orbit, the build-up of large constellations and associated sustainability issues, the need to monitor Earth and climate change from space, and the amazing roadmap of human and robotic exploration missions for the next decade will no doubt inspire a very exciting panel presentations to the conference. We hope you take the opportunity to contribute in one or more of the 180 technical sessions to present your research and network with colleagues working within your field. All abstracts will be peer reviewed, and a limited number of papers will be selected as oral or interactive presentations. We are looking forward to receiving your contribution to be presented at IAC 2022 in Paris.

We firmly believe that your participation in IAC 2022 in Paris will make a significant contribution to the accelerated transfer of space technologies and future projects which can be further enriched in 2023 when the IAC is held in Baku, Azerbaijan. Returning to the city where it was first hosted 50 years ago, the IAC 2023 in Baku will bridge the gap between the established and emerging space nations and encourage the latter to get more involved in space-related activities.

We invite you to join us at the IAC 2022 and help us in making this an unparalleled experience.

3. Message from the International Programme Committee (IPC) Co-Chairs

On behalf of the International Programme Committee, it is a great pleasure to invite you to submit an abstract for the 73rd International Astronautical Congress IAC 2022 that will be held in Paris, France. The IAC brings scientists, practitioners, engineers, leaders of space industry and agencies together in a single forum to discuss recent research breakthroughs, technical advances, cooperation opportunities and emerging space technologies. This forum will provide participants with a holistic and up-to-date view of science, engineering and space technology and offer an access to space knowledge for professionals and experts from around the world. IAC 2022 presents an opportunity to highlight the evolutionary role of international partnerships in exploration, research, and development. It is a time when participants will envision the discoveries to be made and the knowledge to be gained by preparing the future together. Participating in the IAC 2022 will enrich the youth’s knowledge in space science and technology. It will act as an accelerator for STEM education and will be a source of enormous pride and inspiration for the ambitious younger generations.

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Pierre Bousquet
IPC Co-Chair,
Senior Expert Planetaryology,
Centre National d’Études Spatiales (CNES),
France

Dunay Badirkhanov
IPC Co-Chair,
Vice-chairman/CTO,
Azercosmos, Azerbaijan
4. Messages from the Partner Organizations

**Message from the International Academy of Astronautics**

For well over the past sixty years the International Academy of Astronautics, created at the outset of a new Space Age, has provided answers and solutions to the immense challenges that have faced the world community. This has made it a foremost center of excellence in Astronautics, thanks to the concerted efforts of its dedicated members who developed its vision for the role of humankind in Space.

Aiming to mobilize the best talents from many fields of science and technology, the Academy has been most successful in developing a wide array of new activities to explore the unlimited possibilities of Space to improve the quality of life for people all over the world. Decades of continuous progress have been achieved through important international events such as the highly successful Summits in Washington DC and Mexico attended by 25 to 35 Heads of Space Agencies, as well as nearly 25 standalone IAA conferences in the world and 13 symposia each year at the International Astronautical Congress.

The International Academy of Astronautics (IAA) is pleased to invite you to attend the IAA Academy Day open meeting on Sunday and the various IAA symposia throughout the week. The Academy is organizing 13 symposia at next year’s IAC in Paris, France, representing about one third of the IAC technical program, and will co-host some interesting sessions with the IAF and the IISL. On the occasion of the Academy Day, newly elected Academicians will be introduced and the major IAA Awards will be given.

Please join us in advancing humankind’s reach into the Space frontier!

**John Schumacher**
President, International Academy of Astronautics (IAA)

**Message from the International Institute of Space Law**

On behalf of the International Institute of Space Law, I am pleased to invite you to attend our 65th Colloquium on the Law of Outer Space in Paris, France. This year’s Colloquium consists of seven exciting sessions and explores a range of highly relevant issues. Relevant legal questions raised by current public and private space activities will be addressed and debated by the world’s finest space lawyers as well as students and young professionals. IISL will also co-host some interesting sessions with the IAA and the IISL. On the occasion of the Academy Day, newly elected Academicians will be introduced and the major IAA Awards will be given.

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We are greatly looking forward to welcoming you in Paris!

**Harriet Brettle**
Chair, Space Generation Advisory Council (SGAC)

**Anthony Yuen**
Co-Chair, Space Generation Advisory Council (SGAC)

**Message from the Space Generation Advisory Council (SGAC)**

On behalf of SGAC, we are pleased to invite you to the 20th Space Generation Congress (SGC) to be held in Paris, France during September 14-16, 2022 prior to the 73rd International Astronautical Congress (IAC). As the only event of this kind, the Space Generation Congress offers the next generation of space leaders the opportunity to network and to examine critical questions that are facing the space and international community at large.

It is a great pleasure to invite our global youth community to submit an abstract for the 73rd International Astronautical Congress IAC 2022 that will be held in Paris, France. The IAC is an initiative to bring scientists, practitioners, engineers and leaders of space industry and agencies together in a single platform to discuss recent research breakthroughs, technical advances and existing opportunities.

We are looking forward to welcoming you to Paris!

**Harriet Brettle**
Chair, Space Generation Advisory Council (SGAC)

**Anthony Yuen**
Co-Chair, Space Generation Advisory Council (SGAC)
5. International Astronautical Federation (IAF)

Founded in 1951, the International Astronautical Federation is the world’s leading space advocacy body. The IAF has more than 407 members from 73 countries, including all leading space agencies, companies, societies, associations and institutes worldwide.

Following its theme - “A space-faring world cooperating for the benefit of humanity” and its motto “Connecting #GlobalSpace People” – the Federation advances knowledge about space and fosters the development and application of space assets by advancing global cooperation.

As organizer of the annual International Astronautical Congress (IAC), and other meetings on specific subjects, the IAF actively encourages the development of space for peaceful purposes and supports the dissemination of scientific and technical information related to space.

International Astronautical Federation
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Website: www.iafastronauts.org

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Glenda Marie Bertoldi, Deputy Executive Director
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Myriam Morabet, Senior Projects Manager
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Stefano Persiani, Projects Manager

Michel Arnaud, IAF Co-Chairs Advisor (Volunteer)
Elona Feichtinger, Projects Manager and Special Advisor (Volunteer)

IAF Member Organizations 2021

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Adriatic Aerospace Association
Advanced Instrumentation and Technology Centre (AITC)
Aerogel Rocketdyne
Aerospace Industries Association
Aerospace Research Institute
Ana Aerospace LLC
Agencia Espacial Argentina
Argus
Agrupacion Astronautica Espanola
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Airbus Defence and Space
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American Institute of Aeronautics and Astronautics (AIAA)
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ArianeGroup SAS
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Association Aerospatiale et Astronautique de France (AAFAF)
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The International Academy of Astronautics is a community of leading experts committed to expanding the frontiers of space, the newest realm of human activity. To foster the development of astronautics, the Academy undertakes a number of activities, including the recognition of outstanding contributors through elections and awards. It also facilitates professional communication, develops and promotes new ideas and initiatives, engages the public and fosters a sense of community among the members. The IAA is a unique independent non-governmental organization established in 1960 and recognized by the United Nations in 1996. It is an honorary society with an action agenda. With about 1200 elected members and corresponding members from 91 nations, the International Academy of Astronautics works closely with space agencies, industry, the academic community and the national science and engineering academies to determine needs and objectives and to help shape policy and forge cooperation by means of studies, position papers, conferences and publications. The IAA has published more than 70 studies to date and is engaged in the preparation of about 40 others. The Academy also publishes four book series and its journal Acta Astronautica ranked 1st in the space area in the world and containing each year about 3500 refereed papers. The Academy organizes about 25 conferences and regional meetings per year focused on the development and promotion of all space activities and covering all continents including space developing countries. In addition, the Academy activity also includes, in cooperation with the International Astronautical Federation and the International Institute of Space Law, the traditional contribution to the International Astronautical Congress (IAC), where the Academy organizes 13 symposia. The Academy also continues to enjoy its participation in the COSPAR Assemblies and the International Society for Photogrammetry and Remote Sensing (ISPRS) congress. Although the IAA has many connections to these and other similar organizations, it is distinctive as the only International Academy of elected members in the broad area of astronautics and space.

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Phone: 33 (0)1 47 23 82 15
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Website: www.iaaspace.org

7. International Institute of Space Law (IISL)

Founded in 1960, the International Institute of Space Law (IISL) is an independent non-governmental organization dedicated to fostering the field of space law. The membership of the Institute is composed of individuals and institutions from more than forty countries, elected on the basis of their contributions to the field of space law or other social sciences related to space activities. Additionally, prospective membership is open to students and young professionals with a demonstrated interest in space law.

Since 1992, the IISL has organized the annual Manfred Lachs Space Law Moot Court Competition. The competition is based on a hypothetical space law case, and is written by IISL members. Approximately sixty student teams from universities in Africa, the Asia Pacific, Europe, and North America participate. The competition is an important part of the organization’s outreach programme, and is its principal mechanism for engaging future generations of space law experts. The regional champions compete in the World Finals, which take place at the IAC and are judged each year by judges of the International Court of Justice.

This unique feature makes the Manfred Lachs Moot Court one of the most prestigious moot court competitions in the world.

ISL Board of Directors 2021 - 2022

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8. The Space Generation Advisory Council (SGAC)

The Space Generation Advisory Council in Support of the United Nations Programme on Space Applications is a global nongovernmental, non-profit (US 501(c)3) organization and network which aims to represent university students and young space professionals aged 18-35 to the United Nations, space agencies, industry, and academia. Headquartered in Vienna, Austria, the SGAC network of members, volunteers and alumni has grown to more than 16000 members representing more than 168 countries.

SGAC was conceived at UNISPACE III in 1999, as part of the Vienna Declaration, “To create a council to support the United Nations Committee on the Peaceful Uses of Outer Space, through raising awareness and exchange of fresh ideas by youth. The vision is to employ the creativity in advancing humanity through peaceful uses of space”. SGAC holds Permanent Observer status at the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) and regularly takes part in the annual meeting, as well as its Legal and Scientific and Technical Subcommittees. SGAC holds consultative status at the United Nations Economic and Social Council (UN ECOSOC), contributing to discussions on the role of space in achieving the UN Sustainable Development Goals.

As a volunteer-run organization, SGAC believes in empowering its members and providing them with opportunities for professional development through roles in the SGAC teams.

Further information regarding SGAC can be found at: www.spacegeneration.org

9. Message from the IAF Vice President for Technical Activities

The International Programme Committee is pleased to invite you to submit an abstract for consideration for the 73rd International Astronautical Congress to be held in Paris, France from 18 to 22 September 2022. The Congress is organized by the International Astronautical Federation (IAF), hosted by the Centre National d’Études Spatiales (CNES), and will be supported by the International Academy of Astronautics (IAA), the International Institute of Space Law (IISL) and the Space Generation Advisory Council (SGAC) who contribute to the IAC through their particular events and symposia.

Join the global space community at this exciting international gathering – and play an active role in the Technical Programme by presenting your recent work. Submitted abstracts can be considered for oral presentations (as ‘Short Talks’ in the Symposia) and for interactive presentations.

The theme of the Congress – “Space for All” – has been formulated broadly to make this IAC an outstanding occasion to bring together all space communities, alongside the burgeoning global ecosystem and start-ups, entrepreneurs, laboratories, research scientists and manufacturers that could get involved in space activities or benefit from them. This is reflected in the abstract topics, which can be viewed in this first announcement of the Call for Abstracts.

This “Call for Abstracts” is a precursor to a subsequent submission of a final paper, which may be presented at the 73rd IAC. Authors are invited to submit an abstract regarding an original, unpublished paper that has not been submitted in any other forum. Abstracts must fit into one of the following IAC categories: Science and Exploration; Applications and Operations; Technology; Infrastructure; Space and Society. Abstracts must be written in English and the length shall not exceed 400 words. Tables or drawings are not allowed in the abstract. Submit your abstract through the online IAF portal at https://iafastro.directory/iac/account/login/ no later than 28 February 2022.

Submitted abstracts will be evaluated by the Session Chairs on the basis of technical quality and relevance to the session topics. Selected abstracts may be chosen for oral or interactive presentation. Any such choice is not an indication of quality of the submitted abstract. Accepted abstracts will be displayed on the Congress website and published in the IAC Congress Proceedings.

We look forward to receiving your abstracts for IAC 2022 and please check the IAF website regularly to get the latest updates on the Technical Programme!
I. Introduction

This session focuses on medical care for astronauts including operational medicine aspects, countermeasure development and applications, as well as needs for future care systems sustaining missions, including life, microgravity, space exploration, space debris, near-earth objects and SETI

Co-Chairs

Inessa Kozlovskaya
Coordinators

Institut de Biomedical Problems, Russian Academy of Sciences — RUSSIAN FEDERATION

Aichi Medical University — JAPAN

Co-Chairs

Oleg Ovchinnikov
Center National d'Etudes Spatiales (CNES) — FRANCE

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)

Rapporteur

Raffaele Savino
National Micrograv...
A3.2C Moon Exploration – Part 3
This session will address current and future lunar missions. The sessions will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilization and preparatory activities for future solar system exploration.

Co-Chairs
- Bernard Fong (United States: Lawrence Livermore National Laboratory, USA)

Rapporteur
- David Kranzberger (National Aeronautics and Space Administration (NASA), Playa Vista, USA)

A3.3A Mars Exploration – Missions Current and Future
This session covers robotic missions to Mars and the ongoing Mars exploration program. This session will cover current results from ongoing Mars missions and the design for proposed Mars missions.

Co-Chairs
- Victor Argás (Instituto de Ciencias de la Tierra, Spain, Spain)
- Amada Gómez Fiá (Polytechnic of Madrid, Spain)

Rapporteur
- David Kranzberger (National Aeronautics and Space Administration (NASA), Playa Vista, USA)

A3.3B Mars Exploration – Science, Instruments and Technologies
This session covers robotic missions to Mars and the ongoing Mars exploration program. This session will cover current results from ongoing Mars missions and the design for proposed Mars missions.

Co-Chairs
- Victor Argás (Instituto de Ciencias de la Tierra, Spain, Spain)
- Amada Gómez Fiá (Polytechnic of Madrid, Spain)

Rapporteur
- David Kranzberger (National Aeronautics and Space Administration (NASA), Playa Vista, USA)

A3.4A Small Bodies Missions and Technologies (Part 1)
This session covers robotic missions to small bodies. This session will cover current results from ongoing small body missions and the design for proposed small body missions.

Co-Chairs
- Susan McEwen (University of Leicester, UK, UK)
- Stephen Ufford (Space Technology (Ireland) Ltd, Ireland)

Rapporteur
- Marc D. Rayman (NASA Jet Propulsion Laboratory, USA)

A3.4B Small Bodies Missions and Technologies (Part 2)
This session will cover the missions and technological aspects related to the exploration of small bodies including a search for pre-biotic signatures.

Co-Chairs
- Stephen Ufford (Space Technology (Ireland) Ltd, Ireland)
- Susan McEwen (University of Leicester, UK, UK)

Rapporteur
- Marc D. Rayman (NASA Jet Propulsion Laboratory, USA)

A3.5 Solar System Exploration including Ocean Worlds
This session covers robotic missions to Solar System Exploration including ocean worlds and small planetary objects, and space plasma physics except the Earth, Moon, Mars, and small planetary systems. This session will present the missions and technological aspects related to the exploration of ocean worlds (Enceladus, Europa, Titan) is sought. Papers covering both new missions concepts as well as the associated specific technologies are invited.

Co-Chairs
- Jérôme Laveder (CNES, France)

Rapporteur
- Marc D. Rayman (NASA Jet Propulsion Laboratory, USA)

A3.1 Space Exploration Overview
This session covers Space Exploration strategies and architectures, as well as technology roadmaps. Papers of both national and international perspectives are invited, as are papers dealing with the emerging area of commercial space exploration activities.

Co-Chairs
- Christoph Stahlbanger (Canadensys Aerospace Corporation, Canada)
- Bernd Fong (Space Technology (Ireland) Ltd, Ireland)

Rapporteur
- Norbert Frischauf (Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany)

A3.2A Moon Exploration – Part 1
This session will address current and future lunar missions. The sessions will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilization and preparatory activities for future solar system exploration.

Co-Chairs
- Bernd Fong (Space Technology (Ireland) Ltd, Ireland)

Rapporteur
- Peter H. Reed (National Aeronautics and Space Administration (NASA), Playa Vista, USA)

A3.2B Moon Exploration – Part 2
This session will address current and future lunar missions. The sessions will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilization and preparatory activities for future solar system exploration.

Co-Chairs
- Bernd Fong (Space Technology (Ireland) Ltd, Ireland)

Rapporteur
- Peter H. Reed (National Aeronautics and Space Administration (NASA), Playa Vista, USA)
A4
51st IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – THE NEXT STEPS
This symposium, organized by the International Academy of Astronautics (IAA), deals with the scientific, technological and philosophical aspects of the search for Extraterrestrial Intelligence (SETI) including a discussion of all kinds of contacts. The technical list is not limited to extraterrestrial, includes also optical and any kinds of radars. The inter-disciplinary aspects include all relevant implications, risk communication and philosophical considerations of any kind of discovery or contact.

Co-Chairs
Claudio Maccone
Istituto Nazionale di Astrofisica (INAF) — ITALY

A5.1 Human Exploration of the Moon and Cislunar Space
This session will examine the scenarios and infrastructure required to support human exploration of the Moon and Cislunar space. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Nuwan Galle[
Candem Aerospace Corporation — CANADA

A5.2 Human Exploration of Mars
This session will examine the scenarios and infrastructure required to support human exploration of Mars and the moons of Mars. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Maria Antonietta Perini
Ottawa Space Science — ITALY

A5.3 Human and Robotic Partnerships in Exploration - Joint session of the IAF Human Spaceflight and IAF Exploration Symposia
This session will discuss the technologies for current human spaceflight and exploration programmes, and the role of human and robotic partnership in space missions such as asteroid missions, habitat / infrastructure construction, human space mobility systems (e.g. ULA, NASA, ISDEA); and robots/pursuing asteroids to human spaceflight for test, validation, and demonstration purposes. The session also welcomes papers concerning advanced technologies of humans, machines and intelligent systems that are likely to be used in the coming years and the corresponding impact on complex mission design, implementation, and operations.

Co-Chairs
Christian Schilling[
Candem Aerospace Corporation — CANADA

A5.4 Space Transportation Solutions for Deep Space Missions
This session is focused on issues in space transportation capabilities and mission architectures, existing and under study, for human deep space exploration missions as well as in the science and robotic mission areas. Related enabling and support systems, such as robotic servicing and supply, and as well as technology roadways to achieve successful deep space exploration missions shall be discussed. The session will also deal with lessons learned from past deep space missions benefited as well as worldwide needs, requirements, and international cooperation to implement large scale exploration missions.

Co-Chairs
René Vecchiett[
Raytheon Inmarsat Aerospace Systems — ITALY

A5.5 Interactive Presentations - 25th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of SETI addressed in the Agenda. The session will be held in a digital format and available for view by all Congress attendees for the entire Congress week. In addition, as an effort to extend the discussion for the audience, the authors will be invited to submit a presentation for the interactive presentation to share their ideas.

Co-Chairs
Christine Kollinger[
Candem Aerospace Corporation — CANADA

A6.1 Human Exploration of the Moon and Cislunar Space
This session will examine the scenarios and infrastructure required to support human exploration of the Moon and Cislunar space. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Christophe Bonard[
Centre National d’Etudes Spatiales (CNES) — FRANCE

A6.2 Human Exploration of Mars
This session will discuss the technologies for current human spaceflight and exploration programmes, and the role of human and robotic partnership in space missions such as asteroid missions, habitat / infrastructure construction, human space mobility systems (e.g. ULA, NASA, ISDEA); and robots/pursuing asteroids to human spaceflight for test, validation, and demonstration purposes. The session also welcomes papers concerning advanced technologies of humans, machines and intelligent systems that are likely to be used in the coming years and the corresponding impact on complex mission design, implementation, and operations.

Co-Chairs
Christian Schilling[
Candem Aerospace Corporation — CANADA

A6.3 Impact-Induced Misfortunes and Risk Assessment
This session intends to present the role of meteoroid and space debris impacts on spacecraft missions, with special emphasis on the mitigation strategies and impact of debris on missions. The session will address the role of mitigation strategies, risk assessment, and post-mission disposal and active removal techniques.

Co-Chairs
Mark A. Skinner[
The Aerospace Corporation — UNITED STATES

A6.4 Mitigation – Tools, Techniques and Challenges - SEM
This session is focused on the Mitigation part of the SEM (Space Environment Monitoring), implementation of debris prevention and reduction measures; vehicle passive protection strategies for impact survivability studies and operating system faults; advancements for impact survivability studies and operating system faults. The session also addresses new missions and technologies for better understanding of the space environment, and the assessment in space and on the ground, re-entry, hypervelocity impacts and protection, mitigation and standards, post-mission disposal, remediation, debris removal, space debris, collision avoidance and on-orbit technologies associated to space debris domain dominated environment.

Co-Chairs
Christian Schilling[
Candem Aerospace Corporation — CANADA

A6.5 Post Mission Disposal and Space Debris Removal 1 - SEM
This session will focus on the Post-Mission disposal of Space Objects, including Active Debris Removal, (SDR, LEO), orbit control and tracking (OCT), orbital decay and deorbiting of Space Objects, and Space Debris Removal by Active and Passive Means. The session will address the role of mitigation strategies, risk assessment, and post-mission disposal and active removal techniques for space debris and space debris mitigation.

Co-Chairs
Mark A. Skinner[
The Aerospace Corporation — UNITED STATES

A6.6 Post Mission Disposal and Space Debris Removal 2 - SEM
This session will focus on the Post-Mission disposal of Space Objects, including Active Debris Removal, (SDR, LEO), orbit control and tracking (OCT), orbital decay and deorbiting of Space Objects, and Space Debris Removal by Active and Passive Means. The session will address the role of mitigation strategies, risk assessment, and post-mission disposal and active removal techniques for space debris and space debris mitigation.

Co-Chairs
Mark A. Skinner[
The Aerospace Corporation — UNITED STATES

A6.7 Operations in Space Debris Environment, Situational Awareness - SSA
This session will address the role of situational awareness, orbit determination, data aggregation from different sources, relevant data exchanges standards and co-operation analyses.

Co-Chairs
Vincent Martinot[
Centre National d’Etudes Spatiales (CNES) — FRANCE

A6.8 Space Debris, operational observations, orbit determination, catalogue build-up and maintenance, data aggregation from different sources, relevant data exchanges standards and co-operation analyses.

Co-Chairs
Vincent Martinot[
Centre National d’Etudes Spatiales (CNES) — FRANCE

A6.9 Operations in Space Debris Environment, Situational Awareness - SSA
This session will address the role of situational awareness, orbit determination, data aggregation from different sources, relevant data exchanges standards and co-operation analyses.

Co-Chairs
Vincent Martinot[
Centre National d’Etudes Spatiales (CNES) — FRANCE

A7.1 THIRTY-FIRST IAA SYMPOSIUM ON SPACE DEBRIS
This symposium, organized by the International Academy of Astronautics (IAA), will address the complex issues of space debris, including orbital debris, operational debris, and orbital debris reduction. It will cover every aspect of space environment monitoring and mitigation, risk management, and debris removal. Papers are invited to cover topics such as risk assessment and management, track data, debris object characterization, debris removal, debris mitigation, collisions avoidance in space and on the ground, re-entry, hypervelocity impacts and protection, mitigation and standards, post-mission disposal, remediation, debris removal, space debris, collision avoidance, as well as on-orbit technologies associated to space debris domain dominated environment.

Co-Chairs
Christian Schilling[
Candem Aerospace Corporation — CANADA

A7.2 IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM
This symposium, organized by the International Academy of Astronautics (IAA), covers the strategic plans, architectural concepts and technology development for future human exploration of the Moon, Mars, Lagrange Points and NPOs and international cooperation to implement large scale exploration missions. The symposium will examine the current plans for the exploration of the Moon and Cislunar space. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Claudio Maccone
Istituto Nazionale di Astrofisica (INAF) — ITALY

A7.3 IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – THE NEXT STEPS
This symposium, organized by the International Academy of Astronautics (IAA), covers the strategic plans, architectural concepts and technology development for future human exploration of the Moon, Mars, Lagrange Points and NPOs. The symposium will examine the current plans for the exploration of the Moon and Cislunar space. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Claudio Maccone
Istituto Nazionale di Astrofisica (INAF) — ITALY

A8.1 Human Exploration of the Moon and Cislunar Space
This session will examine the scenarios and infrastructure required to support human exploration of the Moon and Cislunar space. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Nuwan Galle[
Candem Aerospace Corporation — CANADA

A8.2 Human Exploration of Mars
This session will examine the scenarios and infrastructure required to support human exploration of Mars and the moons of Mars. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation.

Co-Chairs
Maria Antonietta Perini
Ottawa Space Science — ITALY

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This session intends to present the role of meteoroid and space debris impacts on spacecraft missions, with special emphasis on the mitigation strategies and impact of debris on missions. The session will address the role of mitigation strategies, risk assessment, and post-mission disposal and active removal techniques.

Co-Chairs
Mark A. Skinner[
The Aerospace Corporation — UNITED STATES

A8.4 Mitigation – Tools, Techniques and Challenges - SEM
This session is focused on the Mitigation part of the SEM (Space Environment Monitoring), implementation of debris prevention and reduction measures; vehicle passive protection strategies for impact survivability studies and operating system faults; advancements for impact survivability studies and operating system faults. The session also addresses new missions and technologies for better understanding of the space environment, and the assessment in space and on the ground, re-entry, hypervelocity impacts and protection, mitigation and standards, post-mission disposal, remediation, debris removal, space debris, collision avoidance and on-orbit technologies associated to space debris domain dominated environment.

Co-Chairs
Christian Schilling[
Candem Aerospace Corporation — CANADA
A6.9 Orbit Determination and Propagation - SST

This session will address every aspect of orbit determination coming from the SST (Space Surveillance and Tracking), related to assessment of raw and derived data accuracy, optimal measurements processing and modeling and risk analysis of space debris.

A6.10 Joint Near Earth Objects / Space debris Session

This symposium, organized by the International Astronautical Federation (IAF), will address all topics related to planetary defense from near-Earth objects (NEOs), including remote observation, characterization, modeling and simulation, and methods for mitigating the effects of an impacting asteroid or comet. Additionally, synergistic aspects of investigation, such as space debris mitigation, asteroid mining, and robotic exploration of these near-Earth objects are particularly welcome. Lessons learned and advances in fields that may be applicable to planetary defense and risk assessment will also be considered. The symposium will also be open to contributions on the legal and policy aspects associated with planetary defense.

A6.11 Future Earth Observation Systems

This symposium, organized by the International Astronautical Federation (IAF), will address all topics related to planetary defense from near-Earth objects (NEOs), including remote observation, characterization, modeling and simulation, and methods for mitigating the effects of an impacting asteroid or comet. Additionally, synergistic aspects of investigation, such as space debris mitigation, asteroid mining, and robotic exploration of these near-Earth objects are particularly welcome. Lessons learned and advances in fields that may be applicable to planetary defense and risk assessment will also be considered. The symposium will also be open to contributions on the legal and policy aspects associated with planetary defense.

A7 IAF SYMPOSIUM ON ONGOING AND NEAR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS

The Symposium, organized by the International Astronautical Federation (IAF), invites leaders from the science, space operations and space agencies communities to share information, analysis and perspectives on upcoming and near future endeavors. The Symposium will incorporate both oral sessions and contributed papers, and will be a valuable forum for science and policy makers to share views, and for the community to exchange ideas and explore technical and policy issues. The Symposium will feature presentations and interactive discussions on current and future space science missions, with an emphasis on the scientific and technological advances that are expected to be achieved.

A7.1 Space News and Dissemination

The Symposium is open to everyone who is involved in space science and technology. The Symposium will provide a platform for the exchange of ideas and information on current and upcoming space science missions, and will be a valuable forum for the community to share views and ideas.

A7.2 Science Goals and Drivers for Future Exoplanet, Space Astronomy and Space Science

The session will focus on the scientific goals and drivers for future exoplanet, space astronomy and space science missions. The session will cover a range of topics, including the discovery of exoplanets, the characterization of exoplanet atmospheres, and the study of the fundamental physics of exoplanets.

A7.3 Technology Needs for Future Missions, Systems, and Instruments

The session will focus on the technology needs for future space science missions. The session will cover a range of topics, including the development of new technologies, the integration of technologies, and the assessment of technology readiness.

A7.4 Interactive Presentations - IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SPACE PHYSICS

This symposium, organized by the International Astronautical Federation (IAF), invites leaders from the science, space operations and space agencies communities to share information, analysis and perspectives on upcoming and near future endeavors. The Symposium will incorporate both oral sessions and contributed papers, and will be a valuable forum for science and policy makers to share views, and for the community to exchange ideas and explore technical and policy issues. The Symposium will feature presentations and interactive discussions on current and future space science missions, with an emphasis on the scientific and technological advances that are expected to be achieved.

A8 Orbit Determination and Propagation - SST

This session will address every aspect of orbit determination coming from the SST (Space Surveillance and Tracking), related to assessment of raw and derived data accuracy, optimal measurements processing and modeling and risk analysis of space debris.
This session is focused on advances in space-based navigation systems and services, including the existing global systems (Beidou, Galileo, GLONASS, GPS) and regional systems (EGNOS, IRNSS, QZSS), as well as new systems/services, and systems modeling. It also includes space scenarios for new systems/services, and systems modeling.

**B.2.1 Earth Observation Applications, Societal Challenges and Economic Benefits**

The focus of this session is on recent Earth Observation data to generate information and services for meeting societal challenges, addressing socioeconomic benefits from the data or new commercial approaches for application of Earth Observation. Presentation of algorithm, processing, state and services including consideration of investment cost, economic return, and societal benefits, especially innovative innovative approaches, are encouraged. Optimized satellite constellations, which are not focus on individual techniques or single sensors but instead describe the socio-economic aspects of these collective systems, are also encouraged.

**B.2.2 Advances in Space-based Communication Systems and Services, Part 1**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.2.3 Advances in Space-based Communication Systems and Services, Part 2**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.5 Mitigating the Climate Crisis from Space**

The 2021 IPCC report on climate change issued several stark messages about Earth’s climate change – indisputably human caused, 2010–2020 was the hottest decade in 125,000 years, carbon dioxide concentrations are inrecorded greenhouse gas emissions are the trade cause, and climate events are occurring with increasing frequency in every region of the planet. Science depending on space-based observations played an essential role in these findings. Now and in the future, it will also play an essential role in mitigation. Presentations are welcomed with highest regard to the role of satellite-based earth observations in mitigating climate change including the results, ongoing investigations and plans. Topics include climate, weather, extremes, biomass, ecosystems, biodiversity, infrastructure, and urban safety, measures to reduce risk of climate change, and provision of information to inform societal decisions in the face of climate change.

**B.6 Advances in Space-based Navigation Systems, Services, and Applications**

The 2021 IPCC report on climate change issued several stark messages about Earth’s climate change – indisputably human caused, 2010–2020 was the hottest decade in 125,000 years, carbon dioxide concentrations are inrecorded greenhouse gas emissions are the trade cause, and climate events are occurring with increasing frequency in every region of the planet. Science depending on space-based observations played an essential role in these findings. Now and in the future, it will also play an essential role in mitigation. Presentations are welcomed with highest regard to the role of satellite-based earth observations in mitigating climate change including the results, ongoing investigations and plans. Topics include climate, weather, extremes, biomass, ecosystems, biodiversity, infrastructure, and urban safety, measures to reduce risk of climate change, and provision of information to inform societal decisions in the face of climate change.

**B.6.1 Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM**

This session is focused on advances in space-based navigation systems and services, including the existing global systems (Beidou, Galileo, GLONASS, GPS) and regional systems (EGNOS, IRNSS, QZSS), as well as new systems/services, and systems modeling. It also includes space scenarios for new systems/services, and systems modeling.

**B.6.2 Advances in Space-based Communication Systems and Services, Part 1**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.6.3 Advances in Space-based Communication Systems and Services, Part 2**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.7 Advances in Space-based Navigation Systems, Services, and Applications**

The 2021 IPCC report on climate change issued several stark messages about Earth’s climate change – indisputably human caused, 2010–2020 was the hottest decade in 125,000 years, carbon dioxide concentrations are inrecorded greenhouse gas emissions are the trade cause, and climate events are occurring with increasing frequency in every region of the planet. Science depending on space-based observations played an essential role in these findings. Now and in the future, it will also play an essential role in mitigation. Presentations are welcomed with highest regard to the role of satellite-based earth observations in mitigating climate change including the results, ongoing investigations and plans. Topics include climate, weather, extremes, biomass, ecosystems, biodiversity, infrastructure, and urban safety, measures to reduce risk of climate change, and provision of information to inform societal decisions in the face of climate change.

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**B.8 Space Communications and Navigation Global Technical Session**

B.2.1 Advances in Space-based Navigation Technologies

This session is focused on advances in space-based navigation systems. Technologies include hardware or software necessary for the entire navigation system (sensor, inertial and control system, end-user equipment) such as: sensors, star trackers, fusion algorithms, space-based frequency standards, crosslink ranging techniques, etc. Technologies should be applicable to positive determination, navigation, time determination, and integrity assurance on earth, moon, and potentially other bodies of the solar system.

**B.2.2 Advances in Space-based Communication Systems and Services, Part 1**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.2.3 Advances in Space-based Communication Systems and Services, Part 2**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.

**B.8.1 Space Communications and Navigation Global Technical Session**

A Global session to present and discuss developments in a wide range of satellite communication topics, including fixed, mobile, broadcast, and data relay technologies and services, as well as satellite-based positive determination, communication, and navigation. Both earth and occulted and near-Earth and interplanetary communication topics can be addressed. This session is co-sponsored by the Space Communications and Navigation Committee and the Worldwide Development/New Professionals Programme Committee.

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**B.2.3 Advances in Space-based Communication Systems and Services, Part 2**

This session is focused on new systems, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high throughput satellites (HTS) and low earth orbit satellites (LEO), end-to-end integration into satellite networks, for aircraft, marine and terrestrials, including enhanced frequencies and frequency bands communication (including quantum communication). VSAT/ESIM and software-defined networks technologies included are: system architecture, spectrum issues for new services, and services modeling.
B3.1 Commercial Human Space Programme
This session addresses the utilization and exploitation of space stations, spacecraft, and surface systems and provides the opportunity to discuss achievements, plans and outlooks. The session will address the current and future missions, applications and preparatory plans for human lunar and planetary exploration activities. The session covers human exploration of the Moon including its surface and cislunar space as well as Mars missions. Papers that delve into the programmatic and technical aspects of these activities are encouraged. Both national and international perspectives are invited as are emerging areas of commercial human exploration activities.

Co-Chairs
Kevin D. Foley, The Aerospace Corporation, Antelope, California, USA, and S. P. Korolev Rocket and Space Corporation "State Research Centre of Space Industry", Moscow, Russia

Rapporteur
Eleanor Morgan, Max Space, Inc., United States

B3.2 Small Satellite Operations
This session addresses the utilization and exploitation of space stations, spacecraft, and surface systems and provides the opportunity to discuss achievements, plans and outlooks. The session will address the current and near-term approved small/micro/nano missions whose objective is to achieve returns in the fields of Earth science, solar, interplanetary, planetary, geophysical, astronomical, and emerging and promising smallsat technologies and techniques. This symposium will accept submissions for oral presentations only.

Co-Chairs
Nathan Barden, Space Commercial Services Holdings Pty Ltd, Australia, and Peter Batenburg, Netherlands Space Society (NVR), The Netherlands

Rapporteur
Maria Grulich, Thales Alenia Space Italia, Italy

B3.3 Astronaut Training, Accommodation, and Operations in Space
This 19th Workshop on Small Satellite Programmes at the Service of Developing Countries is the third in a series of workshop held annually by the International Academy of Astronautics (IAA) in collaboration with the European Space Agency (ESA). The workshop is organized jointly by the United Nations Office for Outer Space Affairs (UNOOSA) and the International Academy of Astronautics (IAA). It shall review the needs that could be met and results achieved by developing countries through using small satellites. National space plans and manifestations of globalisation are inextricably linked, hence the importance of the workshop is to provide a forum for discussing opportunities and issues for the future of Human Space Endeavours. This is a Global session co-sponsored by the Human Space Endeavours Committee and the Workforce Development/Young Professionals Programme Committee.

Co-Chairs
Stephen Charles, Netherlands Space Society (NVR), The Netherlands, and Peter Batenburg, Netherlands Space Society (NVR), The Netherlands

Rapporteur
Andreas Hoving, University of Antwerp, Belgium

B3.4 Flight and Ground Operations aspects of Human Spaceflight - Joint Session of the IAF Human Spaceflight and Space Operations Symposium
This session addresses the utilization and exploitation of space stations, spacecraft, and surface systems and provides the opportunity to discuss achievements, plans and outlooks. The session will address the current and near-term approved small/micro/nano missions whose objective is to achieve returns in the fields of Earth science, solar, interplanetary, planetary, geophysical, astronomical, and emerging and promising smallsat technologies and techniques. This symposium will accept submissions for oral presentations only.

Co-Chairs
Nathan Barden, Space Commercial Services Holdings Pty Ltd, Australia, and Peter Batenburg, Netherlands Space Society (NVR), The Netherlands

Rapporteur
Maria Grulich, Thales Alenia Space Italia, Italy

B3.5 Human and Robotic Partnerships in Exploration - Joint Session of the IAF Human Spaceflight and Space Operations Symposium
This session addresses the utilization and exploitation of space stations, spacecraft, and surface systems and provides the opportunity to discuss achievements, plans and outlooks. The session will address the current and near-term approved small/micro/nano missions whose objective is to achieve returns in the fields of Earth science, solar, interplanetary, planetary, geophysical, astronomical, and emerging and promising smallsat technologies and techniques. This symposium will accept submissions for oral presentations only.

Co-Chairs
Nathan Barden, Space Commercial Services Holdings Pty Ltd, Australia, and Peter Batenburg, Netherlands Space Society (NVR), The Netherlands

Rapporteur
Maria Grulich, Thales Alenia Space Italia, Italy
**B4.4 Small Earth Observation Missions**

The call for papers that will present information to decision makers, scientists, engineers, and managers about cost-effective small satellite missions, instruments, technologies, and applications of both current and planned small earth observation missions. This session addresses the technologies, applications and missions tailored through the use of small satellites. The session also addresses the importance of technologies suitable for use on small satellites including those in the agile to multiple payloads range. Particularly encouraging satellite or technology development efforts that need to take advantage of current launch opportunities, such as the development space tourism market and commercial launch capacity, and significant projects for low cost access to space or future remote observation missions affordable to non-governmental organizations as well as traditional users. papers addressing these evolving opportunities would be welcomed.

**Chairman**

Elena M. Panina

**Co-Chairs**

Singapore Space and Technology Alliance (SSTA) — SINGAPORE, REPUBLIC OF

**Rekapport**

Singapore Space and Technology Alliance (SSTA) — SINGAPORE, REPUBLIC OF

**B4.5 Access to Space for Small Satellite Missions**

Any challenge facing the viability and growth of the small satellite community is affordable and reliable space access. Topics of interest for this session include the collection of dedicated launch providers, development of regional, auxiliary payload systems, and separation and dispenser systems, and cross-functional integrative approaches that will enable efficient and cost-effective access to space. Includes issues learned from uses of technical and procurement approaches. For a dedicated discussion of small satellite propulsion systems, please refer to section B4.5A-C6. For a discussion of small launches and concepts and operations, please refer to section G3.2.

**Chairman**

Yann Gerard

**Co-Chairs**

Athleta Defense & Space — FRANCE

**Rekapport**

Space Fence (UK) Ltd — UNITED KINGDOM

**B4.5A Generic Technologies for Small/Micro Platforms**

This session will cover the particular challenges of design, manufacture, testing, operation, and technologies developed for small satellite constellations, and the challenges of obtaining high performance within a small volume and mass. The scope includes electric and electric propulsion systems for small and large scale missions, high fuel control and mission design. The session will cover emerging innovations for small applications for small launchers, for parts, as an enabling stage with the satellite and in system design. The session also includes submitted conference papers on small satellite propulsion systems.

**Chairman**

Jeffrey Lindley

**Co-Chairs**

Aerospace Corporation — UNITED STATES

**Rekapport**

Aerospace Corporation — UNITED STATES

**B4.6 Generic Technologies for Nano/Pico Platforms**

This session covers emerging and promising generic technologies for small and micro platforms. Real-life examples are particularly encouraged, both recently launched and shortly to be launched (next 3 years).

**Chairman**

Philip Davies

**Co-Chairs**

Delft University of Technology (TU Delft) — THE NETHERLANDS

**Rekapport**

Delft University of Technology (TU Delft) — THE NETHERLANDS

**B4.7 Constellations and Distributed Systems**

Small satellite constellations are becoming an important advantage of new opportunities for implementing geographically distributed space-based systems (e.g. Constellations). In this session we focus on current, emerging, or enabling technologies that can be used or are being used to create connected networked data collection systems on small satellites. Specifically, session B4.7 focuses on Constellations (Constellations missions for both Earth-oriented, in-Space and end-to-end communications), distributed architectures (e.g. Distributed constellation) and sensor systems and how these novel and rapid deployment technologies offer the ability to fully utilize emerging nanosatellite projects, working in concert with traditional launchers and ground systems and eventually leading to a new paradigm of distributed system solutions. The session invites contributions that present new models and technologies for distributed systems, define the kind of data to be collected, how data are collected and how the data are integrated and distributed to address key user needs. The session invites contributions covering both technical and operational challenges. The session invites contributions on new models and technologies for distributed systems, define the kind of data to be collected, how data are collected and how the data are integrated and distributed to address key user needs.

**Chairman**

Hans van der Zee

**Co-Chair**

Jürgen Schmitt

**Rapporteur**

Jürgen Schmitt

**Rekapport**

Singapore Space and Technology Alliance (SSTA) — SINGAPORE, REPUBLIC OF

**B5 Small Satellite Missions Global Technical Session**

The Small Satellite Missions Global Technical Session (GTS) in collaboration with the International Academy of Astronautics (IAA) Small Satellite Missions Symposium and the International Astronautical Federation (IAF) Small Satellite Missions Programme Coordinator. This session is unique in that it allows for sharing of information on a global scale with presenters and audience both on the technical level and on the political level. Attendees are invited to discuss emerging trends, significant technologies and relevant policy issues of the small satellite community.

**Chairman**

Rainer Sandau

**Co-Chairs**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**Rekapport**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**B5.1 Tools and Technology in Support of Integrated Applications**

The session will focus on specific technologies, tools and technology in support of integrated applications by addressing the various issues associated with applications development. The session will feature selected papers on the development and implementation of new tools that address problems identified in previous sessions by the participants. The session will also provide an opportunity to discuss and present new developments in support of integrated applications and to explore future research and development trends.

**Chairman**

Robert J. McKnight

**Co-Chair**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**Rekapport**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**B5.2 Emerging Applications**

The session will feature selected papers on the development and implementation of new tools that address problems identified in previous sessions by the participants. The session will also provide an opportunity to discuss and present new developments in support of integrated applications and to explore future research and development trends.

**Chairman**

R. Jane Isely

**Co-Chair**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**Rekapport**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**B5.3 Internet of Things**

The session will feature selected papers on the development and implementation of new tools that address problems identified in previous sessions by the participants. The session will also provide an opportunity to discuss and present new developments in support of integrated applications and to explore future research and development trends.

**Chairman**

Steve C. De Graaf

**Co-Chair**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**Rekapport**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**B6 Space Systems and Operations**

Space systems are more and more involved in the delivery of global services to end users. Integrated Applications are built on the exploitation of space and terrestrial technologies for the benefit of the global population. The symposium will address various aspects of space-based downtown services with a special emphasis to the sustainable development of our planet in line with the objectives defined by the Sustainable Development Goals. Integrated applications combine data from remote sensing assets, such as satellite-related Internet of Things, and terrestrial networks. Satellite Navigation with airborne and ground-based systems, in addition to other technologies, such as big data, drones, analytics, IoT, 5G and others to deliver sustainable solutions and services to all the users' needs. The goal of the symposium is to discuss the different aspects of tools, technologies, and technologies, such as the space and terrestrial data to be collected, where are data collected and integrated, that can enable the development of end-to-end solutions.

**Chairman**

Larry Nash

**Co-Chair**

Robert C. Smith

**Rapporteur**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**Rekapport**

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

**B7 Constellations and Distributed Systems**

Small satellite constellations are becoming an important advantage of new opportunities for implementing geographically distributed space-based systems (e.g. Constellations). In this session we focus on current, emerging, or enabling technologies that can be used or are being used to create connected networked data collection systems on small satellites. Specifically, session B4.7 focuses on Constellations (Constellations missions for both Earth-oriented, in-Space and end-to-end communications), distributed architectures (e.g. Distributed constellation) and sensor systems and how these novel and rapid deployment technologies offer the ability to fully utilize emerging nanosatellite projects, working in concert with traditional launchers and ground systems and eventually leading to a new paradigm of distributed system solutions. The session invites contributions that present new models and technologies for distributed systems, define the kind of data to be collected, how data are collected and how the data are integrated and distributed to address key user needs. The session invites contributions covering both technical and operational challenges. The session invites contributions on new models and technologies for distributed systems, define the kind of data to be collected, how data are collected and how the data are integrated and distributed to address key user needs.?
85.2 Integrated Applications End-to-End Solutions
The session will offer a forum for end-to-end solutions, proof-of-concept applications and current projects that aim to provide innovative, and sustainable solutions that combine terrestrial and space-based data sources with models and other technologies to address specific user requirements. These examples can cover a variety of sectors, like disaster management, land use, environment, education, health services, water, utilities, etc. The user needs, the organization of the user communities, the user value chain, the business case and the societal impact of the solutions are among the many aspects that can be considered. Examples of projects with established partnerships between space and non-space stakeholders are appreciated. The different ways of assessing the impact of specific integrated applications in addressing the users’ stakeholders needs and requirements could also be discussed.

Co-Chairs
Boris Pense — GERMANY
Robert Steiger — SWITZERLAND
Beatrice Nenoni — SWITZERLAND

85.3 Satellite Commercial Applications
The emergence of “New Space” and satellite-based solutions has contributed to the rise of commercial satellite applications. There is an increasing demand for connectivity in several vertical markets such as agriculture, energy, transport and climate change. The latter presents a key role to increase productivity, meanwhile that the downstream market is evolving, new opportunity arises for the development of innovative solutions. This session invites talks pertinent to several areas such as the Commercial Space and SpaceCulture. A Commercial Space Model for Public use, Atmospheres, Oceans, Landscapes, and New Application Video Optics & Video SAR - New Application - Travellers - Outdoors, Automobiles, Yachts, General Aviation, Global communications; Commercializing data about the Earth, Care Analysis of Satellite Commercial Applications.

Co-Chairs
Prof. John Burn — UNITED KINGDOM
Dr. Derycke Yu — BELGIUM
Janard Nellore — UNITED STATES

86 IAF SPACE OPERATIONS SYMPOSIUM

The Space Operations Symposium, organized by the International Astronautical Federation (IAF), addresses all aspects of spaceflight operations. The session addresses both flight and surface operations. This symposium covers both flight and ground systems, and include mission planning, tracking, and real-time operations. Particular focus is provided for commercial space missions, advanced systems, new operations concepts, and small satellite operations.

86.1 Ground Operations - Systems and Solutions
This session focuses on all aspects of ground systems and solutions for all mission types, for both preparation and execution phases.

Co-Chairs
Jose Burges — UNITED STATES
Thierry Lecerf — FRANCE

86.2 New Space Operations Concepts and Advanced Systems
This session focuses on new space operations and addresses advanced concepts, systems and tools for operating new types of missions, improving mission output in quality and quantity, and reducing cost.

Co-Chairs
Mario Carini — ITALY
Thomas Koch — GERMANY
Yasuo Nagano — JAPAN

86.3 Mission Operations, Validation, Simulation and Training
This session addresses the broad topic of operations, from preparation through validation, simulation and training, including operations concepts, execution and lessons learned. This includes both flight and surface operations.

Co-Chairs
Arno Radtke — GERMANY
Jens Mauzer — SWITZERLAND
Matthias Buggeler — GERMANY

86.4 Flight & Ground Operations of HSF Systems - A Joint Session of the IAF Human Spaceflight and IAF Space Operations Symposia
This session addresses topics, advanced concepts, two challenges and their solutions related to flight and ground operations within governmental and commercial human spaceflight. Topics include among others; cutting-edge operational tools, solutions, efficient cost reduction measures, improved operational ground facilities or infrastructure, enhanced logistics concepts as well as new approaches for mission planning, ground transportation, and sustainment.

Co-Chairs
Dmitry Valiav — Russia
Antonio Pasco — Italy
Thomas A. Anderson — GERMANY

86.5 Joint Space Operations / Space Debris Session - STM Operations
This joint session will deal with many aspects of STM (Space Operations) and STM (Space Debris) to facilitate discussions between Space Operations and Space Debris communities for shared understanding of the challenges; issues in operating in a debris-rich environment. It deals with STM - Operations and security. Lessons learned from CSM operations, HST and PMR are especially welcome. Looking at the future, improved STM, automated STM, and huge coordination operations is 102 key challenges for the community and require the appropriate regulatory environment.

Co-Chairs
Dorina Michelotti — UNITED STATES
Hakan Turg — UNITED STATES
John Aukburg — UNITED STATES

86.6.1 Interactive Presentations - IAF SPACE OPERATIONS SYMPOSIUM
This session offers a unique opportunity to deliver your message in an interactive presentation on any of the subjects of Space Operations addressed in the classic sessions. The presenters will be displayed on a digital screen in a dedicated location and available for your questions during the entire week. In addition, one afternoon is dedicated exclusively for the attendees to view the Interactive Presentations, each author will be assigned a specific time where he can present live and interact with the attendees present. The Interactive Presentations may take advantage of all electronic display capabilities, such as; PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will be presented to the author of the best Interactive Presentation in the B Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

Co-Chairs
John Aukburg — UNITED STATES
Otfried Liepack — UNITED STATES

86.6.2 Guidance, Navigation, and Control (1)

Co-Chairs
A. Anilkumar — RUSSIAN FEDERATION
Jean de Lafontaine — FRANCE

C1 IAF ASTRODYNAMICS SYMPOSIUM

This symposium addresses a wide range of topics in astrodynamics, astrodynamics, guidance, navigation and control of space systems. The emphasis of this theme is on the studies and application related to the guidance, navigation and control of Earth-orbiting and interplanetary spacecraft, including formation flying, rendezvous and docking.

Co-Chairs
Daniel Schemels — Colorado State University — UNITED STATES
Andreas Ohndorf — University of Florida — UNITED STATES

C1.1 Attitude Dynamics (1)

Co-Chairs
Ralph Pfeifer — AIT, Austria
Andreas Ohndorf — University of Florida — UNITED STATES

C1.2 Attitude Dynamics (2)

Co-Chairs
Ralf Jahn — Technical University of Darmstadt — GERMANY
Stefan Kranz — University of Queensland — AUSTRALIA

C1.3 Guidance, Navigation and Control (1)

Co-Chairs
Linh Tran — University of Maryland — UNITED STATES
Alessandro Buta — University of Bologna — ITALY

C1.4 Guidance, Navigation and Control (2)

Co-Chairs
Matthew Barlow — University of Glamorgan — UNITED KINGDOM
Adnan Bajwa — University of California, San Diego — UNITED STATES

C1.5 Guidance, Navigation and Control (3)

Co-Chairs
Stefan Kranz — University of Queensland — AUSTRALIA
Michael Turner — University of California, San Diego — UNITED STATES

Category coordinated by John C. Mankins, ARTEMIS Innovation Management Solutions, LLC, UNITED STATES

TECHNOLOGY

Common technologies to space systems, including astrodynamics, structures, power and propulsion

C1 IAF ASTRODYNAMICS SYMPOSIUM

C2 IAF MATERIALS AND STRUCTURES SYMPOSIUM

C3 IAF SPACE POWER SYMPOSIUM

C4 IAF SPACE PROPULSION SYMPOSIUM

Category coordinated by John C. Mankins, ARTEMIS Innovation Management Solutions, LLC, UNITED STATES
C1.6 
**Mission Design, Operations & Optimization (1)**
The theme focuses on designs, operations, and optimization of both earth orbiting and interplanetary missions, with emphasis on studies and experiences related to current and future missions.

**C1.7**
**Orbital Dynamics (2)**
The theme focuses on designs, operations, and optimization of both earth orbiting and interplanetary missions, with emphasis on studies and experiences related to current and future missions.

**C1.8**
**Orbital Dynamics (1)**
The theme focuses on the knowledge of natural motions of objects in orbit around the earth, planets, minor bodies, Lagrangian points and more generally natural orbital dynamics of spacecraft in the solar system. It also covers advances in orbit determination.

**C1.9**
**Mission Design, Operations & Optimization (2)**
The theme focuses on the knowledge of natural motions of objects in orbit around the earth, planets, minor bodies, Lagrangian points and more generally natural orbital dynamics of spacecraft in the solar system. It also covers advances in orbit determination.

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**Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM**
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Astrodynamics addressed in the classical lectures. The interactive lectures are conducted in a format of a simple, but effective, face-to-face interaction with the audience. The participants are encouraged to actively participate in the discussion and engage with the presenters. This unique format provides an opportunity for direct interaction between the presenter and the audience, allowing for a more personalized and interactive experience. The session is designed to foster a dynamic exchange of ideas and to encourage active participation from all attendees.

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**C2**
**IAF MATERIALS AND STRUCTURES SYMPOSIUM**
This symposium, organized by the International Astronautical Federation (IAF), provides an international forum for recent advancements in the field of materials and structures, with a focus on the development and verification of space vehicle structures and systems. The symposium covers a wide range of topics, including advancements in materials applications and novel structural concepts in the rapid prototyping of space systems. Continuous improvements in materials and structural concepts are always needed to ensure the reliability and safety of space systems, especially in the context of evolving mission requirements and technological advancements.

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**C2.1**
**Space Structures I - Development and Verification (Space Vehicles and Components)**
The topics addressed in this session cover the development and verification of various aspects of space vehicle structures and systems. The session focuses on the development and verification of space vehicle structures and systems, including aspects such as design, materials, manufacturing, and testing. The session aims to provide a platform for discussing recent advancements and challenges in the field of space vehicle structures and systems.

**C2.2**
**Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures)**
The topics for this session will be on application of smart materials and systems to space applications, and novel technologies in the rapid prototyping of space systems. The session aims to provide a platform for discussing recent advancements and challenges in the field of space vehicle structures and systems.

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**Space Vehicles – Mechanical/Robotic/Thermal/Fluidic Systems**
This topic covers the development and verification of various aspects of space vehicle structures and systems. The session focuses on the development and verification of space vehicle structures and systems, including aspects such as design, materials, manufacturing, and testing. The session aims to provide a platform for discussing recent advancements and challenges in the field of space vehicle structures and systems.
C3.4 Space Power System for Ambitious Missions
This session focuses on space architectures and technologies enabling long-duration missions of human and robotic space exploration. It addresses new concepts and technologies such as advanced solar power systems, nuclear reactors, and novel architectures for power transmission and distribution.

C3.5 Joint Session on Advanced Nuclear Power and Propulsion Systems
This joint session combines the IAF Space Power and the IAF Propulsion Symposia, including papers addressing all aspects related to nuclear power and propulsion for space applications.

C3.1 Solar Power Satellite
This session focuses on all aspects of conceptual, technical and organizational progress to better integrate space and terrestrial energy activities. It is the primary international forum for scientific and technical discussions and for presentations of conceptual, technical, and organizational progress to better integrate space and terrestrial energy activities.

C3.2 Solar Power Satellite
This session is structured into two half-sessions, one focusing on advances in the field of space solar power plant architectures and one focusing on the field of space power systems, including all types of conceptual, technical, and organizational progress to better integrate space and terrestrial energy activities. It is a primary international forum for scientific and technical exchanges on this topic and provides a unique common platform for discussions. Typically, it will include all system levels, architectural, organizational, and commercial aspects, including modeling and optimization as well as related technical aspects.

C3.3 Advanced Space Power Technologies
This session covers all types of advanced space power technologies and concepts for the satellites, micro/nanosatellite/planetary exploration and domain space activities. These include technologies and concepts related to power generation (solar, nuclear, others) and harvesting, power conditioning, management and distribution, power transmission and energy storage.

C3.4 Space Power System for Ambitious Missions
This session is devoted to exploring concepts ranging from very small power (micro- and mini-satellite power) to very large power systems toward future ambitious space missions and space utilisations such as future moon village. These include concepts and technology developments of space power system for this increasing spacefaring activity by the society, micro- and mini-space science. This session is dedicated to power systems for such applications as well as for long-duration exploration studies and missions.

C3.5 Joint Session on Advanced Nuclear Power and Propulsion Systems
This joint session combines the IAF Space Power and the IAF Propulsion Symposia, including papers addressing all aspects related to nuclear power and propulsion for space applications.
C4.6

Electric Propulsion (2)
This session is dedicated to all aspects of electric propulsion dedicated to science (fundamental, physics, modeling, diagnostic and measurements).
Rapporteur

Vincenzo Zegers
European Space Agency (ESA) — FRANCE

Co-Chair

Brandon Smith
NASA Glenn Research Center — United States

C4.7

Hypergolic, Air-Breathing and Combined Propulsion, and Propulsion Vehicle

This session covers hypergolic, air-breathing and combined cycle propulsion with space applications. The typical types of engine considered in this session include turbopump, rocket, scramjet, accelerating engine, Turbo-Bled Combined Cycle (TECC), Rotor-Based Combined Cycle (RBCC). Hypergolic, hypergolic assisted, Air Turbine Rocket (ATR) and other types of hypergolic combined cycle propulsion, together with the associated vehicle.
Co-Chair

Kai Xiang
China Aerospace Science & Industry Corporation (CASC) — CHINA

Rapporteur

Yan-ke Chen
American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES

C4.8

Joint Session between IAA and IAF for Small Satellite Propulsion Systems
This session will give particular attention to propulsion systems and associated technologies as to enable efficient, cost-effective, small satellite access to space and beyond. Papers are invited discussing the particular challenges of design, manufacturing, testing, operation and technological developments of small satellite propulsion systems, and the challenges of obtaining high performance within a small volume and mass. The scope includes chemical and electrical propulsion systems for major orbit change, fine orbit control and attitude control, for papers with an emphasis on the small satellite and its system design, refer to other 4A sessions. For a focus on other propulsion systems, refer to other 4B sessions.
Co-Chair

Anna Piemonte
General Aviation Advisory Council (GAC) — UNITED STATES

Rapporteur

Jeffrey Ely
The Aerospace Corporation — UNITED STATES

C4.9

New Missions Enabled by New Propulsion Technology and Systems
The session will explore concepts for new missions that can be enabled by specific advancements in propulsion and/or integration of various propulsion technologies and systems.
Co-Chairs

Güngör Kocas
European Space Agency (ESA) — ITALY

Katharine Gipson
Politecnico di Torino — ITALY

Yun-ke Chen
American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES

Rapporteur

Elizabeth Louisa
Jet Propulsion Laboratory - California Institute of Technology — UNITED STATES

C4.10

Joint Session on Advanced and Nuclear Power and Propulsion Systems
This session, organized jointly with the Space Power and the Space Propulsion Symposiums, includes papers addressing all aspects related to advanced and nuclear power and propulsion systems for space applications.
Co-Chairs

American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES

Saul Perlmutter
Lawrence Berkeley National Laboratory — United States

Rapporteur

Junji Tanaka
Josiah Westervelt
European Space Agency — THE NETHERLANDS

C4.11

Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM
Authors with an accepted abstract for an interactive presentation will be invited to prepare slides and display them for the duration of the congress on plasma screens. Authors will be assigned to interactive sessions in which they will be near the plasma screens to engage in interactive discussions with other congress attendees.
Co-Chairs

Elizabeth Louisa
Jet Propulsion Laboratory - California Institute of Technology — UNITED STATES

Yen-ke Chen
American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES

Martin Robson
German Aerospace Center (DLR) — GERMANY

Rapporteur

Venkatesh Varadarajan
NASA Glenn Research Center — United States

IAF SPACE SYSTEMS SYMPOSIUM
The space systems symposium, organized by the International Astronautical Federation (IAF), addresses the present and future development of space systems, architectures, and technologies, with sessions on System Engineering Methods, Processes, and Tools; Enabling Technologies for Space Systems; Significant Achievements in Space Systems with Emphasis on New Missions Reviewed and Future Trends and Practice; Advanced Systems Architecture; Cooperative Space Systems, and Innovative and Flexible Systems of the Future.

Co-Chairs

Roland Böttcher
European Space Agency (ESA) — GERMANY

Jeff Pine
National Aeronautics and Space Administration (NASA) — UNITED STATES

D1.1

Innovative and Visionary Space Systems
This session will explore innovative concepts, and services for space applications in future scenarios. The session objective is to broaden the opportunities for innovation in order to foster the involvement of people, from researchers and subject matter experts to other appropriate stakeholders, in building and advancing the future vision of novel and transformational space systems and relevant applications. In this perspective, the deadline of yesterday are the basis of today and the reality of tomorrow. By proposing novel concepts of space systems, and applications, we can broaden today’s paradigms towards preferable outcomes beyond incremental advancements.

D1.2

Space Systems Architectures
This session addresses current and future space systems architecture design to make promising concepts for future orbiting or exploration missions, both robotic and crewed.

Co-Chairs

Tobias Blümel
ArianeGroup — GERMANY

Matthieu Mounier
Airbus Defence and Space — GERMANY

Rapporteur

Steven Arnold
The Johns Hopkins University Applied Physics Laboratory — United States

D1.3

Technologies to Enable Space Systems
This session will focus on innovative, technological developments that are usually high risk, but which have the potential to significantly enhance the performance of existing and new space systems. Enabling innovative technologies for space applications that result from spin-offs which will be discussed during the session, together with potential spin-off examples include instrumentation, biotechnology, components, micro- and nanorobotics, MEMS, advanced new structures and software technologies.

Co-Chairs

Steven Arnold
The Johns Hopkins University Applied Physics Laboratory — United States

Vincent Monnet
Thales Alenia Space France — France

Rapporteur

Takao Kanai
Japan Aerospace Exploration Agency (JAXA) — Japan

D1.4

Space Systems Engineering - Methods, Processes and Tools (1)
This session will focus on the state and evolution of the new systems engineering methodologies that reduce the time and cost, and improve the quality of space system design. Of special interest are multidisciplinary methods, processes, and tools used for systems design, Product Realization, Technical Management, Operations, and Retirement of space systems to improve risk management, reliability, and quality of life cycle cost estimates. Specifically, presentations may include: state of organizational structures, practice methods, processes, tools, training that benefit space system design, development and operation; state of the art systems engineering methodologies for space systems, including space systems of systems (SoS); engineering design methods and modeling and simulation tools applied to space system design and optimization; methodologies and processes for technical planning, cost, and safety analysis of space system design, advanced space system development environments, such as concurrent engineering design facilities, and novel methods to improve risk management, extend value estimation, configuration management, data management, availability, safety, reliability, maintainability and life cycle cost estimates.

Co-Chairs

Jiaping Wang
ArianeGroup — GERMANY

Peter Diamantaras
National Aeronautics and Space Administration (NASA) — United States

Rapporteur

Jon Holladay
NASA Glenn Research Center — United States

D1.4.B

Space Systems Engineering - Methods, Processes and Tools (2)
This session will focus on the state and evolution of the new systems engineering methodologies that reduce the time and cost, and improve the quality of space system design. Of special interest are multidisciplinary methods, processes, and tools used for systems design, Product Realization, Technical Management, Operations, and Retirement of space systems to improve risk management, reliability, maintainability, and quality of life cycle cost estimates. Specifically, presentations may include: state of organizational structures, practice methods, processes, tools, training that benefit space system design, development and operation; state of the art systems engineering methodologies for space systems, including space systems of systems (SoS); engineering design methods and modeling and simulation tools applied to space system design and optimization; methodologies and processes for technical planning, cost, and safety analysis of space system design, advanced space system development environments, such as concurrent engineering design facilities, and novel methods to improve risk management, extend value estimation, configuration management, data management, availability, safety, reliability, maintainability and quality of life cycle cost estimates.

Co-Chairs

Ghassan Saleem
National Institute for Space Research (INPE) — BRAZIL

Yen-Sen Chen
National Aeronautics and Space Administration (NASA) — United States

Rapporteur

Diana Teixeira
National Aeronautics and Space Administration (NASA) — United States

Category coordinated by Roberta Mugnaiello-Dose, European Space Agency (ESA), UNITED KINGDOM
D1.5 Lessons Learned in Space Systems: Achievements, Challenges, Best Practices, Standards

The first address addresses lessons learned in Space Launch Systems. The learning process is necessary to ensure mission success of future missions. This presentation conveys the learning of mission accomplishments, the challenges to overcome the difficulties and the best practices to solve the issues. The lessons also include the documentation of the lessons learned by the community in design, development, operations and management. This presentation aims to provide lessons learned for future missions, focusing on current and future mission success and challenges.

D1.6 Cooperative and Robotic Systems

This session will focus on cooperative and robotic systems as they apply to the space domain. This emerging topic includes concepts such as constellations, multi satellite architectures, multi-mission capabilities and othe emerging concepts. These systems are enabled by innovative technologies, which are being developed by leading institutes, universities and SMEs. The purpose of the session is to provide an overview of the current status of cooperative and robotic systems, as well as to identify emerging technologies. Papers in this session will look at current missions and future opportunities, while addressing both benefits and challenges in the worldwide space community.

D1.7 Interactive Presentations - IAF SPACE SYSTEMS SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions. The Interactive Presentations will be selected at the discretion of the Rapporteur for a variety of criteria. The primary initial selection criteria is the potential audience for the presentation. In addition, paper authors are expected to prepare a short presentation (5 min) and an extended discussion time (10 min) that focuses on their paper topic and the selected presentation from the list of submitted papers.

D1.8 Space Transportation Solutions for Deep Space Missions

This session focuses on the advanced space transportation technologies and mission architectures. It is designed on the basis of complex and innovative concepts to achieve successful deep space missions.

D1.9 Emerging Global Space Ventures, including Reusability and other Innovations

This session will focus on current and future space missions and technologies, including deep space missions, advanced propulsion technologies and reusable space systems. The session will provide a platform for discuss the latest developments and future trends in the space industry.

D2.1 Launch Vehicles in Service or in Development

In addition to the classic Sessions, a new category of sessions, called Interactive Presentations, is introduced at the 73rd IAC. These sessions offer a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions.

D2.2 Launch Services, Missions, and Facilities

In addition to the classic Sessions, a new category of sessions, called Interactive Presentations, is introduced at the 73rd IAC. These sessions offer a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions.

D2.3 Upper Stages, Space Transfer, Entry and Landing Systems

In addition to the classic Sessions, a new category of sessions, called Interactive Presentations, is introduced at the 73rd IAC. These sessions offer a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions.

D2.4 Future Space Transportation Systems

In addition to the classic Sessions, a new category of sessions, called Interactive Presentations, is introduced at the 73rd IAC. These sessions offer a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions.

D2.5 Technologies for Future Space Transportation Systems

In addition to the classic Sessions, a new category of sessions, called Interactive Presentations, is introduced at the 73rd IAC. These sessions offer a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Systems addressed in the classic Sessions.
D3.3 Space Technology and System Management Practices and Tools

The effective management of space technology and systems development is critical to future success in space exploration, development and discovery. This session is the next in a series of events at the International Astronautical Congress that provides a unique international forum to further the development of a body of best practices and tools for the effective management of space technology and systems development. Best practices and tools are presented and discussed in the fields of requirements capture, project management, decision techniques, cost estimation,崃 risk management, project planning, and technical management. The session also focuses on the effective management of complex systems, such as the development and operation of space systems in a multi-agency, multi-objective, multi-constellation environment. The session is intended for program managers, project managers, system engineers, system architects, and space technology managers.

Chair:
John E. Mardon
Aalto University – FINLAND
Aalto Innovation Management Solutions, Ltd – FINLAND

Rapporteur:
Maria Antonietta Perino
Thales Alenia Space Italy – ITALY

D3.4 Contributions of Moon Village to Solving Global Societal Issues

Moon Village is a concept that brings together efforts, works with, and draws from, experienced private enterprises, governments, academies and others in order to explore and establish a Moon Village in a sustainable manner. A Moon Village is a community of projects carried out by stakeholders from different fields (e.g., technical, scientific, cultural, economic) working together. The implementation of the Moon Village will help to create new business opportunities and foster innovation in several areas. The Moon Village project may contribute to the resolution of several global societal issues, including poverty alleviation, development, and sustainability.

Chair:
Giorgio Saccoccia
European Space Agency (ESA) – UNITED KINGDOM

Rapporteur:
Gary Barnard
Aalto University – FINLAND
C.3.2 Knowledge Management in the Digital Transformation
The challenge of digital transformation for organizations is to adapt their culture and processes to the new environment. Digital transformations and innovations have changed how employers’ needs and the knowledge and therefore KM processes need to adapt to the new environment in helping the firm from the collaboration and operational efficiency of teams to increasing the digital transformation process by identifying what knowledge needs to be digitized, what processes need to be digitized and when. Key themes discussed during the session are: strategies and tools for the digital knowledge sharing, the impact of the culture and external social networks in creating new knowledge, processes and technologies that organizations are using to support their learning ability, innovation, and new ways of working. The session concluded with a debate on the role of knowledge and risk management, methods that allow data, information or knowledge exchange or within or amongst organizations in support of actual organizations, and capturing knowledge management and information in computer models.

C.3.3 Cybersecurity in Space Systems, Risks and Countermeasures
With the rise of new space and the emergence of commercial space industry increasingly digital and data-dependent, the management of cyber-related risks and protection against cybersecurity threats becomes a priority regarding the identification and deployment of relevant cybersecurity measures and solutions. The session covered some of the most discussed topics such as: cybersecurity risk management and operational resilience in space systems, cybersecurity standards and terrestrial systems and spaceflight operations to improve space systems resilience against cyber threats. New technologies and practices emerging in cybersecurity will also be presented such as: the development of quantum cryptography and quantum technologies to disrupt or reduce the risk of cybersecurity threats.

C.3.4 Interactive Presentations - 55
Interactive Presentations: The aim of the session is to deliver key messages in an interactive form of knowledge transfer through digital media, and the audience will have the opportunity to participate in the topic discussions. The presentations will be displayed on a digital screen in a dedicated area for all attendees to follow. The session will cover: excellent presentations, sharing good practices, and the audience will be invited to actively participate in the discussions by asking specific questions and providing feedback.

C.3.5 Commercial Space Flight Safety and Emerging Issues
Topics for the session range from commercial space transportation and safety issues including unique and holistic vehicles, spacecraft, on-orbit and in-space vehicles, transportation and regulatory issues related to commercial non-transportation and commercial transportation, and regulations. The focus of the session is on the development of new technologies, regulations, and policies to ensure the safety and viability of commercial spaceflight operations.

D.3.3 Enabling Safe Commercial Spaceflight: Vehicles and Spaceports
The session will examine innovative initiatives focusing on space education and outreach stakeholders up to the age of 11. Each paper should provide evidence of projects that have already taken place or planning to take place in the future. The sessions aim to encourage the development of educational projects and to facilitate the sharing of best practices. The key themes discussed during the session are: innovative educational models, best practices in teaching and learning, and including space in the curriculum. The session concluded with a debate on the role of space education and outreach in supporting sustainable development goals.

D.3.4 Emerging Global Space Ventures, including Reusability and other Innovations
The focus of the session is on the development of new technologies, regulations, and policies to ensure the safety and viability of commercial spaceflight operations. Of particular interest are: identification of core evolving capabilities (systems, components, technologies) to conduct increasingly complex missions to a range of deep space destinations; new propulsion systems; additional landing sites to foster flexible mission architectures using existing capability building blocks and the new propulsion development; and safety in the “new one mission for one go” concept, in particular the design of reusable propulsion systems.
The unique, original or innovative nature of your activity or programme. ● Include lessons learned, recommendations or other take away messages in the body of your abstract. If any theories are developed, please include some information about the practical applicability of the information. ● Make sure that the abstract provides a coherent idea or rationale. ● It data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- David S. Springer
- Kathleen Coderre

**Rapporteurs**

- Carlo Carone
- Michel Rafa
- Natasha Tsumyakova

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**E1.2 Student Conference – Part 1**

Undergraduate and graduate level students (no more than 28 years of age) present technical papers on any subject in space sciences, industry or technology. These papers will reflect the specific work of the author(s) (no more than two students). The students presenting in this session will compete in the 44th International Student Competition. This session is allocated for two sessions. The following contact persons are available for more information: For the French national competition: Benedicte Escudier - benedicte.escudier@supaero.fr. For the German national competition: Benedikt Escudier - benedikt.escudier@gmx.de. For the Chinese national competition: Marco Schmidt - m.schmidt@nuscience.com.cn. For the Canadian sponsoring programme, please check the CSA website http://www.asc-csa.gc.ca/ The guidelines for the student competition will be distributed from the session chairs to the authors after abstract acceptance.

**Co-Chairs**

- Franko Bernelli-Zazzera
- Marco Schmidt

**Rapporteurs**

- Efrem Moutin
- Mali Gurnett

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**E1.3 Student Conference – Part 2**

Undergraduate and graduate level students (no more than 28 years of age) present technical papers on any subject in space sciences, industry or technology. These papers will reflect the specific work of the author(s) (no more than two students). The students presenting in this session will compete in the 44th International Student Competition. This session is allocated for two sessions. The following contact persons are available for more information: For the French national competition: Benedicte Escudier - benedicte.escudier@supaero.fr. For the Chinese national competition: Marco Schmidt - m.schmidt@nuscience.com.cn. For the Canadian sponsoring programme, please check the CSA website http://www.asc-csa.gc.ca/ The guidelines for the student competition will be distributed from the session chairs to the authors after abstract acceptance.

**Co-Chairs**

- Franco Bernelli-Zazzera
- Marco Schmidt

**Rapporteurs**

- Efrem Moutin
- Mali Gurnett

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**E1.4 In Orbit – Space Based Education Activities**

This session will explore innovative space-based education and outreach programmes for postgraduate students. This can include the development and delivery of innovative courses, project-based work, and post-work placements. Examples should show how the programme is structured for maximum impact. For the impact is measured and how the programme has been evaluated. This session will also consider programmes and activities that focus on the professional development of space education professionals. Examples could include career progression, teacher training or space educators. The audience will be interested in hearing about new space education initiatives. Please provide a short but clear description of the activity or the programme. Please provide any information about the unique, original or innovative nature of your activity or programme. Please include lessons learned, recommendations or other take away messages in the body of your abstract. If any theories are developed, please include some information about the practical applicability of the information. Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- Kathleen Coderre
- Camille Alleyne

**Rapporteurs**

- Olga Zhdanovich
- Hubert Diez

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**E1.5 Poster Sessions**

Presentation of space-related papers by undergraduate and graduate students who participate in an international student competition.

**Co-Chairs**

- Michelle Dimick
- Kevin Stude

**Rapporteurs**

- Emmanouil Petrakis
- Vitaly Schwartz

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**E1.6 Collecting Planets Earth - Space Outreach to the General Public**

This session will focus on activities, programmes and strategies for engaging the general public in space activities, and outreach to the formal education system. When submitting abstracts for this symposium, please: ● Clearly identify the connection to space outreach programme. Please provide a short but clear description of the activity or the programme. ● Include some information about the unique, original or innovative nature of your activity or programme. ● Include lessons learned, recommendations or other take away messages in the body of your abstract. If any theories are developed, please include some information about the practical applicability of the information. ● Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- Natalya Klyueva
- Nelly Ben Hayoun

**Rapporteurs**

- Carol Christian
- Hubert Diez

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**E1.7 New Worlds - Non-Traditional Space Education and Outreach**

This session will focus on new and non-traditional methods of space education and outreach in non-specialised areas and to non-traditional target groups. When submitting abstracts for this symposium, please: ● Clearly identify the work presented as non-traditional. Please provide a short but clear description of the activity or the programme. ● Include some information about the unique, original or innovative nature of your activity or programme. ● Include lessons learned, recommendations or other take away messages in the body of your abstract. If any theories are developed, please include some information about the practical applicability of the information. ● Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- Hubert Diez
- Michel Rafa

**Rapporteurs**

- Carol Christian
- Hubert Diez

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**E1.8 Hands-on Space Education and Outreach**

Hands-on space education and outreach can be a powerful way to introduce and teach Science, Technology, Engineering, Arts and Math (STEAM) concepts, especially with students who are non-specialised. This session will focus on demonstrations and share effective hands-on activities and experiences to regions, teachers and enrichment space-related concepts. During this session, presenters will not only present the ideas behind the activity, but also demonstrate it hands-on as well. When submitting abstracts for this symposium, please: ● Clearly identify the hands-on nature of the work presented, and its impact on children. Please provide a short but clear description of the activity or the programme. Please include some information about the unique, original or innovative nature of your activity or programme. If any theories are developed, please include some information about the practical applicability of the information. Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract. Abstracts will be accepted exclusively for the attendees to view the Interactive Presentations, and the author will be assigned a specific ten minute slot to personally present the topic and interact with the audience.

**Co-Chairs**

- Valene Anne Capparelli
- Daniele S. Melani

**Rapporteurs**

- Carol Christian
- Hubert Diez

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**E2.1 Space Education – Student Conference**

This session will focus on the education and outreach activities of institutions such as museums, space agencies and even for-profit organizations, which work with education with a specific interest for this topic. This session will focus on specific educational and/or outreach activities that the presenter has been involved in, and its connection to space education. Please provide a short but clear description of the activity or the programme. ● Include some information about the unique, original or innovative nature of your activity or programme. If any theories are developed, please include some information about the practical applicability of the information. Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- Kathleen Coderre
- Camille Alleyne

**Rapporteurs**

- Olga Zhdanovich
- Hubert Diez

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**E2.2 Space in Society – Public Engagement in Space through Culture**

This session will focus on the education and outreach activities of institutions such as museums, space agencies and even for-profit organizations, which work with education with a specific interest for this topic. This session will focus on specific educational and/or outreach activities that the presenter has been involved in, and its connection to space education. Please provide a short but clear description of the activity or the programme. ● Include some information about the unique, original or innovative nature of your activity or programme. If any theories are developed, please include some information about the practical applicability of the information. Make sure that the abstract provides a coherent idea or rationale. Data has been gathered as part of the work (including evaluations), please include some reference to that in your abstract.

**Co-Chairs**

- Kathleen Coderre
- Camille Alleyne

**Rapporteurs**

- Olga Zhdanovich
- Hubert Diez

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**GTS.4 Student Team Competition**

Undergraduate and graduate level students present team papers on any subject related to space sciences, industry or technology. These papers will reflect the specific work of the author(s) (no more than two students). The students presenting in this session will compete in the 44th International Student Competition. This session is allocated for two sessions. The guidelines for the student team competition will be distributed from the session chairs to the authors after abstract acceptance.

**Co-Chairs**

- Marco Schmidt
- Vitaly Schwartz

**Rapporteurs**

- Emmanouil Petrakis
- Vitaly Schwartz

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E3.6 Financial Viability and Supplier Monitoring in Times of Economic Vulnerability

The COVID-19 crisis has had unprecedented market volatility and has impacted supply chains in the space sector. With the pandemic, the growth in the space sector that generated unprecedented levels of entrepreneurial activity and startup activity could be reversed. On the other hand, larger space manufacturing industries have not been immune to the crisis. In the wake of the COVID-19 crisis, companies are rethinking their strategies for the future. Another aspect is the exchange on financial viability and supplier monitoring best practices, as well as to understand the criticality of financial impacts to establish better measures and use of resources from public (and private) funding where they can have the maximum impact. A keynote address will be given followed by a panel discussion and presentations for which the call for abstracts is herewith launched.

Co-Chairs
Geraldon Legg
Legg Space Policy Institute, George Washington University — UNITED STATES

Reporteur
Kendra D. Haeuplik-Meusburger
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

E4 35TH IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS

For the 35th time, the International Astronautical Congress (IAC) will provide overview of the current trends in space policy, regulations and economics, by covering national as well as multilateral space policies and plans. The symposium highlights the IAA’s scientific, legal and regulatory contributions.

Co-Chairs
Marcia Smith
Space Policy Institute, George Washington University — UNITED STATES

Reporteur
Kendra D. Haeuplik-Meusburger
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

E3.1 International Cooperation in Using Space for Sustainable Development: Towards a “Space2030+” Agenda

As the societal benefits of space technologies and applications grow, the international community has increasingly shifted its attention to its contributions to the global agenda on sustainable development, in particular the Sustainable Development Goals (SDGs). In this context, the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) has established the Committee of Governmental Experts on the Utilization of Outer Space for Peaceful Purposes (GGE) to provide the opportunity to discuss potential elements of such an agenda, especially how international cooperation in space activities can contribute to these objectives.

Co-Chairs
Josephine Ouon-Charle
European Space Agency (ESA) — THE NETHERLANDS

Reporteur
Sandra Haeuplik-Meusburger
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

E4.1 Memoirs & Organizational Histories

Biographical and organizational memoirs of individuals who have made original contributions to the development and/or application of astronautics in society, history of government agencies, industry, academia & professional societies & organizations being examined in astronautics. This will include the entire spectrum of space history, at least 25 years old.

Co-Chairs
Sandra Haeuplik-Meusburger
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

Reporteur
Brian Jirout
Vienna University of Technology — AUSTRIA

E4.2 Scientific and Technical Histories

The symposium will cover the history of space science, exploration, innovation & technology. Furthermore reflection on the cultural, socio-political impact are parts of this. This will include the entire spectrum of space history, at least 25 years old.

Co-Chairs
Vera Peters
University of Witten-Herdecke — GERMANY

Reporteur
Hannes Mayer
University of Witten-Herdecke — GERMANY

E4.3 History of Middle Eastern Contribution to Astronautics and Astronomy

Technical session with invited & proposed speakers. Origin (technical & political, science and social aspects) of the space activities & programs in the Middle East. This will include the entire spectrum of space history, at least 25 years old.

Co-Chairs
Ulf H. Jäger
National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES

Reporteur
Kerrie Dougherty
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

E3.5 36th IAA/ISLSC Scientific Legal Roundtable: “Autonomous Intelligent Systems in Space: Operational and Legal Challenges”

The 36th Round Table will focus on the issue of launching systems in the development of artificial intelligence based autonomous systems for space operations is opening up a whole new set of questions about how these systems interact with existing legal concepts and technical standards. Autonomous systems that enable collision avoidance will soon become standard practice. The human interaction will be required beyond the programming. One of the first questions is which law - particularly space law - would apply to such space-based AI system? How can the current space law be developed to encompass such emerging technologies? Are there challenges related to the legal framework? The growing interest in autonomous technologies may require a rethink of the traditional concepts behind the regulation of space activities. The specific attributes of autonomous space systems may also require a fresh look at the existing legal framework of which the world of business and technology has to be part. How can the current space law and aspects of technical and legal perspective be examined as to how the technical developments, including systems for data sharing and space traffic management, may shape and transform the emerging body of rules, regulations, and practices that apply to space activities. This will inevitably also include how these technologies relate to the traditional understanding of legal responsibility and liability under national and international space law.

Co-Chairs
Massimo Armellini
European Space Agency (ESA) — FRANCE

Reporteur
Ogilvie Bernanos
University of Houston — UNITED STATES
E5.1 Space Architecture: Habitats, Habitability, and Bases
Space architecture integrates the design and building of human environments for use in space. The session welcomes papers in three areas: 1) research, design, prototyping, testing, manufacture, and operation of habitats (space and analog terrestrial environments); 2) human factors influence human health, psychology, and efficiency, and measurement based on the "human factor"; 3) technology and construction of habitation capable of operating surface or sub-surface human systems designs integration implications.

Co-Chairs
Olga Romanova
University of Arizona — USA

Paradip Sanyal
University of Glasgow — UK

E5.2 Is Space R&D Truly Fostering A Better World For Our Future?
This session solicits papers for a panel discussion focusing on the district benefits to products derived from space research and development (R&D). The goal of this session is to examine and discuss cases of both emerging and established spinoffs, best practices, and associated outcomes of knowledge sharing, technology transfer, and technology commercialization. Drawing on the Space Architecture: Habitats, Habitability, and Bases panel, this session will focus on how specific recent trends in space R&D to society, intends to develop a broader awareness of how we can also identify and promote the benefits of space R&D to influence broader support of space R&D.

Panel members are expected to introduce their specific topic areas and provide case studies, materials, and outcomes. Discussion will conclude with defining a framework for understanding technology transfer policies and practices for both space and non-space utilization. Demonstrating the correlations and synergies between technology transfer and STEM education in inter-disciplinary space courses and technical entrepreneurship. The session encourages the impact of innovation derived from space R&D when transferring into new products, services and processes.

Co-Chairs
Barbara Uden
Queen Mary University of London — UK

E5.3 Contemporary Arts Practice and Outer Space: A Multi-Disciplinary Approach
Since the 1970s a number of artists have been engaging access to space facilities and organizations, critiquing or making experiential the materialization and allocation of space, or in pursuing space technology, material or data independently or in direct exchange with the space sector. Today this project is branching into several directions, ranging from tangibility, interstellar, or on earth and in space analogous environments themselves. In doing this, projects are aiming to expand the contexts of participation and engagement with science. This session addresses the practices of contemporary artists who have developed new ways to appropriate space for their own purposes, the practical foundations of these engagements, and the implications of this emerging aesthetic paradigm for both the fields of space and art. Submissions are welcome from artists and art historians, and from space industry and space agency representatives as well as from the cultural sector facilitating or programming related projects intersecting the accelerated boundary between creative practice.

Co-Chairs
Isaak Alexandre
Western University — Canada

Sally Auffret
University of the Arts — UK

E5.4 Space Assets and Disaster Management
The session will explore the risk space assets can play in situations requiring disaster management and emergency responses. Papers will explore how space assets and applications can be brought to bear with situations monitoring and assessment, shortening response times and mitigating impact on affected populations.

Co-Chairs
Geoffrey Langlands
Clementine Decoopman
E5.5 Sharing Space Achievements and Heritage: Space Museums And Societies
Sharing space achievements and heritage of space museums and societies who represent different national or international organizations and space facilities. The session aims to foster communications around the importance of space museums and space societies and their role in promoting the importance of space exploration, education and inspiration for the general public. This session will contain papers which address the following topics: museums and spaces in various countries, their role in educating the public, the sharing of experiences and the promotion of space achievements and heritage. Papers are welcome from curriculum and educational researchers and their role in promoting the importance of space education and inspiration for the general public.

Co-Chairs
Anne-Marlene Rüede
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — Germany

Jillianne Pierce
Space Florida — USA

E6.1 Entrepreneurship and Innovation: The Practitioners' Perspectives
This session will contain a broad spectrum of entrepreneurship presentations from the perspective of the practitioners. Suggested topics that are suitable for this session can be of any level of analysis and deal with any aspects of entrepreneurship or innovation: levels of analysis span a wide range, including: from microeconomic to mesoeconomic to macroeconomic; the session will cover microeconomic and macroeconomic effects and influences of entrepreneurship and innovation; the session will span specific or partial focus (e.g., industry segment or sub-sector), and more general topics. The session will focus on how to capture lessons learned and to codify them in organizational plans, processes, and procedures going forward. Entrepreneurs who have good ideas, are interested in sharing their perspective, and are interested in capturing and disseminating best practices.

Co-Chairs
Jens Rehse
German Aerospace Centre (DLR) — Germany

Anna Barbara Imhof
metrics shop – space & society — Switzerland

Giulia Melchionna
University of Padova — Italy

E6.2. Finance and Investment: The Practitioners' Perspectives
This session will contain a broad spectrum of finance and investment presentations from the perspective of the practitioners. Suggested topics that are suitable for this session can be of any level of analysis and deal with any aspects of finance or investment: levels of analysis span a wide range, including: from microeconomic to mesoeconomic to macroeconomic; the session will cover microeconomic and macroeconomic effects and influences of finance and investment; the session will span specific or partial focus (e.g., industry segment or sub-sector), and more general topics. The session will focus on how to capture lessons learned and to codify them in organizational plans, processes, and procedures going forward. Entrepreneurs who have good ideas, are interested in sharing their perspective, and are interested in capturing and disseminating best practices.

Co-Chairs
Karen Alexander
London Business School — UK

Tibor Balint
TNO — The Netherlands
Co-Chairs
Kathleen Donohue
Federal Aviation Administration (Office of Commercial Space Transportation (AST)) — UNITED STATES

E7 ISOL COLOQUIUM ON THE LAW OF OUTER SPACE

The 2021 ISOL Colloquium focuses on how the latest technological developments are impacting the development of the law of outer space, and on whether space law should embrace new fields of activities, such as drones, within its scope. The Colloquium looks at current discussions about questions related to the ethics and understanding of artificial intelligence (AI), including autonomous systems and their integration into national and international legal frameworks. The session will also address the interactions of space law with other international law, in particular, with the field of security. It looks at whether existing legal concepts, particularly responsibility and liability for autonomous systems driven by artificial intelligence, are sufficiently regulated, and whether there is a transparent approach to licensing at national level. It also provides insight into how disruptive development activities can be and should be governed by space law.

Co-Chairs
Karin Schlegl
Leopoldina Foundation
Katharina Sörgel
University of Cologne — GERMANY

E7.1 ISOL Highlight Lecture and Young Scholar Session

This session is open for abstracts and papers from space law students under 35 years old. It welcomes contributions on any topics related to space law to features of a regular annual keynote presentation by a leading space law expert.

Co-Chairs
Karin Schlegl
Leopoldina Foundation
Katharina Sörgel
University of Cologne — GERMANY

E7.2 Dispute Settlement

The panel of experts in this area is divided into two parts: (a) The process of settling international conflicts is a fundamental principle of International Law. Disputes relating to outer space activities encompass specific features, which are different from those governing disputes over territorial sovereignty, including the fact that the parties have no common territory. The main aim of this session is to provide the participants with an understanding of the current approaches to space law issues. (b) In order to enable sustainable, effective resolution of disputes, the IISL roundtable format for discussion during the Colloquium will be employed. Participants will be asked to raise specific questions related to space law issues, and the experts will provide their views. The session will address the following issues: (i) disputes relating to the exploitation of resources in outer space; (ii) the role of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS); and (iii) the role of international courts and tribunals in resolving space law disputes.

Co-Chairs
Olga de Gómez-Buitrago
University of Buenos Aires — ARGENTINA
Ingrid Marbee
University of Nijmegen — NETHERLANDS
Rapporteur
Catherine de Sarcas Gontier
Université Paris 1 — FRANCE

E7.3 Balancing Needs: Protection of Space Science

The intense use of outer space by emerging space technology, as mega constellations and associated space economy can have harmful effect on other activities. As an attempt to respond to the growing conflicts in need of space exploration and exploitation, and the regulatory approaches to their balancing, the legal perspective, this paper presents the protection of the stock of Earth resources and the future for the next generation of space exploration with respect to the point of view of protecting the chemical and biological resources, as a consequence. The session intends discussing the study of space exploration and use of outer space, the problem of balancing different needs in space activities, the protection of space science, especially the dangers arising, and responsibilities and the ways to address these. This will be discussed in the context of international law and national regulations.

Co-Chairs
Wong Guey-yao
National University of Singapore — SINGAPORE
Michelle Huxley
University of Mississippi School of Law — UNITED STATES
Rapporteur
Gurudevi Reddy
Global Expert Group for Sustainable Lunar Activities (GELAAG), Implementation Support Officer — INDIA

E7.4 Space Sustainability

Sustainability of space activities is a priority that the generations to come will continue benefiting from various space applications. It requires a comprehensive approach the principles of sustainable development. The objective of sustainable space activities is to implement the principles of sustainability. It requires a comprehensive approach the principles of sustainable development. The objective of sustainable space activities is to implement the principles of sustainability. The aim of the session is to discuss the principles and best practices of sustainable space activities, as well as their implementation. The session will focus on the following aspects: (i) the principles of sustainability; (ii) the implementation of sustainable space activities; (iii) the role of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS); and (iv) the role of international courts and tribunals in resolving space law disputes.

Co-Chairs
Esma Yildirim-Tamer-Oktem
International Institute of Space Law (IISL) — TURKEY
Elke Mellenbach
International Space Law Community (ISL)— GERMANY
Rapporteur
Arthur Harmer
Space Generation Advisory Council (SGAC) — UNITED STATES

E7.5 Safety Zones on Celestial Bodies and in Outer Space

The establishment of safety zones on celestial bodies and in outer space protecting the safety of space activities from harmful interference is a concept developed primarily in space operation and practice. The problem in this field is developing within the global space law and regulatory instruments. The session will also consider the following issues: (i) the definition of space activities; (ii) the role of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS); and (iii) the role of international courts and tribunals in resolving space law disputes. The session will provide a platform for discussing the principles and best practices of sustainable space activities, as well as their implementation. The session will focus on the following aspects: (i) the principles of sustainability; (ii) the implementation of sustainable space activities; (iii) the role of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS); and (iv) the role of international courts and tribunals in resolving space law disputes.

Co-Chairs
John Vermillion
University of South Alabama — UNITED STATES
Elke Mellenbach
International Institute of Space Law (IISL) — TURKEY
Rapporteur
Arthur Harmer
Space Generation Advisory Council (SGAC) — UNITED STATES

E7.6 ISOL Colloquium on the Law of Outer Space

The 2022 ISOL Colloquium focuses on how the latest technological developments are impacting the development of the law of outer space, and on whether space law should embrace new fields of activities, such as drones, within its scope. The Colloquium looks at current discussions about questions related to the ethics and understanding of artificial intelligence (AI), including autonomous systems and their integration into national and international legal frameworks. The session will also address the interactions of space law with other international law, in particular, with the field of security. It looks at whether existing legal concepts, particularly responsibility and liability for autonomous systems driven by artificial intelligence, are sufficiently regulated, and whether there is a transparent approach to licensing at national level. It also provides insight into how disruptive development activities can be and should be governed by space law.

Co-Chairs
Emmanouil Arapoglou
The NEST LABS — GREECE
Mark Scudellari
Oxford University Space Strategy — UNITED KINGDOM
Rapporteur
London Based Group
Radboud Pijpers
Institute of Law and Space Law, University of Cologne — GERMANY

E7.3 Multilingual Astronautical Terminology Symposium

This symposium, organized by the International Academy of Astronautics (IAA), will review the progress made in multilingual space terminology and its impact on international cooperation in space technology. Terminology is key for a better understanding among people using various languages and dialects. Coexistence or simultaneous translation does not remove the risk of misunderstanding during technical meetings andprocurementsindustries, or a smooth translation of labels into legal documents and contracts. It is important to discuss the interpretation and application of concepts and terms contained in international instruments in various languages in order to identify potential misunderstandings, contradictions, and gaps. In addition, the session will address the need to contribute to international instruments, such as the long-term sustainability guidelines of the IAA’s Committee on the Peaceful Uses of Outer Space (IASC/KA2PSUS), in achieving their national or regional priorities, space policies and programmes will also be reflected.

Co-Chairs
Tim O’Keefe
United States Air Force Academy — UNITED STATES
Laetitia Zarkan Cesari
European University of the Americas (UEA) — PERU

Interactive Presentations - ISOL COLOQUIUM ON THE LAW OF OUTER SPACE

The Colloquium is open to anyone interested in the topics presented. The sessions will feature interactive presentations and discussions on the latest developments in space law.
E9.1 Political, Legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal - STM Security

This session will address all non-technical aspects of debris management and security in a debris-dominated environment. This STM session will mainly focus on the economic and technical aspects of space debris mitigation and removal. All the contributions and opportunities for discussion and debate will be considered.

Chair

David B. Spencer
The Aerospace Corporation Switzerland

Serge Plattard
University College London (UCL) — UNITED KINGDOM

Tanja Masson-Zwaan
International Space University (ISU) — THE NETHERLANDS

Repporteur

Samantha Le May
University of Rome “La Sapienza” — ITALY

GTS.1 ENTREPRENEURSHIP AROUND THE WORLD

The Global Technical Symposium (GTS) is designed to offer a modern and eclectic platform at the IAC for sharing technical content to an open-minded audience on-site but also online. Jointly organized by associated technical committees and the Worldspace Development Young Professionals Programme Committee, these sessions are similar to the conventional technical sessions in terms of abstract selection and paper submissions. However, in addition to on-site presentation, these technical papers are also broadcast online. Authors are allowed to present remotely or on-site, and participants are also allowed to listen to the session from the comfort of their homes or at their workplaces in addition to the IAC venue. The IAF hopes that this approach will enable more students and young professionals without the ability to join IAC on-site to contribute to discussion at the IAC.

Chair

Stephen Jewett
Center National d’Etudes Spatiales (CNES) — FRANCE

University College London (UCL) — UNITED KINGDOM

University of Rome “La Sapienza” — ITALY

GTS.2 HUMAN SPACEFLIGHT GLOBAL TECHNICAL SESSION

This session will address all non-technical aspects of human spaceflight and related aspects, including launch vehicle and spacecraft design, human factors, mission and trajectory design, and crew health and safety. This technical session aims to facilitate the exchange of ideas and knowledge among participants from all regions of the world.

Chair

GTS.3 SPACE COMMUNICATIONS AND NAVIGATION GLOBAL TECHNICAL SESSION

This session will address all non-technical aspects of space communications and navigation, including satellite communication systems, navigation systems, and related topics.

Chair

GTS.4 SMALL SATELLITE MISSIONS GLOBAL TECHNICAL SESSION

This session will address all non-technical aspects of small satellite missions, including design, development, operations, and applications.

Chair

GTS.5 STUDENT TEAM COMPETITION

This session will address all non-technical aspects of student team competition, including team organization, technical solutions, and presentation skills.

Chair

GTS.6 SPACE DEBRIS GLOBAL TECHNICAL SESSION

This session will address all non-technical aspects of space debris mitigation and removal, including mitigation strategies, removal methods, and related topics.

Chair

Co-Chairs

Multifaceted/Same

Astrid Jahnke
Universitat der Bundeswehr, Campus (UBC) — GERMANY

Space Communications and Navigation Global Technical Session

GTS.3

B.8

Space Communications and Navigation Global Technical Session

A Global session to present and discuss developments in a wide range of satellite communication topics, including fixed, mobile, broadcasting, and data relay technologies and services, as well as C and X band for satellite-based positioning determination, navigation, and timing. Both invited and contributed intersession space communications topics can be addressed.

Chair

Samantha Le May
University College London (UCL) — UNITED KINGDOM

GTS.4

B.2.3

Small Satellites Global Technical Session

The Small Satellite Missions Global Technical Session (SMT) is a collaborative between the International Academy of Astronautics (IAA) Small Satellites Symposium and the International Astronautical Federation (IAF) WorldSpace Development Young Professionals Programme Committee. This session is unique in that it allows for different organizations in a global scale to present and add to the IAC venue and show the hereof industry/space community. Small satellites are valuable to research and development, educational institutions, and government agencies in the space community. This session provides a unique opportunity to present new ideas and developments in the field of small satellites.

Chair

Samantha Le May
University College London (UCL) — UNITED KINGDOM

international Space University (ISU) — THE NETHERLANDS

Repporteur

Andrea Jaime
Universidad de Jaén (UJA) — SPAIN

GTS.5

B.4.9

Student Team Competition

The Student Team Competition (STC) is a competition that allows student teams from different countries to present their projects and ideas to a jury of experts in the space sector. The competition aims to provide a platform for young professionals to showcase their talents and receive feedback on their work.

Chair

Elena Osorio
Universidad de Antioquia y de los Andes (UAM) — COLOMBIA

Repporteur

Sarah Chisholm
Space Generation Advisory Council (SGAC) — CANADA

GTS.6

B.1.9

Human Spaceflight Global Technical Session

The Human Spaceflight Global Technical Session is targeting individuals and organizations with the objectives of discussing latest practices, future projects, research, and issues for the future of Human Spaceflight. This is a Global session co-sponsored by the Human Spaceflight Advisory Committee and the International Development Young Professionals Programme Committee.
### 11. IAC 2022 Call for Papers Deadlines

<table>
<thead>
<tr>
<th>Month</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>November</td>
<td>Abstract Submission Deadline -&gt; 28 February 2022</td>
</tr>
<tr>
<td>December</td>
<td>Abstract Selection -&gt; 29-31 March 2022</td>
</tr>
<tr>
<td>January</td>
<td>Papers Submission Deadline -&gt; 2 September 2022</td>
</tr>
<tr>
<td>February</td>
<td>Presentations Submission Deadline -&gt; 9 September 2022</td>
</tr>
</tbody>
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### 12. Preliminary IAC 2022 at a Glance

#### Days
- **18 Sept**: Sunday
  - IISL Moot Court, IPC / MoP Reception & Dinner
- **19 Sept**: Monday
  - Pe 4: Heads of Agencies Luncheon, IP Award Ceremony
- **20 Sept**: Tuesday
  - Pe 6: IP Session IISL Dinner, IAF Cross-Cultural Communications and Presentation Workshop
- **21 Sept**: Wednesday
  - Pe 7: UN/IAF Workshop Educators Professional Development Workshop, IAF Public Speaking & Presentation Skills Lab
- **22 Sept**: Thursday
  - Gala Dinner: Special Sessions
- **23 Sept**: Friday
  - IAF Public Speaking & Presentation Skills Lab
- **25 Sept**: Sunday
  - IAC Hosts Summit
- **26 Sept**: Monday
  - IPC General Meeting
- **27 Sept**: Tuesday
  - Special Sessions, IDEA "3G" Diversity Luncheon, IDEA "3G" Diversity Breakfast
- **28 Sept**: Wednesday
  - Pe 5: IPA, IPC, MoP, Special Sessions
- **29 Sept**: Thursday
  - Technical Sessions, Special Sessions
- **30 Sept**: Friday
  - Special Sessions
- **31 Sept**: Saturday
  - IPC / MoP Reception

#### Times
- **08:00** to **23:00**
- **21:00** to **22:00**
- **18:00** to **19:00**

### Please Note:
- *By invitation only; Pre-Congress events as well as the IISL Moot Court are dedicated to the respective participants*
13. Instructions for Authors

Abstract Preparation

Format
• Abstracts must be written in English
• Abstract length should not exceed 400 words.

Content
• Tables or drawings are not allowed in the abstract.
• Formulas can be included using the LaTeX box provided on the abstract submission web page.
• Abstracts should specify: purpose, methodology, results and conclusions.

Authors should indicate that substantive technical and/or programmatic content is included.

Co-authors
All your co-authors should be added at the time you submit your abstract using the tool provided online. You should register all of them online indicating their name, affiliation, full postal address, phone and email address.

Abstract Submission

Signing in
• The submission of abstracts must be done exclusively on the IAF website restricted area https://iafastro.directory/iac/account/login.

If you are submitting an abstract on our website for the first time, you will need to register.

In case you have forgotten your password, please use the password recovery utility.

Submission
• Go to the new abstract submission page.
• Browse the technical programme and choose the symposium and technical session for which you want to submit your abstract.
• Type the title and content of your abstract into the related abstract.
• Confirm that the material is new and original and that it has not been presented at a previous meeting.
• Confirm that your attendance at IAC 2022 to deliver and present the paper is assured.

Note: An abstract can be submitted to only one Technical Session and duplicates will be discarded.

Abstract Selection

Submitted abstracts will be evaluated by the Session Chairs on the basis of technical quality and relevance to the session topics. Prospective authors should certify that the paper was not presented at a previous meeting. Selected abstracts may be chosen for eventual oral or interactive presentation – any such choice is not an indication of quality of the submitted abstract. Their evaluation will be submitted to the Symposium Coordinators, who will make acceptance recommendations to the International Programme Committee which will make the final decision. Please note that any relevance to the Congress’ main theme will be considered as an advantage.

Paper and Presentation Submission

• Details on how to prepare and submit your final paper as well as your presentation material will be available on www.iafastro.org by mid-April.
• Authors with an abstract accepted for oral presentation will be offered a presentation slot of 10 to 20 minutes.
• Authors with an abstract accepted for interactive presentation will be offered a presentation slot of 10 minutes.
• Authors with an abstract accepted for an interactive special presentation will be assigned a specific screen number and will have a dedicated slot during which they will have the opportunity to engage in interactive discussion with other Congress attendees.

Additional Information

Preliminary versions of the IAC proceedings will be available to participants at the Congress electronically. More information about the IAF Digital Library is available on the IAF website: https://www.AIFASTRO.ORG/IAF/IAFDigitalLibrary/

Authors should follow the above general procedure. An additional suitability requirement is that the proposed topic must be related to a potential or on-going IAA Study Group activity.

Authors should follow the above instructions for the submission of their abstracts. In addition to the IAC Proceedings, the papers of the Colloquium, along with other materials, will be published in the Proceedings of IAA. Authors who qualify may ask to be considered for the Dr. I.H. Ph. Diedrichs-Verschoor Award for Best Paper. Please contact the IISL secretary for the regulations at secretary@IISLweb.org.

DEADLINES

<table>
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<td>Abstract Submission</td>
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</tr>
<tr>
<td>Interactive Presentation Submission</td>
<td>1 September 2022</td>
</tr>
<tr>
<td>Paper Submission</td>
<td>2 September 2022</td>
</tr>
<tr>
<td>Oral Presentation Submission</td>
<td>9 September 2022</td>
</tr>
</tbody>
</table>

Please make sure to check the IAF website (www.iafastro.org) and the IAF App regularly to get the latest updates on the Technical Programme!

QUESTIONS

Abstract submission and/or oral presentations: support@IAFASTRO.ORG
Interactive presentations: t5support@IAFASTRO.ORG

14. Space in France

CNES, the French Space Agency, has been innovating for industry, the military and research for 60 years, which we can illustrate with some figures:

• 3 Centimeters is the precision of satellite positioning data from the DORIS instrument operating on several missions (Sentinel-3A and Sentinel-3B, Sentinel-6, SWOT, etc.).
• 1.4 Billion km from Earth is where the U.S.-European James Webb Space Telescope (JWST), the successor to Hubble, will orbit. It has taken 20 years to build and will be launched by a special variant of Ariane 5 from Kourou (French Guiana).
• 800,000 laser shots on Mars fired by the U.S.-French ChemCam instrument on the NASA Curiosity rover since landing in 2012.
• 44 Orbital probes, spacecraft and observatories launched for science over the last 50 years from the Guiana Space Centre: from Gaia and Rosetta to the SPOT satellites, Planck, Herschel and ATV, CNES has hosted a plethora of emblematic ‘passengers’.
• 250 Young students hosted every year by CNES for their end-of-degree internship.
• 82% Engineers and executives, 37% of them women, make up CNES’s workforce.
• 4,000 Tons is the weight of the Ariane 6 mobile gantry, the largest of its kind in the world.

Industry: The French space ecosystem is driving innovation and fueling our economy.

Defense: We are stepping up to the plate to assure our sovereignty and security, on Earth and in space.

Research: To understand our planet and explore the universe, we are pushing the boundaries of knowledge.

60 YEARS OF STARGAZING: In 2022, CNES is celebrating a legacy of 60 years fueling dreams and advancing science and technology. Today, society is in need of space and at CNES we are ready for a new decade of space exploration with you.

And a vision for the coming years: We are now planning for the coming years, which for the first time will be overseen by three ministries (Industry, Research and Armed Forces), which reflects the key transformations in space and CNES’s continuing evolution. It will be predicated on the mantra of ‘space for growth’, with three main lines of action guiding the agency’s efforts over the coming years to serve the nation’s space policy: space as a driver of economic growth, strategic independence and sustainable development. These three priorities will enable France and Europe to meet the economic, strategic, political and intellectual challenges of the new space arena, while grasping the partnership and growth opportunities now emerging.
Join the IAF, the world leading space advocacy body!

Become an IAF Member

- Download the Application Form on [www.iafastro.org](http://www.iafastro.org)
- Participate in the IAF Committees in charge of defining the Technical Programme
- Propose to host a Plenary Event during the IAC
- Propose a Global Networking Forum (GNF) Event to showcase your organization’s latest achievements or to discuss the most interesting topics about Space
- Participate and vote in the General Assembly and nominate IAF Officers
- Host one of our events!

JOIN US

1. Download the Application Form on our website ([www.iafastro.org](http://www.iafastro.org)) or request it to the Secretariat.
2. Complete the Application Form and attach the requested documents.
3. Send everything to our Secretariat ([info@iafastro.org](mailto:info@iafastro.org))
4. We will review your application and ask in case of missing information.
5. Once reviewed, your application will be recommended by the IAF General Counsel.
6. Final approval by the General Assembly during the IAC.

Connecting @ll Space People