



**IAC**  
**2023**  
**BAKU**

# 74<sup>th</sup> INTERNATIONAL ASTRONAUTICAL CONGRESS



2-6 October 2023, Baku, Azerbaijan

**Global Challenges & Opportunities:  
Give Space a Chance**

## Call for Papers & Registration of Interest

ORGANIZED BY



HOSTED BY



SUPPORTED BY



[WWW.IAC2023.ORG](http://WWW.IAC2023.ORG)





*Connecting @ll Space People*

[www.iafastro.org](http://www.iafastro.org)



## IAF Alliance Programme Partners 2022



## Contents

|  |    |
|--|----|
| 1. Message from the International Astronautical Federation (IAF) | 2  |
| 2. Message from the Local Organizing Committee                   | 2  |
| 3. Message from the IPC Co-Chairs                                | 3  |
| 4. Messages from the Partner Organizations                       | 4  |
| 5. International Astronautical Federation (IAF)                  | 6  |
| 6. International Academy of Astronautics (IAA)                   | 12 |
| 7. International Institute of Space Law (IISL)                   | 13 |
| 8. The Space Generation Advisory Council (SGAC)                  | 14 |
| 9. Message from the IAF Vice President for Technical Activities  | 15 |
| 10. Technical Sessions   | 16 |
| 11. IAC 2023 Call for Papers Deadlines                           | 56 |
| 12. Preliminary IAC 2023 at a Glance                             | 57 |
| 13. Instructions for Authors                                     | 58 |
| 14. Space in Azerbaijan  | 59 |



## 1. Message from the International Astronautical Federation (IAF)

Dear Colleagues,

The 74<sup>th</sup> International Astronautical Congress will take place in Baku, Azerbaijan between 2<sup>nd</sup> and 6<sup>th</sup> October 2023.

It is an honour for the International Astronautical Federation to invite world experts specialists in the field of space and to offer all space enthusiasts an opportunity to support and promote the general theme of the Congress “*Global Challenges and Opportunities: Give Space a Chance.*”.

There is a rich history behind holding the IAC in Azerbaijan. The 24<sup>th</sup> International Astronautical Congress was held in Baku in 1973 for the first time in the Soviet Union upon the initiative of Azerbaijan’s National Leader Heydar Aliyev.

This IAC 2023 aims to gather researchers and professionals to discuss new developments in space science and exploration, space applications and operations, space technology, space infrastructure, space and society, and much more.

We have the great pleasure to invite you to propose one or more papers (oral or interactive) in any of the categories scheduled for the different symposia of the Congress. Please visit the instructions in this document.

I would like to thank you in advance for your scientific contribution to the IAC 2023 and I and the incoming IAF President Clay Mowry look forward to seeing you in Baku, Azerbaijan.

Sincerely,



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

## 2. Message from the Local Organizing Committee

The space gives us extensive opportunities to dare, to create, to innovate, and to work in synergy towards a thriving, advanced future of the mankind. And the International Astronautical Congress is an excellent platform that brings us all together, united in the face of global challenges and ready to explore the untapped potential of the space for the benefit of the humanity.

In 2023, the global space community will convene in Baku at the International Astronautical Congress once again, exactly 50 years after Baku hosted the 24<sup>th</sup> edition of the IAC and became the first and the only city in the region to do so. This, certainly, is a major occasion in the history of the space industry development in Azerbaijan, as it is one of the core priorities of our vision as a country aspiring to foster the formation of regional space ecosystem and strengthen its position as an emerging space nation. What’s more, the 74<sup>th</sup> edition of IAC will give you a chance to get a first-hand experience of the unmatched Azerbaijani hospitality, expose yourself to genuine cultural immersion, and enjoy the diverse charms of our beautiful country.

On behalf of the Space Agency of the Republic of Azerbaijan, it is a great pleasure and an honour to invite you to become a part of this remarkable event and submit your abstracts. Serving as an exemplary medium for knowledge-sharing, the IAC offers the opportunity to share your research findings and innovative solutions with a broad audience of space industry members and state officials, scientists and researchers, space experts and practitioners. We are confident that the IAC 2023 will facilitate the forging of strong partnerships that will unite us all even more closely in our joint efforts to achieve global peace and prosperity.

Once again, we would like to extend a welcoming invitation to the IAC 2023 to our friends, colleagues, partners, and, in general, the international space community, and we are much looking forward to seeing you join us in the celebration of space next year in Baku, Azerbaijan.



**Samaddin Asadov**  
*Chair,*  
Azercosmos,  
Azerbaijan

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

It is a real privilege and a great pleasure to host the 74<sup>th</sup> International Astronautical Congress IAC 2023 in Baku, Azerbaijan. Azerbaijan will welcome the global space community to Baku and offer an exceptional congress experience unifying participants into exquisite stream of the past and the future under the theme *Global Challenges and Opportunities: Give Space a Chance.*

On behalf of Azercosmos, Space Agency of the Republic of Azerbaijan, we invite courageous space pioneers, space contributors, scientists, researchers, space experts and practitioners and students to submit their proposals to present at IAC 2023.

Through improving knowledge transfer across academic institutions, the space industry, and societal organizations, IAC 2023 is an excellent platform for showcasing your best practices, achievements, and challenges turning into viable initiatives.

Being a member since 2003, Azerbaijan has been actively involved in IAFs activities. However, our ties with the IAF and the **International Astronautical Congress (IAC)** date back to 1973. For 70 years, the IAC has been a global platform for promoting space for wellbeing of the whole world. And we are proud for the legacy that the 24<sup>th</sup> IAC held in Baku in 1973 has left us with. The 24<sup>th</sup> IAC was one of the most memorable congresses in the history, leaving a lasting impression on guests. We are happy to mention that, in his letter, Stark Draper, the former President of the IAF in 1973, thanked the Azerbaijani community for their warm welcome, as well as congress organizers for arranging such an outstanding event. These words have inspired us and Azercosmos, as a host organization, to put forward the candidacy of Baku city in a bid to host the **74<sup>th</sup> IAC in Baku in 2023!**

Now that the IAC returns to our region after such a long time, it will bring a *breath of fresh air* not only to Azerbaijan, but to the neighboring countries. It will contribute to the regional space platform with many new ideas, discussions and debates, while also creating opportunities for guests to immerse in Azerbaijan’s rich culture. As the **transportation, business and space hub** of the region, Azerbaijan will ensure the greatest benefits to all the participants of the upcoming IACs.

In terms of the organizational standard, the IAC in Baku will be approached with special attention and dedication. **Our institutions and people have mobilized their powers** in order to organize and deliver an exceptional congress experience to all participants. And we are working strenuously with our partners to make IAC 2023 Baku event that could reach everyone, everywhere!

We sincerely hope you grab the chance to demonstrate your research papers publicly by being a contributor in one or more of the 180 technical sessions, and share knowledge and experience with collaborators working inside your sphere. All abstracts will proceed to the peer review and validation. And a certain number of papers will have the privilege of moving on to the next stage as vibrant presentations or oral performances.

We would like to encourage our international partners, individuals from governmental, scientific, academic, and commercial entities; heads of space agencies and space industries; scientists, engineers, enthusiasts, young professionals, and students, in one word: the entire space community, to become parts of the innovative, immersive, and fascinating space event in Baku, Azerbaijan, in 2023.



**Dunay Badirkhanov**  
*IPC Co-Chair,*  
Vice-chairman/CTO,  
Azercosmos,  
Azerbaijan



**Giorgio Saccoccia**  
*IPC Co-Chair,*  
President,  
Italian Space Agency (ASI),  
Italy

## 4. Messages from the Supporting Organizations

### Message from the International Academy of Astronautics (IAA)

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 Baku, representing about one third of the IAC technical programme, 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 with 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 (IISL)

On behalf of the International Institute of Space Law, I am pleased to invite you to attend our 66<sup>th</sup> Colloquium on the Law of Outer Space in Baku, Azerbaijan. This year's Colloquium consists of seven exciting sessions and explores a range of highly relevant issues. 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 a session with the IAA: The 37<sup>th</sup> IAA-IISL 'Scientific Legal Roundtable' will provide an opportunity for lawyers, scientists and engineers to address digitalization in an interdisciplinary setting. These are all issues, to which, we believe, IISL can and should contribute to. No other Institution has this global inclusive reach and such a top-level experienced expert membership paired with bright young scholars, which guarantees relevant contributions.

The World Finals of the 32<sup>th</sup> Manfred Lachs Space Law Moot Court Competition will take place in Baku, welcoming university students from Africa, the Asia Pacific, Europe, Latin America, and North America, and we are proud and honoured that they will, as always, be judged by sitting members of the International Court of Justice. The IISL is proud to be an integral part of the Congress and its Technical Programme and to further the discourse between disciplines so fundamental to our shared ways forward in this new era of the use of space.

We are greatly looking forward to welcoming you in Baku!



**Kai-Uwe Schrogl**  
*President,*  
International Institute of Space Law (IISL)

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

On behalf of SGAC, we are pleased to invite you to the 21<sup>st</sup> Space Generation Congress (SGC) to be held in Baku, Azerbaijan on 28-30 September 2023, prior to the 74<sup>th</sup> International Astronautical Congress (IAC).

In 2023, SGC will focus on emerging space actors, with a view towards involving students and young professionals in the space sector from as many parts of the world as possible. Being the only event of its kind, SGC offers the next generation of space leaders the opportunity to network and examine critical questions that are facing the space and international community at large.

It is with great pleasure that we would like to invite our global youth community to submit an abstract for the 74<sup>th</sup> IAC that will be held in Baku. The IAC brings together scientists, practitioners, engineers, and leaders of the space industry and of agencies together at a single forum to discuss recent research breakthroughs, technical advances and existing opportunities, as well as to grow their space careers.

We are looking forward to welcoming you to Baku!



**Hamza Hameed**  
*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 468 members from 75 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 @ll Space 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**  
100 Avenue de Suffren  
75015 Paris, France  
Tel: +33 1 45 67 42 60  
Website: [www.iafastro.org](http://www.iafastro.org)

## Members of IAF Bureau 2022 – 2023

**IAF PRESIDENT**  
**Clay MOWRY**  
Chief Revenue Officer,  
Voyager Space Holdings,  
United States

**VP: DEVELOPING COUNTRIES AND EMERGING COMMUNITIES**  
**Pilar ZAMORA ACEVEDO**  
Executive Director,  
Colombian Space Agency (AEC),  
Colombia

**VP: DIVERSITY INITIATIVES**  
**Mishaal ASHEMIMRY**  
Aerospace Consultant & Special  
Advisor to CEO,  
Saudi Space Commission (SSC),  
Saudi Arabia

**VP: EDUCATION AND WORKFORCE DEVELOPMENT**  
**Davide PETRILLO**  
Executive Director,  
Space Generation Advisory Council  
(SGAC),  
Italy

**VP: FINANCIAL MATTERS AND INDUSTRY RELATIONS**  
**Andreas LINDENTHAL**  
Head of Business Operations  
Space Systems, Head of Spacecraft  
Equipment, Head of Space Systems  
Germany,  
Airbus Defence and Space GmbH,  
Germany

**VP: HONOURS AND AWARDS**  
**Anthony TSOUGRANIS**  
Europe Team Lead,  
National Aeronautics and Space  
Administration (NASA),  
United States

**VP: IAF GLOBAL NETWORKING FORUM**  
**Steve EISENHART**  
Senior Vice President,  
Space Foundation,  
United States

**VP: RELATIONS WITH INTERNATIONAL ORGANIZATIONS**  
**Anil KUMAR**  
Associate Director, ISTRAC,  
Chief General Manager, Safe &  
Sustainable Space Operations  
Management,  
Indian Space Research Organisation  
(ISRO),  
India

**VP: SCIENCE AND ACADEMIC RELATIONS**  
**Tanja MASSON-ZWAAN**  
Assistant Professor and Deputy  
Director of the International Institute  
of Air and Space Law (IIASL),  
Leiden University  
The Netherlands

**VP: SOCIETIES AND MUSEUMS**  
**Xiaojun WANG**  
President,  
China Academy of Launch Vehicle  
Technology (CALT),  
China

**VP: SPACE ECONOMY AND SPONSORSHIP**  
**Nobu OKADA**  
Founder & CEO,  
Astroscale,  
Japan

**VP: TECHNICAL ACTIVITIES**  
**Lionel SUCHET**  
Chief Operating Officer,  
Centre National d'Etudes Spatiales  
(CNES),  
France

**GENERAL COUNSEL**  
**Sergio MARCHISIO**  
Full Professor of International Law,  
Sapienza University of Rome,  
Italy

**HONORARY SECRETARY**  
**Geir HOVMORK**  
Special Adviser to the Director  
General,  
Norwegian Space Agency,  
Norway

**IAF EXECUTIVE DIRECTOR**  
**Christian FEICHTINGER**  
Executive Director,  
IAF Secretariat,  
Austria

**SPECIAL ADVISOR TO THE IAF PRESIDENT INTERNATIONAL SPACE FORUM (ISF)**  
**Giorgio SACCOCCIA**  
President,  
Italian Space Agency (ASI),  
Italy

**SPECIAL ADVISOR TO PRESIDENT ON PARLIAMENTARIAN AND MINISTERIAL RELATIONS**  
**Dominique TILMANS**  
President,  
EURISY,  
Belgium

**SPECIAL ADVISOR TO PRESIDENT ON SPACE AGENCIES RELATIONS**  
**S. SOMANATH**  
Chairman,  
Indian Space Research Organization  
(ISRO),  
India

**SPECIAL ADVISOR TO PRESIDENT ON THE SUSTAINABILITY, INVESTMENT AND SECURITY (SIS) AGENDA**  
**Joe LANDON**  
Vice President & General Manager,  
Lunar Infrastructure Services,  
Lockheed Martin Corporation,  
United States

## IAF Secretariat

**Christian Feichtinger**, Executive Director  
**Giulia Maria Berardi**, Deputy Executive Director  
**Silvia Antolino**, Senior Communications Manager  
**Isabella Marchisio**, Senior Projects Manager  
**Myriam Morabet**, Senior Projects Manager  
**Giulia Angeletti**, Office Manager

**Emma Boisdur**, Projects Manager  
**Alessandra D'Argenio**, Projects Manager  
**Martina Fabbiani**, Projects Manager  
**Evelina Hedman**, Creative Services & Projects Manager  
**Stefano Pascali**, Projects Manager

**Martin Feichtinger**, Administrative & Project Support  
**Michel Arnaud**, IPC Co-Chairs Advisor (Volunteer)  
**Elena Feichtinger**, Projects Manager and Special Advisor (Volunteer)

## IAF Member Organizations 2022

|   |                 |   |                    |
|---|-----------------|---|--------------------|
| A9C Capital   | Bahrain         | Arianespace   | France             |
| AAKA SPACE STUDIO CORP                                    | Canada          | Asgardia  | Austria            |
| Access e.V.   | Germany         | Asher Space Research Institute (ASRI)                       | Israel             |
| Adriatic Aerospace Association                            | Croatia         | Asia-Pacific Space Cooperation Organization (APSCO)         | China              |
| AED Cluster Portugal                                      | Portugal        | Association Aéronautique & Astronautique de France (3AF)    | France             |
| Aerojet Rocketdyne  | United States   | Association of Space Explorers (ASE)                        | United States      |
| Aerospace Industries Association                          | United States   | Associazione Italiana di Aeronautica e Astronautica (AIDAA) | Italy              |
| Aerospace Research Institute                              | Iran            | Astralintu Space Technologies                               | Ecuador            |
| Aexa Aerospace LLC  | United States   | Astrax, Inc.  | Japan              |
| Agence Spatiale Algérienne (ASAL)                         | Algeria         | Astronautic Technology SDN BHD                              | Malaysia           |
| Agencia Espacial Mexicana (AEM)                           | Mexico          | Astronautical Society of India                              | India              |
| AGI   | United States   | Astrosat Ltd  | United Kingdom     |
| Agrupacion Astronautica Espanola                          | Spain           | Astroscale Pte. LTD   | Japan              |
| Airbus Defence and Space GmbH                             | Germany         | Auspace Pty Ltd   | Australia          |
| Airbus Defence and Space Netherlands B.V.                 | The Netherlands | Australian Space Agency                                     | Australia          |
| Airbus Defence and Space SA                               | Spain           | Austrian Research Promotion Agency (FFG)                    | Austria            |
| Airbus Defence and Space SAS                              | France          | AUSTROSPACE   | Austria            |
| Airbus Ltd.   | United Kingdom  | Axiom Space LLC   | United States      |
| ALE Co., Ltd.   | Japan           | Bauman Moscow State Technical University                    | Russian Federation |
| Alma Mater Studiorum - University of Bologna              | Italy           | Beihang University  | China              |
| American Astronautical Society (AAS)                      | United States   | Beijing FutureSpace Space Technology Institute              | China              |
| American Institute of Aeronautics and Astronautics (AIAA) | United States   | Beijing Infinite Education Inc.                             | China              |
| Andøya Space Center                                       | Norway          | Beijing Interstellar Glory Space Technology Co., Ltd        | China              |
| Angolan National Space Program Management Office (GGPEN)  | Angola          | Beijing Minospace Technologies Co., Ltd                     | China              |
| ANU Institute for Space (InSpace)                         | Australia       | Beijing Smart Satellite Technology Co., Ltd.                | China              |
| ArianeGroup SAS   | France          |   |                    |

|  |                    |   |                    |   |                    |  |                      |
|--|--------------------|---|--------------------|---|--------------------|--|----------------------|
| Beijing SpaceD Aerospace Application & Science Education Technology Co.,Ltd. | China              | Dassault Aviation   | France             | Gokmen Space and Aviation Training Center (GUHEM)                                   | Turkey             | Karman Project   | Germany              |
| Beijing Sunwise Space Technology Ltd.  | China              | DcubeD (Deployables Cubed GmbH)   | Germany            | GomSpace Aps  | Denmark            | KBR  | United States        |
| Belgian Federal Science Policy Office (BELSPO)                               | Belgium            | Deimos Space S.L.   | Spain              | Graz University of Technology (TU Graz)   | Austria            | Keldysh Research Center  | Russian Federation   |
| Ben-Gurion University of the Negev   | Israel             | Delft University of Technology  | The Netherlands    | Gumush Aerospace & Defense  | Turkey             | Kenya Space Agency   | Kenya                |
| Berkeley SETI Research Center  | United States      | Denel Spaceteq  | South Africa       | HE Space  | Germany            | Khalifa University of Science of Technology                            | United Arab Emirates |
| beSpace GmbH   | Germany            | Department of Space Studies, University of North Dakota                             | United States      | Hebrew University of Jerusalem  | Israel             | Khrunichev State Research & Production Space Center                    | Russian Federation   |
| Black Engine Aerospace UG  | Germany            | Dereum Labs S.A. de C.V.  | Mexico             | Hermann-Oberth-Raumfahrt Museum e.V.  | Germany            | King Abdulaziz City for Science & Technology (KACST)                   | Saudi Arabia         |
| Blue Origin LLC  | United States      | Deutsche Gesellschaft für Luft-und Raumfahrt, Lilienthal-Oberth e.V. (DGLR)         | Germany            | Hermes Engineering  | Bulgaria           | Kongsberg Satellite Services AS  | Norway               |
| Brazilian Space Agency (AEB)   | Brazil             | Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)                                | Germany            | High Technology Unit (UAT) Faculty of Engineering - UNAM                            | Mexico             | Korea Aerospace Industries, Ltd  | Korea, Republic of   |
| Bryce Space and Technology   | United States      | Digantara Research and Technologies Private Limited                                 | India              | Hong Kong Aerospace Technology Group Limited (HKATG)                                | China              | Korea Aerospace Research Institute (KARI)                              | Korea, Republic of   |
| Bulgarian Aerospace Agency   | Bulgaria           | Disrupting Space LLC  | United States      | Hungarian Astronautical Society (MANT)  | Hungary            | Korea Association for Space Technology Promotion (KASP)                | Korea, Republic of   |
| California Polytechnic State University                                      | United States      | D-Orbit SpA   | Italy              | IABG Industrienanlagen - Betriebsgesellschaft mbH                                   | Germany            | Korea Astronomy and Space Science Institute                            | Korea, Republic of   |
| Canadensys Aerospace Corporation   | Canada             | Dragonfly Aerospace Pty (Ltd)   | South Africa       | IHI Aerospace Co, Ltd.  | Japan              | Kyushu Institute of Technology   | Japan                |
| Canadian Aeronautics & Space Institute (CASI)                                | Canada             | Dynetics  | United States      | Indian Space Research Organization (ISRO)   | India              | LandSpace Technology Corporation Ltd.                                  | China                |
| Canadian Space Agency  | Canada             | Ecole Polytechnique Fédérale de Lausanne (EPFL)                                     | Switzerland        | Indonesian Space Agency Secretariat (INASA)   | Indonesia          | Lavochkin Science and Production Association                           | Russian Federation   |
| Canadian Space Society   | Canada             | Egyptian Space Agency   | Egypt              | Infostellar   | Japan              | Law Offices of Sterns and Tennen                                       | United States        |
| C-Astra Technologies   | United States      | Embry-Riddle Aeronautical University  | United States      | IngeniArs Srl   | Italy              | Leviathan Space Industry LLC   | United States        |
| Center for Space Technology and Research (CSTAR)                             | United States      | EMXYS (Embedded Instruments and Systems S.L)  | Spain              | INNOSPACE Co. Ltd.  | Korea, Republic of | Libre Space Foundation   | Greece               |
| Center of Space Exploration, Ministry of Education (COSE)                    | China              | EnduroSat AD  | Bulgaria           | Institut d'Estudis Espacials de Catalunya   | Spain              | LIQUIFER Systems Group   | Austria              |
| Central American Association for Aeronautics and Space (ACAE)                | Costa Rica         | Engineers Australia   | Australia          | Institut Français d'Histoire de l'Espace  | France             | Lithuanian Museum of Ethnocosmology                                    | Lithuania            |
| Central Research Institute for Machine Building (JSC TSIIMASH)               | Russian Federation | EngineRoom.io Pty Ltd   | Australia          | Institut Supérieur de l'Aéronautique et de l'Espace (ISAE)                          | France             | Lithuanian Space Association (LSA)                                     | Lithuania            |
| Centre for Mechanical and Aerospace Science and Technologies (C-MAST)        | Portugal           | EOS Data Analytics Inc.   | United States      | Institute for Q-shu Pioneer of Space, Inc. (IQPS)                                   | Japan              | Lockheed Martin Corporation  | United States        |
| Centre for the development of Industrial Technology (CDTI)                   | Spain              | Estonian Business Innovation Agency   | Estonia            | Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS)          | Russian Federation | Luxembourg Space Agency  | Luxembourg           |
| Centre National de la Cartographie et de la Teledetection (CNCT)             | Tunisia            | EUMETSAT  | Germany            | Institute of Experimental and Applied Physics, Czech Technical University in Prague | Czech Republic     | Malaysian Space Agency (MYSA)  | Malaysia             |
| Centre National d'Etudes Spatiales (CNES)                                    | France             | EURISY  | France             | Institute of Mechanics, Chinese Academy of Sciences                                 | China              | Mars Planet  | Italy                |
| Centre Royal de Télédétection Spatiale (CRTS)                                | Morocco            | Euro Space Center   | Belgium            | Institute of Space Technology (IST)   | China              | Massachusetts Institute of Technology                                  | United States        |
| Centro de Investigacion y Difusion Aeronautico Espacial (CIDA-E)             | Uruguay            | Euroconsult   | France             | Instituto de Aeronáutica e Espaço (IAE)   | Pakistan           | Maxar  | United States        |
| China Head Aerospace Technology Co.  | China              | European Conference for Aero-Space Sciences (EUCASS)                                | Belgium            | Instituto Nacional de Pesquisas Espaciais (INPE)                                    | Brazil             | McGill Institute for Aerospace Engineering (MIAE)                      | Canada               |
| Chinese Society of Astronautics (CSA)  | China              | European Organization for Nuclear Research (CERN)                                   | Switzerland        | Instituto Nacional de Tecnica Aeroespacial (INTA)                                   | Brazil             | MDA Corporation  | Canada               |
| CIRA Italian Aerospace Research Centre                                       | Italy              | European Space Agency (ESA)   | France             | Instituto Tecnológico de Costa Rica (TEC)   | Spain              | MEDES - IMPS   | France               |
| Colegio Federado de Ingenieros y de Arquitectos de Costa Rica (CFIA)         | Costa Rica         | European Space Foundation   | Poland             | International Association for the Advancement of Space Safety                       | Costa Rica         | Microcosm, Inc.  | United States        |
| Colombian Space Agency   | Colombia           | European Space Policy Institute (ESPI)  | Austria            | International Institute of Space Commerce   | The Netherlands    | MicroDrive Space Ltd.  | China                |
| Colorado Center for Astrodynamics Research, University of Colorado           | United States      | European Test Services (ETS) B.V.   | The Netherlands    | International Lunar Observatory Association   | Isle of Man        | Mitsubishi Electric Corporation  | Japan                |
| Comision Nacional de Actividades Espaciales (CONAE)                          | Argentina          | European Union Agency for the Space Programme (EUSPA)                               | Czech Republic     | International Peace Alliance  | United States      | Mitsubishi Heavy Industries, Ltd.                                      | Japan                |
| Commission d'Astronautique de l'Academie Roumaine COMSPOC Corp.              | Romania            | Eurospace   | France             | International Space Center - Space Park Israel Ashkelon                             | China              | Mohammed Bin Rashid Space Centre (MBRSC)                               | United Arab Emirates |
| Cosmoexport Aerospace Research Agency  | Russian Federation | Fachhochschule Wiener Neustadt GmbH   | Austria            | International Space University (ISU)  | China              | Moon Village Association (MVA)   | Austria              |
| Council of European Aerospace Societies (CEAS)                               | Belgium            | Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST) | United States      | Internationaler Förderkreis für Raumfahrt – Hermann Oberth – Wernher von Braun e.V. | Israel             | Moscow Aviation Institute (MAI)  | Russian Federation   |
| Croatian Astronautical and Rocket Federation (HARS)                          | Croatia            | Felix & Paul Studios  | Canada             | Intersputnik International Organization of Space Communications                     | France             | MT Aerospace AG  | Germany              |
| CSIRO Astronomy & Space Science  | Australia          | Finnish Astronautical Society   | Finland            | Invap S.E.  | Germany            | Mudd Law   | United States        |
| CSL (Centre Spatial de Liège)  | Belgium            | Firefly Aerospace Inc.  | United States      | Iranian Space Agency  | Iran               | MX Space A.C.  | Mexico               |
| Curtin University  | Australia          | Flinders University   | Australia          | ispace, inc   | Japan              | Nanjing University of Aeronautics and Astronautics                     | China                |
| CVA (Community of Ariane Cities)   | France             | Fondazione E. Amaldi  | Italy              | Israel Aerospace Industries. Ltd.   | Israel             | NanoAvionika UAB (NanoAvionics LLC)                                    | Lithuania            |
| Cyprus Astronautical Society   | Cyprus             | Fraunhofer Alliance Space   | Germany            | Israel Space Agency   | Israel             | Nanoracks  | United States        |
| Cyprus Space Exploration Organisation (CSEO)                                 | Cyprus             | Fundacion para el Desarrollo de las Ciencias la Sociedad y el Estado (FUNDECISE)    | Costa Rica         | Italian Space Agency (ASI)  | Italy              | National Aeronautics and Space Administration (NASA)                   | United States        |
| Czech Space Alliance   | Czech Republic     | Future Space Leaders Foundation   | United States      | Japan Aerospace Exploration Agency (JAXA)   | Japan              | National Aerospace Agency (NASA) of Azerbaijan Republic                | Azerbaijan           |
| Czech Space Office   | Czech Republic     | G.A.U.S.S. Srl  | Italy              | Japan Manned Space Systems Corporation (JAMSS)                                      | Japan              | National Astronomical Research Institute of Thailand                   | Thailand             |
| Dalian University of Technology (DUT)  | China              | Geo-Informatics and Space Technology Development Agency (GISTDA)                    | Thailand           | Japan Society for Aeronautics and Space Sciences (JSASS)                            | Japan              | National Autonomous University of Honduras                             | Honduras             |
| Danish Aerospace Company A/S   | Denmark            | German Aerospace Industries Association (BDLI)                                      | Germany            | Japanese Rocket Society   | Japan              | National Institute of Information and Communications Technology (NICT) | Japan                |
| Danish Astronautical Society   | Denmark            | GIFAS   | France             | Joanneum Research   | Japan              | National Oceanic and Atmospheric Administration (NOAA)                 | United States        |
|  |                    | GK Launch Services, JSC   | Russian Federation | JSC Glavkosmos  | Austria            | National Space Centre  | Ireland              |
|  |                    | GKN Aerospace Engine Systems  | Sweden             | JSC NPO Energomash  | Russian Federation | National Space Research and Development Agency (NASRDA)                | Nigeria              |
|  |                    | Global Defence for Industrial Transformation  | United States      | JSC SRC Progress  | Russian Federation | National Space Science Agency (NSSA)                                   | Bahrain              |
|  |                    | GMV Aerospace & Defence SAU   | Spain              |   |                    |  |                      |



|   |                    |  |                    |  |                      |   |                 |
|---|--------------------|--|--------------------|--|----------------------|---|-----------------|
| National Space Society  | United States      | Saudi Space Commission (SSC)   | Saudi Arabia       | Technical University of Košice   | Slovak Republic      | UK Space Agency   | United Kingdom  |
| NEC Corporation   | Japan              | Secure World Foundation  | United States      | Techno System Developments S.R.L.  | Italy                | United Launch Alliance LLC  | United States   |
| Netherlands Aerospace Centre (NLR)                                | The Netherlands    | SEMECCEL Cité de l'Espace  | France             | Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences | China                | Universiti Teknologi Mara (UITM)  | Malaysia        |
| Netherlands Space Office (NSO)                                    | The Netherlands    | SENER Ingenieria y Sistemas, S.A.  | Spain              | Teledyne Brown Engineering   | United States        | University Mediterranea of Reggio Calabria                                      | Italy           |
| Netherlands Space Society (NVR)                                   | The Netherlands    | Serbian Office for Space Sciences, Research and Development (SERBSPACE)      | Serbia             | Telespazio S.p.A.  | Italy                | University of Adelaide  | Australia       |
| NeutronStar Systems UG (hb)                                       | Germany            | SES  | Luxemburg          | Telespazio VEGA UK LTD   | United Kingdom       | University of Alabama in Huntsville   | United States   |
| New Zealand Space Agency  | New Zealand        | Shaanxi Engineering Laboratory for Microsatellites                           | China              | Tensor Tech CO., LTD.  | Taiwan, China        | University of Naples "Federico II"  | Italy           |
| NGC Aerospace Ltd.  | Canada             | Shaanxi XingYi Space technologies Co. Ltd.                                   | China              | Tesat-Spacecom GmbH & Co. KG   | Germany              | University of South Australia   | Australia       |
| Nigerian Meteorological Agency                                    | Nigeria            | Shamakhly Astrophysical Observatory  | Azerbaijan         | Thales Alenia Space France   | France               | University of Strathclyde   | United Kingdom  |
| Norsk Astronautisk Forening                                       | Norway             | Shoal Group  | Australia          | Thales Alenia Space Italia   | Italy                | University of Tartu   | Estonia         |
| Northrop Grumman Corporation                                      | United States      | SIDERALIS Foundation   | Ecuador            | The Aerospace Corporation  | United States        | University of Vigo  | Spain           |
| Northwestern Polytechnical University                             | China              | Sierra Space   | United States      | The Andy Thomas Space Foundation   | Australia            | University POLITEHNICA of Bucharest - Research Center for Aeronautics and Space | Romania         |
| Norwegian Space Agency  | Norway             | Simera Sense   | Belgium            | The Boeing Company   | United States        | University Space Program, Universidad Nacional Autonoma de Mexico               | Mexico          |
| Novespace   | France             | Singapore Space and Technology Ltd (SSTL)                                    | Singapore          | The British Interplanetary Society   | United Kingdom       | University Wuerzburg  | Germany         |
| Office for Space Technology & Industry, Singapore                 | Singapore          | Singapore Technologies Engineering Limited                                   | Singapore          | The Chinese Aeronautical and Astronautical Society located in Taipei                 | Taiwan, China        | UNSW Australia  | Australia       |
| Office National d'Etudes et de Recherches Aérospatiales (ONERA)   | France             | Sirius XM Radio  | United States      | The Federal University of Technology, Akure (FUTA)                                   | Nigeria              | Valispace   | Germany         |
| OHB Italia Spa  | Italy              | Sitael Spa   | Italy              | The Institute for Earth and Space Exploration  | Canada               | Victorian Space Science Education Centre  | Australia       |
| OHB System AG - Munich  | Germany            | Sky and Space Global (UK) Ltd  | United Kingdom     | The Johns Hopkins University Applied Physics Laboratory                              | United States        | Vieira de Almeida & Associados  | Portugal        |
| OHB System AG-Bremen  | Germany            | Slovak Investment and Trade Development Agency (SARIO) - Slovak Space Office | Slovakia           | The Korean Society for Aeronautical and Space Sciences                               | Korea, Republic of   | Vietnam National Space Center (VNSC)  | Vietnam         |
| Open Cosmos   | United Kingdom     | SODERN   | France             | The National Space Science and Technology Center (NSSTC)                             | United Arab Emirates | Virgin Galactic L.L.C   | United States   |
| Pacific West Data Pty Ltd - Trading as ACME SpaceTek              | Australia          | Soletop Co., Ltd   | Korea, Republic of | The Ohio State University College of Engineering                                     | United States        | Viterbi School of Engineering, USC  | United States   |
| Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) | Pakistan           | South African National Space Agency (SANSA)                                  | South Africa       | The Planetary Society  | United States        | VITO nv   | Belgium         |
| Paraguayan Space Agency   | Paraguay           | South African Space Association (SASA)                                       | South Africa       | The Sergei Korolev Space Museum  | United States        | Von Karman Institute for Fluid Dynamics   | Belgium         |
| Peoples's Friendship University of Russia (RUDN)                  | Russian Federation | Space Agency of Republic of Azerbaijan (Azercosmos)                          | Azerbaijan         | The University of Sydney   | Ukraine              | Voyager Space Holdings  | United States   |
| PJSC "Elmiz"  | Ukraine            | Space Applications Services NV/SA  | Belgium            | The University of Winnipeg   | Australia            | WFB - Wirtschaftsförderung Bremen   | Germany         |
| Planet Labs Germany GmbH  | Germany            | Space Canada Corporation   | Canada             | ThrustMe   | Canada               | Women in Aerospace Europe (WIA-E)   | The Netherlands |
| Polish Academy of Sciences  | Poland             | Space Center Houston   | United States      | TNO  | France               | World Space Week Association  | United States   |
| Polish Astronautical Society                                      | Poland             | Space Commercial Services Holdings (Pty) Ltd                                 | South Africa       | Tsinghua University  | The Netherlands      | Xovian Research & Technologies Pvt. Ltd   | India           |
| Polish Space Agency (POLSA)                                       | Poland             | Space Flight Laboratory (SFL)  | Canada             | Turkish Space Agency (TUA)   | China                | Yuzhnoye State Design Office  | Ukraine         |
| Politecnico di Milano   | Italy              | Space Foundation   | United States      | U.S. Geological Survey   | Turkey               | ZARM Fab GmbH   | Germany         |
| Politecnico di Torino   | Italy              | Space Generation Advisory Council (SGAC)                                     | Austria            | UAE Space Agency   | United States        | Zero2infinity   | Spain           |
| Portugal Space Agency   | Portugal           | Space Industry Association of Australia                                      | Australia          |  | United Arab Emirates | Zhuhai Orbita Aerospace Science & Technology Co. Ltd                            | China           |
| PRATIAN LLC   | Puerto Rico        | Space Policy Institute, George Washington University                         | United States      |  |                      |   |                 |
| PricewaterhouseCoopers Advisory (PwC)                             | France             | Space Tech Expo - Smarter Shows Ltd  | United Kingdom     |  |                      |   |                 |
| Proximai  | United States      | Space Trust  | United Kingdom     |  |                      |   |                 |
| PTS Planetary Transportation Systems GmbH                         | Germany            | Spacebit Global Ltd  | United Kingdom     |  |                      |   |                 |
| Purple Mountain Observatory (PMO)                                 | China              | SpaceBuzz  | The Netherlands    |  |                      |   |                 |
| QinetiQ Space nv  | Belgium            | SpaceChain Foundation Ltd.   | Singapore          |  |                      |   |                 |
| Qwaltec Inc.  | United States      | SpaceForest  | Poland             |  |                      |   |                 |
| Rafael Advanced Defense Systems Ltd.                              | Israel             | SpaceLand Africa   | Mauritius          |  |                      |   |                 |
| Ramirez de Arellano y Abogados, S.C. Law Firm                     | Mexico             | SpaceNed   | The Netherlands    |  |                      |   |                 |
| Reaction Engines  | United Kingdom     | Spacety  | China              |  |                      |   |                 |
| RFA - Rocket Factory Augsburg                                     | Germany            | SpaceX   | United States      |  |                      |   |                 |
| Rocket Research Institute, Inc.                                   | United States      | Spade  | France             |  |                      |   |                 |
| Romanian Space Agency (ROSA)                                      | Romania            | Spartan Space  | France             |  |                      |   |                 |
| ROSCOSMOS   | Russian Federation | Starburst Aerospace Ltd  | Israel             |  |                      |   |                 |
| Rovsing A/S   | Denmark            | Stardust Technologies Inc.   | Canada             |  |                      |   |                 |
| RUAG Space  | Sweden             | State Space Agency of Ukraine (SSAU)   | Ukraine            |  |                      |   |                 |
| S.P. Korolev Rocket and Space Corporation Energia                 | Russian Federation | Stellenbosch University  | South Africa       |  |                      |   |                 |
| Safran Aircraft Engines   | France             | STM (Savunma Teknolojileri Muhendislik ve Ticaret A.S.)                      | Turkey             |  |                      |   |                 |
| Saint Petersburg State University of Aerospace Instrumentation    | Russian Federation | Surrey Satellite Technology Ltd (SSTL)                                       | United Kingdom     |  |                      |   |                 |
| Samara National Research University (Samara University)           | Russian Federation | Swedish Society for Aeronautics and Astronautics                             | Sweden             |  |                      |   |                 |
| Sapienza University of Rome                                       | Italy              | Swedish Space Cooperation (SSC)  | Sweden             |  |                      |   |                 |
| Satellogic  | Spain              | Swiss Space Office (SSO)   | Switzerland        |  |                      |   |                 |
| Satrec Initiative   | Korea, Republic of | SwissSpace Association   | Switzerland        |  |                      |   |                 |
|   |                    | Teaching Science and Technology, Inc (TSTI)                                  | United States      |  |                      |   |                 |



## 6. International Academy of Astronautics (IAA)

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 1<sup>st</sup> 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.



**Address:** 6 rue Galilée, 75016 Paris  
**Mailing address:** P.O. Box 1268-16 – 75766 Paris Cedex 16 – France  
**Phone:** 33 (0)1 47 23 82 15  
**Email:** sgeneral@iaamail.org  
**Website:** www.iaaspace.org



**PRESIDENT**  
**John SCHUMACHER**  
United States



**SECRETARY GENERAL**  
**Jean-Michel CONTANT**  
France

## IAA Board of Trustees 2021-2023

### PRESIDENT

**John Schumacher** (United States)

### VICE-PRESIDENT SCIENTIFIC ACTIVITIES

**Marius-Ioan Piso** (Romania)

### VICE-PRESIDENT PUBLICATIONS & COMMUNICATION

**Kailasavadivoo Sivan** (India)

### VICE-PRESIDENT AWARDS & MEMBERSHIP

**Chrysoula Kourtidou-Papadeli** (Greece)

### VICE-PRESIDENT FINANCE

**Shigeki Kinai** (Japan)

### PAST-PRESIDENT

**Peter Jankowitsch** (Austria)

### SECRETARY GENERAL

**Jean-Michel Contant** (France)

### LEGAL COUNSEL

**Leslie Tennen** (United States)

## Trustees Section 1, Basic Sciences

**Ralph McNutt Jr.** (United States, *Chairman*)  
**Athena Coustenis** (France)

**Rumi Nakamura** (Japan)  
**Tilman Spohn** (Germany)

**Antonio Viviani** (Italy)  
**Wang Jinnian** (China)

**Lev Zelenyi** (Russian Federation)

## Trustees Section 2, Engineering Sciences

**Weimin Bao** (China, *Chairman*)  
**Vladimir Agapov** (Russia)

**James Chilton** (United States)  
**Junichiro Kawaguchi** (Japan)

**Daniel Neuenschwander** (Switzerland)  
**Paolo Teofilatto** (Italy)

**Raman Umamaheswaran** (India)

## Trustees Section 3, Life Sciences

**Elena Fomina** (Russia, *Chairman*)  
**Jeffrey Davis** (United States)

**Du Jichen** (China) **Jichen Du**  
**Jens Jordan** (Germany)

**Chiaki Mukai** (Japan)  
**Dumitru-Dorin Prunariu** (Romania)

**Thais Russomano** (Brazil)

## Trustees Section 4, Social Sciences

**Filippo Graziani** (Italy, *Chairman*)  
**Natalia Archinard** (Switzerland)

**Miguel Bello-Mora** (Spain)  
**Jose R. Braga Coelho** (Brazil)

**Joseph Landon** (United States)  
**Efim Malitkov** (Russia)

**Wu Meirong** (China)

## 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 development 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.



**Email:** info@iislweb.org  
**Website:** <http://iislweb.space>  
**Facebook:** <https://www.facebook.com/spacelaw>  
**Twitter:** [https://twitter.com/iisl\\_space](https://twitter.com/iisl_space)

## IISL Board of Directors 2022 - 2023



**PRESIDENT**  
**Kai-Uwe SCHROGL**  
Germany



**VICE PRESIDENT**  
**Setsuko AOKI**  
Japan



**VICE PRESIDENT**  
**Diane HOWARD**  
United States



**EXECUTIVE SECRETARY**  
**P.J. BLOUNT**  
United States



**TREASURER**  
**Dennis J. BURNETT**  
United States

## Members of the Board

**Frans G. von der Dunk** (The Netherlands)  
**Marco Ferrazzani** (Italy)  
**Steven Freeland** (Australia)  
**Joanne Irene Gabrynowicz** (United States)  
**Mahulena Hofmann** (Czech Republic)  
**Ranjana Kaul** (India)  
**Peter Martinez** (South Africa)  
**Martha Mejia-Kaiser** (Mexico/Germany)

**Elina Morozova** (Russian Federation)  
**Olavo de Oliveira Bittencourt Neto** (Brazil)  
**Masahiko Sato** (Japan)  
**Lesley Jane Smith** (United Kingdom)  
**Olga Stelmakh-Drescher** (Ukraine)  
**Jenni Tapio** (Finland)  
**Fabio Tronchetti** (Italy/China)  
**Guoyu Wang** (China)

## 8. Space Generation Advisory Council (SGAC)

The Space Generation Advisory Council in Support of the United Nations Programme on Space Applications is a global non-governmental, 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 21000 members representing more than 165 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](http://www.spacegeneration.org)



### Space Generation Advisory Council (SGAC)

European Space Policy Institute  
Schwarzenbergplatz 6  
A-1030 Vienna, Austria

**E:** [info@spacegeneration.org](mailto:info@spacegeneration.org)  
**W:** [www.spacegeneration.org](http://www.spacegeneration.org)  
**Facebook:** [@spacegeneration](https://www.facebook.com/spacegeneration)  
**Twitter:** [@SGAC](https://twitter.com/SGAC)



## 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 74<sup>th</sup> International Astronautical Congress to be held in Baku, Azerbaijan from 2 to 6 October 2023. The Congress is organized by the International Astronautical Federation (IAF), hosted by the Space Agency of the Republic of Azerbaijan (Azercosmos), 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. The Space domain is experiencing quick modifications; one could say a revolution, both for users and developers of Space solutions. Coming years will be for sure a game changer for all space actors. It is the right time to join the global space community at this exciting international gathering – and play an active role in the Technical Programme by presenting your recent work. Holding the Congress under the theme “**Global Challenges and Opportunities: Give Space a Chance**” in Azerbaijan’s capital will make a significant contributions to the establishment of closer ties with foreign space agencies, companies and organizations, to the development of human capital.

This “Call for Abstracts” is a precursor to a subsequent submission of a final paper, which may be presented at the 74<sup>th</sup> 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: **A. Science and Exploration; B. Applications and Operations; C. Technology; D. Infrastructure; E. 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. Submitted abstracts can be considered for oral presentations (as 'Short Talks' in the Symposia) and for interactive presentations.

Submit your abstract through the online IAF portal at <https://iafastro.directory/iac/account/login/> by **28 February 2023**. Submitted abstracts will be evaluated by the Session Chairs on the basis of technical quality and relevance to the session topics. Abstracts will be considered for an **oral or interactive presentation. All selected papers will be treated as equally important** in the presentation sessions and Congress Proceedings, differing only in the format of the presentation sessions (in other words, Oral Presentation papers will NOT be considered more important than Interactive Presentation papers).

Their evaluation will be submitted to the International Programme Committee, which will make the final decision during the IAF Spring Meetings to be held in March 2023 in Paris, France. Please note that any relevance to the Congress main theme will be considered as an advantage. 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 2023 and please check the IAF website regularly to get the latest updates on the Technical Programme!



**Lionel SUCHET**  
*Vice President, Technical Activities*  
International Astronautical Federation (IAF)



## 10. IAC 2023 Technical Sessions



Category



### SCIENCE AND EXPLORATION

Systems sustaining missions, including life, microgravity, space exploration, space debris, near-earth objects and SETI

- A1 IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM
- A2 IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM
- A3 IAF SPACE EXPLORATION SYMPOSIUM
- A4 52<sup>ND</sup> IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – THE NEXT STEPS
- A5 26<sup>TH</sup> IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM
- A6 21<sup>ST</sup> IAA SYMPOSIUM ON SPACE DEBRIS
- A7 IAF SYMPOSIUM ON ONGOING AND NEAR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS

Category coordinated by Maria Antonietta Perino, *Thales Alenia Space Italia, Italy*

|             |   |
|-------------|---|
| <b>A1</b>   | <p><b>IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM</b><br/>This symposium jointly organised by the International Academy of Astronautics (IAA) and the International Astronautical Federation (IAF) addresses all aspects of space life sciences research and practice in human and robotic spaceflight, from Low Earth Orbit (LEO) to the universe beyond, and from the Big Bang to the lives of future explorers on other planets of our solar system.</p> <p><b>Coordinators</b><br/><b>Peter Graef</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i><br/>— GERMANY</p> <p><b>Oleg Orlov</b><br/><i>Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS)</i> — RUSSIAN FEDERATION</p>   |
| <b>A1.1</b> | <p><b>Behaviour, Performance and Psychosocial Issues in Space</b><br/>This session considers psychosocial, interpersonal, cultural, cognitive, sleep, circadian rhythm and human factors issues and countermeasures related to human spaceflight and space exploration.</p> <p><b>Co-Chairs</b><br/><b>Nick Kanas</b><br/><i>University of California, San Francisco (UCSF)</i><br/>— UNITED STATES</p> <p><b>Gro M. Sandal</b><br/><i>University of Bergen</i> — NORWAY</p> <p><b>Rapporteur</b><br/><b>Vadim Gushin</b><br/><i>Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS)</i> — RUSSIAN FEDERATION</p>  |
| <b>A1.2</b> | <p><b>Human Physiology in Space</b><br/>This session focuses on physiological effects of short- and long-duration spaceflight, and how this affects general health. Research into mitigation (countermeasures) of space effects are also included.</p> <p><b>Co-Chairs</b><br/><b>Elena Fomina</b><br/><i>State Scientific Center of Russian Federation, Institute of Biomedical Problems, Russian Academy of Sciences</i><br/>— RUSSIAN FEDERATION</p> <p><b>Jens Jordan</b><br/><i>Institute of Aerospace Medicine (DLR)</i> — GERMANY</p> <p><b>Rapporteur</b><br/><b>Alain Maillet</b><br/><i>MEDES - IMPS</i> — FRANCE</p> <p><b>Angeliqve Van Ombergen</b><br/><i>European Space Agency (ESA)</i> — THE NETHERLANDS</p>   |
| <b>A1.3</b> | <p><b>Medical Care for Humans in Space</b><br/>This session focuses on medical care for astronauts including operational medicine aspects, countermeasure development and applications, as well as needs for future care for astronauts during long term, stays in space and missions to and on the Moon and Mars. A further focus will lie on medical care for passengers and operators of commercial suborbital and orbital space flights.</p> <p><b>Co-Chairs</b><br/><b>Satoshi Iwase</b><br/><i>Aichi Medical University</i> — JAPAN</p> <p><b>Oleg Orlov</b><br/><i>Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS)</i> — RUSSIAN FEDERATION</p> <p><b>Rapporteur</b><br/><b>Hasan Birol Cotuk</b><br/>— TURKEY</p> <p><b>Katrin Stang</b><br/><i>DLR (German Aerospace Center)</i> — GERMANY</p>  |
| <b>A1.4</b> | <p><b>Medicine in Space and Extreme Environments</b><br/>Over the last decades numerous space missions and experiments have taken place. The use of microgravity as a tool to study new fundamentals of life revealed a substantial number of new scientific insights and surprises. Space is the most famous extreme environment but different extreme environments also exist on Earth, such as high altitudes, confined and isolated environments like Antarctica and Arctic or even submarines. Results from research in these environments can be successfully applied for the benefits of human beings both in space and on Earth. This session will cover the latest scientific results and technological achievements from medical-physiological or psychological research in extreme environments for the benefit on Earth.</p> <p><b>Co-Chairs</b><br/><b>Oleg Orlov</b><br/><i>Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS)</i> — RUSSIAN FEDERATION</p> <p><b>Hanns-Christian Gunga</b><br/><i>Charité Universitätsmedizin Berlin</i> — GERMANY</p> <p><b>Rapporteur</b><br/><b>Jeffrey R. Davis</b><br/><i>Exploring 4 Solutions</i> — UNITED STATES</p> <p><b>Alexander Choukér</b><br/><i>University of Munich</i> — GERMANY</p> |
| <b>A1.5</b> | <p><b>Radiation Fields, Effects and Risks in Human Space Missions</b><br/>The major topics of this session are the characterization of the radiation environment by theoretical modeling and experimental data, radiation effects on physical and biological systems, countermeasures to radiation and radiation risk assessment.</p> <p><b>Co-Chairs</b><br/><b>Lawrence Pinsky</b><br/><i>University of Houston</i> — UNITED STATES</p> <p><b>Guenther Reitz</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i> — GERMANY</p> <p><b>Rapporteur</b><br/><b>Premkumar Saganti</b><br/><i>Prairie View A&amp;M University</i> — UNITED STATES</p>   |

|              |  |
|--------------|--|
| <b>A1.6</b>  | <p><b>Astrobiology and Exploration</b><br/>Space exploration planning now includes ambitious goals like human missions to the Moon and Mars, and sophisticated robotic exploration of targets relevant for astrobiology such as the Mars subsurface and the primary ocean worlds Europa, Enceladus, and Titan. Astrobiology is, therefore, becoming a space flight science, ready for direct measurements of habitability and the presence of life off Earth in many places. The session invites papers related to astrobiology, biomarkers, life detection, and planetary protection.</p> <p><b>Co-Chairs</b><br/><b>Petra Rettberg</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i><br/>— GERMANY</p> <p><b>Stephan Ulamec</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i> — GERMANY</p> <p><b>Rapporteur</b><br/><b>Fathi Karouia</b><br/><i>National Aeronautics and Space Administration (NASA), Ames Research Center / UCSF</i> — UNITED STATES</p> <p><b>Tetyana Milojevic</b><br/><i>University of Orléans</i> — FRANCE</p>   |
| <b>A1.7</b>  | <p><b>Life Support, Habitats and EVA Systems</b><br/>This session will address strategies, solutions and technologies in providing for human requirements during future deep space and planetary/lunar surface exploration.</p> <p><b>Co-Chairs</b><br/><b>Ulrich Kuebler</b><br/><i>Airbus DS GmbH</i> — GERMANY</p> <p><b>Khalid Badri</b><br/><i>Mohammed Bin Rashid Space Centre (MBRSC)</i> — UNITED ARAB EMIRATES</p> <p><b>Rapporteur</b><br/><b>Hong Liu</b><br/><i>Beihang University</i> — CHINA</p> <p><b>Gisela Detrell</b><br/>— GERMANY</p>  |
| <b>A1.8</b>  | <p><b>Biology in Space</b><br/>This session focuses on all aspects of biology and biological systems related to gravity in ground-based and space flight experiments as well as on topics not covered by other sessions of this symposium.</p> <p><b>Co-Chairs</b><br/><b>Didier Chaput</b><br/><i>Centre National d'Etudes Spatiales (CNES)</i> — FRANCE</p> <p><b>Fengyuan Zhuang</b><br/><i>Beihang University</i> — CHINA</p> <p><b>Rapporteur</b><br/><b>Jancy McPhee</b><br/><i>The Aerospace Corporation</i> — UNITED STATES</p>  |
| <b>A1.IP</b> | <p><b>Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM</b><br/>This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Life Sciences addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated exclusively for the attendees to view the Interactive Presentations, and the author will be assigned a specific eight minute slot to personally present the topic and interact with the attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips, etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.</p> <p><b>Co-Chairs</b><br/><b>Didier Chaput</b><br/><i>Centre National d'Etudes Spatiales (CNES)</i> — FRANCE</p> <p><b>Jancy McPhee</b><br/><i>The Aerospace Corporation</i> — UNITED STATES</p> |
| <b>A2</b>    | <p><b>IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM</b><br/>The objective of the Microgravity Science and Processes Symposium, organized by the International Astronautical Federation (IAF), is to highlight and discuss the state of the art in microgravity (reduced-gravity) physical sciences and processes, as well as to prepare for future orbital infrastructure. Session topics cover all microgravity science disciplines (material science, fluid physics, combustion science, fundamental physics), current results and research perspectives, together with relevant technology developments.</p> <p><b>Vice-Coordinator</b><br/><b>Valentina Shevtsova</b><br/><i>Université Libre de Bruxelles</i> — BELGIUM</p> <p><b>Vice-Coordinator</b><br/><b>Angelika Diefenbach</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i> — GERMANY</p>   |
| <b>A2.1</b>  | <p><b>Gravity and Fundamental Physics</b><br/>This session is devoted to the search for new fields of research in condensed matter physics and gravitational physics including cryogenic fluids, critical fluids, equivalence principle, atomic clock and plasma crystals.</p> <p><b>Co-Chairs</b><br/><b>Hanns Selig</b><br/><i>Geradts GmbH</i> — GERMANY</p> <p><b>Antonio Viviani</b><br/><i>Università degli Studi della Campania "Luigi Vanvitelli"</i> — ITALY</p> <p><b>Rapporteur</b><br/><b>Qi Kang</b><br/><i>National Microgravity Laboratory, Institute of Mechanics, Chinese Academy of Sciences</i> — CHINA</p>   |
| <b>A2.2</b>  | <p><b>Fluid and Materials Sciences</b><br/>The main focus of the session is on perspective research fields in fluid and materials sciences, multi-phase and chemically reacting flows including theoretical modeling, numerical simulations, and results of pathfinder laboratory and space experiments.</p> <p><b>Co-Chairs</b><br/><b>Nickolay N. Smirnov</b><br/><i>Lomonosov Moscow State University</i> — RUSSIAN FEDERATION</p> <p><b>Satoshi Matsumoto</b><br/><i>Japan Aerospace Exploration Agency (JAXA)</i> — JAPAN</p> <p><b>Rapporteur</b><br/><b>Thomas Driebe</b><br/><i>DLR (German Aerospace Center)</i> — GERMANY</p>  |
| <b>A2.3</b>  | <p><b>Microgravity Experiments from Sub-Orbital to Orbital Platforms</b><br/>This session presents recent results of microgravity experiments from all disciplines using different microgravity platforms, including drop towers, parabolic aircrafts, sounding rockets and capsules.</p> <p><b>Co-Chairs</b><br/><b>Raffaele Savino</b><br/><i>University of Naples "Federico II"</i> — ITALY</p> <p><b>Rainer Willnecker</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)</i> — GERMANY</p>   |
| <b>A2.4</b>  | <p><b>Science Results from Ground Based Research</b><br/>This session is focused on the results of ground based preparatory experiments from all disciplines.</p> <p><b>Co-Chairs</b><br/><b>Valentina Shevtsova</b><br/><i>Université Libre de Bruxelles</i> — BELGIUM</p> <p><b>Antonio Viviani</b><br/><i>Università degli Studi della Campania "Luigi Vanvitelli"</i> — ITALY</p> <p><b>Rapporteur</b><br/><b>Nickolay N. Smirnov</b><br/><i>Lomonosov Moscow State University</i> — RUSSIAN FEDERATION</p>  |

|              |   |
|--------------|---|
| <b>A2.5</b>  | <p><b>Facilities and Operations of Microgravity Experiments</b><br/>This session is devoted to new diagnosis developments, new instruments definition and concepts for the future, ground and flight operation (telescience, robotics, hardware &amp; software).</p> <p><b>Co-Chairs</b><br/><b>Rainer Willnecker</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Gabriel Pont</b><br/><i>Centre National d'Etudes Spatiales (CNES) — FRANCE</i></p> <p><b>Rapporteur</b><br/><b>Satoshi Matsumoto</b><br/><i>Japan Aerospace Exploration Agency (JAXA) — JAPAN</i></p>   |
| <b>A2.6</b>  | <p><b>Microgravity Sciences on board ISS and beyond</b><br/>This session focuses on the presentation of scientific and operational results obtained from microgravity sciences research conducted on large orbital platforms, in particular the ISS. Papers on planned or newly developed research topics and experiment scenarios are also invited. The session is not limited to the usage of the ISS but comprises the preparation scenarios for further long term flight opportunities beyond the low earth orbit such as Deep Space Gateway.</p> <p><b>Co-Chairs</b><br/><b>Stefan Van Vaerenbergh</b><br/><i>Université Libre de Bruxelles — BELGIUM</i></p> <p><b>Angelika Diefenbach</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Angelika Diefenbach</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Cora Thiel</b><br/><i>University of Zurich — SWITZERLAND</i></p> <p><b>Peter Graef</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Satoshi Matsumoto</b><br/><i>Japan Aerospace Exploration Agency (JAXA) — JAPAN</i></p>  |
| <b>A2.7</b>  | <p><b>Life and Physical Sciences under reduced Gravity</b><br/>This session focusses on the presentation of scientific and operational results obtained from life and physical sciences research conducted on large orbital platforms, in particular the ISS. Papers on planned or newly developed research topics and experiment scenarios are also invited. The session is not limited to the usage of the ISS but comprises the preparation scenarios for further long term flight opportunities beyond the low earth orbit such as Deep Space Gateway.</p> <p><b>Co-Chairs</b><br/><b>Angelika Diefenbach</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Cora Thiel</b><br/><i>University of Zurich — SWITZERLAND</i></p> <p><b>Peter Graef</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Satoshi Matsumoto</b><br/><i>Japan Aerospace Exploration Agency (JAXA) — JAPAN</i></p>   |
| <b>A2.IP</b> | <p><b>Interactive Presentations - IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM</b><br/>This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Microgravity Sciences and Processes addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.</p> <p><b>Co-Chairs</b><br/><b>Gabriel Pont</b><br/><i>Centre National d'Etudes Spatiales (CNES) — FRANCE</i></p> <p><b>QI KANG</b><br/><i>National Microgravity Laboratory, Institute of Mechanics, Chinese Academy of Sciences — CHINA</i></p> |
| <b>A3</b>    | <p><b>IAF SPACE EXPLORATION SYMPOSIUM</b><br/>This symposium, organized by the International Astronautical Federation (IAF), covers the current and future robotic missions and material plans for initiatives in the exploration of the Solar System.</p> <p><b>Coordinators</b><br/><b>Vincenzo Giorgio</b><br/><i>Thales Alenia Space Italia — ITALY</i></p> <p><b>Pierre W. Bousquet</b><br/><i>Centre National d'Etudes Spatiales (CNES) — FRANCE</i></p> <p><b>Keyur Patel</b><br/><i>National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES</i></p>   |
| <b>A3.1</b>  | <p><b>Space Exploration Overview</b><br/>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.</p> <p><b>Co-Chairs</b><br/><b>Kathy Laurini</b><br/><i>Dynetics — UNITED STATES</i></p> <p><b>Keyur Patel</b><br/><i>National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES</i></p> <p><b>Rapporteurs</b><br/><b>Norbert Frischauf</b><br/><i>TU GRAZ — AUSTRIA</i></p>   |
| <b>A3.2A</b> | <p><b>Moon Exploration – Part 1</b><br/>This session will address current and future lunar missions. The session will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilisation and preparatory activities for future solar system exploration.</p> <p><b>Co-Chairs</b><br/><b>Bernard Foing</b><br/><i>ILEWG "EuroMoonMars" — THE NETHERLANDS</i></p> <p><b>David Korsmeyer</b><br/><i>National Aeronautics and Space Administration (NASA), Ames Research Center — UNITED STATES</i></p> <p><b>Rapporteur</b><br/><b>Pierre-Alexis Joumel</b><br/><i>Airbus Defence and Space — GERMANY</i></p> <p><b>Nadeem Ghafoor</b><br/><i>Canadensys Aerospace Corporation — CANADA</i></p>  |
| <b>A3.2B</b> | <p><b>Moon Exploration – Part 2</b><br/>This session will address current and future lunar missions. The session will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilisation and preparatory activities for future solar system exploration.</p> <p><b>Co-Chairs</b><br/><b>Bernard Foing</b><br/><i>ILEWG "EuroMoonMars" — THE NETHERLANDS</i></p> <p><b>David Korsmeyer</b><br/><i>National Aeronautics and Space Administration (NASA), Ames Research Center — UNITED STATES</i></p> <p><b>Rapporteurs</b><br/><b>Pierre-Alexis Joumel</b><br/><i>Airbus Defence and Space — GERMANY</i></p> <p><b>Nadeem Ghafoor</b><br/><i>Canadensys Aerospace Corporation — CANADA</i></p>   |

|              |  |
|--------------|--|
| <b>A3.2C</b> | <p><b>Moon Exploration – Part 3</b><br/>This session will address current and future lunar missions. The session will address orbital missions, robotic surface missions, as well as life sciences on the Moon, resource utilisation and preparatory activities for future solar system exploration.</p> <p><b>Co-Chairs</b><br/><b>Bernard Foing</b><br/><i>ILEWG "EuroMoonMars" — THE NETHERLANDS</i></p> <p><b>David Korsmeyer</b><br/><i>National Aeronautics and Space Administration (NASA), Ames Research Center — UNITED STATES</i></p> <p><b>Rapporteurs</b><br/><b>Sylvie Espinasse</b><br/><i>European Space Agency (ESA) — THE NETHERLANDS</i></p> <p><b>Nadeem Ghafoor</b><br/><i>Canadensys Aerospace Corporation — CANADA</i></p>   |
| <b>A3.3A</b> | <p><b>Mars Exploration – Missions Current and Future</b><br/>The planet Mars is being explored now and in the coming years with multiple robotic missions from a variety of nations. This session will cover current results from ongoing Mars missions and the designs for proposed Mars missions.</p> <p><b>Co-Chairs</b><br/><b>Vincenzo Giorgio</b><br/><i>Thales Alenia Space Italia — ITALY</i></p> <p><b>Pierre W. Bousquet</b><br/><i>Centre National d'Etudes Spatiales (CNES) — FRANCE</i></p> <p><b>Rapporteurs</b><br/><b>Cheryl Reed</b><br/><i>Northrop Grumman Innovation Systems — UNITED STATES</i></p> <p><b>Amalia Ercoli Finzi</b><br/><i>Politecnico di Milano — ITALY</i></p>  |
| <b>A3.3B</b> | <p><b>Mars Exploration – Science, Instruments and Technologies</b><br/>The planet Mars is being explored now and in the coming years with multiple robotic missions from a variety of nations. This session will cover science, instruments and technologies for Mars missions including expected experiments. Papers on any aspects of the search for evidence or extinct Martian life, and forward and backward contamination are particularly welcome.</p> <p><b>Co-Chairs</b><br/><b>Vincenzo Giorgio</b><br/><i>Thales Alenia Space Italia — ITALY</i></p> <p><b>Pierre W. Bousquet</b><br/><i>Centre National d'Etudes Spatiales (CNES) — FRANCE</i></p> <p><b>Rapporteurs</b><br/><b>Cheryl Reed</b><br/><i>Northrop Grumman Innovation Systems — UNITED STATES</i></p> <p><b>Amalia Ercoli Finzi</b><br/><i>Politecnico di Milano — ITALY</i></p>  |
| <b>A3.4A</b> | <p><b>Small Bodies Missions and Technologies (Part 1)</b><br/>This session will present the missions and technological aspects related to the exploration of small bodies including a search for pre-biotic signatures.</p> <p><b>Co-Chairs</b><br/><b>Susan McKenna-Lawlor</b><br/><i>Space Technology (Ireland) Ltd. — IRELAND</i></p> <p><b>Stephan Ulamec</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Rapporteurs</b><br/><b>Norbert Frischauf</b><br/><i>TU GRAZ — AUSTRIA</i></p> <p><b>Marc D. Rayman</b><br/><i>NASA Jet Propulsion Laboratory — UNITED STATES</i></p>   |
| <b>A3.4B</b> | <p><b>Small Bodies Missions and Technologies (Part 2)</b><br/>This session will present the missions and technological aspects related to the exploration of small bodies including a search for pre-biotic signatures.</p> <p><b>Co-Chairs</b><br/><b>Stephan Ulamec</b><br/><i>Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY</i></p> <p><b>Susan McKenna-Lawlor</b><br/><i>Space Technology (Ireland) Ltd. — IRELAND</i></p> <p><b>Rapporteurs</b><br/><b>Marc D. Rayman</b><br/><i>NASA Jet Propulsion Laboratory — UNITED STATES</i></p> <p><b>Norbert Frischauf</b><br/><i>TU GRAZ — AUSTRIA</i></p>   |
| <b>A3.5</b>  | <p><b>Solar System Exploration including Ocean Worlds</b><br/>This session covers robotic missions for Solar System exploration (inner and outer planets and their satellites, and space plasma physics) except the Earth, Moon, Mars, and small bodies covered in other sessions of this symposium. Special emphasis on papers addressing missions to so-called Ocean Worlds (Enceladus, Europa, Titan) is sought. Papers covering both new mission concepts as well as the associated specific technologies are invited.</p> <p><b>Co-Chairs</b><br/><b>Mariella Graziano</b><br/><i>GMV Aerospace &amp; Defence SAU — SPAIN</i></p> <p><b>Junichiro Kawaguchi</b><br/><i>Australian National University (ANU) — AUSTRALIA</i></p> <p><b>Rapporteurs</b><br/><b>Charles E. Cockrell Jr</b><br/><i>National Aeronautics and Space Administration (NASA) — UNITED STATES</i></p> <p><b>Alain Ouellet</b><br/><i>Canadian Space Agency — CANADA</i></p>   |
| <b>A3.IP</b> | <p><b>Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM</b><br/>This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Exploration addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.</p> <p><b>Co-Chairs</b><br/><b>Christian Sallaberger</b><br/><i>Canadensys Aerospace Corporation — CANADA</i></p> <p><b>Bernard Foing</b><br/><i>ILEWG "EuroMoonMars" — THE NETHERLANDS</i></p> |



**A4 52<sup>ND</sup> 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, technical and interdisciplinary aspects of the Search for Extra-Terrestrial Intelligence (SETI) on an international scale. SETI researchers are typically looking for anomalies in astronomical data, potentially associated with other technical civilisations in the Milky Way and beyond (so-called “techno-signatures”). The search includes all parts of the electromagnetic spectrum and utilises cutting-edge technologies deployed on some of the largest telescopes in the world. The interdisciplinary aspects of the topic involve the social and societal consequences of detecting a signal, engaging with a very wide variety of human cultural pursuits - including art, language, education, science, anthropology, sociology, psychology, legal, political and institutional issues, interactions with the media, public outreach and risk communication.

**Coordinators**

**Mike Garrett** **Andrew Siemion**  
*University of Manchester — UNITED KINGDOM* *Berkeley SETI Research Center — UNITED STATES*

**A4.1 SETI 1: SETI Science and Technology**  
All technical aspects involved in the search for extraterrestrial intelligence, including current and future search strategies.

**Co-Chair**

**Steve Croft**  
*University California Berkeley — UNITED STATES*

**A4.2 SETI 2: SETI and Society**  
All aspects concerning the societal implications of extraterrestrial intelligence are considered, including public reaction to a discovery, risk communication and the possible impacts on society..

**Co-Chair**

**Kathryn Denning**  
*York University — CANADA*

**A4.IP Interactive Presentations - 52<sup>nd</sup> IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps**  
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 classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Claudio Maccone** **Steve Croft**  
*International Academy of Astronautics (IAA) and Istituto Nazionale di Astrofisica (INAF) — ITALY* *University California Berkeley — UNITED STATES*

**A5 26<sup>TH</sup> 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, Lagrangian Points and NEO’s.

**Coordinators**

**Christian Sallaberger** **Maria Antonietta Perino**  
*Canadensys Aerospace Corporation — CANADA* *Thales Alenia Space Italia — 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**

**Nadeem Ghafoor**  
*Avalon Space — CANADA*

**Michael Raftery**  
*Boeing Defense Space & Security — UNITED STATES*

**Rapporteur**

**Marc Haese**  
*DLR, German Aerospace Center — GERMANY*

**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 Perino**  
*Thales Alenia Space Italia — ITALY*

**Kathy Laurini**  
*Dynetics — UNITED STATES*

**Rapporteur**

**Norbert Frischauf**  
*TU GRAZ – AUSTRIA*

**A5.3 B3.6 Human and Robotic Partnerships in Exploration - Joint session of the IAF Human Spaceflight and IAF Exploration Symposia**  
This session seeks papers on new systems and technologies for current human spaceflight and exploration programmes, and the role of human and robotic partnerships in areas such as onboard robotic assistants, habitat / infrastructure construction support, human mobility support systems (e.g. EVA mobility aids, rovers); and robotic precursor activities to human spaceflights for test, validation, and demonstration of systems. This session also welcomes papers considering how the roles of humans, machines and intelligent systems are likely to evolve in the coming years and the corresponding impact on complex mission design, implementation, and operations.

**Co-Chairs**

**Christian Sallaberger**  
*Canadensys Aerospace Corporation — CANADA*

**Mark Hemsell**  
*The British Interplanetary Society — UNITED KINGDOM*

**Rapporteur**

**Juergen Schlutz**  
*European Space Agency (ESA) — GERMANY*

**A5.4 Deep Space Habitats and Resources**  
This session will focus on the habitability aspects for Moon and Mars outposts and bases and to sustain human deep space exploration missions and the needed resources, exploring technical solutions like greenhouses, plant-growth in space, harvesting water from the Moon and Mars regolith.

**Co-Chairs**

**Maria Antonietta Perino**  
*Thales Alenia Space Italia — ITALY*

**Barbara Imhof**  
*LIQUIFER Systems Group — AUSTRIA*

**Rapporteurs**

**Olga Bannova**  
*University of Houston — UNITED STATES*

**Sandra Haeuplik-Meusburger**  
*TU Wien — AUSTRIA*

**A5.IP Interactive Presentations - 26<sup>th</sup> 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 Human Exploration of the Solar System addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Christian Sallaberger** **Maria Antonietta Perino**  
*Canadensys Aerospace Corporation — CANADA* *Thales Alenia Space Italia — ITALY*

**A6 21<sup>ST</sup> IAA SYMPOSIUM ON SPACE DEBRIS**  
The Symposium will address the complete spectrum of issues associated to space debris, including orbital sustainability and operations in debris dominated environment. It will cover every aspect of Space Environment Management (SEM) including Mitigation and Remediation measures, Space Surveillance and Tracking (SST), Space Situational Awareness (SSA), Space Traffic Management (STM), including all aspects of measurements, modelling, risk assessment in space and on the ground, re-entry, hypervelocity impacts and protection, mitigation and standards, post-mission disposal, remediation, debris removal, Space Surveillance, collision avoidance as well as non-technical topics associated to space debris dominated environment.

**Coordinators**

**Christophe Bonnal** **Riccardo Bevilacqua** **Pierre Omalý**  
*Centre National d’Etudes Spatiales (CNES) — FRANCE* *Embry-Riddle Aeronautical University — UNITED STATES* *CNES — FRANCE*

**A6.1 Space Debris Detection, Tracking and Characterization - SST**  
This session will address every aspect of SST (Space Surveillance and Tracking), advanced ground and space-based measurement techniques, relating processing methods, and results of space debris characterization.

**Co-Chairs**

**Mark A. Skinner**  
*The Aerospace Corporation — UNITED STATES*

**Vladimir Agapov**  
*— RUSSIAN FEDERATION*

**Rapporteur**

**Thomas Schildknecht**  
*SwissSpace Association — SWITZERLAND*

**A6.2 Modelling and Risk Analysis**  
This session will address the characterization of the current and future debris population and methods for in-orbit and on-ground risk assessments. The in-orbit analysis will cover collision risk estimates based on statistical population models and deterministic catalogues, and active collision avoidance.

**Co-Chairs**

**Marlon Sorge**  
*The Aerospace Corporation — UNITED STATES*

**Dan Oltrogge**  
*COMSPOC Corporation — UNITED STATES*

**Rapporteur**

**Carmen Pardini**  
*ISTI-CNR — ITALY*

**A6.3 Impact-Induced Mission Effects and Risk Assessments**  
This session addresses disruptions of spacecraft operations induced by hypervelocity impacts including spacecraft anomalies, perturbation of operations, component failures up to mission loss, and spacecraft fragmentations. It includes risk assessments for impact vulnerability studies and corresponding system tools. Further topics are spacecraft impact protection and shielding studies, laboratory impact experiments, numerical simulations, and on-board diagnostics to characterize impacts such as impact sensors, accelerometers, etc.

**Co-Chairs**

**Zizheng Gong**  
*Beijing Institute of Spacecraft Environment Engineering, China Academy of Space Technology (CAST) — CHINA*

**Yukihito Kitazawa**  
*— JAPAN*

**Rapporteur**

**Jean-Claude Traineau**  
*Office National d’Etudes et de Recherches Aéropatiales (ONERA) — FRANCE*

**A6.4 Mitigation - Tools, Techniques and Challenges - SEM**  
This session will focus on the Mitigation part of the SEM (Space Environment Monitoring), implementation of debris prevention and reduction measures; vehicle passive protection at system level including end of life strategies and tools to verify the efficiency of the implemented measures. The session will also address practical experiences in the planning and verification of measures and issues and lessons learnt in the actual execution of mitigation actions.

**Co-Chairs**

**Pierre Omalý**  
*Centre National d’Etudes Spatiales (CNES) — FRANCE*

**Satomi Kawamoto**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

**Rapporteur**

**Holger Krag**  
*European Space Agency (ESA) — GERMANY*

**A6.5 Post Mission Disposal and Space Debris Removal 1 - SEM**  
This session will focus on the Remediation part of the SEM, dealing with ADR (Active Debris Removal), JCA (Just in time Collision Avoidance), LDTM (Large Debris Traffic Management) among solutions. It will address post-mission disposal and active removal techniques “ground and space based”, review potential solutions and identify implementation difficulties.

**Co-Chairs**

**Balbir Singh**  
*Manipal Institute of Technology, Manipal Academy of Higher Education — INDIA*

**Roberto Opromolla**  
*University of Naples “Federico II” — ITALY*

**Rapporteur**

**Laurent Francillout**  
*Centre National d’Etudes Spatiales (CNES) — FRANCE*

**A6.6 Post Mission Disposal and Space Debris Removal 2 - SEM**  
This session will focus on the Remediation part of the SEM, dealing with ADR (Active Debris Removal), JCA (Just in time Collision Avoidance), LDTM (Large Debris Traffic Management) among solutions. It will address post-mission disposal and active removal techniques “ground and space based”, review potential solutions and identify implementation difficulties.

**Co-Chairs**

**Marko Jankovic**  
*DFKI GmbH, Robotics Innovation Center — GERMANY*

**Dmitriy Grishko**  
*Bauman Moscow State Technical University — RUSSIAN FEDERATION*

**Rapporteur**

**Jason Forshaw**  
*Astroscale Ltd — UNITED KINGDOM*

**A6.7 Operations in Space Debris Environment, Situational Awareness - SSA**  
This session will address the multiple aspects associated to STM (Space Traffic Management) and SSA (Space Situational Awareness) including safe operations in space dealing with Space Debris, operational observations, orbit determination, catalogue build-up and maintenance, data aggregation from different sources, relevant data exchanges standards and conjunction analyses.

**Co-Chairs**

**Vincent Martinot**  
*Thales Alenia Space France — FRANCE*

**T.S. Kelso**  
*COMSPOC Corporation — UNITED STATES*

**Rapporteur**

**Noelia Sanchez Ortiz**  
*Barrabes.biz — SPAIN*



**A6.8 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 mitigation, debris remediation and STM. Papers may focus on aspects of responsibility, liability and registration, on the role of bodies such as UNCOPUOS or IADC, as well as on insurance, financial incentives and funding. In addition, security-related aspects and the role of international cooperation in addressing these issues may be considered.

**Co-Chairs**

**David Spencer**  
*The Aerospace Corporation — UNITED STATES*

**Serge Plattard**  
*University College London (UCL) — UNITED KINGDOM*

**Tanja Masson-Zwaan**  
*International Institute of Air and Space Law, Leiden University — THE NETHERLANDS*

**Rapporteur**

**Victoria Samson**  
*Secure World Foundation — UNITED STATES*

**Rapporteur**

**Emma Kerr**  
*Deimos Space UK Ltd — UNITED KINGDOM*

**Andrea Capurso**  
*LUISS Guido Carli University — ITALY*

**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, optical measurements processing and modelling and risk analysis of space debris.

**Co-Chairs**

**Jan Siminski**  
*European Space Agency (ESA) — GERMANY*

**Juan Carlos Dolado Perez**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Rapporteur**

**Paolo Marzioli**  
*Sapienza University of Rome — ITALY*

**A6.10 TBD**  
TBD

**Co-Chairs**

**Thomas Schildknecht**  
*SwissSpace Association — SWITZERLAND*

**Darren McKnight**  
*LeoLabs — UNITED STATES*

**Daniel Mazanek**  
*National Aeronautics and Space Administration (NASA)/ Langley Research Center — UNITED STATES*

**Rapporteur**

**Philipp Maier**  
*— GERMANY*

**Rapporteur**

**Camilla Colombo**  
*Politecnico di Milano — ITALY*

**Alissa J. Haddaji**  
*Harvard University — UNITED STATES*

**A6.1P Interactive Presentations - 21<sup>st</sup> IAA SYMPOSIUM ON SPACE DEBRIS**  
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Debris addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Francesca Letizia**  
*European Space Agency (ESA) — GERMANY*

**Paolo Marzioli**  
*Sapienza University of Rome — ITALY*

**Roberto Opromolla**  
*University of Naples "Federico II" — ITALY*

**Rapporteur**

**Emma Kerr**  
*Deimos Space UK LTD — AUSTRALIA*

**Rapporteur**

**Christophe Bonnal**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Marko Jankovic**  
*DFKI GmbH, Robotics Innovation Center — GERMANY*

**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 industry, and space-agencies community to share information, insights, and planning for ongoing and near future space missions in exoplanets, astronomy, space physics, fundamental physics, and outer-solar-system planetary science. The Symposium will comprise both invited talks and contributed papers in these five areas of scientific endeavor. For each, the Symposium solicits discussion of phenomena coming within our reach over the next decades; their enabling measurement and system technologies, including significant progress made by industry and research laboratories; mission concepts to implement such investigations, and corporate and space agency strategies to prioritize and invest in bringing them into reality.

**Coordinators**

**Andrew Court**  
*TNO — THE NETHERLANDS*

**Alessandra Di Cecco**  
*Agenzia Spaziale Italiana (ASI) — ITALY*

**A7.1 Space Astronomy Missions, Strategies and Plans**  
The session comprises invited talks by international space-agency division directors about their long-term views, priorities, and plans to implement developments and missions for the four fields (exoplanets, space astronomy, space physics and fundamental physics). The mission scope ranges from flagship-class, large-class, medium-class, and small-class to smallsat platforms. The programme scope includes status updates on current programmes, near-term investment priorities, and long-range directions, including the relationship to community and guiding research panels.

**Co-Chairs**

**Eric Wille**  
*ESA — THE NETHERLANDS*

**Alessandra Di Cecco**  
*Agenzia Spaziale Italiana (ASI) — ITALY*

**Rapporteur**

**Andrew Court**  
*TNO — THE NETHERLANDS*

**A7.2 Science Goals and Drivers for Future Exoplanet, Space Astronomy and Space Physics**  
The session has invited and contributed talks about scientific motivations, goals, opportunities, and needs in the four fields (exoplanets, space astronomy, space physics, and fundamental physics). New directions for measurements that are being opened by emergent results and newly understood phenomena will be explored, and science roadmaps to pursue them will be discussed.

**Co-Chair**

**Pietro Ubertini**  
*INAF — ITALY*

**Maria Cristina Falvella**  
*Italian Space Agency (ASI) — ITALY*

**Rapporteur**

**Alessandra Di Cecco**  
*Agenzia Spaziale Italiana (ASI) — ITALY*

**A7.3 Technology Needs for Future Missions, Systems, and Instruments**  
The third session includes invited and contributed talks about the technology challenges and plans required to enable breakthrough science objectives in: exoplanet detection and characterization; astronomy throughout the electromagnetic spectrum and using gravitational waves; space physics including fractional gravity regimes and heliophysics; and fundamental physics including relativity. Topical focus includes measurement techniques, data types, performance requirements, instrument designs, mission concepts and systems, and associated technology developments.

**Co-Chairs**

**Eric Wille**  
*ESA — THE NETHERLANDS*

**Andrew Court**  
*TNO — THE NETHERLANDS*

**Rapporteur**

**Maria Cristina Falvella**  
*Italian Space Agency (ASI) — ITALY*

**A7.IP Interactive Presentations - IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SPACE PHYSICS**  
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Astronomy addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the A Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Andrew Court**  
*TNO — THE NETHERLANDS*

**Alessandra Di Cecco**  
*Agenzia Spaziale Italiana (ASI) — ITALY*



## APPLICATIONS AND OPERATIONS

On-going and future operational applications, including Earth observation, communication, navigation, human space endeavours and small satellites

- B1 IAF EARTH OBSERVATION SYMPOSIUM**
- B2 IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM**
- B3 IAF HUMAN SPACEFLIGHT SYMPOSIUM**
- B4 30<sup>TH</sup> IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS**
- B5 IAF SYMPOSIUM ON INTEGRATED APPLICATIONS**
- B6 IAF SPACE OPERATIONS SYMPOSIUM**

Category coordinated by Igor V. Sorokin, S.P. Korolev Rocket and Space Corporation Energia, RUSSIAN FEDERATION

**B1 IAF EARTH OBSERVATION SYMPOSIUM**  
The Earth Observation Symposium, organized by the International Astronautical Federation (IAF), covers all aspects of Earth observations from space, including observations related to the Earth's environment, societal and economic benefit. Aspects include programs, constellations, missions, and systems; microwave and optical sensors; land, oceanographic, atmospheric, geological, geophysical, societal, economic, and business; the associated science, ground data-processing, applications and services; through all life cycle phases from research and technology through, planning, conceptualization, development, commissioning, operations, retirement and historical retrospective. Participation is encouraged from all sectors including institutional (including Government, Agencies, multi-lateral, non-Governmental, Academic) and Commercial.

**Coordinators**

**Luís Ferreira**  
*Airbus Defence and Space — GERMANY*

**Harry Cikanek**  
*National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES*

**B1.1 International Cooperation in Earth Observation Missions**  
Focus is on efforts being made by governments, agencies, international bodies, commercial providers, other organizations, and society to achieve coordination, cooperation, and compatibility in the development of space-based Earth observation systems. Presentations are encouraged which involve cooperative efforts with developing countries. Papers on planned, and ongoing missions involving coordination among commercial, government and other entities are especially encouraged. This session also addresses international coordination and cooperation in Earth Observation data-related systems. It also addresses major international collaboration in payloads and data sharing like Copernicus and among meteorological agencies.

**Co-Chairs**

**Mukund Kadursrinivas Rao**  
*National Institute of Advanced Studies (NIAS) — INDIA*

**José Gavira Izquierdo**  
*European Space Agency (ESA) — THE NETHERLANDS*

**Rapporteur**

**Charles Wooldridge**  
*National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES*

**B1.2 Earth Observation Systems**  
Emphasis is on functional and technical description of envisioned, planned recently launched, and ongoing systems, missions, constellations, and programs for experimental and operational Earth observation. Descriptions of present systems as well as new concepts and innovative Earth Observation systems are encouraged. This session includes governmental / agency programs, public-private partnerships, commercial programs, and academic / non-governmental / non-commercial programs.

**Co-Chairs**

**Timo Stuffer**  
*OHB System AG — GERMANY*

**Alain Gleyzes**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Rapporteur**

**Annamaria Nassisi**  
*Thales Alenia Space Italia — ITALY*

**B1.3 Earth Observation Sensors and Technology**  
Focus is on Earth Observation sensors and instruments including future concepts being proposed, developed, tested, or calibrated, and those in operations for all aspects of Earth observation. Driven by user and scientific requirements, particular emphasis is on systems and technologies that make innovative measurements and deliver improved performance for science, operational or commercial applications.

**Co-Chairs**

**Andrew Court**  
*TNO — THE NETHERLANDS*

**Roland Le Goff**  
*SODERN — FRANCE*

**Rapporteur**

**Kate Becker**  
*National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES*

**B1.4 Earth Observation Data Systems and Technology**  
The focus is on the development and operations of Earth Observation-related data processing systems. The emphasis of the session is on the challenges of emerging information and web-based technology (e.g. Big Data, Cloud-based operations, internet of things, crowd sourcing) for acquisition, communication, processing, dissemination and archiving of data. The session also covers innovative methods for making data analysis ready, the extraction of information from these resulting large data sets (e.g. machine learning and artificial intelligence) and methods for making the information available timely to decision makers. This session also includes the evolving data processing infrastructure like federated Cloud systems and digital twin.

**Co-Chairs**

**Gunter Schreiber**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**James Graf**  
*Jet Propulsion Laboratory — UNITED STATES*

**Rapporteur**

**Annamaria Nassisi**  
*Thales Alenia Space Italia — ITALY*

**B1.5 Earth Observation Societal and Economic Applications, Challenges and Benefits**  
The focus of the session is on using Earth Observation data to generate information and deliver applications and services for meeting sustainable development challenges, addressing socio-economic benefits, and delivering commercial applications from the data. Presentation of analyses, methods, algorithms, processing, case studies and results from developing and operating applications and services including consideration of investment cost, economic return, and societal benefits, especially leveraging innovative approaches, are encouraged. Optimized application satellite constellations, which do not focus on individual techniques or single satellites and describe the socio-economic aspects of these collective systems, are also encouraged.





## Co-Chairs

### Masami Onoda

Japan Aerospace Exploration Agency (JAXA) — UNITED STATES

### Na Yao

Qian Xuesen Laboratory of Space Technology, China Academy of Space Technology (CAST) — CHINA

## Rapporteurs

### Michael Kern

European Space Agency (ESA) — THE NETHERLANDS

### Annamaria Nassisi

Thales Alenia Space Italia — ITALY

## B1.6

### Assessing and Mitigating the Global Freshwater Crisis

Water is life and with Earth's changing climate, water availability, quality and security are under stress creating a global societal crisis. Despite its importance, the challenges of assessing and monitoring fresh water are poorly understood as is the ability to generate products to inform decision makers. The vantage point of space affords a unique opportunity to make the critical measurements related with fresh water. This session will focus on the past, present and future space flight missions devoted to making freshwater measurements. It will also include modelling systems for predicting availability and address products generated for societal benefits.

## Co-Chairs

### Parag Vaze

National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES

### Elizabeth Seward

— UNITED KINGDOM

## Rapporteur

### Shimrit Maman

Ben-Gurion University of the Negev — ISRAEL

## B1.7

### Earth Observations to address Earth's Environment and Climate Challenges

The IPCC reports on climate change articulate the major global environmental challenges that require vast and sustained measurement and information systems to monitor key climate parameters and inform decision makers and enable potential mitigations. Global governmental agencies, commercial and public/private partnerships are investing in creating systems and applications for environmental monitoring and prediction, and climate monitoring and change mitigation. This session focuses on the latest major findings in climate research and the systems being used to address the climate challenges, Earth Observations science, weather, oceanography, and land monitoring. Presentation of algorithms, processing chains and services especially leveraging innovative approaches, are encouraged. Optimized application satellite constellations, which do not focus on individual techniques or single satellites and describe the environmental / climate aspects of these collective systems, are also encouraged.

## Co-Chairs

### Harry Cikanek

National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES

### Oana van der Togt

TNO — THE NETHERLANDS

## Rapporteur

### Taryn Tomlinson

Canadian Space Agency — CANADA

## B1.1P

### Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Earth Observation addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also 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

### Luis Ferreira

Airbus Defence and Space — GERMANY

### Harry A. Cikanek

National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES

## B2

### IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM

This symposium, organized by the International Astronautical Federation (IAF), examines developments in space-based systems, services, applications, and technologies as they relate to communication and navigation. Communication topics include fixed, broadcast, high-throughput, mobile, optical, and quantum communications. Navigation topics include position, velocity, and time determination and tracking for both relative and inertial reference frames. The symposium addresses geostationary, non-geostationary, and extra-terrestrial systems and constellations. The topics of IoT and M2M as they relate to communication and navigation are also applicable to this symposium.

## Coordinators

### Rita Lollock

The Aerospace Corporation — UNITED STATES

### Morio Toyoshima

National Institute of Information and Communications Technology (NICT) — JAPAN

## B2.1

### Advances in Space-based Navigation Technologies

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

## Co-Chairs

### Peter Buist

European Union Agency for the Space Programme (EUSPA) — THE NETHERLANDS

### Joe M. Strausi

The Aerospace Corporation — UNITED STATES

## Rapporteur

### Sanat K Biswas

IIIT Delhi — INDIA

## B2.2

### Advances in Space-based Communication Systems and Services, Part 1

This session is focused on all aspects of new space communications, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high-throughput satellites (HTS) and low earth orbit systems; 5G integration into satellite networks; Ku- and Ka-band, Q/V bands and higher frequencies and laser communication (including quantum communications); VSAT/ESIM and radio/television and internet services, including video to users; near-Earth and interplanetary services. It also includes spectrum issues for new systems/services, and systems modeling.

## Co-Chairs

### Robert D. Briskman

Sirius XM Radio — UNITED STATES

### Laszlo Bacszardi

Hungarian Astronautical Society (MANT) — HUNGARY

## Rapporteur

### Dunay Badirkhanov

Space Agency of Republic of Azerbaijan (Azercosmos) — AZERBAIJAN

## B2.3

### Advances in Space-based Communication Systems and Services, Part 2

This session is focused on all aspects of new space communications, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high-throughput satellites (HTS) and low earth orbit systems; 5G integration into satellite networks; Ku- and Ka-band, Q/V bands and higher frequencies and laser communication (including quantum communications); VSAT/ESIM and radio/television and internet services, including video to users; near-Earth and interplanetary services. It also includes spectrum issues for new systems/services, and systems modeling.

## Co-Chairs

### Otto Koudelka

Joanneum Research — AUSTRIA

### Morio Toyoshima

National Institute of Information and Communications Technology (NICT) — JAPAN

## Rapporteur

### Steven Shumsky

Millennium Space Systems, A Boeing Company — UNITED STATES

## B2.4

### Advances in Space-based Communication Systems and Services, Part 3

This session is focused on all aspects of new space communications, services, architecture and infrastructure: fixed, mobile and broadcast services, including the high-throughput satellites (HTS) and low earth orbit systems; 5G integration into satellite networks; Ku- and Ka-band, Q/V bands and higher frequencies and laser communication (including quantum communications); VSAT/ESIM and radio/television and internet services, including video to users; near-Earth and interplanetary services. It also includes spectrum issues for new systems/services, and systems modeling.

## Co-Chairs

### Dipak Srinivasan

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

### Ramon P. De Paula

National Aeronautics and Space Administration (NASA) — UNITED STATES

## Rapporteur

### Sara AlMaeni

Mohammed Bin Rashid Space Centre (MBRSC) — UNITED ARAB EMIRATES

## B2.5

### Advances in Space-based Communication Technologies, Part 1

This session is focused on all aspects of payload, spacecraft, and Earth station technologies for space-based communications and data relay. It covers applications ranging from those used in nanosatellites to those applicable to large, high throughput systems, and integrated applications and services. It includes modulation and coding, propagation, power amplifiers, adaptive transmit technologies, inter-satellite links, laser technology (as applicable to communications), antenna (including phased array) design, Q/V band technologies, onboard processing, digital payload technologies, security including quantum key distribution via satellite, and other technology relevant to satellite communication.

## Co-Chairs

### Debra Emmons

The Aerospace Corporation — UNITED STATES

### Amane Miura

National Institute of Information and Communications Technology (NICT) — JAPAN

## Rapporteur

### Nader Alagha

ESA — THE NETHERLANDS

## B2.6

### Advances in Space-based Communication Technologies, Part 2

This session is focused on all aspects of payload, spacecraft, and Earth station technologies for space-based communications and data relay. It covers applications ranging from those used in nanosatellites to those applicable to large, high throughput systems, and integrated applications and services. It includes modulation and coding, propagation, power amplifiers, adaptive transmit technologies, inter-satellite links, laser technology (as applicable to communications), antenna (including phased array) design, Q/V band technologies, onboard processing, digital payload technologies, security including quantum key distribution via satellite, and other technology relevant to satellite communication.

## Co-Chairs

### Elemer Bertenyi

Canadian Aeronautics and Space Institute — CANADA

### Enrique Pacheco Cabrera

Incomspace — MEXICO

## Rapporteurs

### K.R. Sridhara Murthi

NIAS — INDIA

### Steven Shumsky

Millennium Space Systems, A Boeing Company — UNITED STATES

## B2.7

### Advances in Space-based Navigation Systems, Services, and Applications

This session is focused on advances in space-based navigation systems, including the existing global systems (Beidou, Galileo, GLONASS, GPS) and regional systems (EGNOS, IRNSS, QZSS, WAAS), as well as proposed and emerging new space-based systems. The session also addresses advances in the services and applications of those systems for position determination, navigation, time determination, and integrity assurance on Earth, Moon, and potentially other bodies of the solar system.

## Co-Chairs

### Raj Thilak Rajan

Technical University of Delft — THE NETHERLANDS

### Giovanni B. Palmerini

Sapienza University of Rome — ITALY

## Rapporteurs

### Norbert Frischauf

TU GRAZ — AUSTRIA

### Joshua Critchley-Marrows

The University of Sydney — AUSTRALIA

## B2.8

## GTS.3

### 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 those for satellite-based position, velocity, and time determination and tracking for navigation. Both Earth's orbital and interplanetary space communications topics can be addressed. This session is co-sponsored by the Space Communications and Navigation Committee and the Workforce Development/Young Professionals Programme Committee.

## Co-Chairs

### Kevin Shortt

Airbus Defence & Space — GERMANY

### Stephanie Wan

Space Generation Advisory Council (SGAC) — UNITED STATES

## Rapporteur

### Joshua Critchley-Marrows

The University of Sydney — AUSTRALIA

## B2.1P

### Interactive Presentations - IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Communications and Navigation addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also 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

### Morio Toyoshima

National Institute of Information and Communications Technology (NICT) — JAPAN

### Rita Lollock

The Aerospace Corporation — UNITED STATES

### Manfred Wittig

— GERMANY

## B3

### IAF HUMAN SPACEFLIGHT SYMPOSIUM

The symposium, organized by the International Astronautical Federation (IAF), invites papers on all aspects of on-going and planned human spaceflight including the design, development, operations, utilization and future plans of space missions involving humans. The scope covers past, present and planned space missions and programmes in LEO and beyond, both governmental and private. The Human Spaceflight Symposium will also feature discussions on preparations for the launch of new human spaceflight capabilities and collaborative efforts of human and robotic systems and technologies.

## Coordinators

### Kevin D. Foley

The Boeing Company — UNITED STATES

### Igor V. Sorokin

S.P. Korolev Rocket and Space Corporation Energia — RUSSIAN FEDERATION

### Peter Batenburg

Netherlands Space Society (NVR) — THE NETHERLANDS



## B3.1

### Governmental Human Spaceflight Programmes (Overview)

The session provides the forum for updates and annual "Overview" presentations on present and evolving governmental Human Spaceflight programmes. Each year, the session will focus on specific themes dealing with human spaceflight exploration. These will be selected by the session chairs based on the received abstracts. The session will accept manuscripts from any organization (agencies, industries, research centers, academia, etc.) dealing with international, Governmental human space programmes initiatives. The range of topic to be addressed in this session include mission to low Earth orbit (LEO) and those beyond Earth orbit (BEO) and include orbital systems, crew and cargo transportation systems, as well as surface systems and operations on the Moon. The format of the session (e.g. panel, pitching presentations, keynote speech) will be a result of such a selection.

#### Co-Chairs

##### Sam Scimemi

National Aeronautics and Space Administration (NASA)  
— UNITED STATES

##### Juergen Schlutz

European Space Agency (ESA) — GERMANY

#### Rapporteur

##### Rainer Willnecker

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

## B3.2

### Commercial Human Spaceflight Programmes

This session provides a forum for papers describing commercial human orbital and sub-orbital endeavours including orbital space stations, commercial transportation systems, services, operation and uses, as well as human-tended space station platforms. This session also accepts papers on commercial human spaceflight activities in cis-lunar space and lunar surface operations. Topics include the status of development, testing, operations and utilization; the architecture and performance of various systems; orbital infrastructure development; commercial operations and utilization projects, market and economic development activity, and other pertinent areas of commercial human spaceflight. Examples of activity include but are not limited to commercial utilization and other commercial activity on the International Space Station, international capability for commercial transportation, activities planned for future human spaceflight platforms either in low Earth orbit (LEO) or beyond Earth orbit (BEO) and other applications are appropriate for this session.

#### Co-Chairs

##### Sergey K. Shaevich

Khrunichev State Research & Production Space Center  
— RUSSIAN FEDERATION

##### Michael W. Hawes

Lockheed Martin Corporation — UNITED STATES

##### Michael E. Lopex Alegria

MLA Space, LLC — UNITED STATES

#### Rapporteur

##### Gene Rice

RWI - Rice Wiggels Int'l — UNITED STATES

## B3.3

### Utilization & Exploitation of Human Spaceflight Systems

This session addresses the utilization and exploitation of space stations, spacecraft, and surface systems and provides the opportunity to discuss achievements, plans and outlooks. Topics for discussion include proposed or available payload facilities, experiments, research, manufacturing, and other on-orbit and surface activity and its related planning, accommodation, and implementation. Additional items appropriate for discussion include scientific and industrial utilization applications and engineering research and technology demonstrations, as well as uses of space stations (ie. International Space Station and Chinese Space Station Tjangan) and other crewed vehicles as test beds for exploration. We also invite papers on challenges for future sustainability of human spaceflight which may be investigated through utilization of on-orbit crew and crewed platforms, and includes those in cis-lunar space and on the surface of the Moon. These may include investigation of in-situ resources and other potential economic and technological enablers, results of advanced manufacturing tests and demonstrations, and reduction and mitigation of risks

#### Co-Chairs

##### Cristian Bank

Eumetsat — GERMANY

##### Eleanor Morgan

Lockheed Martin Space Systems — UNITED STATES

## B3.4

### Flight & Ground Operations aspects of Human Spaceflight - Joint Session of the IAF Human Spaceflight and IAF Space Operations

## B6.4

### Symposia

This session addresses systems, advanced concepts, key 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

##### Dieter Sabath

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

##### Annamaria Piras

Thales Alenia Space Italia — ITALY

#### Rapporteurs

##### Thomas A.E. Andersen

Danish Aerospace Company A/S — DENMARK

##### Maria Grulich

Deutsches Zentrum fuer Luft- und Raumfahrt (DLR)  
— GERMANY

## B3.5

### Astronaut Training, Accommodation, and Operations in Space

This session begins with an Astronaut Roundtable where an international group of astronauts from the various programmes will discuss their experiences in a roundtable format. There will be an extended Question and Answer period of interaction with the audience. This session concentrates on all aspects of spaceflight that are unique to the presence of astronauts. It encompasses astronaut activities such as selection, training, workload management, and task division between flight and ground segments. It includes spacecraft systems and robotic tools; interfaces; international command, control and communications; payloads; research; and utilization. It addresses the unique spacecraft systems required to safely accommodate astronauts during intravehicular and extravehicular activities. The session includes astronaut pre-mission, mission, and post-mission support of technological and scientific space-based research and utilization of human space complexes and the space environment.

#### Co-Chairs

##### Igor V. Sorokin

S.P. Korolev Rocket and Space Corporation Energia — RUSSIAN FEDERATION

##### Alan T. DeLuna

American Astronautical Society (AAS) — UNITED STATES

#### Rapporteur

##### Keiji Murakami

Japan Aerospace Exploration Agency (JAXA) — JAPAN

## B3.6

## A5.3

### Human and Robotic Partnerships in Exploration - Joint session of the IAF Human Spaceflight and IAF Exploration Symposia

This session seeks papers on new systems and technologies for current human spaceflight and exploration programmes, and the role of human and robotic partnerships in areas such as onboard robotic assistants, habitat / infrastructure construction support, human mobility support systems (e.g. EVA mobility aids, rovers); and robotic precursor activities to human spaceflights for test, validation, and demonstration of systems. This session also welcomes papers considering how the roles of humans, machines and intelligent systems are likely to evolve in the coming years and the corresponding impact on complex mission design, implementation, and operations.

#### Co-Chairs

##### Christian Sallaberger

Canadensys Aerospace Corporation — CANADA

##### Mark Hempzell

The British Interplanetary Society — UNITED KINGDOM

#### Rapporteur

##### Jan Marius Bach

DLR (German Aerospace Center) — GERMANY

## B3.7

### Advanced Systems, Technologies, and Innovations for Human Spaceflight

This session is designed to examine and identify the potential evolution of key elements of Human Spaceflight missions, especially those driven by advanced technologies and innovations. Papers are solicited that address potential future subsystems, technologies, innovations, logistics, processes, procedures, etc. Papers are also encouraged that address key factors in enabling innovation and new system insertion in human space flight, including reliability, availability, first time use, learning by doing, early testing and integration results, and prototyping. Topics which enable or significantly improve future human space mission objectives are of interest including for exploration, commercial initiatives, tourism, and industrial undertakings. Also, lessons learned from past missions and their application to future missions are essential topics in this session.

#### Co-Chairs

##### Michele Gates

NASA Headquarters — UNITED STATES

##### Sebastien Barde

Centre National d'Etudes Spatiales (CNES) — FRANCE

#### Rapporteur

##### Gi-Hyuk Choi

Korean Aerospace Research Institute — KOREA, REPUBLIC OF

## B3.8

### Human Space & Exploration

This session addresses 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-Chair

##### Dan King

MDA Corporation — CANADA

## B3.9

## GTS.2

### Human Spaceflight Global Technical Session

The Human Space Endeavours Global Technical Session is targeting individuals and organizations with the objective of sharing best practices, future projects, research 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

##### Guillaume Girard

Zero2infinity — SPAIN

##### Andrea Jaime

Isar Aerospace — GERMANY

## B3.1P

### Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Human Spaceflight addressed in the classic Sessions. The presentation will be displayed on digital screens in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also 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-Chair

##### Peter Batenburg

Netherlands Space Society (NVR) — THE NETHERLANDS

## B4

### 30<sup>TH</sup> IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS

The International Academy of Astronautics (IAA) Symposium on Small Satellite Missions is focused on recent advances in small satellite class missions weighing much less than 1000kg, addressing needs in government, commerce, or academia. Papers should focus on how microsatellites, nanosatellites, CubeSats and small and "megaconstellations" amongst others enable valuable results for the mission end-user. Papers should benefit the wider smallsat community, and demonstrate a degree of ingenuity and innovation in small satellite utilization, design, manufacture and/or engineering. Papers can report on important lessons-learned, describe notable missions in the planning stages, or include topics that demonstrate the value of small satellites and their constellations, their applications. Sessions cover the role that small satellites can play in developing space nations, science, exploration, "NewSpace", communications and Earth Observation. Sessions also cover cost-effective operations, affordable and reliable access to space through launch, and emerging and promising smallsat technologies and techniques.

#### Coordinators

##### Alex da Silva Curiel

Surrey Satellite Technology Ltd (SSTL) — UNITED KINGDOM

##### Jian Guo

Delft University of Technology (TU Delft) — THE NETHERLANDS

#### Support

##### Rhoda Shaller Hornstein

— UNITED STATES

## B4.1

### 24<sup>TH</sup> Workshop on Small Satellite Programmes at the Service of Developing Countries

This 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 satisfied and results achieved by developing nations through using small satellites. National space plans and examples of application results and benefits shall be included. Small satellite programmes in Africa, Middle-East, and Central Asia would be of particular interest to the session. The workshop shall also review the results of international cooperation, technology transfer, lessons learned and the extent to which these efforts have contributed to the space maturity of developing countries.

#### Co-Chairs

##### Sias Mostert

Space Commercial Services Holdings (Pty) Ltd — SOUTH AFRICA

##### Nathalie Ricard

United Nations Office for Outer Space Affairs — AUSTRIA

#### Rapporteurs

##### Danielle Wood

Massachusetts Institute of Technology (MIT) — UNITED STATES

##### Pierre Molette

— FRANCE

## B4.2

### Small Space Science Missions

This 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, astronomy/astrophysics observations, and fundamental physics. Emphasis will be given to results achieved, new technologies and concepts, and novel management techniques.

#### Co-Chairs

##### Larry Paxton

The Johns Hopkins University Applied Physics Laboratory — UNITED STATES

##### Norbert M.K. Lemke

OHB System AG - Oberpfaffenhofen — GERMANY

#### Rapporteurs

##### Roberta Mugellesi-Dow

European Space Agency (ESA) — UNITED KINGDOM

##### Oana van der Togt

TNO — THE NETHERLANDS

## B4.3

### Small Satellite Operations

This session covers the planning for, and execution of, cost-effective approaches for Small Satellite Operations, with emphasis on new missions, including constellations of small satellites, with new models of operation to reduce mission lifecycle costs and to minimize the cost impact of mission extensions. Papers addressing innovation, an entrepreneurial approach to new business opportunities, novel finance and business models, management techniques, and international cooperation in support of Small Satellite Operations are particularly encouraged. Papers that discuss the application of novel technology to mission operations, such as automation and autonomy, constraint resolution, and timeline planning, as well as reports on missions recently accomplished and lessons learned, are also welcome. For papers not addressing small satellites, please refer to Symposium B6.

#### Co-Chairs

##### Andreas Hornig

AerospaceResearch.net — GERMANY

##### Peter M. Allan

STFC — UNITED KINGDOM

##### Stephan Roemer

Antwerp Space — BELGIUM





**Rapporteur**

**Lynette Tan**  
*Singapore Space and Technology LTD (SSTL) — SINGAPORE, REPUBLIC OF*

**B4.4**

**Small Earth Observation Missions**

We call for papers that will present information to decision makers, scientists, engineers, and managers about cost-effective small satellite missions, instruments, technologies, and designs of both current and planned Earth and near-Earth missions. This session addresses the technologies, applications and missions achieved through the use of small, cost-effective satellites to observe the Earth and near-Earth space. Innovative cost-effective solutions to the needs of the science and applications communities are sought. Satellite technologies suited for use on small satellites including those in the single to multiple CubeSat ranges are particularly encouraged. Satellite or technology development efforts that make use of innovative launch opportunities, such as the developing space tourism market and commercial launch capability, hold significant promise for low-cost access to space make Earth observation missions attainable to non-governmental organizations as well as traditional users: papers addressing these evolving opportunities would be welcomed.

**Co-Chairs**

|   |   |
|---|---|
| <b>Carsten Tobehn</b><br><i>European Space Agency (ESA) — THE NETHERLANDS</i> | <b>Larry Paxton</b><br><i>The Johns Hopkins University Applied Physics Laboratory — UNITED STATES</i> |
|---|---|

**Rapporteurs**

|   |   |
|---|---|
| <b>Werner R. Balogh</b><br><i>European Space Agency (ESA) — SWITZERLAND</i> | <b>Marco Gomez Jenkins</b><br><i>— UNITED KINGDOM</i> |
|---|---|

**B4.5**

**Access to Space for Small Satellite Missions**

A key 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 utilization of dedicated launches; development of ride-share systems, auxiliary payload systems, and separation and dispenser systems; and responsive integration approaches that will enable efficient small satellite access to space. Includes lessons learned from users on technical and programmatic approaches. For a dedicated discussion of small satellite propulsion systems, please refer to session B4.5A-C4.8. For a discussion of small launchers concepts and operations, please refer to session D2.7.

**Co-Chairs**

|  |   |
|--|---|
| <b>Yves Gerard</b><br><i>Airbus Defence &amp; Space — FRANCE</i> | <b>Philip Davies</b><br><i>Deimos Space UK Ltd — UNITED KINGDOM</i> |
|--|---|

**Rapporteurs**

|  |   |
|--|---|
| <b>Jeffery Emdee</b><br><i>The Aerospace Corporation — UNITED STATES</i> | <b>Carlos Niederstrasser</b><br><i>Northrop Grumman Corporation — UNITED STATES</i> |
|--|---|

**B4.5A  
C4.8**

**Joint Session between IAA and IAF for Small Satellite Propulsion Systems**

This session will pay particular attention to propulsion systems and associated technologies as an enabler to efficient small satellite access to space and orbit change. Papers are invited discussing the particular challenges of design, manufacture, testing, operations 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 electric propulsion systems for major orbit changes, fine orbit control and maintenance, and end-of-life disposal. This session will be accepting submissions for oral presentations only. For papers with an emphasis on the small satellite and its system design, refer to other B4 sessions. For a focus on other propulsion systems and technologies, refer to other C4 sessions.

**Co-Chairs**

|   |  |
|---|--|
| <b>Jeff Emdee</b><br><i>The Aerospace Corporation — UNITED STATES</i> | <b>Arnau Pons Lorente</b><br><i>Space Generation Advisory Council (SGAC) — UNITED STATES</i> |
|---|--|

**B4.6A**

**Generic Technologies for Small/Micro 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).

**Co-Chairs**

|   |  |
|---|--|
| <b>Philip Davies</b><br><i>Deimos Space UK Ltd — UNITED KINGDOM</i> | <b>Joost Elstak</b><br><i>Airbus Defence and Space Netherlands — THE NETHERLANDS</i> |
|---|--|

**Rapporteurs**

|   |  |
|---|--|
| <b>Jian Guo</b><br><i>Delft University of Technology (TU Delft) — THE NETHERLANDS</i> | <b>Thomas Terzibaschian</b><br><i>DLR, German Aerospace Center — GERMANY</i> |
|---|--|

**B4.6B**

**Generic Technologies for Nano/Pico Platforms**

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

**Chairman**

**Andy Vick**  
*RAL Space — UNITED KINGDOM*

**Co-Chair**

**Zeger de Groot**  
*Innovative Solutions in Space BV — THE NETHERLANDS*

**Rapporteurs**

|  |  |
|--|--|
| <b>Martin von der Ohe</b><br><i>Lacuna Space — GERMANY</i> | <b>Eugene D Kim</b><br><i>Satrec Initiative — KOREA, REPUBLIC OF</i> |
|--|--|

**B4.7**

**Constellations and Distributed Systems**

Small satellites offer important advantages in creating new opportunities for implementing spatially-distributed space-based systems (e.g. Constellations). In this session we focus on new, emerging, or enabling technologies that can be used or are being used to create networked data collection systems via small satellites. Specifically, Session B4.7 focuses on Constellations (e.g. Constellation missions for Earth Observation, IoT/M2M and LEO Communications), distributed architectures (e.g. Distributed SAR systems) and sensor systems and how these low-cost and rapidly delivered technologies offer the potential to fulfill complex user needs, working in coordination with other small or large space infrastructures (e.g. mega-constellations), as well as with airborne or terrestrial assets. Papers should show how cross-platform compatibility (both hardware and software aspects) can be used to enable these systems, any standards that are proposed or adopted, design techniques that enable this cross-platform compatibility, etc. We are particularly interested in technologies that enable small spacecraft to play an important role in upcoming applications, such as (but not limited to) civil security, telecommunications in remote areas, navigation support (e.g., along the new foreseen routes in the Arctic), natural disaster management (e.g., damage assessment and first responders support), and planetary exploration. In this regard, the development and usage of Commercial-off-the-shelf (COTS) technologies are also of specific interest to the session. Distributed systems and their impact in terms of new opportunities for the emerging Commercial Space Industry and new commercial space missions with small platforms is also of specific interest to the session. The integrated applications of these sensor systems are covered in Symposium Session B5.2, and the broader view of tools and technologies to enable integrated applications are covered in B5.1. In B4.7 authors are also invited to analyze technological enhancements and new developments needed to guarantee small satellite integration with existing and scheduled assets from both the bus and payload perspectives. Also analysis of inter-operability within integrated systems can be addressed, like payload data management, spacecraft operation, and formation flying.

**Co-Chairs**

|  |  |
|--|--|
| <b>Rainer Sandau</b><br><i>International Academy of Astronautics (IAA) — GERMANY</i> | <b>Michele Grassi</b><br><i>University of Naples "Federico II" — ITALY</i> |
|--|--|

**Rapporteurs**

|   |  |
|---|--|
| <b>Jaime Esper</b><br><i>National Aeronautics and Space Administration (NASA) — UNITED STATES</i> | <b>Aaron Rogers</b><br><i>Maxar Technologies — UNITED STATES</i> |
|---|--|

**B4.8**

**Small Spacecraft for Deep-Space Exploration**

This session focuses on innovative small spacecraft designs, systems, missions and technologies for the exploration and commercialization of space beyond Earth orbit. Target destinations for these miniaturized space probes include the Earth's Moon, Mars, comets and asteroids, as well as other destinations that are targets for in-situ resource utilization (ISRU). Small exploration probes covered by this session may come in many different forms including special-purpose miniature spacecraft, standard format small platforms such as Cubesats or other microsats, nanosats, picosats, etc. Topics include new and emerging technologies including the use of commercial off the shelf (COTS) technologies, miniaturized subsystems including propulsion, avionics, guidance navigation & control, power supply, communication, thermal management, and sensors and instruments. The main focus of this session is on new and emerging systems, missions, driving technologies and applications that are both government-funded as well as driven by commercial ventures.

**Co-Chairs**

|  |  |
|--|--|
| <b>Leon Alkalai</b><br><i>Mandala Space Ventures — UNITED STATES</i> | <b>Rene Laufer</b><br><i>Luleå University of Technology — SWEDEN</i> |
|--|--|

**Rapporteurs**

|   |   |
|---|---|
| <b>Amanda Stiles</b><br><i>Rocket Lab — UNITED STATES</i> | <b>Jaime Esper</b><br><i>National Aeronautics and Space Administration (NASA) — UNITED STATES</i> |
|---|---|

**B4.9  
GTS.5**

**Small Satellite Missions Global Technical Session**

The Small Satellite Missions Global Technical Session (GTS) is a collaboration between the International Academy of Astronautics (IAA) Small Satellite Missions Symposium and the International Astronautical Federation (IAF) Workforce Development/Young Professionals Programme Committee. This session is unique in that it allows for sharing of information on a global scale with presenters and audience both at the IAC venue and online at their home/work/university locations. Abstracts are solicited regarding operational missions or mature proposals for small satellite systems and related topics. These must have clear relevance on an international scale or at a business level, and must also provide young professionals a taste of what the space sector has to offer. Where possible, abstracts should have a wide interest in the community and should include transferable knowledge or lessons learned. Abstracts highlighting ingenuity or innovation are preferred. Examples include space missions utilizing small satellites that address specific new societal, scientific or commercial challenges, or novel technologies that have the potential to revolutionize space missions and/or enable their access to space. Papers are to describe the specific need, the small satellite approach that addresses this need, the benefits of this approach and the use of space technology, and demonstrate that other non-space approaches provide inferior solutions. Papers from, or directed at the young professional community are preferred. This session will be accepting submissions for oral presentations only.

**Co-Chairs**

|  |  |
|--|--|
| <b>Matthias Hetscher</b><br><i>DLR (German Aerospace Center) — GERMANY</i> | <b>Norbert M.K. Lemke</b><br><i>OHB System AG - Oberpfaffenhofen — GERMANY</i> |
|--|--|

**Rapporteurs**

|   |  |
|---|--|
| <b>Alex da Silva Curiel</b><br><i>Surrey Satellite Technology Ltd (SSTL) — UNITED KINGDOM</i> | <b>Victoria Barabash</b><br><i>Luleå University of Technology — SWEDEN</i> |
|---|--|

**B4.IP**

**Interactive Presentations: 30<sup>TH</sup> IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS**

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects on small satellite missions addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also 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**

|  |  |  |
|--|--|--|
| <b>Danil Ivanov</b><br><i>Keldysh Institute of Applied Mathematics, RAS — RUSSIAN FEDERATION</i> | <b>Balbir Singh</b><br><i>Manipal Institute of Technology, Manipal Academy of Higher Education — INDIA</i> | <b>Andreas Hornig</b><br><i>Jena-Optronik GmbH — GERMANY</i> |
|--|--|--|

**Rapporteur**

|  |   |
|--|---|
| <b>Klaus Schilling</b><br><i>Zentrum für Telematik — GERMANY</i> | <b>Jian Guo</b><br><i>Delft University of Technology (TU Delft) — THE NETHERLANDS</i> |
|--|---|

**B5**

**IAF SYMPOSIUM ON INTEGRATED APPLICATIONS**

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. This symposium will address various aspects of space-based downstream services with a special emphasis on the sustainable development of our planet in line with the objectives defined by the U.N. Sustainable Development Goals. Integrated applications combine data from existing space assets, such as satellite communications, Earth observation, satellite navigation with airborne and ground-based systems, in addition to other technologies, such as big data, drones, analytics, internet of things, 5G, and others to deliver sustainable solutions and services responding to users' needs. The goal of the symposium is to discuss the different types of systems, tools, and technologies, such as the kind of space and non-space data to be collected and how data are collected and integrated that can enable the development of end-to-end solutions.

**Coordinators**

|  |   |
|--|---|
| <b>Jeanne Holm</b><br><i>City of Los Angeles — UNITED STATES</i> | <b>Roberta Mugellesi-Dow</b><br><i>European Space Agency (ESA) — UNITED KINGDOM</i> |
|--|---|

**B5.1**

**Tools and Technology in Support of Integrated Applications**

The session will focus on specific systems, tools, and technology in support of integrated applications by addressing the various issues associated with applications development, the kind of data to be collected, how data are collected, and how the data are integrated and distributed to address key user needs. Integrated applications are built on the exploitation of space and terrestrial technologies for the benefit of the global population. Emerging technologies, such as machine learning, artificial intelligence, digital twins, the internet of things, and other advanced technologies are rapidly revolutionizing and reshaping infrastructure and global-local economies. Leveraging these new transformative developments and understanding their disruptive potential with respect to technology, shifting demographics, and global connectivity is essential for space technologies. Possible topics include: ground-truthing of data collected from space platforms; innovative, low-cost solutions for data distribution and access that focus on the space segment; new ways of integrating space and non-space data; data fusion and visualization tools; and enabling technologies in support of new developments, models in support of applications, managing integrated applications programmes, and public outreach efforts to connect the public to these applications.

**Co-Chairs**

|  |   |
|--|---|
| <b>Jeanne Holm</b><br><i>City of Los Angeles — UNITED STATES</i> | <b>Roberta Mugellesi-Dow</b><br><i>European Space Agency (ESA) — UNITED KINGDOM</i> |
|--|---|

**Rapporteur**

**Beatrice Barresi**  
*European Space Agency (ESA) — UNITED KINGDOM*

**B5.2 Integrated Applications End-to-End Solutions**  
The session will be a forum for end-to-end solutions, case studies, 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/crisis monitoring and management, energy, food security, smart cities, transport, health, maritime, education, and tourism. The user needs, the organizations of the user communities, the service 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 and stakeholders needs and requirements will also be discussed.

**Co-Chairs**

**Boris Penne**  
*OHB System AG — GERMANY*

**Roberta Mugellesi-Dow**  
*European Space Agency (ESA) — UNITED KINGDOM*

**Rapporteurs**

**Stefano Ferretti**  
*Space Renaissance International — ITALY*

**Marion Allayioti**  
*European Space Agency (ESA) — UNITED KINGDOM*

**B5.3 Satellite Commercial Applications**  
The emergence of “New Space” and satellite-based IoT 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, and transport and satellite IoT plays a key role to increase productivity. Meanwhile, the downstream market is evolving through innovative approaches to amplifying satellite services, M2M and 5G/6G technologies are changing the traditional satellite services with satellite IoT as the key application. This session solicits papers pertinent to several areas such as the commercial space and space culture; a commercial space model for public users; atmosphere, ecosphere, environment; new application video optics and video SAR; new application-travelers (outdoors, automobiles, sailboat, general aviation); global communications; commercializing data about the Earth; and case analysis of satellite commercial applications.

**Co-Chairs**

**John M. Horack**  
*The Ohio State University College of Engineering — UNITED STATES*

**Dengyun Yu**  
*China Aerospace Science and Technology Corporation (CASC) — CHINA*

**Rapporteur**

**Samuel Malloy**  
*The Ohio State University — UNITED STATES*

**B5.1P Interactive Presentations - IAF SPACE OPERATIONS SYMPOSIUM**  
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of integrated applications addressed in the classic Sessions. The IP session is not restricted to any specific topic related to space law and invites authors to contribute presentations on any interesting, relevant and current space law issues. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Roberta Mugellesi-Dow**  
*European Space Agency (ESA) — UNITED KINGDOM*

**Jeanne Holm**  
*City of Los Angeles — UNITED STATES*

**B6 IAF SPACE OPERATIONS SYMPOSIUM**  
The Space Operations Symposium, organized by the International Astronautical Federation (IAF), addresses all aspects of spaceflight operations. The sessions address space operations including human spaceflight and robotic space missions, from low-Earth and geosynchronous orbit, to lunar, planetary, science and exploration missions. The symposium covers both flight and ground systems, and included mission planning, training, and real time operations. Particular focus is provided for commercial space operations, advanced systems, new operations concepts, and small satellite operations.

**Coordinators**

**Andreas Rudolph**  
*European Space Agency (ESA) — GERMANY*

**Otfrid Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

**Zeina Mounzer**  
*Telespazio VEGA Deutschland GmbH — GERMANY*

**B6.1 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**

**Sean Burns**  
*EUMETSAT — GERMANY*

**Claude Audouy**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Rapporteurs**

**Regina Mosenkis**  
*Airbus Defence & Space — GERMANY*

**Keyur Patel**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

**B6.2 Innovative Space Operations Concepts and Advanced Systems**  
This session focuses on innovative space operations and addresses advanced concepts, systems, approaches, and tools for operating existing and new types of missions, improving mission output in quality and quantity, and reducing cost.

**Co-Chairs**

**Mario Cardano**  
*Thales Alenia Space France — ITALY*

**Thomas Kuch**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**Rapporteurs**

**Jackelynne Silva-Martinez**  
*NASA — UNITED STATES*

**Yuichiro Nogawa**  
*Japan Manned Space Systems Corporation (JAMSS) — JAPAN*

**B6.3 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**

**Andreas Rudolph**  
*European Space Agency (ESA) — GERMANY*

**Zeina Mounzer**  
*Telespazio VEGA Deutschland GmbH — GERMANY*

**Rapporteurs**

**Borre Pedersen**  
*Kongsberg Satellite Services AS — NORWAY*

**Matthew Duggan**  
*The Boeing Company — UNITED STATES*

**B6.4 Flight & Ground Operations of HSF Systems - A Joint Session of the IAF Human Spaceflight and IAF Space Operations Symposia**  
This session addresses systems, advanced concepts, key 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**

**Dieter Sabath**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**Annamaria Piras**  
*Thales Alenia Space Italia — ITALY*

**Rapporteurs**

**Thomas A.E. Andersen**  
*Danish Aerospace Company ApS — DENMARK*

**Maria Grulich**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**B6.5 Large Constellations & Fleet Operations**  
Access to space has been simplified, and opened the door to a wider range of missions. Organisations are opting for distributed architectures of small satellite constellations instead of single-satellite missions. The complexity of the overall system has shifted, and necessitated a focus on efficient management and operation of a multitude of heterogeneous smaller elements. This session addresses the operations of large constellations, covering all related elements and phases; the operations concepts and solutions, the required ground segment architecture, the scale-up, deployment, and exploitation, the space traffic management approaches, end-of-life management, as well as the advantages, challenges, the outlook and foreseen developments.

**Co-Chairs**

**John Auburn**  
*Astroscale Ltd — UNITED KINGDOM*

**Zeina Mounzer**  
*Telespazio VEGA Deutschland GmbH — GERMANY*

**Rapporteurs**

**Andreas Rudolph**  
*European Space Agency (ESA) — GERMANY*

**Shawn Linam**  
*Qwaltec, Inc. — UNITED STATES*

**B6.1P Interactive Presentations - IAF SPACE OPERATIONS SYMPOSIUM**  
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Operations addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also 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 Auburn**  
*Astroscale Ltd — UNITED KINGDOM*

**Otfrid G. Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — 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 IAF ASTRODYNAMICS SYMPOSIUM**  
This symposium addresses advances in orbital mechanics, attitude dynamics, guidance, navigation and control of space systems

**Coordinators**

**Daniel Scheeres**  
*Colorado Center for Astrodynamics Research, University of Colorado — UNITED STATES*

**Vincent Martinot**  
*Thales Alenia Space France — FRANCE*

**C1.1 Attitude Dynamics (1)**  
This theme discusses advances in spacecraft attitude dynamics and control, as well as design, testing and performance of novel attitude sensors and actuators. This theme also covers dynamics and control of multiple interconnected rigid and flexible bodies, including tethered systems, and in-orbit assembly.

**Co-Chairs**

**Zhanfeng Meng**  
*China Academy of Space Technology (CAST) — CHINA*

**Giovanni B. Palmerini**  
*Sapienza University of Rome — ITALY*

**Rapporteur**

**Robert G. Melton**  
*Pennsylvania State University — UNITED STATES*

**C1.2 Attitude Dynamics (2)**  
This theme discusses advances in spacecraft attitude dynamics and control, as well as design, testing and performance of novel attitude sensors and actuators. This theme also covers dynamics and control of multiple interconnected rigid and flexible bodies, including tethered systems, and in-orbit assembly.

**Co-Chairs**

**Gianmarco Radice**  
*— SINGAPORE, REPUBLIC OF*

**Mikhail Ovchinnikov**  
*Keldysh Institute of Applied Mathematics, RAS — RUSSIAN FEDERATION*

**Rapporteur**

**Hyochong Bang**  
*Korea Advanced Institute of Science and Technology (KAIST) — KOREA, REPUBLIC OF*

**C1.3 Guidance, Navigation and Control (1)**  
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**

**Guo Linli**  
*Institute of Manned Space System Engineering, China Academy of Space Technology (CAST) — CHINA*

**Krishna Kumar**  
*Ryerson University — CANADA*

**Rapporteur**

**Juan Carlos Bastante**  
*OHB System AG-Bremen — GERMANY*



## C1.4 Guidance, Navigation and Control (2)

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

**Mai Bando**  
Kyushu University — JAPAN

**Eberhard Gill**  
Delft University of Technology — THE NETHERLANDS

### Rapporteur

**Hanspeter Schaub**  
Colorado Center for Astrodynamics Research, University of Colorado — UNITED STATES

## C1.5 Guidance, Navigation & Control (3)

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

**Yung Fu Tsai**  
National Cheng Kung University — TAIWAN, CHINA

**Jean de Lafontaine**  
NGC Aerospace Ltd. — CANADA

### Rapporteur

**Tang Liang**  
Beijing Institute of Control Engineering, China Academy of Space Technology (CAST) — CHINA

## C1.6 Mission Design, Operations & Optimization (1)

The theme covers design, operations and optimization of Earth-orbiting and interplanetary missions, with emphasis on studies and experiences related to current and future missions.

### Co-Chairs

**Yury Razoumny**  
Peoples' Friendship University of Russia (RUDN) — RUSSIAN FEDERATION

**Mauro Pontani**  
Sapienza University of Rome — ITALY

### Rapporteur

**Tang Liang**  
Beijing Institute of Control Engineering, China Academy of Space Technology (CAST) — CHINA

## C1.7 Mission Design, Operations & Optimization (2)

The theme covers design, operations and optimization of Earth-orbiting and interplanetary missions, with emphasis on studies and experiences related to current and future missions.

### Co-Chairs

**Erick Lansard**  
Thales Research & Technology — FRANCE

**Richard Epenoy**  
Centre National d'Etudes Spatiales (CNES) — FRANCE

### Rapporteur

**Mauro Pontani**  
Sapienza University of Rome — ITALY

## C1.8 Orbital Dynamics (1)

This theme discusses advances in 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.

### Co-Chairs

**Elena Fantino**  
Khalifa University of Science and Technology (KUST) — UNITED ARAB EMIRATES

**Yuichi Tsuda**  
Japan Aerospace Exploration Agency (JAXA) — JAPAN

### Rapporteur

**Kathleen Howell**  
Purdue University — UNITED STATES

## C1.9 Orbital Dynamics (2)

This theme discusses advances in 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.

### Co-Chairs

**Othon Winter**  
UNESP - São Paulo State University — BRAZIL

**Josep J. Masdemont**  
Universitat Politècnica de Catalunya (UPC) — SPAIN

### Rapporteur

**David C. Folta**  
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center — UNITED STATES

## C1.IP 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 classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the C Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

### Co-Chairs

**Diane Davis**  
National Aeronautics and Space Administration (NASA), Johnson Space Center — UNITED STATES

**Florian Renk**  
European Space Agency (ESA) — GERMANY

## C2 IAF MATERIALS AND STRUCTURES SYMPOSIUM

This symposium, organized by the International Astronautical Federation (IAF), provides an international forum for recent advancements in assessment of the latest technology achievements in space structures, structural dynamics, and materials. The Symposium addresses the design and development of space vehicle structures and mechanical/thermal/fluidic systems. Future advances in several space systems applications for space power, space transportation, astrodynamics, space exploration, space propulsion and space station will depend increasingly on the successful application of innovative materials and the development of structural concepts - particularly those relating to very large deployable (and assembled) space structures. For these applications to occur, increased interaction between these technology communities, and collaboration among technologists and mission planners need to be pursued. Substantial improvements are essential in a wide range of current technologies, including nanotechnologies, to reduce projected costs and increase potential scientific returns from respective mission system applications. Papers in this symposium will review the projected advances in materials and space structures in this domain for advanced space systems applications.

### Coordinator

**Jochen Albus**  
ArianeGroup — GERMANY

**Alwin Eisenmann**  
IABG Industrieanlagen - Betriebsgesellschaft mbH — GERMANY

## C2.1 Space Structures I - Development and Verification (Space Vehicles and Components)

The topics addressed in this session cover the aspects of the development and verification of space vehicle structures (e.g. pressurized propellant tanks, non-pressurized structures of space vehicles, control surfaces) and their components (e.g. fluidic equipment and propulsive lines). The aspects of development, verification, and qualification concern:

- Thermo-Mechanical loads and environment
- New structural concepts (e.g. multi-functional structures, design concepts for reusability)
- Structure design and verification (stiffness, strength, static and dynamic stability, damage tolerance, reusability)
- Structure optimization
- Materials
- Static and dynamic ground testing
- Exploitation of flight measurements and in-orbit testing
- Lessons learned related to space vehicle structures and components development, verification and qualification.

### Co-Chairs

**Alwin Eisenmann**  
IABG Industrieanlagen - Betriebsgesellschaft mbH — GERMANY

**Andreas Rittweger**  
DLR (German Aerospace Center) — GERMANY

### Rapporteurs

**Jochen Albus**  
ArianeGroup — GERMANY

**Markus Geiss**  
OHB System AG — GERMANY

## C2.2 Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures)

The topics to be addressed include evaluation of analysis versus test results for deployable and dimensionally stable structures, e.g. reflectors, telescopes, antennas; examination of both on-ground and in-orbit testing, thermal distortion and shape control, structural design, development and verification; lessons learned.

### Co-Chairs

**Paolo Gasbarri**  
University of Rome "La Sapienza" — ITALY

**Oliver Kunz**  
Beyond Gravity — SWITZERLAND

### Rapporteurs

**Aicke Patzelt**  
MT Aerospace AG — GERMANY

**Thomas Sinn**  
DcubeD (Deployables Cubed GmbH) — GERMANY

## C2.3 Space Structures - Dynamics and Microdynamics

The topics to be addressed include dynamics analysis and testing, modal identification, landing and impact dynamics, pyroshock, test facilities, vibration suppression techniques, damping, micro-dynamics, in-orbit dynamic environment, dynamics and control of robotic manipulators for the assembly of space structures, wave structural propagation, excitation sources and in-orbit dynamic testing.

### Co-Chairs

**Harijono Djojodihardjo**  
— INDONESIA

**Élcio Jeronimo de Oliveira**  
INNOSPACE Co. Ltd — BRAZIL

### Rapporteurs

**Ijar M. Da Fonseca**  
ITA-DCTA — BRAZIL

**Paolo Gasbarri**  
Sapienza University of Rome — ITALY

## C2.4 Advanced Materials and Structures for High Temperature Applications

The topics to be addressed include advanced materials and structures for high temperature applications in space related domains. This includes carbon-carbon and ceramic matrix composites, ultra high temperature ceramics, ablative materials, ceramic tiles and insulations, together with innovative structural concepts making use of the above, for propulsion systems, launchers, hypersonic vehicles, entry vehicles, aero capture, power generation. The session covers the full spectrum of material, design, manufacturing and testing aspects.

### Co-Chairs

**David E. Glass**  
National Aeronautics and Space Administration (NASA) — UNITED STATES

**Thierry Pichon**  
ArianeGroup — FRANCE

### Rapporteur

**Zijun Hu**  
China Academy of Launch Vehicle Technology (CALT) — CHINA

## C2.5 Advancements in Materials Applications and Rapid Prototyping

The topics to be addressed include advancements in materials applications and novel technical concepts in the rapid prototyping of space systems. Continuous improvements in materials and structural concepts are always needed to achieve extremely demanding goals in performance, reliability, and affordability of space components, especially in terms of greater accuracy/dimensional stability, longer life, greater survivability to both natural and threat environments, and producibility capability for high volume production. Different rapid prototyping processes are currently used for different materials in the fabrication of metal, ceramic, and plastic parts. However, as very new technique, Additive Manufacturing is strongly emerging due to the capability of optimization of structural parts for space applications as it concerns weight reduction, improvement of mechanical properties and reduction of development and lead times as well as the reduction of costs. Furthermore AM processes make three-dimensional parts directly from CAD models by adding materials layer by layer.

### Co-Chairs

**Giuliano Marino**  
CIRA Italian Aerospace Research Centre — ITALY

**Behnam Ashrafi**  
National Research Council — CANADA

### Rapporteurs

**James Tucker**  
— UNITED STATES

**Raymond Clinton**  
NASA — UNITED STATES

## C2.6 Space Environmental Effects and Spacecraft Protection

The focus of the session will be on space environmental effects and spacecraft protection. The effects of vacuum, radiation, atomic oxygen, spacecraft charging, thermal cycling, dissociation, meteoroids and space debris impact on space systems, materials and structures, and microelectronics will be addressed. Protective and shielding technologies, including analysis simulation and testing of debris impact, and susceptibility of Commercial-Off-The-Shelf (COTS) micro-electronics to space radiation will be covered.

### Co-Chairs

**Antonio Del Vecchio**  
CIRA Italian Aerospace Research Centre — ITALY

**Anatoliy Lohvynenko**  
Yuzhnoye State Design Office — UKRAINE

### Rapporteur

**Kyeum-rae Cho**  
Pusan National University — KOREA, REPUBLIC OF

## C2.7 Space Vehicles – Mechanical/Robotic/Thermal/Fluidic Systems

The topics to be addressed include novel technical concepts for mechanical/robotic/thermal/fluidic systems and subsystems of launchers, manned and unmanned spacecraft, re-entry vehicles and small satellites. Advanced subsystems and design of future exploration missions will be covered, considering issues arising from material selection, cost efficiency and reliability, and advancements in space vehicle development with respect to engineering analysis, manufacturing, and test verification. It is also planned to discuss the issues of experimental and computational simulation of functioning and full-scale tests of space vehicles and their systems/subsystems. Attention will be paid to the problem of verification and validation of mathematical models for the design and experimental development of these objects at various phases of their life cycle.

### Co-Chairs

**Brij Agrawal**  
Naval Postgraduate School — UNITED STATES

**Oleg Alifanov**  
Moscow Aviation Institute (MAI) — RUSSIAN FEDERATION

### Rapporteurs

**Guoliang Mao**  
Beijing Institute of Aerodynamics — CHINA

**Federica Angeletti**  
University of Rome "La Sapienza" — ITALY



## C2.8

### Specialized Technologies, Including Nanotechnology

Specialized material and structures technologies are explored in a large variety of space applications both to enable advanced exploration, and science/observation mission scenarios to perform test verifications relying on utmost miniaturization of devices and highest capabilities in structural, thermal, electrical, electromechanical/ optical performances offered by the progress in nanotechnology. Examples are the exceptional performances at nano-scale in strength, electrical, thermal conduction of Carbon nanotubes which are experiencing first applications at macro-scale such as nano-composite structures, high efficiency energy storage wheels, MEMS and MOEMS devices. Molecular nanotechnology and advances in manipulation at nano-scale offer the road to molecular machines, ultracompact sensors for science applications and mass storage devices. The Session encourages presentations of specialized technologies, in particular of nanomaterial related techniques and their application in devices offering unprecedented performances for space applications.

#### Co-Chairs

**Mario Marchetti**  
Associazione Italiana di Aeronautica e Astronautica (AIDAA) — ITALY

**Pierre Rochus**  
CSL (Centre Spatial de Liège) — BELGIUM

#### Rapporteur

**Bangcheng Ai**  
China Aerospace Science and Industry Corporation — CHINA

## C2.9

### Smart Materials and Adaptive Structures

The focus of the session will be on application of smart materials to spacecraft and launch vehicle systems, novel sensor and actuator concepts and new concepts for multi-functional and intelligent structural systems. Also included in the session will be new control methods for vibration suppression and shape control using adaptive structures as well as comparisons of predicted performance with data from ground and in-orbit testing.

#### Co-Chairs

**Pavel Trivailo**  
RMIT University (Royal Melbourne Institute of Technology) — AUSTRALIA

**Hiroshi Furuya**  
Tokyo Institute of Technology — JAPAN

#### Rapporteurs

**Paolo Gaudenzi**  
Sapienza University of Rome — ITALY

**Écio Jeronimo de Oliveira**  
INNOSPACE Co. Ltd — BRAZIL

## C2.IP

### Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Materials and Structures addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the C Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

#### Co-Chairs

**Jochen Albus**  
ArianeGroup — GERMANY

**Alwin Eisenmann**  
IABG Industrieanlagen - Betriebsgesellschaft mbH — GERMANY

## C3

### IAF SPACE POWER SYMPOSIUM

Reliable energy systems continue to be key for all space missions. The future exploration and development of space depend on new, more affordable and more reliable energy sources of diverse types ranging from the very small to the extraordinarily large. Moreover, the continuing support for space activities by the public requires that these activities are increasingly inserted into the global challenge to transition current terrestrial energy systems into more environmentally friendly, sustainable ones. The space sector has traditionally served as cutting edge precursor for the development of some renewable power systems. These activities are now put into a much larger space & energy perspective. These range from joint technology development up to visionary concepts such as space solar power plants. The Space Power Symposium, organized by the International Astronautical Federation (IAF), addresses all these aspects, covering the whole range from power generation, energy conversion & storage, power management, power transmission & distribution at system and sub-system levels including commercial considerations. It will include, but not be restricted, to topics such as advanced solar and nuclear systems for spacecraft power and propulsion, novel power generation and energy harvesting, and examine the prospects for using space-based power plants to provide energy remotely to the Earth or other planets.

#### Coordinator

**John C. Mankins**  
ARTEMIS Innovation Management Solutions, LLC — UNITED STATES

**Koji Tanaka**  
Institute of Space and Astronautical Science (ISAS), Japan  
Aerospace Exploration Agency — JAPAN

## C3.1

### Solar Power Satellite

This session deals with all aspects of concepts and architectures for space-based solar power plants and concepts integrating space and terrestrial energy activities. It will be structured in two half-sessions, one focusing on advances in the field of space solar power plant architectures and one on activities in the field of space & energy, including all types of conceptual, technical and organizational progress to better integrate space and terrestrial energy activities. It is the primary international forum for scientific and technical exchanges on this topic and thus provides a unique common platform for discussions. Typically it will include all system-level, architectural, organizational and commercial aspects, including modeling and optimization as well as related non-technical aspects.

#### Co-Chairs

**John C. Mankins**  
ARTEMIS Innovation Management Solutions, LLC — UNITED STATES

**Ming Li**  
China Academy of Space Technology (CAST) — CHINA

#### Rapporteurs

**Leopold Summerer**  
European Space Agency (ESA) — THE NETHERLANDS

**Koji Tanaka**  
Institute of Space and Astronautical Science (ISAS), Japan  
Aerospace Exploration Agency — JAPAN

## C3.2

### Wireless Power Transmission Technologies and Application

This session focuses on all aspects of wireless power transmission systems. It covers wireless power transmission technologies, including laser, microwave-based as well as novel wireless power transmission technologies from the short ranges (e.g. within spacecraft or between two surface installations) up to the very large distances for space exploration and power transmission from space to ground. The session covers theoretical as well as applied and experimental results, including emitter/receiver antenna architectures and deployment.

#### Co-Chairs

**Nobuyuki Kaya**  
Kobe University — JAPAN

**Ming Li**  
China Academy of Space Technology (CAST) — CHINA

#### Rapporteurs

**Massimiliano Vasile**  
University of Strathclyde — UNITED KINGDOM

**Haroon B. Oqab**  
Space Canada Corporation — CANADA

## C3.3

### Advanced Space Power Technologies

This session covers all types of advanced space power technologies and concepts for the satellites, moon/asteroid/planetary exploration and manned space activities. These include technologies and concepts related to power generation (solar, nuclear, other) and harvesting, power conditioning, management and distribution, power transmission and energy storage.

#### Co-Chairs

**Matthew Perren**  
Airbus Defence & Space — UNITED KINGDOM

**Gary Barnhard**  
XISP-Inc — UNITED STATES

#### Rapporteurs

**Lee Mason**  
National Aeronautics and Space Administration (NASA), Glenn Research Center — UNITED STATES

**Koji Tanaka**  
Institute of Space and Astronautical Science (ISAS), Japan  
Aerospace Exploration Agency — JAPAN

## C3.4

### Space Power System for Ambitious Missions

This session is devoted to emerging concepts ranging from very small power (micro and milli-watt power) to very large power systems toward future ambitious space missions and space utilizations such as future moon village. These include concepts and technology developments of space power system for the increasing spacecraft market by the nano-, micro- and mini spacecraft. This session is dedicated to power systems for such applications as well as for long-duration exploration probes and sensors.

#### Co-Chairs

**Massimiliano Vasile**  
University of Strathclyde — UNITED KINGDOM

**Shoichiro Mihara**  
Japan Space Systems — JAPAN

#### Rapporteurs

**Xinbin Hou**  
CAST — CHINA

**Koji Tanaka**  
Institute of Space and Astronautical Science (ISAS), Japan  
Aerospace Exploration Agency — JAPAN

## C3.5

## C4.10

### Joint Session on Advanced and Nuclear Power and Propulsion Systems

This session, organized jointly between the Space Power and the Space Propulsion Symposia, addresses all aspects related to nuclear power and propulsion systems for space applications. The session also addresses all types of propellantless propulsion including (but not limited to) solar sails, magnetic sails, laser propulsion, tethers, etc.

#### Co-Chairs

**Leopold Summerer**  
European Space Agency (ESA) — THE NETHERLANDS

**Jerome Breteau**  
European Space Agency (ESA) — FRANCE

**Christian Bach**  
Technical University Dresden — GERMANY

#### Rapporteurs

**Simon Feast**  
British Interplanetary Society — UNITED KINGDOM

**Alexander Lovtsov**  
Keldysh Research Center — RUSSIAN FEDERATION

## C3.IP

### Interactive Presentations - IAF SPACE POWER SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Power addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the C Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

#### Coordinators

**Ming Li**  
China Academy of Space Technology (CAST) — CHINA

**Koji Tanaka**  
Institute of Space and Astronautical Science (ISAS), Japan  
Aerospace Exploration Agency — JAPAN

## C4

### IAF SPACE PROPULSION SYMPOSIUM

The Space Propulsion Symposium addresses sub-orbital, Earth to orbit and in-space propulsion. The general areas considered include both chemical and non-chemical rocket propulsion, air-breathing propulsion, and combined air-breathing and rocket systems. Typical specific propulsion categories of interest are liquid, solid and hybrid rocket systems, ramjet, scramjet, detonation-based propulsion and various combinations of air-breathing and rocket propulsion and nuclear, electric, solar and other advanced rocket systems, and propulsion systems dedicated to small satellites. The Symposium also welcomes contributions on component technologies, the operation and application to missions of overall propulsion systems, and unique propulsion test facilities.

#### Coordinators

**Angelo Cervone**  
Delft University of Technology (TU Delft) — THE NETHERLANDS

**Elena Toson**  
Space Generation Advisory Council (SGAC) — ITALY

**Riheng Zheng**  
Beihang University — CHINA

#### Christophe Bonhomme

Centre National d'Etudes Spatiales (CNES) — FRANCE

## C4.1

### Liquid Propulsion (1)

The session Liquid Propulsion (1) is dedicated to Liquid Rocket Engines (mono-propellant or bi-propellant), with particular emphasis on full engine systems. The session welcomes manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Christophe Bonhomme**  
Centre National d'Etudes Spatiales (CNES) — FRANCE

**Markus Jaeger**  
— GERMANY

#### Rapporteurs

**Ozan Kara**  
Space Generation Advisory Council (SGAC) — TURKEY

**Jerome Breteau**  
European Space Agency (ESA) — FRANCE

## C4.2

### Liquid Propulsion (2)

The session Liquid Propulsion (2) is dedicated to Liquid Rocket Engines (mono-propellant or bi-propellant), with particular emphasis on sub-systems and specific components (including propellants). The session welcomes manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Angelo Cervone**  
Delft University of Technology (TU Delft) — THE NETHERLANDS

**Annafederica Urbano**  
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace — FRANCE

#### Rapporteurs

**Christian Bach**  
Dresden University of Technology (DUT) / Technische Universität Dresden — GERMANY

**Martin Velander**  
GKN Aerospace Engine Systems — SWEDEN

## C4.3

### Solid and Hybrid Propulsion (1)

The session Solid and Hybrid Propulsion (1) is dedicated to Solid and Hybrid Rocket motors, with particular emphasis on full systems. The session welcomes manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Stéphane Henry**  
ArianeGroup — FRANCE

**Mario Kobald**  
Hyimpulse Technologies GmbH — GERMANY

#### Rapporteurs

**Toru Shimada**  
Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency — JAPAN

**Jean-Claude Traineau**  
Office National d'Etudes et de Recherches Aéropatiales (ONERA) — FRANCE

## C4.4

### Solid and Hybrid Propulsion (2)

The session Solid and Hybrid Propulsion (2) is dedicated to Solid and Hybrid Rocket motors, with particular emphasis on sub-systems and specific components (including propellants). The session welcomes manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Didier Boury**  
ArianeGroup SAS — FRANCE

**Adam Okninski**  
Łukasiewicz Research Network – Institute of Aviation (ILOT) — POLAND

#### Rapporteurs

**Christophe Bonhomme**  
Centre National d'Etudes Spatiales (CNES) — FRANCE

**Arif Karabeyoglu**  
Koc University — TURKEY

## C4.5

### Electric Propulsion (1)

The sessions Electric Propulsion (1) and Electric Propulsion (2) are dedicated to all aspects of Electric Propulsion, including full systems, sub-systems and specific components. The sessions welcome manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Garri A. Popov**  
Research Institute of Applied Mechanics and Electrodynamics (RIAME), MAI — RUSSIAN FEDERATION

**Mariano Andrenucci**  
Independent consultant — ITALY

#### Rapporteurs

**Vito Salvatore**  
CIRA Italian Aerospace Research Center, Capua — ITALY

**Vincent Guyon**  
Safran Aircraft Engines — FRANCE

## C4.6

### Electric Propulsion (2)

The sessions Electric Propulsion (1) and Electric Propulsion (2) are dedicated to all aspects of Electric Propulsion, including full systems, sub-systems and specific components. The sessions welcome manuscripts on all research and development areas: design, testing (including diagnostics and test facilities), analysis and calculations, modelling, applications, science and fundamentals.

#### Co-Chairs

**Alexander Lovtsov**  
SSC Keldysh Research Centre — RUSSIAN FEDERATION

**Markus Jaeger**  
— GERMANY

#### Rapporteurs

**Angelo Cervone**  
Delft University of Technology (TU Delft) — THE NETHERLANDS

**Simon Feast**  
British Interplanetary Society — UNITED KINGDOM

## C4.7

### Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle

This session covers hypersonic air-breathing and combined cycle propulsion with space applications. The typical types of engine considered in this session include: turbojet, ramjet, Scramjet, detonation engine, Turbine Based Combined Cycle (TBCC), Rocket Based Combined Cycle (RBCC), Hypersonic Pre-cooled Propulsion, Air Turbo Rocket (ATR) and other types of hypersonic combined cycle propulsion, together with the associated vehicle.

#### Co-Chairs

**Toru Shimada**  
Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency — JAPAN

**Jean-Claude Traineau**  
Office National d'Etudes et de Recherches Aéropatiales (ONERA) — FRANCE

#### Rapporteurs

**Didier Boury**  
ArianeGroup SAS — FRANCE

**Martin Velander**  
GKN Aerospace Engine Systems — SWEDEN

## C4.8

### B4.5A

### Joint Session between IAA and IAF for Small Satellite Propulsion Systems

This session will pay particular attention to propulsion systems and associated technologies as an enabler to efficient small satellite access to space and orbit change. Papers are invited discussing the particular challenges of design, manufacture, testing, operations 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 changes, fine orbit control and maintenance, and end-of-life disposal. For papers with an emphasis on the small satellite and its system design, refer to other B4 sessions. For a focus on other propulsion systems and technologies, refer to other C4 sessions.

#### Co-Chairs

**Arnau Pons Lorente**  
Space Generation Advisory Council (SGAC) — UNITED STATES

**Jeff Emdee**  
The Aerospace Corporation — UNITED STATES

#### Rapporteurs

**Elena Toson**  
T4i — ITALY

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

## C4.9

### Disruptive Propulsion Concepts for Enabling New Missions

This session will explore advanced and disruptive propulsion technologies, systems, ideas (including integration of different propulsion concepts) showing potential to enable new mission concepts, or to enhance the capabilities of current mission concepts.

#### Co-Chairs

**Vito Salvatore**  
CIRA Italian Aerospace Research Center, Capua — ITALY

**Elena Toson**  
T4i — ITALY

#### Rapporteurs

**Sabrina Corpino**  
Politecnico di Torino — ITALY

**Arnau Pons Lorente**  
Space Generation Advisory Council (SGAC) — UNITED STATES

## C4.10

### C3.5

### Joint Session on Nuclear Power and Propulsion Systems, and Propellantless Propulsion

This session, organized jointly between the Space Power and the Space Propulsion Symposia, addresses all aspects related to nuclear power and propulsion systems for space applications. The session also addresses all types of propellantless propulsion including (but not limited to) solar sails, magnetic sails, laser propulsion, tethers, etc.

#### Co-Chairs

**Jerome Breteau**  
European Space Agency (ESA) — FRANCE

**Leopold Summerer**  
ESA - European Space Agency — THE NETHERLANDS

**Christian Bach**  
Technical University Dresden — GERMANY

#### Rapporteurs

**Simon Feast**  
British Interplanetary Society — UNITED KINGDOM

**Alexander Lovtsov**  
Keldysh Research Center — RUSSIAN FEDERATION

## C4.IP

### Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM

Authors with an abstract accepted for an interactive presentation will be asked 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 must be near the plasma screens to engage in interactive discussions with other congress attendees.

#### Coordinators

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

**Angelo Cervone**  
Delft University of Technology (TU Delft) — THE NETHERLANDS

**Ozan Kara**  
Space Generation Advisory Council (SGAC) — TURKEY

#### Mario Kobald

German Aerospace Center (DLR) — GERMANY

## Category



## INFRASTRUCTURE

Systems sustaining space missions, including space system transportation, future systems and safety

- D1 IAF SPACE SYSTEMS SYMPOSIUM
- D2 IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM
- D3 21<sup>ST</sup> IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT
- D4 21<sup>ST</sup> IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE
- D5 56<sup>TH</sup> IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES
- D6 IAF SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES

Category coordinated by Roberta Mugellesi-Dow, European Space Agency (ESA), UNITED KINGDOM

## D1

### 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 implications for Lessons Learned and future Training and Practice; Advanced System Architectures; Cooperative Space Systems, and Innovative and Visionary Space Systems of the future.

#### Coordinators

**Reinhold Bertrand**  
European Space Agency (ESA) — GERMANY

**Jill Prince**  
National Aeronautics and Space Administration (NASA) — UNITED STATES

**Tibor S. Balint**  
Jet Propulsion Laboratory — 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 dreams of yesterday are the hope of today and the reality of tomorrow. By proposing novel concepts of space systems, and applications, we can broaden today's paradigm towards preferable outcomes beyond incremental advancements.

#### Co-Chairs

**Tibor S. Balint**  
Jet Propulsion Laboratory — UNITED STATES

**Peter Dieleman**  
National Aerospace Laboratory (NLR) — THE NETHERLANDS

#### Rapporteur

**Camillo Richiello**  
CIRA Italian Aerospace Research Centre — ITALY

## D1.2

### Space Systems Architectures

This session addresses current and future space systems architectures designed to realize promising concepts for Earth orbiting or exploration missions, both robotic and crewed. These architectures and their elements and building blocks should aim at an increase in functionality, performance, efficiency, reliability and flexibility of operations, while building on state-of-the-art, innovative or even disruptive technologies. The scope of the session includes architectures for single satellite systems or multiple satellite systems, such as constellations, formations, swarms, distributed systems, and system-of-systems (including hybridization with terrestrial systems). Ground-versus-space allocation of functionality and aspects of autonomy, both on-board and on-ground, may be addressed.

#### Co-Chairs

**Matteo Emanuelli**  
*Airbus Defence and Space — GERMANY*

**Thierry Floriant**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

#### Rapporteur

**Eberhard Gill**  
*Delft University of Technology — THE NETHERLANDS*

## 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 often result from spin-ins which will be discussed during the session, together with potential spin-offs. Examples include instrumentation, biotechnology, components, micro- and nano-technology, MEMs, advanced new structures and software techniques.

#### Co-Chairs

**Steven Arnold**  
*The Johns Hopkins University Applied Physics Laboratory — UNITED STATES*

**Xavier Roser**  
*Thales Alenia Space France — FRANCE*

#### Rapporteur

**Yoshihisa Arikawa**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

## D1.4.A

### Space Systems Engineering - Methods, Processes and Tools (1)

This session will focus on state-of-the-art systems engineering methodologies that reduce the time and cost, and improve the quality of space system design. Of special interest are multi-disciplinary methods, processes, and tools used for System Design, Product Realization, Technical Management, Operations, and Retirement of space systems to improve risk management, safety, reliability, testability, 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 operations; state of the art systems engineering methodologies for space systems, including space system(s) of systems (SoS); engineering design methods or modeling and simulation tools applied to space system design and optimization; methodologies and processes for technical planning, control, assessment and decision analysis of space system design; advancement in space system development environments, such as concurrent engineering design facilities; and novel methods to improve risk management, earned value management, configuration management, data management, availability, safety, reliability, testability and quality of life cycle cost estimates.

#### Co-Chairs

**Dapeng Wang**  
*Beihang University — CHINA*

**Peter Dieleman**  
*National Aerospace Laboratory (NLR) — THE NETHERLANDS*

#### Rapporteur

**Hui Du**  
*China Academy of Space Technology (CAST) — CHINA*

## D1.4.B

### Space Systems Engineering - Methods, Processes and Tools (2)

This session will focus on state-of-the-art systems engineering methodologies that reduce the time and cost, and improve the quality of space system design. Of special interest are multi-disciplinary methods, processes, and tools used for System Design, Product Realization, Technical Management, Operations, and Retirement of space systems to improve risk management, safety, reliability, testability, 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 operations; state of the art systems engineering methodologies for space systems, including space system(s) of systems (SoS); engineering design methods, modeling and simulation tools applied to space system design and optimization; methodologies and processes for technical planning, control, assessment and decision analysis of space system design; advancement in space system development environments, such as concurrent engineering design facilities; novel methods to improve risk management, earned value management, configuration management, data management, availability, safety, reliability, testability and quality of life cycle cost estimates.

#### Co-Chairs

**Gelson Loureiro**  
*Instituto Nacional de Pesquisas Espaciais (INPE) — BRAZIL*

**Norbert Frischauf**  
*TU Graz — AUSTRIA*

#### Rapporteur

**Jon Holladay**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

## D1.5

### Lessons Learned in Space Systems: Achievements, Challenges, Best Practices, Standards

This session addresses Lessons Learned in Space Systems on all aspects of the life cycle. The learning from the past is the necessary way to ensure mission success of future missions. This retrospective viewpoint includes the achievement of mission accomplishments, the challenges to overcome the difficulties and the best practices to lead the mission success, incorporating documentation of Lessons Learned. The scope of the session also includes the standards in design, development and operation; lessons learned in design, development and operation; achievement from development in project management; achievement from mission success and on-orbit operation; best practices of project management and systems engineering; challenges in project or programme development; challenges to overcome the difficulties on orbit; improvement of a Space system from former system development and operation; discussion of standards to assure the mission; and the documentation of learned lessons to preserve and make them available to future missions.

#### Co-Chairs

**Yoshihisa Arikawa**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

**Igor V. Belokonov**  
*Samara State Aerospace University — RUSSIAN FEDERATION*

#### Rapporteur

**Giuseppe Guidotti**  
*Deimos Space SLU — SPAIN*

## D1.6

### Cooperative and Robotic Space 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, and on-orbit servicing of space systems and technologies. Hosted payloads, where their objectives may be unrelated to the principal mission, are also addressed. Additional areas of interest include collaborative robotic systems, such as space robotic systems and manipulators, robotic/human interactions and distributed multi-agent technologies. Papers in this session will look at current missions and future opportunities, while addressing both benefits and challenges as the world-wide space community moves into these exciting areas.

#### Co-Chairs

**Klaus Schilling**  
*Zentrum für Telematik — GERMANY*

**Otfrid G. Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

#### Rapporteurs

**Steven Arnold**  
*The Johns Hopkins University Applied Physics Laboratory — UNITED STATES*

**Audrey Berquand**  
*European Space Agency (ESA) — THE NETHERLANDS*

## D1.1P

### 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 presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best interactive Presentation in the D Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

## Co-Chairs

**Reinhold Bertrand**  
*European Space Agency (ESA) — GERMANY*

**Jill Prince**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

## D2

### IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM

Topics of this symposium, orgit be possible some social media advertisment connctanized by the International Astronautical Federation (IAF), address worldwide space transportation solutions and innovations as well as relevant technologies needed and ground support infrastructure. The symposium addresses existing vehicles, vehicles in development and future space transportation solutions.

#### Coordinators

**Yuguang Yang**  
*China Aerospace Science & Industry Corporation (CASIC) — CHINA*

**Markus Jaeger**  
*— GERMANY*

**Randolph Kendall**  
*The Aerospace Corporation — UNITED STATES*

## D2.1

### Launch Vehicles in Service or in Development

Review of up to date status of launch vehicles currently in use in the world or under short term development.

#### Co-Chairs

**Danilo Sakay**  
*Brazilian Space Agency (AEB) — BRAZIL*

**Yorichika Mihara**  
*Mitsubishi Heavy Industries, Ltd. — JAPAN*

#### Rapporteur

**Martin Sippel**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

## D2.2

### Launch Services, Missions, Operations and Facilities

Review of the current and planned launch services and support, including economics of space transportation systems, financing, cost, insurance, licensing. Advancements in ground infrastructure, ground operations, production methods, mission planning and mission control for both expendable and reusable launch services.

#### Co-Chairs

**Francesco Santoro**  
*Altec S.p.A. — ITALY*

**Vincent Taponier**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

#### Rapporteur

**Jeremy Pinier**  
*National Aeronautics and Space Administration (NASA), Langley Research Center — UNITED STATES*

## D2.3

### Upper Stages, Space Transfer, Entry and Landing Systems

Discussion of existing, planned or new advanced concepts for cargo and human orbital transfer. Includes current and near term transfer, entry and landing systems, sub-systems and technologies for accommodating crew and cargo transfer in space.

#### Co-Chairs

**Oliver Kunz**  
*Beyond Gravity — SWITZERLAND*

**Bryan Smith**  
*NASA Glenn Research Center — UNITED STATES*

#### Rapporteur

**Oleg Ventskovsky**  
*Yuzhnoye SDO European Representation in Brussels — UKRAINE*

## D2.4

### Future Space Transportation Systems

Discussion of future overall transportation system designs and operational concepts for both expendable and reusable systems for Earth-to orbit transportation and exploration missions.

#### Co-Chairs

**José Gavira Izquierdo**  
*European Space Agency (ESA) — THE NETHERLANDS*

**Nicolas Bérend**  
*ONERA - The French Aerospace Lab — FRANCE*

#### Rapporteur

**Emmanuelle David**  
*Ecole Polytechnique Fédérale de Lausanne (EPFL) — SWITZERLAND*

## D2.5

### Technologies for Future Space Transportation Systems

Discussion of technologies enabling new reusable or expendable launch vehicles and in-space transportation systems. Emphasis is on early TRL hardware development and verification prior to flight, including ground testing and/or innovative technology prototype demonstrations not yet involving flight.

#### Co-Chairs

**Mathieu Chaize**  
*ArianeGroup SAS — FRANCE*

**Lin Shen**  
*China Academy of Launch Vehicle Technology (CALT) — CHINA*

#### Rapporteurs

**Andrea Esposito**  
*Northrop Grumman Corporation — ITALY*

**Andrea Jaime**  
*Isar Aerospace — GERMANY*

## D2.6

### Future Space Transportation Systems Verification and In-Flight Experimentation

Discussion of atmospheric and in-space flight testing and qualification of system, sub-system, and advanced technologies for future launch vehicles and in-space transportation systems. Emphasis is on higher TRL in-flight experimentation, demonstration, and qualification, including test plans and innovative technology prototype demonstrations involving or leading to flight as well as new and unique test platforms and capabilities.

#### Co-Chairs

**David E. Glass**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

**Christie Maddock**  
*University of Strathclyde — UNITED KINGDOM*

#### Rapporteurs

**Tetsuo Hiraiwa**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

**Aaron Weaver**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

**Nicole Viola**  
*Politecnico di Torino — ITALY*

## D2.7

### Small Launchers: Concepts and Operations

Discussion of existing, planned and future Launchers for small payloads ranging from 1500 kg to as low as 1 kg into Low Earth Orbit. Includes innovative solutions such as airborne systems, evolutions from sub-orbital concepts, combinations of existing/emerging elements and new elements, reusable, partially reusable and expendable concepts, and flexible, highly responsive concepts. Includes mission operations, design, development, and specific constraints.

#### Co-Chairs

**Harry A. Cikanek**  
*National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES*

**Ulf Palmnäs**  
*Swedish Space Corporation (SSC) — SWEDEN*

#### Rapporteur

**Florian Ruhhammer**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*





## D2.8

### Space Transportation Solutions for Deep Space Missions

This session is focused on in-space transportation capabilities and mission architectures, existing or under study, for human deep space exploration missions as well as the driving scientific mission objectives. Related enabling and support missions, such as robotic servicing and supply, as well as technology roadmaps to achieve successful deep space exploration missions shall be discussed. The session will also deal with lessons learned from past deep space missions beyond LEO as well as worldwide needs, requirements, and international cooperation to implement large scale exploration missions.

#### Co-Chairs

**Kenneth Bruce Morris**  
*Sierra Space — UNITED STATES*

**Josef Wiedemann**  
*MT Aerospace AG — GERMANY*

## D2.9

## D6.2

### Emerging Space Ventures, including Space Logistics and Space Safety for Sustainability

This session is dedicated to discussions of technical innovations or initiatives to achieve sustainable (considering cost, operability, capability and impact) Space Transportation Systems. Of particular interest are: - Identification of core evolving capabilities (systems, components, technologies) to conduct increasingly complex missions to a range of destinations over time - Addressing of emerging Space logistics, safety, technical challenges to foster flexible mission architectures using interoperability of building block components, and avoiding "one mission for one goal" (i.e. Single destination systems).

#### Co-Chairs

**Aline Decadi**  
*European Space Agency (ESA) — FRANCE*

**Charles E. Cockrell Jr.**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

#### Rapporteur

**Michele Cristina Silva Melo**  
*BRAZILIAN SPACE AGENCY (AEB — BRAZIL)*

## D2.IP

### Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Transportation Solutions and Innovations addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the D Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

#### Co-Chairs

**Christophe Bonnal**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Jens Lassmann**  
*ArianeGroup — GERMANY*

#### Rapporteur

**Markus Jaeger**  
*— GERMANY*

## D3

### 21<sup>ST</sup> IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT

This symposium, organised by the International Academy of Astronautics (IAA), will involve papers and discussion that traverse a wide range of highly valuable future space capabilities (FSC) – in other words “building blocks” for future space exploration, development and discovery – that could enable dramatic advances in global space goals and objectives. The international discussion of future directions for space exploration and utilisation is fully underway, including activities involving all major space-faring nations. Decisions are now being made that will set the course for space activities for many years to come. New approaches are needed that establish strategies, architectures, concepts and technologies that will lead to sustainable human and robotic space exploration and utilisation during the coming decades. The symposium will examine the possible paths, beginning with current capabilities such as the International Space Station, which may lead to ambitious future opportunities for space exploration, discovery and benefits. The sessions that comprise this symposium are key elements of current or planned International Academy of Astronautics (IAA) studies.

#### Coordinators

**John C. Mankins**  
*ARTEMIS Innovation Management Solutions, LLC — UNITED STATES*

**Alain Pradier**  
*European Space Agency (ESA) — THE NETHERLANDS*

## D3.1

### Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development

Future scenarios for sustainable exploration and development in space will unfold in the context of global conditions that vary greatly from those of the 1950s-1970s (the first generation of space programmes, driven by international competition), or those of the 1980s-2000s (the second generation of space programmes, enabled by international cooperation). Looking to the future, it is likely that space-faring countries will pursue their goals and objectives in a more building-block fashion focused on developing high-value future space capabilities, rather than through massive, geo-politically driven programmes. Increasingly, these developments may also reflect future commercial space opportunities. As a result, it is important that the international community should engage in an ongoing discussion of strategies and architectures to frame a “building block” approach to our future in space. Such a discussion should involve sustainable budgets and multiple-purpose system-of-systems capabilities that lead to a diverse range of future activities of broad benefit to humanity. This session, which is related to a prospective new International Academy of Astronautics (IAA) study group, will address strategies and architectural approaches that may allow a new paradigm, a “building block” approach, to be established among the space-faring countries. Papers are solicited in these and related areas..

#### Co-Chairs

**John C. Mankins**  
*ARTEMIS Innovation Management Solutions, LLC — UNITED STATES*

**Maria Antonietta Perino**  
*Thales Alenia Space Italia — ITALY*

#### Rapporteur

**Anouk Girard**  
*University of Michigan — UNITED STATES*

## D3.2A

### Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems

The emergence of novel systems and infrastructures will be needed to enable ambitious scenarios for sustainable future space exploration and utilization. New, reusable space infrastructures must emerge in various areas include the following: (1) infrastructures that enable affordable and reliable access to space for both exploration systems and logistics; (2) infrastructures for affordable and reliable transportation in space, including access to/from lunar and planetary surfaces for crews, robotic and supporting systems and logistics; (3) infrastructures that allow sustained, affordable and highly effective operations on the Moon, Mars and other destinations; and, (4) supporting in space infrastructures that provide key services (such as communications, navigation, etc.). Considering its focus on design and operation solutions for future crewed missions, in 2022 this session will be jointly curated with the recently-formed IAF Space Habitats Committee, whose aims include fostering research and partnerships in the design, the construction, the scalability, the commercialization, the disassembling and the sustainability of space habitats and associated infrastructures, emphasizing Moon and Mars surface structures and orbital stations. Papers are solicited in all areas related to the scope of this session, from a variety of disciplinary approaches.

#### Co-Chairs

**Paivi Jukola**  
*Aalto University — FINLAND*

**Gary Barnhard**  
*XISP-Inc — UNITED STATES*

**Julie Patarin-Jossec**  
*Russian Academy of Sciences — FRANCE*

#### Rapporteurs

**Christopher Moore**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

**Junjiro Onoda**  
*ISAS/JAXA — JAPAN*

## D3.2B

### Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies

The emergence of new technologies will be essential to realizing the various systems and infrastructures that will be needed to enable ambitious scenarios for sustainable future space exploration, utilization and eventual settlement. Technologies for new, reusable space infrastructures are needed, including the following: (1) infrastructures that enable affordable and reliable access to space for both exploration systems and logistics; (2) infrastructures for affordable and reliable transportation in space, including access to/from lunar and planetary surfaces for crews, robotic and supporting systems and logistics; (3) infrastructures that allow sustained, affordable and highly effective robotic and human operations on the Moon, Mars and other destinations; and, (4) supporting in space infrastructures that provide key services (such as communications, navigation, etc.). Papers are solicited in these and related areas.

#### Co-Chairs

**Alain Pradier**  
*European Space Agency (ESA) — THE NETHERLANDS*

**Christopher Moore**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

#### Rapporteurs

**Alain Dupas**  
*European Bank for Reconstruction and Development — FRANCE*

**Gary Barnhard**  
*XISP-Inc — UNITED STATES*

## 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 an ongoing series at the International Astronautical Congress that provides a unique international forum to further the development of a family of “best practices and tools” in this important field. Specific areas of potential interest include: (1) Technology Management Methodologies and Best Practices; (2) R&D Management Software Tools and Databases; and (3) Systems Analysis Methods and Tools. The full range of R&D activities is appropriate for discussion, ranging from technology development long-term planning, through technology R&D programmes, to system development projects, with special emphasis on the transition of new technologies from one stage to the next. Particular topics could include: Technology Readiness Levels (TRLs) and Technology Readiness Assessments, Technology R&D Risk Assessments and Management, Advanced Concepts Modeling Approaches and Tools, etc. Either more theoretical discussions, or examples of applications of R&D management techniques and/or tools to specific R&D programmes and projects are of interest for the session.

#### Co-Chairs

**John C. Mankins**  
*ARTEMIS Innovation Management Solutions, LLC — UNITED STATES*

**Paivi Jukola**  
*Aalto University — FINLAND*

#### Rapporteur

**Maria Antonietta Perino**  
*Thales Alenia Space Italia — ITALY*

## D3.IP

### Interactive Presentations Interactive Presentations - 21<sup>ST</sup> IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Building Blocks for Future Space Exploration and Development addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the D 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 C. Mankins**  
*ARTEMIS Innovation Management Solutions, LLC — UNITED STATES*

**Alain Pradier**  
*European Space Agency (ESA) — THE NETHERLANDS*

**Maria Antonietta Perino**  
*Thales Alenia Space Italia — ITALY*

## D4

### 21<sup>ST</sup> IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE

This 21<sup>st</sup> symposium is organized by the International Academy of Astronautics (IAA). In Space Activities the focus is usually kept on the short term developments, at the expense of future goals. The Symposium will discuss topics with at least 20 to 30 years prospective lead time and identify technologies and strategies that need to be developed. These developments will be examined with the goal to support also short/medium term projects and to identify priorities required for their development. The Sessions in the Symposium will address innovative technologies and Strategies to develop Space Elevator as well as Interstellar Precursor Missions. A session will address also how the Moon Village can contribute to the resolution of World Societal Changes as well as increasing the countries engaged in lunar activities.

#### Coordinators

**Giuseppe Reibaldi**  
*Moon Village Association (MVA) — AUSTRIA*

**Yu Lu**  
*China Academy of Launch Vehicle Technology, China — CHINA*

## D4.1

### Innovative Concepts and Technologies

1) In order to realize future, programs of space exploration and resource utilization, a focused suite of transformational new system concepts and enabling technologies must be developed during the coming decades. The technical objectives to be pursued should be drawn from a broad, forward-looking view of the technologies and system needed, but must be sufficiently focused, to allow tangible progression and dramatic improvements over current capabilities. 2) Ideally, the concepts should be presented in three categories: 1. Concepts which represent a significant advance, but require laboratory advancement, and 2. Concepts which have been demonstrated to some level in the laboratory, but require demonstration to validate their utility, and 3. Concepts which identify cross-cutting advances which, when combined can be successfully developed to support transformational new system concept. Papers are solicited in these and related areas.

#### Co-Chairs

**Ayman Ahmed**  
*Egyptian Space Agency (EgSA) — EGYPT*

**Timothy Cichan**  
*Lockheed Martin Corporation — UNITED STATES*

#### Rapporteur

**Xiaowei Wang**  
*China Academy of Launch Vehicle Technology (CALT) — CHINA*

## D4.2

### Contribution of Moon Village to Solving Global Societal Issues

Moon Village is a concept that brings together efforts, world-wide, from the private sector, governments, academics and others to explore and use the Moon in a sustainable manner. Moon Village is a community of projects carried out by stakeholders from different fields (for example, technical, scientific, cultural, economic) working together. The implementation of the Moon Village has already started with missions and activities in line with its spirit. It is a major step forward for the peaceful development of humankind. Moon Village can offer a new start to humanity on the Moon and on the Earth by contributing to solve global societal issues. The session will discuss the contributions of the Moon Village to the solution of global challenges (e.g., energy, population, sustainable development, many others). How the Moon Village will support the understanding of the global societal issues and bring benefits to society on a global scale will also be discussed. The session will include also the identification of the related technologies that need to be developed. The definition of a roadmap complementary to the UN Agenda 2030 will be also discussed.

#### Co-Chairs

**Giuseppe Reibaldi**  
*Moon Village Association (MVA) — AUSTRIA*

**Yu Lu**  
*China Academy of Launch Vehicle Technology, China — CHINA*

#### Rapporteur

**Paivi Jukola**  
*Aalto University — FINLAND*

## D4.3

### Modern Day Space Elevators Customer Design Drivers

Modern Day Space Elevator design concepts are driven from many arenas. The first is the dynamic situation of deploying 100,000 km of tether in the space environment from the surface of the ocean to the altitude well beyond geosynchronous. Within the Earth based region there are design drivers due to the various environments ranging from the ocean and atmospheric demands near the Earth Port as well as the tremendous temperature range and environmental challenges of the vacuum of space. In addition, the architect and systems engineer must consider a vast range of requirements from customers. The demands of a million tonnes deposited on the surface of Mars (or the Moon) and the needs at geosynchronous for 3,000,000 tonnes of space solar power satellites solidifies requirements to move massive payloads routinely, daily, inexpensively and oriented to customers’ needs. In addition, the dramatic need to accomplish all of this without damaging the Earth’s atmosphere will ensure that the Space Elevator as the Green Road to Space will be realized. Indeed, these customer demands will lead to the realization that Space Elevators will enable missions of vast importance to humanity (saving the planet with Space Solar Power satellite delivery, Mars Settlement delivery, Lunar habitat support, and missions to the outer planets). This session will discuss needs of Space Elevators’ future customers and start the refinement of design criteria and identify customer requirements necessary to initiate realistic designs. The Keynote Speech for this technical session will be entitled the “Jerome Pearson Memorial Lecture.”



**Co-Chairs**

**Peter Swan**  
*International Space Elevator Consortium — UNITED STATES*

**Yoji Ishikawa**  
*Obayashi Corporation — JAPAN*

**Rapporteur**

**Jerry Eddy**  
*International Space Elevator Consortium (ISEC) — UNITED STATES*

**D4.4**

**Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond**

Knowledge about space beyond our solar system and between the stars—that is interstellar space—is lacking data. Even as IBEX, NASA's Interstellar Background Explorer, studies the edge of our solar system, it still is confined to earth orbit. Arguably, some of the most compelling data to understand the universe we live in will come from sampling the actual environment beyond our solar system as Voyager 1 and Voyager 2 spacecraft are on the threshold of doing. In the 36 years since the Voyager probes' launches, significant advances in materials science, analytical chemistry, information technologies, imaging capabilities, communications and propulsion systems have been made. The recently released IAA study: "Key Technologies to Enable Near-Term Interstellar Scientific Precursor Missions" along with significant initiatives like the DARPA seed-funded 100 Year Starship and the Breakthrough Starshot project, signal the need, readiness and benefits to aggressively undertaking interstellar space missions. This session seeks to define specific strategies and key enabling steps to implement interstellar precursor missions within the next 10-15 years. Suggestions for defined projects, payloads, teams, spacecraft and mission profiles that leverage existing technological capacities, yet will yield probes that generate new information about deep space, rapidly exit the solar system and which can be launched before 2040 are sought.

**Co-Chairs**

**Mae Jemison**  
*100 Year Starship — UNITED STATES*

**Giancarlo Genta**  
*Politecnico di Torino — ITALY*

**Rapporteur**

**Les Johnson**  
*National Aeronautics and Space Administration (NASA), Marshall Space Flight Center — UNITED STATES*

**D4.5**

**Space Resources, the Enabler of the Earth-Moon Ecosphere**

1) With NASA announcing the Artemis Program to return to the Moon by 2024, and increasing numbers of companies investing in extraterrestrial resource utilization, this session is dominated by technology assessments and legal analyses associated with space resources. 2) In particular, the National Aeronautics and Space Administration is seeking commercially developed payloads to exploit lunar resources for supplies, fuel and other consumables. There are many opportunities to participate. 3) One issue which nags U.S. investors is the lack of a legal regime for authorization and continuing oversight of commercial entities seeking to exploit space resources for profit. Fortunately, Luxembourg has defined such a legal regime for its country's payloads. 4) This session seeks innovative ideas and concepts in the legal and technological regime. This session also seeks willing investors to present concepts for financing concepts to exploit space resources.

**Co-Chairs**

**Roger X. Lenard**  
*LPS — UNITED STATES*

**Mark Sundhal**  
*Cleveland State University — UNITED STATES*

**Rapporteur**

**Peter Swan**  
*International Space Elevator Consortium — UNITED STATES*

**D4.1P**

**Interactive Presentations - 21<sup>ST</sup> IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE**

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Visions and Strategies for the Future addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the D Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Helen Tung**  
*NewSpace2060 — AUSTRALIA*

**Gongling Sun**  
*International Space University — FRANCE*

**D5**

**56<sup>TH</sup> IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES**

Increasingly complex challenges around quality, safety, and security reflect how a space system can be developed and operated to perform its functions at its best with the proper robustness. In that environment, where radiation is not the least stress and possible ill-intentioned actions may occur, decreasing the level of failures in space activities is a must. Knowledge management (the proper capturing, protecting, and sharing of knowledge) and application of lessons learned and experience are key factors. This International Academy of Astronautics Symposium will be a lively discussion and raise awareness of new and innovative approaches to: obtain and run reliable and safe space systems: design solutions, validation, and tests; software development, validation, and security; and methods, management approaches, and regulations to improve the quality, efficiency, and collaborative ability of space programs and operations. All aspects are considered: risk management, complexity and security of systems and operations, knowledge and information management, human factors, economical constraints, international cooperation, norms, and standards.

**Coordinators**

**Jeanne Holm**  
*City of Los Angeles — UNITED STATES*

**Roberta Mugellesi-Dow**  
*European Space Agency (ESA) — UNITED KINGDOM*

**D5.1**

**For a Successful Space Program : Quality and Safety!**

Space is a difficult challenge and no complex program can be successful without a creative and thoughtful approach to quality and safety! Relying on luck cannot be the only way to proceed. Beginners and veterans, in science or industry, for small or large programs, will share projects, methods, observations, and analyses of successes or failures. This session deals with methods, tests, and standards for the analysis and mitigation of the many risks to maintain the desired quality and required safety. It offers an opportunity to discuss all aspects of the life cycle (including design, development and production philosophy, and operations) and the associated risk management approach. It concerns all types of space missions: transportation systems, orbital systems, exploration vehicles, and is also a management, workforce, and education issue.

**Co-Chairs**

**Manola Romero**  
*3AF — FRANCE*

**Alexander S. Filatyev**  
*Lomonosov Moscow State University — RUSSIAN FEDERATION*

**Rapporteur**

**Kaitlyn Holm**  
*University of Pennsylvania — UNITED STATES*

**D5.2**

**Emerging Trends of Knowledge Management in Organizations**

Digital transformation and innovations, such as artificial intelligence, machine learning, cloud computing, new collaboration tools, and intelligent search technologies are changing how people access and share knowledge. Knowledge management's evolution with new techniques and technologies is changing how space activities succeed when you ensure the people in the programs can access the lessons and knowledge needed. Key themes addressed during the session are trends, innovations, practical challenges, and solutions and technologies adopted in knowledge management in organizations to sustain, energize, and invigorate the ability to learn, innovate, and share knowledge. The session includes case studies that demonstrate how KM strategies have been applied and lessons learned, the challenges faced by organizations, and innovative solutions that facilitate knowledge sharing and collaboration for mission success.

**Co-Chairs**

**Roberta Mugellesi-Dow**  
*European Space Agency (ESA) — UNITED KINGDOM*

**Patrick Hambloch**  
*The Planetary Society — GERMANY*

**Rapporteurs**

**Daniel Galaretta**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Jeanne Holm**  
*City of Los Angeles — UNITED STATES*

**D5.3**

**Predicting, Testing, and Measuring the Effects of the Space Environment on Space Missions**

The space environment can strongly impact the performance and reliability of space missions. It has several natural and induced components, including high-energy radiation, plasma, atomic oxygen, planetary dust, extreme temperature, vacuum, micro-gravity, micrometeoroid and debris, and molecular and particulate contamination. Environmental conditions yield constraints at the design phase, and important risks in the course of the mission. The evaluation of the nominal and worst-case conditions to be met, mitigation and protection options, and of their impact on missions and flight systems are thus of prime importance. This session will encompass the following topics: space weather, plasma, spacecraft charging, radiation, atomic oxygen, planetary dust, molecular and particulate contamination, plume-induced contamination effects and interactions, and combined environments such as flight measurements, physical processes, prediction of nominal or worst case condition, ground testing, flight experiments and lessons learned, modelling and prediction, and thermos-optical degradation effects.

**Co-Chairs**

**Henry de Plinval**  
*Office National d'Etudes et de Recherches Aérospatiales (ONERA) — FRANCE*

**Teppel Okumura**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

**Rapporteur**

**Carlos Soares**  
*NASA Jet Propulsion Laboratory — UNITED STATES*

**D5.4**

**Cybersecurity in Space Systems, Risks and Countermeasures**

With the rising of New Space and the emergence of commercial space industry increasingly digital and data-dependent, the management of cyber-related risks and protection against cyberattacks has become a priority requiring the identification and deployment of relevant cybersecurity measures and solutions. This session aims at raising awareness on several related topics: cybersecurity risks encountered by space systems; tools & methods aiming at preventing & forecasting cyberattacks; risks assessment and cyber intelligence; countermeasures and engineering approach to design and protect space systems, data and space-enabled solutions; dedicated training, information sharing and analysis; and cybersecurity standards on 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 key distribution or use of blockchain in space systems.

**Co-Chairs**

**Julien Airaud**  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

**Stefano Zatti**  
*University of Rome "La Sapienza" — ITALY*

**Rapporteur**

**Nil Angli**  
*European Space Agency (ESA) — UNITED KINGDOM*

**D5.1P**

**Interactive Presentations - 56<sup>TH</sup> IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES**

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Safety, Quality and Knowledge Management in Space Activities addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the D Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**

**Jeanne Holm**  
*City of Los Angeles — UNITED STATES*

**Roberta Mugellesi-Dow**  
*European Space Agency (ESA) — UNITED KINGDOM*

**D6**

**IAF SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES**

Topics of this symposium, organized by the International Astronautical Federation (IAF), address commercial safety and regulatory policy issues for orbital and suborbital space transportation and spaceports. The goal is to identify issues common to commercial operators of both human and robotic space vehicles to increase international safety and interoperability.

**Coordinators**

**Jean-Bruno Marciacq**  
*JBM Aerospace — GERMANY*

**Francesco Santoro**  
*Altec S.p.A. — ITALY*

**D6.1**

**Commercial Space Flight Safety and Emerging Issues**

Topics for this session cover commercial space transportation and safety issues including human and robotic vehicles, spaceports, reentry vehicles, in-space transportation vehicles, and regulations. Papers related to commercial space transportation are also encouraged on: policy and law; operations and training; best practices and standards; pilot, crew and participant safety; and ground operations and launch site safety.

**Co-Chairs**

**John Sloan**  
*Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST) — UNITED STATES*

**Francesco Santoro**  
*Altec S.p.A. — ITALY*

**Rapporteur**

**Gennaro Russo**  
*Campania Aerospace District, DAC — ITALY*

**D6.2**

**Emerging Space Ventures, including Space Logistics and Space Safety for Sustainability**

This session is dedicated to discussions of technical innovations or initiatives to achieve sustainable (considering cost, operability, capability and impact) Space Transportation Systems. Of particular interest are: - Identification of core evolving capabilities (systems, components, technologies) to conduct increasingly complex missions to a range of destinations over time - Addressing of emerging Space logistics, safety, technical challenges to foster flexible mission architectures using interoperability of building block components, and avoiding "one mission for one goal" (i.e. Single destination systems).

**Co-Chairs**

**Aline Decadi**  
*European Space Agency (ESA) — FRANCE*

**Charles E. Cockrell Jr.**  
*National Aeronautics and Space Administration (NASA) — UNITED STATES*

**Rapporteur**

**Michele Cristina Silva Melo**  
*Brazilian Space Agency (AEB) — BRAZIL*

**D6.3**

**Enabling Safe Commercial Spaceflight: Vehicles and Spaceports**

This session addresses new and existing spaceports and factors that launch vehicle and spaceplane operators may use in evaluating the selection of a launch and/or landing location. Topics include: safety, air and spaceport facilities, runways, geography, air and space traffic, weather, population density, access to workforce and technical support, customer needs, regulations, and other areas. Papers are welcome from spaceports, airports, space transportation providers, support equipment providers, academia, commercial companies and governments.

**Co-Chairs**

**John Sloan**  
*Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST) — UNITED STATES*

**Francesco Santoro**  
*Altec S.p.A. — ITALY*

**Rapporteur**

**Gennaro Russo**  
*Campania Aerospace District, DAC — ITALY*

**D6.1P**

**Interactive Presentations - IAF SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES**

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Commercial Spaceflight Safety Issues addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the D Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.



## Category



### SPACE AND SOCIETY

Interaction of space with society, including education, policy and economics, history, space security and law

- E1 IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM
- E2 50<sup>TH</sup> STUDENT CONFERENCE
- E3 35<sup>TH</sup> IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS
- E4 56<sup>TH</sup> IAA HISTORY OF ASTRONAUTICS SYMPOSIUM
- E5 33<sup>RD</sup> IAA SYMPOSIUM ON SPACE AND SOCIETY
- E6 IAF BUSINESS INNOVATION SYMPOSIUM
- E7 IISL COLLOQUIUM ON THE LAW OF OUTER SPACE
- E8 IAA MULTILINGUAL ASTRONAUTICAL TERMINOLOGY SYMPOSIUM
- E9 IAF SYMPOSIUM ON SECURITY, STABILITY AND SUSTAINABILITY OF SPACE ACTIVITIES
- E10 IAF SYMPOSIUM ON PLANETARY DEFENSE AND NEAR-EARTH OBJECTS

Category coordinated by Lyn Wigbels, *American Astronautical Society (AAS) – UNITED STATES*

#### E1

##### IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM

This symposium, organized by the International Astronautical Federation (IAF) Space Education and Outreach Committee (SEOC), explores best practices and innovative approaches to space education at all levels. Through its 10 sessions, the symposium showcases activities, methods and techniques for education, outreach to the general public, and workforce development. The symposium keynotes, including the one by the winner of the IAF Frank J. Malina Astronautics Medal, highlight some of the best education and outreach programs from around the world. When submitting abstracts for this symposium, please note that: Abstracts should present a coherent story or idea, and follow a logical sequence. The work should be the original work of the authors. It should share information that is innovative and new or put a new spin on an old subject. The novelty can be in idea, methodology and approach, or in results and recommendations. Papers should have clear education or outreach content. They should also be in the scope of the session they are submitted to. Authors are encouraged to clearly identify target groups, benefits, lessons-learned, recommendations and include measures of critical assessment. Only providing technical details of projects, even if carried out in an educational context, will not usually qualify. Preference is given to papers which present the pedagogical theories behind the work presented. Papers reporting on programmes/activities that have already taken place will be given preference over papers dealing with concepts and plans for the future. Papers covering topics/activities which have been reported at a prior IAC must state this explicitly and detail both the additional information to be presented and the added value that this represents.

##### Coordinators

|   |   |
|---|---|
| <b>Jessica Culler</b><br><i>NASA Ames Research Center — UNITED STATES</i> | <b>Seyed Ali Nasser</b><br><i>Space Generation Advisory Council (SGAC) — CANADA</i> |
|---|---|

#### E1.1

##### Ignition - Primary Space Education

This session will explore innovative programs focusing on space education and outreach to students up to the age of 11. Emphasis will be placed on programs that effectively engage primary school students in Science, Technology, Engineering, Arts and Mathematics (STEAM), help them develop key skills, and foster a long-term passion for space. This session will also consider programs and activities that focus on the professional development of primary school teachers, or on educational methodologies of relevance to primary education. When submitting abstracts for this session, please: Clearly identify the connection to primary education/outreach and to space. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

##### Co-Chairs

|   |   |
|---|---|
| <b>Kaori Sasaki</b><br><i>Japan Aerospace Exploration Agency (JAXA) — JAPAN</i> | <b>Carol Carnett</b><br><i>International Space University (ISU) — UNITED STATES</i> |
|---|---|

##### Rapporteurs

|  |  |
|--|--|
| <b>Christopher Vasko</b><br><i>European Space Agency (ESA) — THE NETHERLANDS</i> | <b>Matteo Emanuelli</b><br><i>Airbus Defence and Space — GERMANY</i> |
|--|--|

#### E1.2

##### Lift Off - Secondary Space Education

This session will explore innovative programs focusing on space education and outreach to students aged 11 to 18. Emphasis will be placed on programs that effectively engage secondary school students in Science, Technology, Engineering, Arts and Math (STEAM), help them develop key skills, and foster a long-term passion for space. This session will also consider programs and activities that focus on the professional development of secondary school teachers, or on educational methodologies of relevance to secondary education. When submitting abstracts for this session, please: Clearly identify the connection to secondary education/outreach and to space activities. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

##### Co-Chairs

|   |  |
|---|--|
| <b>Seyed Ali Nasser</b><br><i>Space Generation Advisory Council (SGAC) — CANADA</i> | <b>Christopher Vasko</b><br><i>European Space Agency (ESA) — THE NETHERLANDS</i> |
|---|--|

#### E1.3

##### On Track - Undergraduate Space Education

This session will explore innovative space education and outreach programs dedicated to undergraduate students. This can include the development and delivery of innovative courses, project-based work, and work placements. Emphasis should be placed on how the program is structured for maximum impact, how the impact is measured and how the lessons learned are being applied to other courses. This session will also consider programs and activities that focus on the professional development of undergraduate educators, or on educational methodologies of relevance to undergraduate education. When submitting abstracts for this session, please: Clearly identify the connection to undergraduate space education. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

##### Co-Chairs

|  |   |
|--|---|
| <b>Hubert Diez</b><br><i>CNES — FRANCE</i> | <b>Camille Alleyne</b><br><i>NASA — UNITED STATES</i> |
|--|---|

##### Rapporteurs

|  |  |
|--|--|
| <b>Michal Kunes</b><br><i>— CZECH REPUBLIC</i> | <b>Ozan Kara</b><br><i>Space Generation Advisory Council (SGAC) — TURKEY</i> |
|--|--|

#### E1.4

##### In Orbit - Postgraduate Space Education

This session will explore innovative space education and outreach programs for postgraduate students. This can include the development and delivery of innovative courses, project-based work, and work placements. Emphasis should be placed on how the program is structured for maximum impact, how the impact is measured and how the lessons learned are being applied to other courses. This session will also consider programs and activities that focus on the professional development of postgraduate educators, or on educational methodologies of relevance to postgraduate education. When submitting abstracts for this session, please: Clearly identify the connection to postgraduate space education. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

##### Co-Chairs

|   |   |
|---|---|
| <b>David B. Spencer</b><br><i>The Aerospace Corporation — UNITED STATES</i> | <b>Camille Alleyne</b><br><i>NASA — UNITED STATES</i> |
|---|---|

##### Rapporteurs

|   |   |
|---|---|
| <b>Carol Carnett</b><br><i>International Space University (ISU) — UNITED STATES</i> | <b>Remco Timmermans</b><br><i>International Space University (ISU) — UNITED KINGDOM</i> |
|---|---|

#### E1.5

##### Enabling the Future - Developing the Space Workforce

This session will focus on the challenges, opportunities and innovative approaches to developing the current and future global space workforce. The work presented in this session may include but is not limited to: formal professional development and accreditation programs, professional development activities by companies, nonprofits and other actors, When submitting abstracts for this symposium, please: Clearly identify the connection to space workforce development. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

##### Co-Chairs

|   |  |
|---|--|
| <b>Kathleen Coderre</b><br><i>Lockheed Martin (Space Systems Company) — UNITED STATES</i> | <b>Olga Zhdanovich</b><br><i>Modis — THE NETHERLANDS</i> |
|---|--|

##### Rapporteurs

|  |  |
|--|--|
| <b>Michal Kunes</b><br><i>— CZECH REPUBLIC</i> | <b>Hubert Diez</b><br><i>CNES — FRANCE</i> |
|--|--|

#### E1.6

##### Calling Planet Earth - Space Outreach to the General Public

This session will focus on activities, programs and strategies for engaging the general public in space activities, and outside the formal education system. When submitting abstracts for this symposium, please: Provide context describing the research and/or analysis you conducted when choosing the purpose of the activity, targeting an audience, and designing the activity. Clearly state the goal of the activity, the intended audience, the measurable objectives that were set, and if the activity is in planning or has already occurred. Provide a short but clear description of the activity or the programme. Include information about anything that makes the activity unique, original or innovative. Provide information about how your participants/audience were drawn to the activity (e.g., how it was promoted or disseminated). Set up the analysis you'll provide in your presentation, which should include results and evaluation of the activity, if it has been completed, or a thorough description of the expected outcomes of the activity. You will be expected to assess results against your measurable objectives that indicate if your goal was met. Include your top-level lessons learned, best practices, recommendations for future activities, practical applicability of theoretical work, or other takeaway findings.

##### Co-Chairs

|   |   |
|---|---|
| <b>Jessica Culler</b><br><i>NASA Ames Research Center — UNITED STATES</i> | <b>Nelly Ben Hayoun</b><br><i>SETI Institute — UNITED KINGDOM</i> |
|---|---|

##### Rapporteurs

|   |   |
|---|---|
| <b>Remco Timmermans</b><br><i>International Space University (ISU) — UNITED KINGDOM</i> | <b>Frank Friedlaender</b><br><i>Lockheed Martin Space Systems Company — UNITED STATES</i> |
|---|---|

#### E1.7

##### New Worlds - Non-Traditional Space Education and Outreach

This session will focus on novel and non-standard methods of space education and outreach in non-traditional areas and to non-traditional target groups. When submitting abstracts for this symposium, please: Provide context describing the research and/or analysis you conducted when choosing the purpose of the activity, targeting an audience, and designing the activity. Clearly state the goal of the activity, the intended audience, the measurable objectives that were set, and if the activity is in planning or has already occurred. Provide a short but clear description of the activity or the programme. Ensure that you are familiar with common outreach techniques and programmes, and include information about what makes your activity distinctly unique, original, or innovative. Provide information about how your participants/audience were drawn to the activity (e.g., how it was promoted or disseminated). Set up the analysis you'll provide in your presentation, which should include results and evaluation of the activity, if it has been completed, or a thorough description of the expected outcomes of the activity. You will be expected to assess results against your measurable objectives that indicate if your goal was met. Include your top-level lessons learned, best practices, recommendations for future activities, practical applicability of theoretical work, or other takeaway findings.

##### Co-Chairs

|  |  |
|--|--|
| <b>Victoria Mayorova</b><br><i>Bauman Moscow State Technical University — RUSSIAN FEDERATION</i> | <b>Olga Zhdanovich</b><br><i>Modis — THE NETHERLANDS</i> |
|--|--|

##### Rapporteurs

|  |  |
|--|--|
| <b>Carol Christian</b><br><i>STScI — UNITED STATES</i> | <b>Kaori Sasaki</b><br><i>JAXA — JAPAN</i> |
|--|--|

#### 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 diverse learners. This session will demonstrate and share effective hands-on activities and experiments to explore, teach and reinforce space-related concepts. During the session, presenters will not only present the ideas behind the activity, but also demonstrate it hands-on at the IAC. When submitting abstracts for this symposium, please: Clearly identify the hands-on nature of the work presented, and its space connection. Provide context describing the research and/or analysis you conducted when choosing the purpose of the activity, targeting an audience, and designing the activity. Clearly state the goal of the activity, the intended audience, the measurable objectives that were set, and if the activity is in planning or has already occurred. Provide a short but clear description of the activity or the programme. Ensure that you are familiar with common outreach techniques and programmes, and include information about what makes your activity distinctly unique, original, or innovative. Provide information about how your participants/audience were drawn to the activity (e.g., how it was promoted or disseminated). Set up the analysis you'll provide in your presentation, which should include results and evaluation of the activity, if it has been completed, or a thorough description of the expected outcomes of the activity. You will be expected to assess results against your measurable objectives that indicate if your goal was met. Include your top-level lessons learned, best practices, recommendations for future activities, practical applicability of theoretical work, or other takeaway findings.

##### Co-Chairs

|   |  |
|---|--|
| <b>Lyn Wigbels</b><br><i>American Astronautical Society (AAS) — UNITED STATES</i> | <b>Valerie Anne Casasanto</b><br><i>NASA Goddard/University of Maryland, Baltimore County (UMBC) — UNITED STATES</i> |
|---|--|

## Rapporteurs

**Carol Carnett**  
International Space University (ISU) — UNITED STATES

**Kevin Stube**  
The Planetary Society — UNITED STATES

## E1.9

### Space Culture – Public Engagement in Space through Culture

This session will focus on the education and outreach activities of institutions such as museums, space agencies and non-profit organizations, which link space education with culture. When submitting abstracts for this symposium, please: Clearly identify both the educational and cultural aspects of the work presented, and its connection to space activities. Provide a short but clear description of the activity or the program. Include some information about the unique, original or innovative nature of your activity or program. Include lessons learned, recommendations or other takeaway 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 narrative. Include reference to data gathered through evaluations, surveys or other means, if applicable.

#### Co-Chairs

**Nelly Ben Hayoun**  
SETI Institute — UNITED KINGDOM

**Mike Garrett**  
University of Manchester — UNITED KINGDOM

## Rapporteurs

**Carol Oliver**  
University of New South Wales — AUSTRALIA

**Nahum Romero**  
KOSMICA — GERMANY

## E1.IP

### Interactive Presentations - IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM

This session offers a unique opportunity to share your education and outreach activities through an interactive presentation on any of the subjects of the symposium. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated exclusively for the attendees to view the Interactive Presentations presented by the authors. Authors will be assigned a ten-minute slot to present the topic and interact with the attendees present. The Interactive Presentation may take advantage of digital capabilities, including Powerpoints, embedded hyperlinks, pictures, audio and video clips. An award will be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. When submitting abstracts for this session, please: Provide context describing the research and/or analysis you conducted when choosing the purpose of the activity, targeting an audience, and designing the activity. Clearly state the goal of the activity, the intended audience, the measurable objectives that were set, and if the activity is in planning or has already occurred. Provide a short but clear description of the activity or the programme. Include information about anything that makes the activity unique, original or innovative. Provide information about how your participants/audience were drawn to the activity (e.g., how it was promoted or disseminated). Set up the analysis you'll provide in your presentation, which should include results and evaluation of the activity, if it has been completed, or a thorough description of the expected outcomes of the activity. You will be expected to assess results against your measurable objectives that indicate if your goal was met. Include your top-level lessons learned, best practices, recommendations for future activities, practical applicability of theoretical work, or other takeaway findings.

#### Co-Chairs

**Kevin Stube**  
The Planetary Society — UNITED STATES

**Jessica Culler**  
NASA Ames Research Center — UNITED STATES

## E2

### 51<sup>ST</sup> STUDENT CONFERENCE

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

#### Coordinators

**Franco Bernelli-Zazzera**  
Politecnico di Milano — ITALY

**Marco Schmidt**  
University of Applied Sciences Würzburg-Schweinfurt — GERMANY

## E2.1

### Student Conference – Part 1

Undergraduate and graduate level students (no more than 28 years of age) present technical papers on any project in space sciences, industry or technology. These papers will represent the specific work of the author(s) (no more than two students). The students presenting in this session will compete in the 51st International Student Competition. This session is NOT for team projects. Team project papers should be submitted to session E2.3. To accommodate for the different national education schemes, the distinction between undergraduate and graduate students is based uniquely upon the number of years of university education, as follows: - undergraduate students: students who did their work within the 4th year at university level, for instance a Bachelor thesis. - graduate students: students who did their work from the 5th year at university level, for instance a Master thesis. If appropriate, faculty members that advised students during the preparation of their work can be listed as a co-author (never as a first author) and their status of advisors must be clearly indicated. Principle responsibilities for a submitted student conference paper fall with the student author/s and as such they must be listed first. The content of the paper should mainly reflect the contribution of the student. Faculty co-authors cannot present the paper or answer questions at the student conferences. The selection of the oral presentations is solely based on the submitted abstracts. We strongly recommend that you submit an abstract with an extensive description of your topic, including a detailed explanation of your contribution and the novelty of your work. French, German, US, UK and Canadian students submitting abstracts for the sessions E2.1 and E2.2 will be forwarded to the corresponding national competition coordinators. The following contact persons are available for more information: For the French national competition: Emmanuel Zenou – emmanuel.zenou@isae-supaero.fr For the German national competition: Marco Schmidt – marco.schmidt@uni-wuerzburg.de For the US national competition: - Michael Lagana - MichaelL@aiaa.org For the UK national competition: Vix Southgate - iac\_comp@bis-space.com For the Canadian sponsoring program, please check the CSA website <http://www.asc-csa.gc.ca/> Paper accepted for the competition and the presentations will be evaluated along the following criteria: Technical Content, Originality, Practical Application, General Presentation, Knowledge of the Subject.

#### Co-Chairs

**Franco Bernelli-Zazzera**  
Politecnico di Milano — ITALY

**Emmanuel Zenou**  
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) — FRANCE

#### Rapporteur

**Jeong-Won Lee**  
Korea Aerospace Research Institute (KARI) — KOREA, REPUBLIC OF

## E2.2

### Student Conference – Part 2

Undergraduate and graduate level students (no more than 28 years of age) present technical papers on any project in space sciences, industry or technology. These papers will represent the specific work of the author(s) (no more than two students). The students presenting in this session will compete in the 51st International Student Competition. This session is NOT for team projects. Team project papers should be submitted to session E2.3. To accommodate for the different national education schemes, the distinction between undergraduate and graduate students is based uniquely upon the number of years of university education, as follows: - undergraduate students: students who did their work within the 4th year at university level, for instance a Bachelor thesis. - graduate students: students who did their work from the 5th year at university level, for instance a Master thesis. If appropriate, faculty members that advised students during the preparation of their work can be listed as a co-author (never as a first author) and their status of advisors must be clearly indicated. Principle responsibilities for a submitted student conference paper fall with the student author/s and as such they must be listed first. The content of the paper should mainly reflect the contribution of the student. Faculty co-authors cannot present the paper or answer questions at the student conferences. The selection of the oral presentations is solely based on the submitted abstracts. We strongly recommend that you submit an abstract with an extensive description of your topic, including a detailed explanation of your contribution and the novelty of your work. French, German, US, UK and Canadian students submitting abstracts for the sessions E2.1 and E2.2 will be forwarded to the corresponding national competition coordinators. The following contact persons are available for more information: For the French national competition: Emmanuel Zenou – emmanuel.zenou@isae-supaero.fr For the German national competition: Marco Schmidt – marco.schmidt@uni-wuerzburg.de For the US national competition: - Michael Lagana - MichaelL@aiaa.org For the UK national competition: Vix Southgate - iac\_comp@bis-space.com For the Canadian sponsoring program, please check the CSA website <http://www.asc-csa.gc.ca/> Paper accepted for the competition and the presentations will be evaluated along the following criteria: Technical Content, Originality, Practical Application, General Presentation, Knowledge of the Subject.

#### Co-Chairs

**Marco Schmidt**  
University of Applied Sciences Würzburg-Schweinfurt — GERMANY

**Frank Friedlaender**  
Lockheed Martin Space Systems Company — UNITED STATES

#### Rapporteur

**Emmanuel Zenou**  
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) — FRANCE

## E2.3

### GTS.4

### Student Team Competition

Undergraduate and graduate level student teams (students no more than 28 years of age) present papers on any subject related to space sciences, industry or technology. These papers will represent the work of the authors (three or more students). Students presenting in this session will compete for the Hans von Muldau Team Award. If appropriate, faculty members that advised students during the preparation of their work can be listed as a co-author (never as a first author) and their status of advisors must be clearly indicated. Principle responsibilities for a submitted student conference paper fall with the student authors and as such they must be listed first. The content of the paper should mainly reflect the contribution of the students. Faculty co-authors cannot present the paper or answer questions at the student conferences. The selection of the oral presentations is solely based on the submitted abstracts. We strongly recommend that you submit an abstract with an extensive description of your topic, including a detailed explanation of your contribution and the novelty of your work. Furthermore, a short description how your team worked together to achieve the project goal should be included. Paper accepted for the competition and the presentations will be evaluated along the following criteria: Technical Content, Originality, Practical Application, General Presentation, Knowledge of the Subject.

#### Co-Chairs

**Emmanuel Zenou**  
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) — FRANCE

**Franco Bernelli-Zazzera**  
Politecnico di Milano — ITALY

#### Rapporteur

**Kathleen Coderre**  
Lockheed Martin (Space Systems Company) — UNITED STATES

## E2.4

### Educational Pico and Nano Satellites

Joint session with SUAC. The session covers all aspects related to educational small satellites.

#### Co-Chairs

**Xiaozhou Yu**  
Dalian University of Technology (DUT) — CHINA

**Franco Bernelli-Zazzera**  
Politecnico di Milano — ITALY

## E3

### 36<sup>TH</sup> IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS

This Symposium, organized by the International Academy of Astronautics (IAA), 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 also integrates the IAA/IISL Scientific-Legal Roundtable.

#### Coordinators

**Jacques Masson**  
European Space Agency (ESA) — THE NETHERLANDS

**Bernard Schmidt-Tedd**  
Leuphana University — GERMANY

**Pieter Van Beekhuizen**  
— THE NETHERLANDS

## E3.1

### International Cooperation in using Space for Sustainable Development: Towards a "Space2030" Agenda

As the societal benefits of space technologies and applications are growing, the international community has increasingly shifted its attention to their contributions to the global agendas on sustainability and development, in particular the Sustainable Development Goals (SDGs). In this regard, the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) has decided to develop a "Space2030" agenda and its implementation plan. This session provides the opportunity to discuss the agenda as finalized at COPUOS 2021, its implementation, especially how international cooperation in space activities can contribute to these objectives.

#### Co-Chairs

**Isabelle Duvaux-Bechon**  
European Space Agency (ESA) — FRANCE

**Dumitru-Dorin Prunariu**  
Commission d'Astronautique de l'Académie Roumaine — ROMANIA

#### Rapporteurs

**Alexander Soucek**  
Austrian Space Forum — AUSTRIA

**Peter Stubbe**  
DLR (German Aerospace Center) — GERMANY

## E3.2

### The Future of Space Exploration and Innovation

Technological innovation, new policies and initiatives have allowed public and private actors to once again focus their energy on both human and robotic space exploration ventures. Established and new players are preparing new missions and initiatives to different destinations be it Low Earth orbits, Moon or Mars. This session provides an opportunity to discuss the changing space exploration context and current opportunities and challenges opportunities for future space activities in this domain.

#### Co-Chairs

**Marc Haese**  
DLR, German Aerospace Center — GERMANY

**Nicolas Peter**  
International Space University (ISU) — FRANCE

#### Rapporteurs

**Devanshu Ganatra**  
International Institute of Space Law (IISL) — UNITED STATES

**Anmol Dhawan**  
International Institute of Space Law (IISL) — INDIA

## E3.3

### Space Economy Session – A Focus on In-space Operations and their Potential to Stimulate Economic Development

Over the past few years a number of national space agencies have issued policy, strategic, and implementation plans for in-space activities that are likely to have significant economic impact. These activities include satellite servicing, other rendezvous and proximity operations, and assembly/manufacturing of components. Also in recent years, market segments are emerging for products and services delivered to in-orbit locations as well as to cis-lunar and deeper space destinations. Priority in this session will be given to papers that focus on the economic analysis of these new and emerging market segments and on the impacts they will have in stimulating broader economic developments in space and on the Earth. Papers dealing with the space economy at large, and with overall economic impacts of space activities are still considered within the scope of this session and will also be given consideration for presentation.

#### Co-Chairs

**Pieter Van Beekhuizen**  
— THE NETHERLANDS

**Henry Hertzfeld**  
Space Policy Institute, George Washington University — UNITED STATES

#### Rapporteurs

**Luigi Scatteia**  
PricewaterhouseCoopers Advisory (PwC) — FRANCE

**Bhavya Lal**  
National Aeronautics and Space Administration (NASA) — UNITED STATES

## E3.4

### Assuring a Safe, Secure and Sustainable Space Environment for Space Activities

Space Activities provide a wealth of increasing benefits for people on Earth. However, space actors have come to realize that the benefits of the space infrastructure for the world community depend on technical, legal, policy and political means to keep a safe, secure and sustainable space environment. This session will explore the progress being made within multilateral fora, the private sector and individual countries in supporting the goal of a safe, secure and sustainable space environment. It will focus on the LTS follow-up process at UNCOPUOS, the Guidelines agreed upon, new initiatives for STM and the way forward.

#### Co-Chairs

**Peter Stubbe**  
German Aerospace Center (DLR) — GERMANY

**Jana Robinson**  
The Prague Security Studies Institute — CZECH REPUBLIC

#### Rapporteur

**Gina Petrovici**  
German Aerospace Center (DLR) — GERMANY



E3.5  
E7.6

### 37<sup>th</sup> IAA/IISL Scientific Legal Roundtable: “Space Launch from Celestial Bodies: Technology, Law and Policy”

Space launches from Earth have long been the defining technical and legal qualification for states and other entities desiring to engage in the exploration and utilization of the outer space region. Representing a hard-won scientific and technological achievement, space launches are also the basis for assigning legal jurisdiction, supervision, and liability to the launching state under the five foundational outer space treaties. Rapidly growing numbers of non-governmental commercial space companies and facilities are soon moving space launch operations to the Moon and other celestial bodies, augmenting and in some cases replacing governmental space launch entities. Prospects for an extensive expansion of deep space explorations on the Moon, asteroids, and planets will include a greatly diversified range of space launch technologies and regulatory regimes. Space exploration will require both crewed and uncrewed launches, while sample return missions from asteroids, planets, and their moons will also feature dynamically evolving technologies as well as concerns for contamination and environmental protection. This 37th Joint IAA IISL Roundtable will examine the scientific, technical, legal, and regulatory aspects of space launches from celestial bodies.

#### Co-Chairs

**Junichiro Kawaguchi**  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

**Melissa Kemper Force**  
*Spaceport America — UNITED STATES*

#### Rapporteurs

**Nicola Rohner-Willsch**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**Ivan Fino**  
*Italian National Research Council (CNR) — ITALY*

E3.6

### Cost and Procurement Impacts on Space Programmes Linked to High Inflation and World-wide Scarcity of Components and Materials

From the first half of 2021, the world-wide overall production and supply chain has been affected by a marked scarcity of electronic components, affecting several sectors including Space. Additionally, the period has been marked by a high inflationary trend which is now increasing rapidly, following the world crisis due to COVID and the geopolitical tensions. In this context, the role of countries/companies in space technology supply chains and space related services in Europe severely affected -directly or indirectly- by the economic/politic crisis could lead to acute challenges for Space Programmes for several years to come. The purpose of this technical session is to identify specifically the impacts on costs and on the procurement process of Space Programmes linked to high inflation and world-wide scarcity of components and materials, and to exchange on measures taken and additional ways forwards from Industry and Public Procurement Organizations perspectives, as well as to exchange on how these problems are addressed in the full commercial sector by customers and suppliers.

#### Co-Chairs

**Christine Klein**  
*European Space Agency (ESA) — FRANCE*

**Henry Hertzfeld**  
*Space Policy Institute, George Washington University — UNITED STATES*

#### Rapporteurs

**Karina Miranda Sanchez**  
*ESA — THE NETHERLANDS*

**Raphaëlle Leglise**  
*ESA — SPAIN*

E3.IP

### Interactive Presentations - 36<sup>th</sup> IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS

Authors with an abstract accepted for an interactive presentation will be asked 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 must be near plasma screens to engage in interactive discussions with other congress attendees.

#### Co-Chairs

**Jacques Masson**  
*European Space Agency (ESA) — THE NETHERLANDS*

**Bernhard Schmidt-Tedd**  
*Leuphana University — GERMANY*

E4

### 57<sup>th</sup> IAA HISTORY OF ASTRONAUTICS SYMPOSIUM

The symposium covers the entire spectrum of space history, at least 25 years old. History of space science, technology & development, rocketry, human spaceflight and personal memoirs are included. This year a special focus is laid on the origin (technical & political, science and social aspects) of the national Western Asian space activities & programs.

#### Coordinators

**A. Ingemar Skoog**  
*— GERMANY*

**Tal Inbar**  
*— ISRAEL*

**Otfrid G. Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

**Sandra Haeuplik-Meusburger**  
*TU Wien — AUSTRIA*

E4.1

### Memoirs & Organizational Histories

Autobiographical & biographical memoirs of individuals who have made original contributions to the development & application of astronautics & rocketry. History of government, agencies, industrial, academic & professional societies & organisations long engaged in astronautical endeavors. This will include the entire spectrum of space history, at least 25 years old.

#### Co-Chairs

**Kerrie Dougherty**  
*— AUSTRALIA*

**Niklas Reinke**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

#### Rapporteurs

**Stephen Doyle**  
*International Institute of Space Law (IISL) — UNITED STATES*

**Philippe Cosyn**  
*— BELGIUM*

E4.2

### Scientific and Technical Histories

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

#### Co-Chairs

**Vera Pinto Gomes**  
*European Commission — BELGIUM*

**Randy Liebermann**  
*— UNITED STATES*

#### Rapporteurs

**Hannes Mayer**  
*Karl Franzens Universität Graz — AUSTRIA*

**Sandra Haeuplik-Meusburger**  
*TU Wien — AUSTRIA*

E4.3

### History of Western Asia Contribution to Astronautics

Origin (technical & political, science and social aspects) of the national Western Asian space activities & programs. This will include the entire spectrum of space history, at least 25 years old. A focus on the last 40 years is preferred. Western Asia is defined by: [https://en.wikipedia.org/wiki/Western\\_Asia](https://en.wikipedia.org/wiki/Western_Asia)

#### Co-Chair

**Otfrid G. Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

E4.IP

#### Rapporteurs

**Nathalie Tinjod**  
*European Space Agency (ESA) — FRANCE*

**Kerrie Dougherty**  
*— AUSTRALIA*

**Piero Messina**  
*European Space Agency (ESA) — FRANCE*

### Interactive Presentations - 57<sup>th</sup> IAA HISTORY OF ASTRONAUTICS SYMPOSIUM

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of the history of astronautics addressed in the classic Sessions. The IP session is not restricted to any specific topic related to space law and invites authors to contribute presentations on any interesting, relevant and current space law issues. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

#### Co-Chair

**Otfrid G. Liepack**  
*National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory — UNITED STATES*

E5

### 34<sup>th</sup> IAA SYMPOSIUM ON SPACE AND SOCIETY

This 34<sup>th</sup> symposium is organized by the International Academy of Astronautics (IAA). Presentations will review the impact and benefits of space activities on the quality of life on Earth and in space. A broad range of topics may be covered including arts and culture, space architecture, and society's expectations from space exploration and research, as well as technology and knowledge transfer.

#### Coordinators

**Geoffrey Langedoc**  
*Canadian Aeronautics & Space Institute (CASI) — CANADA*

**Olga Bannova**  
*University of Houston — UNITED STATES*

E5.1

### Space Architecture: Habitats, Habitability, and Bases

Space Architecture integrates all topics related to designing and building human environments for use in space. The session welcomes papers in three areas: 1) research, design, prototype testing, manufacture, and operation of habitats for space and analog terrestrial environments; 2) how habitats influence human health, psychology, and efficiency, and requirements based on the “human factor”; 3) fabrication and construction of habitable complexes on planetary surfaces or in orbit and 4) human systems integration design implications.

#### Co-Chairs

**Olga Bannova**  
*University of Houston — UNITED STATES*

**Anna Barbara Imhof**  
*Liquifer Systems Group (LSG) — AUSTRIA*

#### Rapporteur

**Anne-Marlene Rüede**  
*Ecole Polytechnique Fédérale de Lausanne (EPFL) — SWITZERLAND*

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 distinct benefits to society from 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 goals, best practices, and associated outcomes of knowledge sharing, technology transfer, and technology commercialization programmes as they relate specifically to societal benefits. Presenters will identify distinctive ways their organizations are promoting the relevance of space R&D to diverse societies. Attendees will develop a broader awareness of how they can also identify and promote the benefits of space R&D in order to influence broader support of space R&D investments. Panel Members are asked to introduce novel practices which: - Increase attendee understanding of how innovations resulting from space R&D have changed, and will continue to change, the world. - Promote productive thinking about optimizing space R&D investments in order to maximize societal benefits. - Increase the understanding of technology transfer policies and practices for both space and non-space utilization. - Demonstrate the correlation and synergies between technology transfer and STEM education for interdisciplinary space careers and technical entrepreneurship. - Measurably demonstrate the impact of innovation derived from space R&D when transferred into new products, services and processes.

#### Co-Chairs

**Olga Bannova**  
*University of Houston — UNITED STATES*

**Nona Minnifield Cheeks**  
*Innovatyr, LLC — UNITED STATES*

#### Rapporteurs

**Anna Barbara Imhof**  
*Liquifer Systems Group (LSG) — AUSTRIA*

**Kerry Leonof**  
*National Aeronautics and Space Administration (NASA), Goddard Space Flight Center — UNITED STATES*

E5.3

### Contemporary Arts Practice and Outer Space: A Multi-Disciplinary Approach

Since the late 1970s a number of artists have been negotiating access to space facilities and organisations, critiquing or making experiential the exploration and utilisation of space, or re-purposing space technology, materials or data independently or in direct exchange with the space sector. Today this important practice is branching into a several directions, ranging from performance, installation, video, or conceptual work situated in space or space analogous environments themselves, to commercial gallery contexts and the realm of participation and public engagement with science. This session addresses the practice of contemporary artists who have developed new ways to appropriate space for their work, the conceptual and practical foundations of their engagement, 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 crossing over the increasingly blurred boundaries of creative practice.

#### Co-Chairs

**Richard Clar**  
*Art Technologies — UNITED STATES*

**Sasha Alexander**  
*Western Sydney University — AUSTRALIA*

#### Rapporteur

**Yuri Tanaka**  
*Tokyo University of the Arts — JAPAN*

E5.4

### Space Assets and Disaster Management

This session will explore the role space assets can play in situations requiring disaster management and emergency response. Papers will discuss how space assets and applications can be brought to bear to assist with situation monitoring and assessment, shortening response times and mitigating impact on affected populations.

#### Co-Chairs

**Geoffrey Langedoc**  
*Canadian Aeronautics & Space Institute (CASI) — CANADA*

**Jillianne Pierce**  
*Space Florida — UNITED STATES*

E5.5

### Sharing Space Achievements and Heritage: Space Museums And Societies

Space societies, professional associations and museums form a special and important group of IAF members - nearly one quarter of the membership and, as a sector, second in size after space industries. They include professional societies, space museums, space associations, non-profit organizations and other organizations interested in space activities. Some have a large membership of 10 000 or more, others can be small; a few are already a century old, others are just being created. They exist in traditional and emerging space nations. Together they champion the interests of an impressive number of individuals and organizations connected to space. Space Museums are the visible face of space for most of the general public. This symposium offers a podium for ideas and proposals to enhance the interaction between the organizations, their members and the Federation. Papers may address proposals to exchange experiences and best practices; sharing articles, exhibitions or educational material; novel ideas to help outreach to the general public, etc. Of particular interest are papers exploring ways to foster communication and collaboration and to develop mutual benefits amongst young societies, representatives of emerging space nations and museums within and outside the IAF family.



**Co-Chairs**  
**Scott Hatton**  
*The British Interplanetary Society — UNITED KINGDOM*  
**Jean-Baptiste Desbois**  
*SEMECCEL Cité de l'Espace — FRANCE*  
**Ines Prieto**  
*SEMECCEL Cité de l'Espace — FRANCE*

**Rapporteur**  
**Clementine Decoopman**  
*Space Generation Advisory Council (SGAC) — AUSTRIA*

**E5.6 Simulating Space Habitation: Habitats, Design and Simulation Missions**  
 This session covers all topics related to preparing for and simulating future space habitats and its associated facilities. This includes lessons learned as well as design proposals for future habitats, either orbital or surface structures. The session especially welcomes papers with an interdisciplinary approach and providing inputs from all fields relevant for future crewed missions, including innovative technologies, interior and design elements, as well as studies related to human factors and social-cultural dynamics of space missions.

**Co-Chairs**  
**Anna Barbara Imhof**  
*Liquifer Systems Group (LSG) — AUSTRIA*  
**Julie Patarin-Jossec**  
*Russian Academy of Sciences — FRANCE*  
**Rapporteur**  
**Sandra Haeuplik-Meusburger**  
*TU Wien — AUSTRIA*

**E5.IP Interactive Presentations - 34<sup>th</sup> IAA SYMPOSIUM ON SPACE AND SOCIETY**  
 This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space and Society addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chairs**  
**Geoffrey Languedoc**  
*Canadian Aeronautics & Space Institute (CASI) — CANADA*  
**Olga Bannova**  
*University of Houston — UNITED STATES*

**E6 IAF BUSINESS INNOVATION SYMPOSIUM**  
 The Business Innovation Symposium, organized by the International Astronautical Federation (IAF), is designed to offer papers that observe, study, analyze, describe, and/or propose any topic related to space activities that have commercial objectives, whether from an academic and/or practitioner perspective.

**Coordinators**  
**Ken Davidian**  
*— UNITED STATES*  
**Nancy C. Wolfson**  
*American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES*

**E6.1 Space Entrepreneurship and Investment: The Practitioners' Perspectives**  
 This session contains a broad spectrum of entrepreneurship, innovation, finance and investment presentations from the practitioner's perspective. Suggested topics suitable for this session can be at any level of analysis, including (from macroscopic to microscopic) the space sector, industries (e.g., propulsion), industry segments (e.g., chemical propulsion), individual firms, a portion of or a group of individuals within a firm, or an individual. Example entrepreneurship and innovation topics suitable for this session include descriptions related to entrepreneurship and innovation such as new market sectors, new businesses, new business plans, new projects, recent experiences of start-up companies. Suitable finance or investment topics apply to large programmes, new firms, the analysis methodologies of markets, or new developments in the finance and investment communities (including angel investors, venture capital organizations, and investment banks).

**Co-Chair**  
**Gary Martin**  
*International Space University — UNITED STATES*  
**Rapporteur**  
**Azam Shaghghi**  
*Space Tourism Society Canada — CANADA*

**E6.2. Public-Private Partnerships: Traditional and New Space Applications**  
 The session brings experts from various space industry segments together to discuss new developments fostering the commercialization of space from the public and private perspectives. This innovative session brings together leaders from the private sector and government agencies to address the general role and new practices to encourage public and private partnerships (PPP). The session also seeks papers on new creative PPP business models in traditional space industry applications (such as satellite-based services involving Earth observation, navigation, and communications). Along with new space industry applications (including space tourism, space-industrialization, space resource utilization-asteroid mining, commercialization of orbital debris and similar activities). This session opens with a 1 hr. OR 1.5 hr. invited keynote speaker and panel of experts for a discussion and Q&A period, and the following 1.5 hr. wraps up with paper presentations. E.g. (he IAF will set the duration time for each session) E6. 2 Part #1 – Either 1 hr. OR 1.5 hr. > (e.g., from 15:00 to 16:30) Panel discussion with private space sector-business-finance and Space Agency speakers. Part #2 – 1.5 hr. > (e.g., from 16:30 to 18:00) for Oral Presentations (about nine authors whose abstracts have been selected)

**Co-Chairs**  
**Ken Davidian**  
*— UNITED STATES*  
**Gary Martin**  
*International Space University — UNITED STATES*  
**John Culton**  
*The University of Adelaide — AUSTRALIA*

**Rapporteurs**  
**Nancy C. Wolfson**  
*American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES*  
**Kevin Stube**  
*The Planetary Society — UNITED STATES*

**E6.3 Innovation: The Academics' Perspectives**  
 This session will contain academic presentations, at any level of analysis, and on any aspect of entrepreneurship, innovation, finance, or investment, organization theory, investment, etc. Variance and phenomenological studies are encouraged. Qualitative, quantitative, or mixed methods approaches are all accepted. Academic domains of interest include strategic management, economics, leadership, innovation management, and all perspectives of organization theory (including organizational economics, cognition and interpretation, power and dependence, technology, learning, complexity and computation, institutions, networks, ecology, and evolution). At a minimum, submissions are expected to be at the level of working papers performed as part of any graduate degree programme (i.e., masters, doctoral, and post-graduate). This work can include theoretical and applied research.

**Co-Chairs**  
**Ken Davidian**  
*— UNITED STATES*  
**George A. Danos**  
*Cyprus Space Exploration Organisation (CSEO) — CYPRUS*  
**Rapporteur**  
**Daria Stepanova**  
*Moscow Institute of Physics and Technology — RUSSIAN FEDERATION*

**E6.4 Strategic Risk Management for Successful Space & Defence Programmes**  
 The space economy has arrived. Today, space is a vital component in spurring innovation and driving the development of state-of-the-art capabilities; Creating vast market opportunities; Accelerating global economic growth; Promoting collaboration; Building the capacity for scientific excellence; and Contributing to our safety and quality of life. By 2030, the space economy is projected to reach 1 trillion dollars. Nevertheless, in the current fraught geopolitical and economic context, it appears that no organization is fully prepared to capitalize on this near-term explosion of growth and avoid a "space hype bubble." There will be extensive new markets, scientific advancements, and human benefits if we can mitigate risks and realize opportunities. Abstracts would be welcome on the following topics:  
 - How are geopolitical and socio-economic changes affecting our risk management practices? What are the major consequences of current and future crises on our risk predictions?  
 - Are we better prepared to foresee the "unpredictable" and grasp opportunities linked to the changing world?  
 - Do we have the right capacity to face such changes in terms of Human resources and other capabilities?

**Co-Chairs**  
**Maria-Gabriella Sarah**  
*European Space Agency (ESA) — FRANCE*  
**Helen Tung**  
*NewSpace2060 — AUSTRALIA*  
**Ruediger Suess**  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

**Rapporteur**  
**Andrew Court**  
*TNO — THE NETHERLANDS*

**E6.5 GTS.1 Entrepreneurship Around the World**  
 Entrepreneurship has different characteristics that differ from country to country around the world. Some of the challenges that entrepreneurs face transcend national and cultural borders, but some others do not. This session welcomes papers and presentations that describe the barriers experienced by real entrepreneurs in their different countries and regions around the world. A summary discussion will identify the commonalities and unique characteristics of nation-specific entrepreneurial barriers as identified by the presenters. This is a technical session co-sponsored by the IAF Entrepreneurship and Investment Committee (EIC) and the IAF Workforce Development/Young Professionals Programme Committee, as part of the Global Technical Sessions – presenters can present in person at the IAC or from their home/work/university location.

**Co-Chairs**  
**Lisa La Bonté**  
*Arab Youth Venture Foundation — UNITED ARAB EMIRATES*  
**George A. Danos**  
*Cyprus Space Exploration Organisation (CSEO) — CYPRUS*  
**Nancy C. Wolfson**  
*American Institute of Aeronautics and Astronautics (AIAA) — UNITED STATES*

**E6.IP Interactive Presentations - IAF BUSINESS INNOVATION SYMPOSIUM**  
 This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Business Innovation addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Co-Chair**  
**Ken Davidian**  
*— UNITED STATES*

**E7 IISL COLLOQUIUM ON THE LAW OF OUTER SPACE**  
 The 2023 IISL 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 cyber, within its scope. The Colloquium looks at current discussions about questions related to the ethics and understanding of what is meant by treaty law terms freedom of exploration and use. It examines how space situational awareness (SSA), space surveillance and tracking (SST) can be integrated as elements within a greater framework for effective space traffic management. It serves as a forum to discuss developments of national space law as a constitutive element of the overall framework of space law enforcing and detailing the principles and general norms of space law, in particular within 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 homogenous approach to licensing at national level. It also provides insights as to how disruptive NewSpace activities can and should be accommodated by space law.

**Coordinators**  
**Lesley Jane Smith**  
*Leuphana University of Lüneburg/Weber-Steinhaus & Smith — GERMANY*  
**Catherine Doldirina**  
*International Institute of Space Law (IISL) — ITALY*  
**Tanja Masson-Zwaan**  
*International Institute of Air and Space Law, Leiden University — THE NETHERLANDS*

**E7.1 Young Scholars Session with Keynote Lecture**  
 This session is open for abstracts and papers from space lawyers under 35 years old. It welcomes contributions on any topics related to space law. It also features a regular, annual keynote presentation by a leading space law expert. Keynote by Prof. Steven Freeland.

**Co-Chairs**  
**Setsuko Aoki**  
*Keio University — JAPAN*  
**Ilgar Abdullayev**  
*Space Agency of Republic of Azerbaijan (Azercosmos) — AZERBAIJAN*

**E7.2 UNCOPUOS and ITU Registration of Large Constellations**  
 UNCOPUOS and ITU are two different international structures with interest in space activities. They have a contrasting history, material scope, and membership. Their diverging working methods manifest themselves in their approach to obtaining information about space objects. Whereas the method of advance publication, coordination and notification of frequency assignments used by radio stations onboard space objects, as well as their recording in the Master International Frequency Register used for decades by the ITU allows to obtain an early information about satellite systems, the 1975 UN Registration Convention elaborated by the UNCOPUOS requires limited information on space objects already launched into outer space. These differences become obvious in recent cases of registration of large constellations. The session invites papers which observe the methods of registration of large constellations, discuss the relation of UNCOPUOS and ITU, and analyze the possibility of their further synergies leading to the enhanced information of the space community about satellite networks and systems.

**Co-Chairs**  
**Tare Brisibe**  
*OnAir — SWITZERLAND*  
**Frans G. Von der Dunk**  
*University of Nebraska, College of Law — THE NETHERLANDS*  
**Rapporteur**  
**Dimitra Stefoudi**  
*Leiden University — THE NETHERLANDS*

**E7.3 Legal Issues Relating to Emerging Space Activities on Celestial Bodies**  
 Plans to engage in activities on the Moon and other celestial bodies are rapidly developing. These range from possible resource exploitation activities all the way to permanent human settlements. Whilst the fascination with life 'off-earth' and the creation of a cis-lunar economy are inspiring many, they also require careful consideration regarding a range of legal issues and will necessitate the development of a clear legal framework to guide the way humanity engages in such activities. Among other issues, this session aims to explore questions about appropriate off-earth governance requirements, the rules that will regulate the interactions between humans living on celestial bodies and the regulation of any in situ resource exploitation and associated activities. This will involve an assessment of the existing legal framework for space as well as a 'gap analysis' as to what areas require further consideration.



**Co-Chairs**  
Alexander Soucek  
*Austrian Space Forum — AUSTRIA*

Jenni Tapio  
*Ministry of Economic Affairs and Employment of Finland — FINLAND*

**Rapporteur**  
Laetitia Zarkan Cesari  
*University of Luxembourg — LUXEMBOURG*

**E7.4 Key Governance Issues in the New Space Age**  
The New Age Space is qualified by new age technologies, applications and the use of space for new age space activities - in and off the Earth's orbit. To consistently ensure safe, sustainable and secure use of outer space for peaceful purpose will become an ever more critical space governance concern. Therefore, given the general uncertainty around concepts like "Benefit and Uses of Outer Space to all Humankind", could we explore New Age Space qua the UN Development Goals 2030 in context to: (i) Role of New Age space technologies – telecommunications/RS&EO/GNSS to extend the benefits of space to developing and least developed countries; (ii) Space Environment Governance; (iii) Long Term Economic Development on Earth; (iv) Global Governance for Space Security and (v) Capacity Building in Global Space Governance

**Co-Chairs**  
Gérardine Goh Escolar  
*Bynkershoek Law Institute — THE NETHERLANDS*

Kuan-Wei Chen  
*Centre for Research of Air and Space Law, Faculty of Law, McGill University — CANADA*

**Rapporteur**  
Antonino Salmeri  
*Open Lunar Foundation — ITALY*

**E7.5 Supervision of Space Activities**  
Corresponding to the important transformation of the space sector there is a growing importance to ensure that outer space remains free for exploration and use, and that all actors uphold the fundamental principles. Hence, the national regulators responsible for the authorization and continuing supervision of national space activities are required to put in place adequate means in place to ensure that the national activities are conducted with due regard to the corresponding interests of other countries. This is also reflected by inclusion of 'supervision' as Guideline A.3 of the LTS Guidelines (the Guidelines for the long-term sustainability of outer space activities adopted by COPUOS in 2019). What should be the role of space situational awareness (SSA) data, or how should various non-legally binding instruments pertaining to space activities be considered in this process?

**Co-Chairs**  
Ulrike M. Bohlmann  
*ESA — FRANCE*

Bernhard Schmidt-Tedd  
*— GERMANY*

**Rapporteur**  
Laetitia Zarkan Cesari  
*University of Luxembourg — LUXEMBOURG*

**E7.6 E3.5 37<sup>th</sup> IAA/IISL Scientific Legal Roundtable: "Space Launch from Celestial Bodies: Technology, Law and Policy"**  
Space launches from Earth have long been the defining technical and legal qualification for states and other entities desiring to engage in the exploration and utilization of the outer space region. Representing a hard-won scientific and technological achievement, space launches are also the basis for assigning legal jurisdiction, supervision, and liability to the launching state under the five foundational outer space treaties. Rapidly growing numbers of non-governmental commercial space companies and facilities are soon moving space launch operations to the Moon and other celestial bodies, augmenting and in some cases replacing governmental space launch entities. Prospects for an extensive expansion of deep space explorations on the Moon, asteroids, and planets will include a greatly diversified range of space launch technologies and regulatory regimes. Space exploration will require both crewed and uncrewed launches, while sample return missions from asteroids, planets, and their moons will also feature dynamically evolving technologies as well as concerns for contamination and environmental protection. This 37<sup>th</sup> Joint IAA IISL Roundtable will examine the scientific, technical, legal, and regulatory aspects of space launches from celestial bodies.

**Co-Chairs**  
Junichiro Kawaguchi  
*Japan Aerospace Exploration Agency (JAXA) — JAPAN*

Melissa Kemper Force  
*Spaceport America — UNITED STATES*

**Rapporteurs**  
Nicola Rohner-Willsch  
*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY*

Ivan Fino  
*Italian National Research Council (CNR) — ITALY*

**E7.7 Recent Developments in Space Law with Particular Focus on Space Debris Remediation**  
The pollution of the most important orbits by space debris belongs to the pressing challenges for the international community. As a consequence a set of non-binding principles on space debris mitigation were drafted and agreed upon. Now the even greater challenge is the elimination of the waste from the orbits. In view of new existing technologies contributions are encouraged that highlight a possible legal framework for space debris remediation. Space debris remediation will be the special focus of this panel that moreover invites other contributions containing recent challenges for space legislation.

**Co-Chairs**  
Peter Stubbe  
*German Aerospace Center (DLR) — GERMANY*

Maria-del-Carmen Muñoz-Rodríguez  
*European Space Agency (ESA) — SPAIN*

**Rapporteur**  
Gina Petrovici  
*German Aerospace Center (DLR) — GERMANY*

**E7.1P Interactive Presentations - IISL COLLOQUIUM ON THE LAW OF OUTER SPACE**  
The IP session is not restricted to any specific topic related to space law and invites authors to contribute presentations on any interesting, relevant and current space law issues.

**Co-Chair**  
Antonino Salmeri  
*Open Lunar Foundation — ITALY*

Gina Petrovici  
*ECSL — GERMANY*

**E8 IAA 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. Terminology is a key issue for a better understanding among people using various languages and dialects. Consecutive or simultaneous translation does not remove the risk of ambiguity during technical meetings and accuracy in terminology is essential during all phases of cooperation. The session will address issues such as standardization of definitions in space science and technology. The specific character of emerging space countries will also be discussed.

**Coordinators**  
Susan McKenna-Lawlor  
*Space Technology (Ireland) Ltd. — IRELAND*

Tetsuo Yoshimitsu  
*Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency — JAPAN*

**E8.1 Multilingual Astronautical Terminology**  
This session, 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. Terminology is a key issue for a better understanding among people using various languages and dialects. Consecutive or simultaneous translation does not remove the risk of ambiguity during technical meetings and accuracy in terminology is essential during all phases of cooperation. The session will address issues such as standardization of definitions in space science and technology. The specific character of emerging space countries will also be discussed.

**Co-Chairs**  
Susan McKenna-Lawlor  
*Space Technology (Ireland) Ltd. — IRELAND*

Tetsuo Yoshimitsu  
*Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency — JAPAN*

**Rapporteur**  
Fabrice Dennemont  
*International Academy of Astronautics (IAA) — FRANCE*

**E9 IAF SYMPOSIUM ON SPACE SECURITY, STABILITY AND SUSTAINABILITY OF SPACE ACTIVITIES**  
This symposium, organized by the International Astronautical Federation (IAF), will address two major issues regarding safe and secure operations of space systems via two separate sessions: i) policy, legal, institutional and economic aspects of space debris detection, mitigation and removal, jointly with the IAA Symposium on Space Debris, and, ii) cyber security threats to space missions and countermeasures to address them, jointly with the IAA Symposium on Safety, Quality and Knowledge Management on Space Activities. Papers dealing with non-technical aspects of space debris mitigation and removal, as well as planetary defence against asteroid impact threats, and case studies focusing on countermeasures needs, including cryptography processes, operational security, supply chain and other aspects relevant to ensure a "cyber secure" mission will be well received in this Symposium.

**Coordinators**  
Serge Plattard  
*University College London (UCL) — UNITED KINGDOM*

Stefano Zatti  
*University of Rome "La Sapienza" — ITALY*

**E9.1 A6.8 Policy, Legal, Institutional, Economic and Security Aspects of Debris Mitigation, Debris Remediation and STM**  
This session will address all non-technical aspects of debris mitigation, debris remediation and STM. Papers may focus on aspects of responsibility, liability and registration, on the role of bodies such as UNCOPUOS or IADC, as well as on insurance, financial incentives and funding. In addition, security-related aspects and the role of international cooperation in addressing these issues may be considered.

**Co-Chairs**  
David Spencer  
*The Aerospace Corporation — UNITED STATES*

Serge Plattard  
*University College London (UCL) — UNITED KINGDOM*

Tanja Masson-Zwaan  
*International Institute of Air and Space Law, Leiden University — THE NETHERLANDS*

**Rapporteurs**  
Andrea Capurso  
*LUIS Guido Carli University — ITALY*

Emma Kerr  
*Deimos Space UK Ltd — UNITED KINGDOM*

Victoria Samson  
*Secure World Foundation — UNITED STATES*

**E9.2 Cyber-based Security Threats to Space Missions: Establishing the Legal, Institutional and Collaborative Framework to Counteract them**

The increasingly pervasive network connectivity following the Internet explosion introduces a whole new families of cyber-security threats to space missions. To send commands to a spacecraft now you would not need to build a ground station, but you can penetrate from your home or office the existing ground infrastructures, bypassing their protection measures, from anywhere in the world. The questions to be addressed in the session will span across the following issues: - What is the interest of cyber-crime and cyber-activism with respect to space activities? - How are aerospace organisations managing the ability to introduce the right level of security measures in the process to plan and develop new missions? - What legal and protection framework is or has to be put in place to enable secure cooperation across corporate and international boundaries? - How is knowledge about security threats captured, shared, and used to follow the evolution of cyber threats? - Which ones of these specific threats are to be expected to target space missions, from the ground and from space? - What is particularly to be expected from the cyber-space to target outer space? Contribution are expected to focus on cyber-specific legislation, best practices, processes, collaboration methods between law enforcement and institutional partners, and any other aspects of the organization of space missions that are all constituting the formal components to keep a mission "cyber secure".

**Co-Chairs**  
Julien Airaud  
*Centre National d'Etudes Spatiales (CNES) — FRANCE*

Stefano Zatti  
*University of Rome "La Sapienza" — ITALY*

**E9.3 Norms and Standards for Safe and Responsible Behaviour in Space**  
The rapid expansion and evolution of the global space arena is characterized by an increasing number and diversity of space actors and the emergence of new kinds of space systems, some of which involve very large constellations of satellites numbering in the thousands to tens of thousands, and also new kinds of space activities, such as on-orbit servicing, refueling, in-orbit assembly and manufacturing, active debris removal, and so on. With increasing congestion in the Earth's orbital environment, these new kinds of space activities raise questions about the safety of space operations, particularly when contingency situations arise (such as conjunctions), or when spacecraft operate in close proximity to each other and there are no clear, widely accepted international standards or norms of behaviour. For this reason, it is important to identify and leverage best practices from government and industry to ensure safety of flight and safe rendezvous and proximity operations of spacecraft. These best practices may subsequently be codified as norms and standards for safe and responsible behaviour in space. This session is intended to be a forum to allow practitioners to discuss and socialize the types of norms, standards and behaviours that would be conducive to the safety of space operations.

**Co-Chairs**  
Peter Martinez  
*— SOUTH AFRICA*

Annamaria Nassisi  
*Thales Alenia Space Italia — Italy*

**E9.IP Interactive Presentations - IAF SYMPOSIUM ON SPACE SECURITY, STABILITY AND SUSTAINABILITY OF SPACE ACTIVITIES**  
This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Space Security addressed in the classic Sessions. The IP session is not restricted to any specific topic related to space law and invites authors to contribute presentations on any interesting, relevant and current space law issues. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Coordinator**  
Serge Plattard  
*University College London (UCL) — UNITED KINGDOM*

**E10 IAF SYMPOSIUM ON PLANETARY DEFENSE AND NEAR-EARTH OBJECTS**  
This symposium, organized by the International Astronautical Federation (IAF), will address all aspects of the hazards associated with the impact of asteroids and comets on Earth and their mitigation. Due to the multidisciplinary nature of planetary defense, the symposium additionally aims to establish joint sessions with other symposiums investigating synergies and lessons learned.

**Coordinators**  
Alex Karl  
*Space Applications Services — BELGIUM*

Alissa J. Haddaji  
*Harvard University — UNITED STATES*

**E10.1 Planetary Defense from Asteroids and Comets**  
This session will address all aspects of the hazards associated with the impact of asteroids and comets on Earth and their mitigation, covering these broad areas of interest:  
1. An overview about the latest developments and mission summaries related to recent, ongoing or upcoming missions with a focus on planetary defense.  
2. Advances in pre-impact determinations and prevention of impacts, such as discovery and characterisation, along with mission & campaign designs to deflect or disrupt a hazardous object.  
3. Advances in preparation for impact, such as impact consequences & disaster management and response coordination on local and international levels.  
4. General considerations such as the influence of legal, social and economic aspects on the decision to act by decision makers, the deflection methods used as well as public education and communication to various audiences  
5. Lessons learned from other missions and endeavours that could benefit planetary defense and vice versa.



**Co-Chairs**

**Daniel Mazanek**  
NASA — UNITED STATES

**Changyin Zhao**  
Purple Mountain Observatory (PMO) — CHINA

**Rapporteurs**

**Alejandro J. Roman Molinas**  
Paraguayan Space Agency — PARAGUAY

**Alex Karl**  
Space Applications Services — BELGIUM

**E10.2**

**Informing Planetary Defense**

This session will address all aspects that contribute towards informing future planetary defense, such as:

1. Results from the first impact deflection test with DART, e.g. results, incl. results from ground based observations regarding the orbital period change, physical characteristics of Didymos and Dimorphos, as well as geology of the impact site, revised numerical modelling of DART impact, as well as Didymos' dynamics based on DART impact.
2. Results from sample return missions on NEO properties as well as expected results from other NEO missions.
3. Legal considerations that would contribute towards the decision to act.
4. Any other transdisciplinary research that enhances our understanding of making better decisions and ensuring successful mitigation of a threat posed by an asteroid or comet impact.

**Co-Chairs**

**Daniel Mazanek**  
NASA — UNITED STATES

**Alissa J. Haddaji**  
Harvard University — UNITED STATES

**Rapporteurs**

**Philipp Maier**  
Institute of Space Systems, University of Stuttgart — GERMANY

**E10.IP**

**Interactive Presentations - IAF SYMPOSIUM ON PLANETARY DEFENSE AND NEAR-EARTH OBJECTS**

This session offers a unique opportunity to deliver your key messages in an interactive presentation on any of the subjects of Planetary Defense and Near-Earth Objects addressed in the classic Sessions. The presentation will be displayed on a digital screen in a dedicated location and available for view by all Congress attendees for the entire Congress week. In addition, one afternoon is dedicated 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 attendees present. The Interactive Presentation may take advantage of all electronic display capabilities, such as: PowerPoint charts, embedded hot links, pictures, audio and video clips etc. An award will also be presented to the author of the best Interactive Presentation in the E Category at a special ceremony. An Abstract that follows the standard format must be submitted by the deadline for standard IAC abstracts.

**Coordinators**

**Alex Karl**  
Space Applications Services — BELGIUM

**Alissa J. Haddaji**  
Harvard University — UNITED STATES

**Co-Chairs**

**Kevin Shortt**  
Airbus Defence & Space — GERMANY

**Stephanie Wan**  
Space Generation Advisory Council (SGAC) — UNITED STATES

**Rapporteur**

**Eric Wille**  
ESA — THE NETHERLANDS

**GTS.4  
E2.3**

**Student Team Competition**

Undergraduate and graduate level student teams present papers on any subject related to space sciences, industry or technology. These papers will represent the work of the authors (three or more students). Students presenting in this session will compete for the Hans von Muldau Team Award. The selection of the oral presentations is solely based on the submitted abstracts. We strongly recommend that you submit an abstract with an extensive description of your topic, including a detailed explanation of your contribution and the novelty of your work. Furthermore, a short description how your team worked together to achieve the project goal should be included. The guidelines for the student competition will be distributed from the session chairs to the authors after abstract acceptance.

**Co-Chairs**

**Emmanuel Zenou**  
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) — FRANCE

**Andrea Jaime**  
Isar Aerospace — GERMANY

**Rapporteur**

**Kathleen Coderre**  
Lockheed Martin (Space Systems Company) — UNITED STATES

**GTS.5  
B4.9**

**Small Satellite Missions Global Technical Session**

The Small Satellite Missions Global Technical Session (GTS) is a collaboration between the International Academy of Astronautics (IAA) Small Satellite Missions Symposium and the International Astronautical Federation (IAF) Workforce Development/Young Professionals Programme Committee. This session is unique in that it allows for sharing of information on a global scale with presenters and audience both at the IAC venue and online at their home/work/university locations. Abstracts are solicited regarding operational missions or mature proposals for small satellite systems and related topics. These must have clear relevance on an international scale or at a business level, and must also provide young professionals a taste of what the space sector has to offer. Where possible, abstracts should have a wide interest in the community and should include transferable knowledge or lessons learned. Abstracts highlighting ingenuity or innovation are preferred. Examples include space missions utilizing small satellites that address specific new societal, scientific or commercial challenges, or novel technologies that have the potential to revolutionize space missions and/or enable their access to space. Papers are to describe the specific need, the small satellite approach that addresses this need, the benefits of this approach and the use of space technology, and demonstrate that other non-space approaches provide inferior solutions. Papers from, or directed at the young professional community are preferred. This session will be accepting submissions for oral presentations only.

**Co-Chairs**

**Matthias Hetscher**  
DLR (German Aerospace Center) — GERMANY

**Norbert M.K. Lemke**  
OHB System AG - Oberpfaffenhofen — GERMANY

**Rapporteurs**

**Alex da Silva Curiel**  
Surrey Satellite Technology Ltd (SSTL) — UNITED KINGDOM

**Victoria Barabash**  
Luleå University of Technology — SWEDEN

**Category**



**GTS. GLOBAL TECHNICAL SYMPOSIUM (GTS)**

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 Workforce Development-Young Professional Programme Committee, these sessions are similar to the conventional technical sessions in terms of abstract selection and paper submissions. However, in addition to the on-site presentation of the technical papers, these sessions 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.

- GTS.1 ENTREPRENEURSHIP AROUND THE WORLD
- GTS.2 HUMAN SPACEFLIGHT GLOBAL TECHNICAL SESSION
- GTS.3 SPACE COMMUNICATIONS AND NAVIGATION GLOBAL TECHNICAL SESSION
- GTS.4 STUDENT TEAM COMPETITION
- GTS.5 SMALL SATELLITE MISSIONS GLOBAL TECHNICAL SESSION

Coordinated by **Stephanie Wan**, Space Generation Advisory Council (SGAC) — UNITED STATES and **Seyed Ali Nasseri**, Space Generation Advisory Council (SGAC) — CANADA

**GTS.1  
E6.5**

**Entrepreneurship Around the World**

Entrepreneurship has different characteristics that differ from country to country around the world. Some of the challenges that entrepreneurs face transcend national and cultural borders, but some others do not. This session welcomes papers and presentations that describe the barriers experienced by real entrepreneurs in their different countries and regions around the world. A summary discussion will identify the commonalities and unique characteristics of nation-specific entrepreneurial barriers as identified by the presenters. This is a technical session co-sponsored by the IAF Entrepreneurship and Investment Committee (EIC) and the IAF Workforce Development/Young Professionals Programme Committee, as part of the Global Technical Sessions — presenters can present in person at the IAC or from their home/work/university location.

**Co-Chairs**

**Juergen Drescher**  
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) — GERMANY

**Lisa La Bonté**  
Arab Youth Venture Foundation — UNITED ARAB EMIRATES

**Gary Martin**  
International Space University — UNITED STATES

**Rapporteur**

**Ken Davidian**  
— UNITED STATES

**GTS.2  
B3.9**

**Human Spaceflight Global Technical Session**

The Human Space Endeavours Global Technical Session is targeting individuals and organizations with the objective of sharing best practices, future projects, research 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**

**Guillaume Girard**  
Zero2infinity — SPAIN

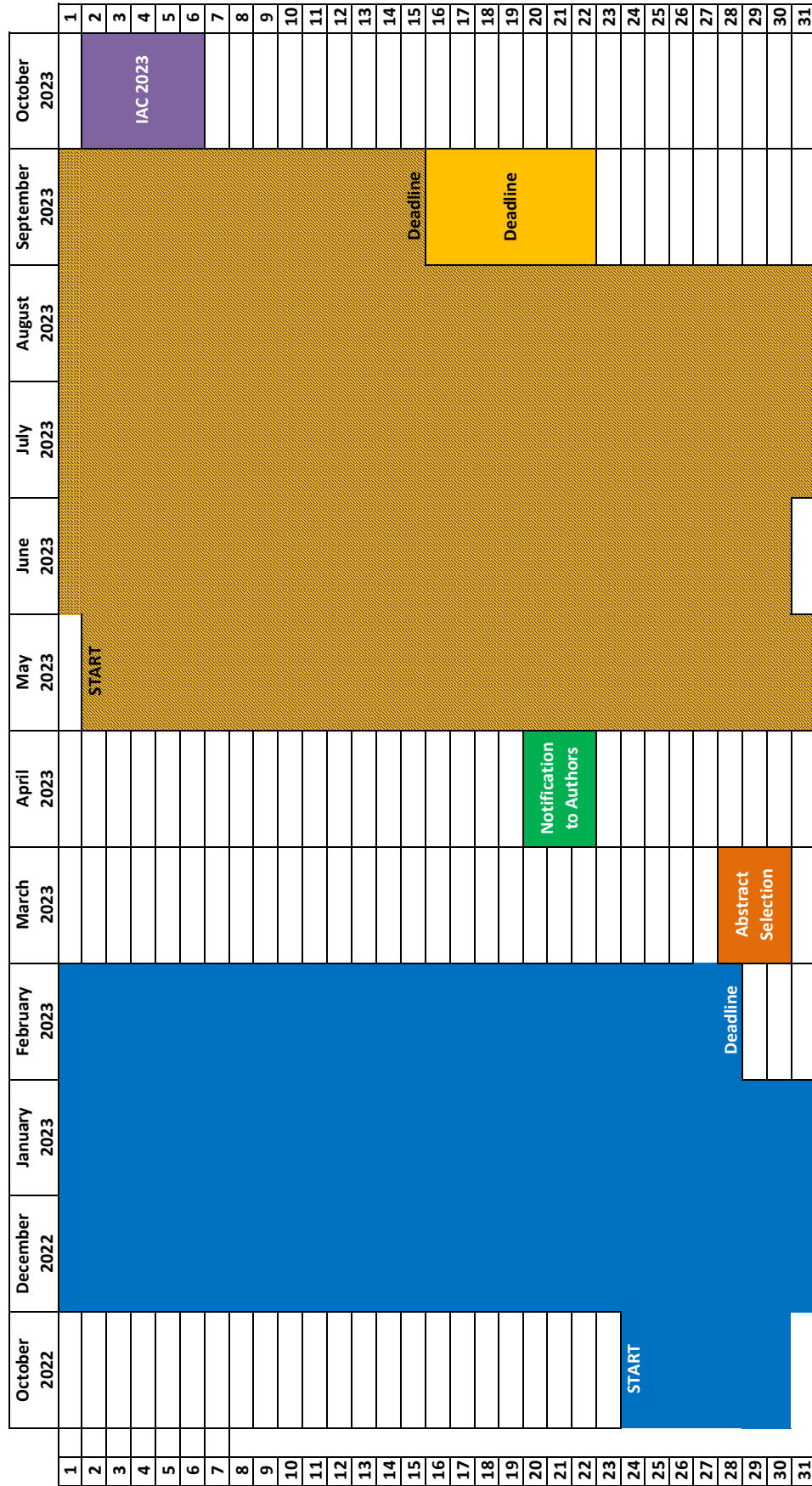
**Andrea Jaime**  
Isar Aerospace — GERMANY

**GTS.3  
B2.8**

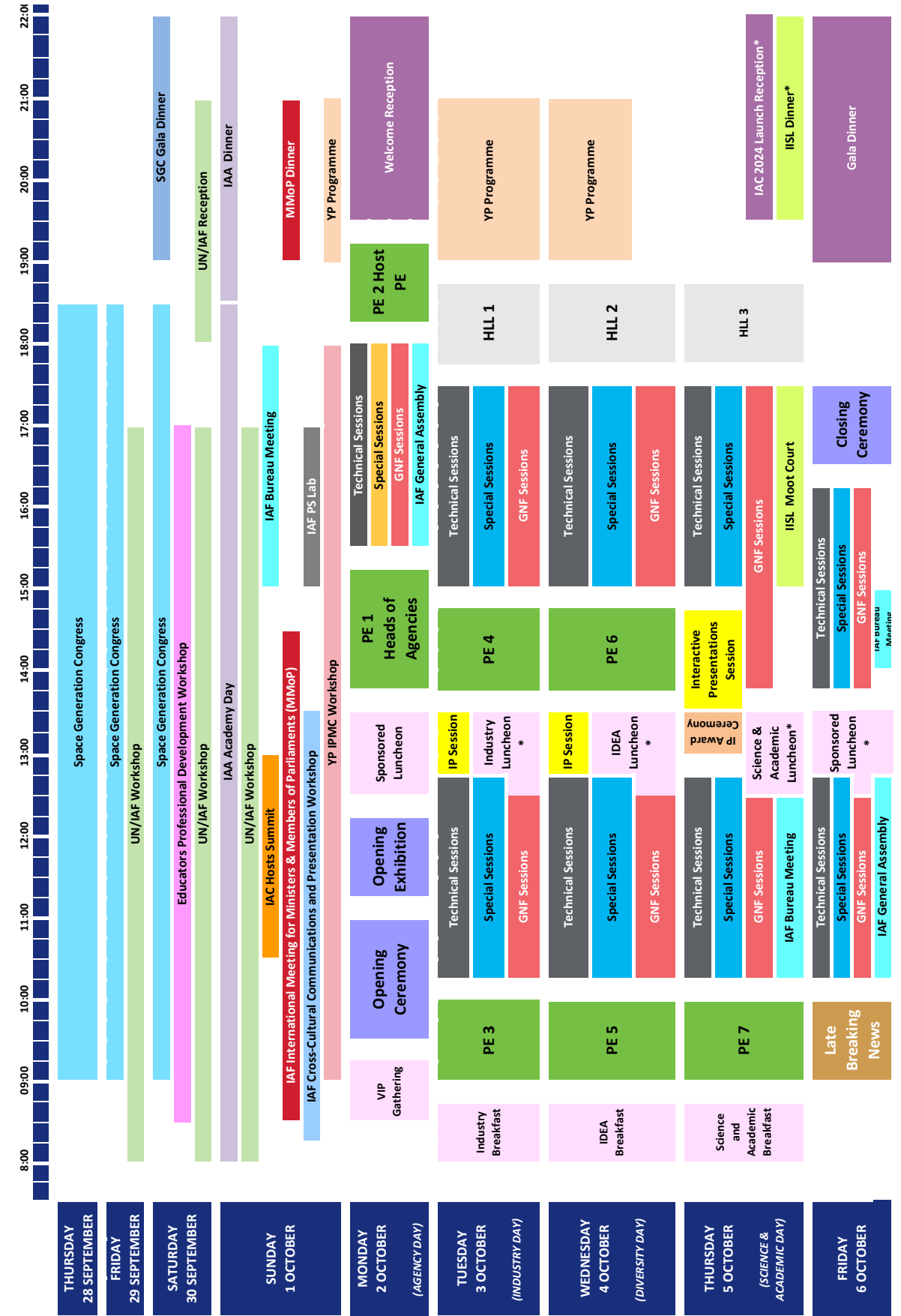
**Space Communications and Navigation Global Technical Session**

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 those for satellite-based position determination, navigation, and timing. Both Earth's orbital and interplanetary space communications topics can be addressed. This session is co-sponsored by the Space Communications and Navigation Committee and the Workforce Development/Young Professionals Programme Committee.

## 11. IAC 2023 Call for Papers Deadlines



## 12. Preliminary IAC 2023 at a Glance



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.
- Abstracts 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/iaf/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 fields.
- Choose your presentation preference: oral presentation only, interactive presentation only, oral or interactive.
- 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 2023 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](http://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 presentation will be asked to prepare slides and display them for the duration of the congress on screens. Authors 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://dl.iafastro.directory/>

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 IISL. Authors who qualify may ask to be considered for the Dr I.H. Ph. Diederiks-Verschoor Award for Best Paper. Please contact the IISL secretary for the regulations at [secretary@iislweb.org](mailto:secretary@iislweb.org).

### DEADLINES

|                                     |                          |
|-------------------------------------|--------------------------|
| Abstract Submission                 | <b>28 February 2023</b>  |
| Interactive Presentation Submission | <b>11 September 2023</b> |
| Paper Submission                    | <b>15 September 2023</b> |
| Oral Presentation Submission        | <b>22 September 2023</b> |

Please make sure to check the IAF website ([www.iafastro.org](http://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](mailto:support@iafastro.org)

Interactive presentations: [ipsupport@iafastro.org](mailto:ipsupport@iafastro.org)



## 14. Space in Azerbaijan: Upholding the Legacy, Shaping the Future

Innovation and aspiration to explore and harness the power of knowledge for the benefit of the world have always been a cross-cutting theme throughout Azerbaijan's space history spanning centuries. The foundation of space exploration in Azerbaijan was laid centuries ago, with people looking up into the sky in pursuit of discovering what the universe has stored away. Let us take a journey down the memory lane and reflect on the main milestones of the emergence and establishment of space industry in Azerbaijan.

1259

The Maragha Observatory, a widely recognized regional scientific hub of the time, was established by Nasraddin Tusi, a prominent Azerbaijani astronomer, scientist, and thinker. He was at the origins of space activities in Azerbaijan by making an immense contribution to the scientific exploration of space through his prolific research in the fields of astronomy and physics.

1959

Named after Tusi, the Shamakhi Astrophysical Observatory, established in 1959, follows through on the significant work in space research and helps to investigate the solar system bodies, study the solar and stellar physics, and solar-terrestrial relations.

1973

A milestone year for Azerbaijan's space industry as the 24<sup>th</sup> International Astronautical Congress under the theme "Space Research: Influence on Science and Technology" was held in Baku, the only city in the region that hosted this prominent event. The event left fundamental legacy for the space industry of Azerbaijan as over succeeding years, space research was highly prioritized, and Azerbaijani scientists and engineers were actively involved in the space program of the USSR.

1987

Musa Manarov, an Azerbaijani astronaut and space engineer, flew into space aboard Soyuz TM-4 crewed spaceship as a flight engineer. Later, in 1990, he participated in his second space mission on Soyuz TM-11.

2010

Azercosmos, the Space Agency of the Republic of Azerbaijan, was founded as the first and only satellite operator in the Caucasus region, becoming the main leading force behind the development of innovative space ecosystem in Azerbaijan.

2013

Azerspace-1 telecommunication satellite – the first-ever satellite of Azerbaijan – was successfully launched into the orbit.

2014

Azersky Earth observation satellite was successfully launched into the orbit.

2018

Azerspace-2 telecommunication satellite was successfully launched into the orbit.

2021

By a Presidential decree, Azercosmos was transformed into the Space Agency of the Republic of Azerbaijan.

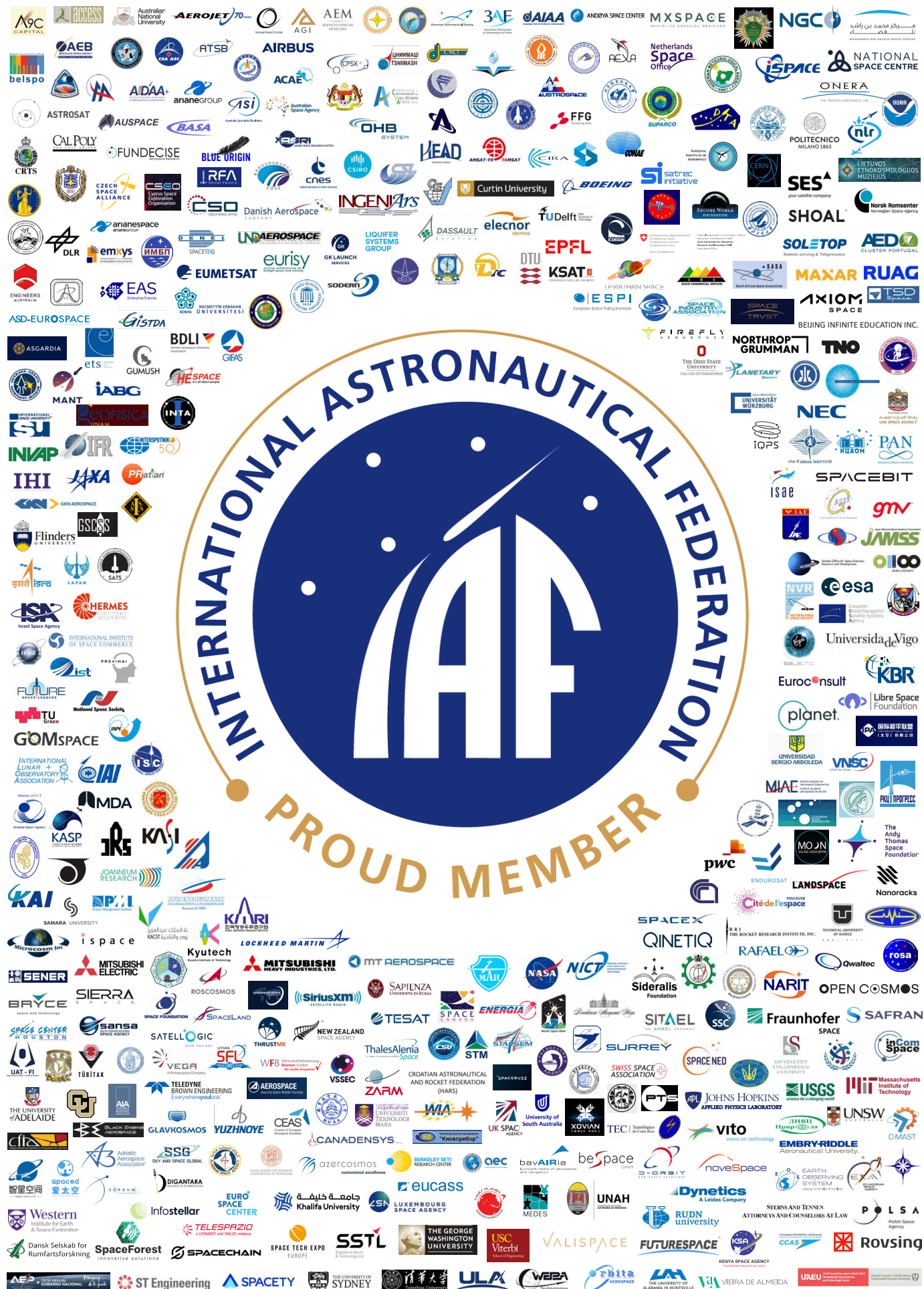
2023

The global space community will get together in Baku for the IAC once again half a century later, showcasing the world the latest developments and insights within the space sector.

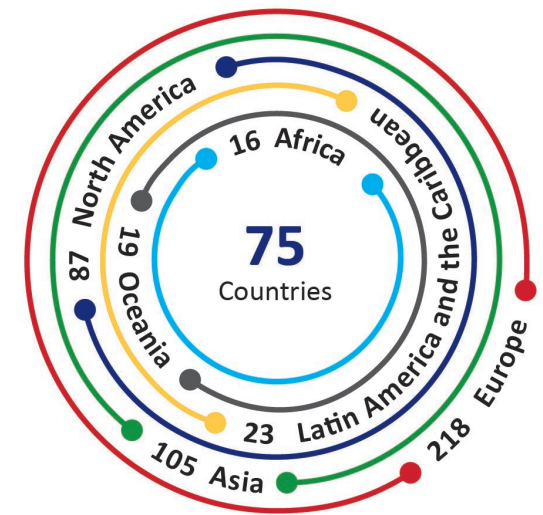
Azerbaijan is taking gradual steps towards becoming one of the leading players on the global space arena, expressing its commitment to creating a better connected, developed, and secure world for future generations. The IAC 2023 is a perfect example of demonstrated allegiance and dedication of Azerbaijan to the common cause of exploring the space together and tackling the global challenges with the help of the space and the boundless knowledge it equips us with.







# 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*

ORGANIZED BY:



### International Astronautical Federation

100 Avenue de Suffren  
75015 Paris, France

**Phone:** +33 1 45 67 42 60

**E-mail:** [info@iafastro.org](mailto:info@iafastro.org)

[www.iafastro.org](http://www.iafastro.org)

***Connecting @ll Space People***

HOSTED BY:



### Azercosmos, Space Agency of the Republic of Azerbaijan

72 Uzeyir Hajibayli str.  
Baku, Azerbaijan, AZ1000

**Phone:** +99412 310 0055

**E-mail:** [info@azercosmos.az](mailto:info@azercosmos.az)

[www.azercosmos.az](http://www.azercosmos.az)

Be part of the conversation [@iafastro](#) and [#IAC2023](#)

