63rd IAC
International Astronautical Congress

www.iac2012.org
1 - 5 October 2012, Naples, Italy

Call for Papers & Registration of Interest

Space science and technology for the needs of all
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Message from the President of the IAF

It is my pleasure to invite you to attend the 2012 International Astronautical Congress which will take place in the beautiful city of Naples, heart of the historic region of Campania, this is the fourth Italian IAC.

The 7th International Astronautical Congress, organised by the Associazione Italiana Razzi (AIR), was held in Rome in 1956 and graced by the presence of Pope Pius XII. It came at an important time for the space industry being the starting pistol for the International Geophysical Year. This culminated just one year later with the launch of Sputnik. The Associazione Italiana di Aeronautica e Astronautica (AIDAA) invited participants to Rome for the 1981 Congress. This particular Congress was vital to the development of the Unispace series of United Nations sponsored space conferences. Organised in 1997, also by AIDAA, the 48th International Astronautical Congress was held in a former Fiat plant in Turin. The stunningly successful exhibition became the industry benchmark for all those which followed.

In 2012, the space industry stands at an important crossroads with the continuing emergence of space-faring powers such as China and India, the consolidation of international cooperation in Europe, Africa and South America and the growing importance of the commercial sector in the United States.

I am confident our Italian hosts, along with the Federation, the IAA and iISL, will produce a Congress of remarkable significance.

Berndt Feuerbacher
President, International Astronautical Federation

Message from the Local Organising Committee

IAC 2012 brings prestige to Italy, Naples and the Campania region in many ways.

It rewards the work and involvement of Italian aerospace. The Naples region and the surrounding province have had a long involvement with this industry with a widespread and innovative industrial base, ranging from small companies, through medium-sized high technology enterprises to large, leading world-class organisations. Italy has always been able to deploy its great abilities in this field, achieving great successes.

Representatives of national and regional politics, industry, universities, the world of research, but most of all, the whole Campania region, has come together with ASI to help set up and organise the 63rd International Astronautical Congress. This makes Naples and Campania excel in this important global context.

The thousands of delegates will enjoy the renowned Neapolitan hospitality which has distinguished the city over the centuries. Naples will show the world that it is a land of excellence - not only for its food and landscape, but also because of its position at the leading edge of high technology.

Enrico Saggese
Chair, Local Organising Committee

Message from the IPC Co-Chairs

Today, space is no longer just a field of advanced technological development and of scientific research of excellence, but has become an essential asset for everyday life. Space has spurred countless scientific and technological achievements which are commonly used in aeronautics, medicine, material science and production, in information and communications technology. In parallel, more and more services are carried out through the use of space applications, ranging from detection of natural disasters and environmental monitoring to global navigation and telecommunication.

Using space missions to build a better understanding of the universe fulfills our centuries-old curiosity and leads humanity into the future, opening up new frontiers of knowledge.

The International Astronautical Congresses have always represented an arena in which issues have been discussed with friendship and among experts: scientists, technicians and managers from universities, agencies, research centres and industry. At the same time it introduces students and young professionals to the field.

In 2012 the IAC will come to Naples for the first time, the hometown of the late Professor Luigi G. Napolitano, a former president of the IAF and an extraordinary space scientist who marked pioneering work in fields such as microgravity and aerothermodynamics of re-entry. The theme of the conference will be “Space science and technology for the needs of all” and from one of the oldest European cities, we will give a look into the future and into how that future will be increasingly tied to space, in the interest and for the welfare of all of us.

We look forward to welcoming you to IAC 2012 in Naples, Italy, for an exciting experience.

Antonio Moccia and Li Ming
IPC Co-Chairs

Message from the President of the International Academy of Astronautics

The International Academy of Astronautics (IAA) is pleased to invite you to attend our symposia throughout the week. In addition to organising yearly around 20 conferences worldwide, the Academy organises 11 symposia every year at the IAC, representing nearly one third of the IAC programme, and will co-host in Naples some exciting sessions with the IAF and the iISL.

Italy, ranking 7th within IAA membership, is important to us. Indeed, the Academy was shaped by famous Academicians space pioneers including Italians L. Broglio, L. Napolitano and P. Santini. In addition, last year during the unprecedented IAA Heads of Space Agencies Summit, Giovanni Bignami received the highest award of the International Academy of Astronautics, the von Karman Award and this year Enrico Saggese is elected IAA Trustee.

We look forward to your presence in Naples.

Gopalan Madhavan Nair
President of the International Academy of Astronautics

Message from the President of the International Institute of Space Law

On behalf of the International Institute of Space Law I am pleased to invite you to attend our 55th Colloquium on the Law of Outer Space. We have selected topical issues that will be addressed and debated by the world’s finest space lawyers, and will co-host some exciting sessions with our sister organisations, the IAF and the IAA.

We will also welcome many promising students in the context of the prestigious Manfred Lachs Space Law Moot Court Competition, judged by members of the International Court of Justice, and during our annual Young Scholars session.

More and more space players know that legal issues of space activities merit proper attention – please join us in Naples!

Tanja Masson-Zwaan
President of the International Institute of Space Law
International Astronautical Federation (IAF)

Founded in 1951, the International Astronautical Federation is the world’s leading space advocacy body with more than 200 members on six continents including all leading space agencies, space companies, societies, associations and institutes worldwide.

Following its theme “A space-faring world cooperating for the benefit of humanity”, the Federation advances knowledge about space, fostering the development and application of space assets by advancing global cooperation.

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

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IAF Member Organisations

Associations and Professional Societies

- Agencia Espacial Españo/a, Spain
- American Astronautical Society (AAS), United States
- American Institute of Aeronautics and Astronautics (AIAA), United States
- Association pour l’Aviation et l’Astronautique de France (AAAF), France
- Association of Arab Remote Sensing Centers (AARSC), Libya
- Association of Specialist Technical Operators in Space (ASTOS), United Kingdom
- Association Nationale d’Astronautique et d’Astronautique (ANAA), Italy
- Astronaut Club Europe (ACE), France
- Astronautical Society of India, India
- ATUQMA - Tunisian Association for Communication and Space Sciences, Tunisia
- Australian Research Promotion Agency, Austria
- Canadian Aeronautics & Space Institute (CASI), Canada
- Chinese Society of Astronautics, China
- Croatian Astronautical and Rocket Federation (HARS), Croatia
- Cypriot Astronautical Society, Cyprus
- Czech Space Alliance, Czech Republic
- Danish Astronautical Society, Denmark
- Deutsche Gesellschaft für Luft und Raumfahrt, Lilienthal Oberth e.V. (DLR), Germany
- Engineer Australia, Australia
- Enterprise Brno, Brno, Czech Republic
- EURUS, France
- European Conference for Aeronautical and Space Sciences (EAC), Belgium
- European Space Agency, France
- Federation of Amateur Astronomers (FAA), Argentina
- Finnish Astronautical Society, Finland
- GFAS, France
- Hungarian Astronautical Society (HAMS), Hungary
- Institut Français de l’Espace, France
- International Association for the Advancement of Space Safety, The Netherlands
- International Federation for Spaceflight - Hermann Oberth – Wernher von Braun e.V., Germany
- Israel Society of Aeronautics & Astronautics, Israel
- Japan Society for Astronautics and Space Sciences (JSASS), Japan
- Japanese Rocket Society, Japan
- Lithuanian Space Association (LSSA), Lithuania
- Japanese Society of Aeronautics and Space Sciences (JSASS), Japan
- Polish Astronautical Society, Poland
- Prosopago-The Portuguese Association of Space Industries, Portugal
- Russian Academy of Sciences, Russia
- SafeWorld Foundation, Switzerland
- Swedish Space Association, Sweden
- The British Interplanetary Society, United Kingdom
- The Chinese Astronautical and Astronautical Society located in Taipei, Taiwan, China
- The Korean Society for Astronautics and Space Sciences, Republic of Korea
- The Planetary Society, United States
- TOYOTA, Turkey
- World Space Week Association, United States
- X PRIZE Foundation, United States

Industry

- ASC Capital, Belarus
- Acutronic Sports AG, Switzerland
- Aeronaut-Genval Corporation, United States
- Ängsöminaerflygtrafik AB, Sweden
- Airspace, France
- Astrium GmbH, Germany
- Astrium SAS France, France
- Astrium UK, United Kingdom
- Astronautic Technology SDN BHD, Malaysia
- Carlo Gavazzi Space, Italy
- Dassault Aviation, France
- Deimos Space S.L., Spain
- Dutch Space, The Netherlands
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- EADS Sodiers, France
- Euroestel, Germany
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- Lockheed Martin Corporation, United States
- MDA Corporation, Canada
- Microcom, Inc., USA
- Mitsubishi Electric Corporation, Japan
- Mitsubishi Heavy Industries, Ltd., Japan
- MT Aerospace AG, Germany
- NCC Toshiba Space Systems Ltd., Japan
- NFS Aerospace System, Canada
- Orthogon German Space Technology, United States
- Novospace, France
- OHB-System AG, Germany
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1 - 5 October 2012, Naples, Italy

6 7
The International Academy of Astronautics (IAA) was founded in 1960 by Theodor von Karman. The Academy is an independent international community of leading experts committed to expanding the frontiers of space, the realm of human activity. To foster the development of astronautics, the Academy undertakes a number of activities, including the recognition of outstanding contributors through election 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. This is a unique non-governmental organisation established in 1960 and recognised by the United Nations in 1996.

It is in honor of a society with an action agenda. With 1200 elected members and corresponding members from 87 nations, it works closely with space agencies, industry, the academic community and the national space 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 published 9 studies in 2010 and is engaged in the preparation of 40 studies. The Academy publishes the journal Acta Astronautica containing refereed papers.

The Academy now yearly organises 20 conferences and regional meetings focused on the development and promotion of new initiatives. This activity includes also, 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 sponsors 11 Symposia. The Academy also continues to enjoy its participation in the COSPAR Assemblies by sponsoring and co-sponsoring symposia. Although the IAA has many connections to these and other similar organisations, it is distinctive as the only international Academy of elected members in broad area of astronautics and space.

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The International Institute of Space Law (IISL)

Founded in 1960, the International Institute of Space Law (IISL) is an independent non-governmental organisation dedicated to fostering the development of space law. The membership of the Institute is composed of individuals and institutions from more than forty countries who have been elected on the basis of their contributions to the field of space law or other social sciences related to space activities. The IISL is an officially recognised observer at sessions of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and organises a variety of conferences on space law throughout the year. The IISL holds its annual Colloquium at the International Astronautical Congress and interested authors are invited to submit abstracts this year for the Colloquium sessions.

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Executive Secretary: Corinne M. Jorgenson – USA
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**Introduction to the Technical Programme**

Based on recent experiences of the IAC, the Naples technical programme promises to be one of the most varied and detailed ever.

The IAC Technical Programme, the IAA Commissions and the ISSL Programme Committees contain some of the world’s best-recognised experts in their fields. These bodies will independently or jointly discuss, propose and run Symposia, with the International Programme Committee making the final choice of papers for the 63rd IAC.

The technical programme for 2012 Congress is shown below. All Symposia are grouped into four categories, A. Science and Exploration. B. Applications and Operations, C. Technology, D. Infrastructure and E. Space Society, so that it should be easy for everybody to find where to go. You are highly encouraged to submit abstracts for the Congress to be held in the wonderful city of Naples!

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**Category coordinated by Marcus Dejmek, Canadian Space Agency - CANADA**

<table>
<thead>
<tr>
<th>Category</th>
<th>A1 SPACE LIFE SCIENCES SYMPOSIUM</th>
<th>A2 MICROGRAVITY SCIENCES AND PROCESSES</th>
<th>A3 SPACE EXPLORATION SYMPOSIUM</th>
<th>A4 ABUS SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) - THE NEW STARS</th>
<th>A5 HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM</th>
<th>A6 SPACE DEBRIS SYMPOSIUM</th>
<th>A7 SPACE ASTRONOMY SYMPOSIUM</th>
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<td><strong>A1</strong></td>
<td>SPACE LIFE SCIENCES SYMPOSIUM</td>
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<td>The symposium jointly organized by the International Academy of Astronautics and the International Astronautical Federation addresses all aspects of space life science research and practice in human and robotic spaceflight, from low Earth orbit (LEO) to the universe beyond, and from the Big Bang to the life of future explorers on other planets of our solar system.</td>
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<td>Coordinator</td>
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<td>Institute for Biomedical Problems – Russia</td>
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<td><strong>Behaviour, Performance and Psychosocial Issues in Space</strong></td>
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<td>This session considers psychological, interpersonal, social, cognitive, circadian/sleep and human factors issues and countermeasures related to human spaceflight and space exploration.</td>
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<td>This session focuses on all aspects of spaceflights physiology that relate to human health and to the countermeasures employed to maintain health and performance.</td>
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<td>The 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 be on medical care for passengers and operations of commercial suborbital and orbital space flights.</td>
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<td><strong>A1.4</strong></td>
<td><strong>Radiation Fields, Effects and Risks in Human Space Missions</strong></td>
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<td>The major topics of this session are the assessment of the radiation environment by theoretical modelling and experimental data, radiation effects on physical and biological systems, countermeasures to radiation and radiation risk assessment.</td>
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<td><strong>Co-Chair</strong></td>
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**A5** **ASTROBIOLOGY AND EXPLORATION**

**A5.1** **Astrobiology and Exploration**

Astrobiology plays a key role in the preparation of space exploration endeavors to find life in our solar system and beyond. Investigating habitability constraints and intervening technology to search for organic compounds and life will provide support to current and future robotic missions to inter- and inner solar system bodies as well as to human exploration missions targeting the Earth-Moon-Mars spine. The session presents papers on conceptual and technical support for space exploration.

**Co-Chair** | Petro Hinterberg | Alexander Hörz | | | | | |
| **Reporters** | | | | | | | |

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**A5.2** **Life Support and EVA Systems**

This session will address strategies, solutions and technologies in providing for human requirements during future deep space and planetary/lunar surface exploration.

**Co-Chair** | Oishi Mitsuji | | | | | | |
| **Reporters** | | | | | | | |

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**A5.3** **Biological Science**

This session focusses on 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.

**Co-Chair** | Catherine Corder | | | | | | |
| **Reporters** | | | | | | | |

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**A5.4** **Private Human Spaceflight**

This session focusses on crew and passengers of commercial suborbital and orbital spaceflights as well as on future life sciences research opportunities in private human spaceflight.

**Co-Chair** | Rupert Genter | | | | | | |
| **Reporters** | | | | | | | |

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**A6** **MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM**

**A6.1** **Microgravity Sciences**

The objective of the Microgravity Science and Processes Symposium is to highlight and discuss the state of the art in microgravity (induced) physical sciences and processes, as well as to prepare for future orbit infrastructures. Session topics cover all microgravity science disciplines (material science, fluid physics, combustion, fundamental physics), current results and research perspectives, together with relevant technology developments.

**Co-Chair** | Antonio Variani | | | | | | |
| **Reporters** | | | | | | | |

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**A6.2** **Fluid and Materials Sciences**

The main focus of the session is on research fields in fluid and materials sciences, multi-phase and chemically reacting flows including theoretical modelling, numerical simulations, and results of pathfinder laboratory and space experiments.

**Co-Chair** | Rainldor Fortezza | | | | | | |
| **Reporters** | | | | | | | |

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**A6.3** **Microgravity Experiments from Sub-Orbital to Orbital Platforms**

This session presents recent results of microgravity experiments from all disciplines using different microgravity platforms, including drop towers, parabolic aircrafts, sounding rockets and capsules.

**Co-Chair** |  | | | | | | |
| **Reporters** | | | | | | | |

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**A6.4** **Microgravity Sciences Onboard the International Space Station and Beyond**

Aimed at the presentation of results obtained from large orbiting platforms, in particular the ISS, as well as preparation scenarios for future long term flight operations. The session includes description and performance of ground and orbit infrastructure.

**Co-Chair** | Juan Acebal | | | | | | |
| **Reporters** | | | | | | | |
A3 SPACE EXPLORATION SYMPOSIUM

This symposium covers the current and future robotic missions and travel plans for the exploration of the Solar System.

Co-Chair
Christian Sallenger
VITA-CON Corporation — CANADA

Rapporteur
Christian Sallenger
VITA-CON Corporation — CANADA

A3.1 Space Exploration Overview

This session covers space-exploration strategies and architectures, as well as technology roadmaps. Papers of both national and international perspectives are invited, as are papers dealing with the emerging areas of commercial space-exploration activities.

Co-Chair
Christian Sallenger
VITA-CON Corporation — CANADA

Rapporteur
Christian Sallenger
VITA-CON Corporation — CANADA

A3.2A Moon Exploration — Part 1

This session will address current and future lunar missions. The session will address orbital missions, robotic surface missions, as well as science on the Moon, resource utilisation and preparatory activities for future solar system exploration.

Co-Chair
Bernard Foing
European Space Agency (ESA) — THALI THE NETHERLANDS

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A3.2B Moon Exploration — Part 2

This session will address current and future lunar missions. The session will address orbital missions, robotic surface missions, as well as science on the Moon, resource utilisation and preparatory activities for future solar system exploration.

Co-Chair
Bernard Foing
European Space Agency (ESA) — THALI THE NETHERLANDS

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A3.3A Mars Exploration — Part 1

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 including expected experiments. Papers on any aspects of the search for evidence of extinct or extant Martian life, and forward and backward contamination are particularly welcome.

Co-Chair
Vincenzo Giorgio
University of Insubria — ITALY

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A3.3B Mars Exploration — Part 2

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 including expected experiments. Papers on any aspects of the search for evidence of extinct or extant Martian life, and forward and backward contamination are particularly welcome.

Co-Chair
Vincenzo Giorgio
University of Insubria — ITALY

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A3.4 Small Bodies Missions and Technologies

This session will present the missions and technological aspects related to the exploration of small bodies including a search for primitive signatures.

Co-Chair
Samantha McMonigle
Planetary Science (Io) (Simpl) — JAXA — JAPAN

Rapporteur
Marc G. Rayman
Jet Propulsion Laboratory — California Institute of Technology — UNITED STATES

A3.5 Solar System Exploration

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. Papers covering both new mission concepts as well as the associated specific technologies are invited.

Co-Chair
Guy R深渊
Japan Aerospace Exploration Agency (JAXA) — JAPAN

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A4 SETI SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) — The Next Steps

This sympoisum is organized by the IAU Working Group 12 and is devoted to assessing the current state of the search for extraterrestrial intelligence (SETI) including a discussion of all kinds of contexts. The technical side is not linked to the microwave window, but includes also optical and any kind of radiation. The interdisciplinary aspects include all societal implications, risk communication and philosophical considerations of any kind of discovery or contact.

Co-Chair
Christian Sallenger
VITA-CON Corporation — CANADA

Rapporteur
Christian Sallenger
VITA-CON Corporation — CANADA

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
Luigi Walpás
Tegnér-Göteborgs universitet — SVECEN

Rapporteur
Douglas Shauck
SETI Institute and California Institute of Integral Studies — UNITED STATES

A4.2 SETI 2: SETI and Society

All aspects concerning the social implications of extraterrestrial intelligence are considered, including public reaction to a discovery.

Co-Chair
Paula Monica
University of Nevisia — ALBERT

Rapporteur
N. Paul Shauck
The SETI society, Inc. — UNITED STATES

A5 HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM

This symposium covers the strategic plans, architectural concepts and technology development for future human exploration of the Solar System.

Co-Chair
Christian Sallenger
VITA-CON Corporation — CANADA

Rapporteur
Christian Sallenger
VITA-CON Corporation — CANADA

A5.1 Near Term Strategies for Lunar Surface Infrastructure

This session will look at the study of lunar surface infrastructure elements to support human exploration from lunar outposts or sortie missions. Papers are invited to discuss technology roadmaps as well as interfaces to allow international cooperation and lunar surface activities.

Co-Chair
Maria Antonietta Pinto
Thales Alenia Space Italia — ITALY

Rapporteur
Thales Alenia Space Italia — ITALY

A5.2 Long Term Scenarios for Human Moon/Mars Presence

Many studies of human Moon and Mars missions have been conducted in the 15 years since the first Apollo Moon landing. Utilisation of colonization of the Moon and Mars will require that a long term, sustainable strategy be developed and followed. In addition, future lunar and Mars enterprises must be considered as part of an evolving space infrastructure that can utilise the goods and service requirements from colocated or coevolved or even ever an additional human and robotic space infrastructure. Some of the projects to be discussed in this session include: life support systems, station foundations, and ways and benefits to humanity that might result from human exploration and ultimately colonization. A goal of the session is the advancement of a strategy leading toward self-sustaining colonies.

Co-Chair
William M. England
The Boeing Company — UNITED STATES

Rapporteur
William M. England
The Boeing Company — UNITED STATES

A5.3 Joint Session on Human and Robotic Partnerships to Realize Space Exploration Goals

This session seeks papers on new systems and technologies for future human-solar system exploration missions, and the role of human and robotic partnerships in areas such as human surface mobility systems (hoven); habitat/infrastructure construction; robotic assistants; and, perunac avation activities such as sample return, in situ plant growth and food production demonstration. Th session also welcomes papers considering how the role 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-Chair
Christian Sallenger
VITA-CON Corporation — CANADA

Rapporteur
Christian Sallenger
VITA-CON Corporation — CANADA

A6 SPACE DEBRIS SYMPOSIUM

The symposium will address the complete spectrum of technical issues of space debris: measurements, modeling, risk assessment and space and on the ground, science, hypervelocity impacts and protection, mitigation and standards, and space law.urenavenent.

Co-Chair
Michael L. Johnson
National Aeronautics and Space Administration (NASA) — UNITED STATES

Rapporteur
Gerhard Schubert
European Space Agency (ESA) — SPAIN

A6.1 Mitigation of Space Debris — Part 1

This session will address the mitigation of space debris, with an emphasis on long-term measures, and space law and standards. Papers are invited to discuss the status and future of space debris mitigation and the role of national and international cooperation.

Co-Chair
Michael L. Johnson
National Aeronautics and Space Administration (NASA) — UNITED STATES

Rapporteur
Gerhard Schubert
European Space Agency (ESA) — SPAIN

A6.2 Mitigation of Space Debris — Part 2

This session will address the mitigation of space debris, with an emphasis on long-term measures, and space law and standards. Papers are invited to discuss the status and future of space debris mitigation and the role of national and international cooperation.

Co-Chair
Michael L. Johnson
National Aeronautics and Space Administration (NASA) — UNITED STATES

Rapporteur
Gerhard Schubert
European Space Agency (ESA) — SPAIN

A6.3 Mitigation of Space Debris — Part 3

This session will address the mitigation of space debris, with an emphasis on long-term measures, and space law and standards. Papers are invited to discuss the status and future of space debris mitigation and the role of national and international cooperation.

Co-Chair
Michael L. Johnson
National Aeronautics and Space Administration (NASA) — UNITED STATES

Rapporteur
Gerhard Schubert
European Space Agency (ESA) — SPAIN

A6.4 Mitigation of Space Debris — Part 4

This session will address the mitigation of space debris, with an emphasis on long-term measures, and space law and standards. Papers are invited to discuss the status and future of space debris mitigation and the role of national and international cooperation.

Co-Chair
Michael L. Johnson
National Aeronautics and Space Administration (NASA) — UNITED STATES

Rapporteur
Gerhard Schubert
European Space Agency (ESA) — SPAIN
### A6.1 Measurements
This session will address advanced ground and space-based measurement techniques, relating processing methods, and results on the derived spatial and temporal distribution of debris.

**Chair:** Patrick Leprêtre  
University of Leuven — UNITED STATES

**Rapporteur:** Thomas Trösch  
Astronomische Observatorium der Universität Bonn (AUB) — GERMANY

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

**Chair:** Ludger Anmean  
B71-IRM — ONLY

**Rapporteur:** Gunther Schneider  
Deutsches Zentrum für Luft- und Raumfahrt e.V (DLR) — GERMANY

### A6.3 Hypervelocity Impacts and Protection
This session will address passive protection, shielding and damage predictions. Shaving impacts will be supported by experimental and computational results of HVI tests. Use of HE techniques for debris mitigation.

**Chair:** James H. Iglett  
Electric Rocket Technology Group — USA

**Rapporteur:** Frank Schubert  
University of Stuttgart, Institut für Raketentechnik, Ernst-Mach-Institut (IMA) — GERMANY

### A6.4 Mitigation and Standards
This session will focus on the definition and implementation of debris prevention and reduction measures and passive protection. The session will also address space debris mitigation guidelines and standards that already exist or are in preparation at the national and international levels.

**Chair:** Fernando Alby  
Centro Nacional de Espacio, Stuttgart (CNEA) — FRANCE

**Rapporteur:** John W. Hussey  
United States

### A6.5 Space Debris Removal Issues
This session will address active removal techniques in space and on-ground.

**Chair:** Heimann Kleinleder  
European Space Agency (ESA) — GERMANY

**Rapporteur:** Gerhard Kugler  
Japan Aerospace Exploration Agency (JAXA) — JAPAN

### A6.6 Political, Economic and Institutional Aspects of Space Debris Mitigation and Removal (Joint with Space Security Committee)
This session will deal with the non-technical aspect of space debris mitigation and removal. Economic issues including financial benefit and insurance, political aspects such as the role of CSUOSPs are important issues to pass from the future. The role of international cooperation in addressing these issues will be discussed.

**Chair:** Katsuku Saito  
Institute of Space and Astronautical Science (ISAS) — JAPAN

**Rapporteur:** Charlotte Mathieu  
European Space Agency (ESA) — FRANCE

### APPLICATIONS AND OPERATIONS
Ongoing and future operational applications, including Earth observation, communication, navigation, human space endeavours and small satellites

#### B1 Earth Observation Symposium
The symposium focuses on space missions which deal with collecting information about the Earth and its environment. Session topics deal with all aspects of Earth observation missions including the policy and infrastructure of international cooperation and coordination, the emergence of commercial systems to satisfy market needs, the technical descriptions of new missions and sensors to be used, data processing and GIS, environmental applications and global change studies, and the use of commercial systems.

**Chair:** John W. Hussey  
Consultant — UNITED STATES

**Rapporteur:** David Smith  
National Oceanic and Atmospheric Administration (NOAA) — UNITED STATES

#### B2 SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM
This symposium examines development in technology, applications and systems as they relate to fixed and mobile communication services, satellite broadcasting, position determination, navigation and timing, and integrated multimedia processing.

**Chair:** John W. Hussey  
Consultant — UNITED STATES

**Rapporteur:** Pierre Barroil  
European Space Agency (ESA) — GERMANY

#### B3 HUMANKIND SPACE ENDEAVOURS

#### B4 SMALL SATELLITE MISSIONS

#### B5 SYMPOSIUM ON INTEGRATED APPLICATIONS

#### B6 SPACE OPERATIONS SYMPOSIUM
Category coordinated by Denis J.P. Moura, European Defence Agency - BELGIUM

#### B1.2 Future Earth Observation Systems
Emphasis is on technical descriptions of planned and new space systems and missions for experimental and operational Earth observation. Descriptions of new and innovative Earth observation systems are encouraged.

**Chair:** Benoit Boissin  
Centre National d’Etudes Spatiales (CNES) — FRANCE

**Rapporteur:** Gérard Schirrer  
Deutsches Zentrum für Luft- und Raumfahrt e.V (DLR) — GERMANY

#### B1.3 Earth Observation Sensors and Technology
Focus is on sensors now being developed or tested for all aspects of Earth observation. Particular emphasis is on new sensors for meeting the growing demand of user markets.

**Chair:** Andrew Court  
Two — THE NETHERLANDS

**Rapporteur:** Yeon-Joo Chong  
National University of Singapore — ASIA, SINGAPORE

#### B1.4 Earth Observation Data Management Systems
Earth Observation Data Acquisition, Processing, Dissemination and Archiving.

**Chair:** Bruce K. Quick  
U.S. Geological Survey — UNITED STATES

**Rapporteur:** Carlos Villegas  
University of Rome / IAC Spazio — ITALY

#### B1.5 Earth Observation Applications and Economic Benefits
Earth Observation value-added products.

**Chair:** Loğğol Bocasol  
Australis and Associates — ITALY

**Rapporteur:** Paul Kavanagh  
Thales Alenia Space France — FRANCE

#### B1.6 Dual Use Earth Observation
Focus on the dual use (civilian and military) aspects of Earth Observation missions at the programmatic, organizational and technical levels.

**Chair:** Jon Kohler  
Czech Space Office — CZECH REPUBLIC

**Rapporteur:** Luciano Anselmo  
INAF — ITALY

#### B2 SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM

#### B2.1 Near-Earth and Interplanetary Communications
Spheres with relative motion between space and ground segments, in both near-earth and interplanetary environments, will be discussed, with particular emphasis on unique concepts, techniques, and technologies.

**Chair:** Michael Witting  
European Space Agency (ESA) — GERMANY

**Rapporteur:** Frans van Berkel  
ABB Aerospace and Defence — THE NETHERLANDS

#### B2.2 Advanced Technologies
Future promising space communication and navigation technology will be presented, as applied to existing and developing systems.

**Chair:** Edward W. Ashford  
Airbus Defence and Space — THE NETHERLANDS

**Rapporteur:** Zdeněk Novák  
B. Bely & Associates Inc. — CANADA

#### B2.3 Advanced Systems
Advanced satellite communications and applications will be presented.

**Chair:** Robert Hinson  
Space Systems/Loral — UNITED STATES

**Rapporteur:** Kostas Tsatsos  
National Technical University of Athens — GREECE

#### B2.4 Fixed and Broadcast Communications
Adoption of fixed and broadcast systems will be presented, including DVB land and broadcast/television direct-to-user applications.

**Chair:** Otto Kuska  
Globa Satellite Communications Technology — INDIA

**Rapporteur:** Akira Miyamoto  
National Institute of Information and Telecommunications Technology — JAPAN

#### B2.5 Mobile Satellite Communications and Navigation Technology
New and emerging technologies for mobile and personal satellite communications and navigation will be presented.

**Chair:** Robin Black  
Deimos-ISpace — UNITED STATES

**Rapporteur:** Jean-Paul Aigrain  
Centre National d’Etudes Spatiales (CNES) — FRANCE

#### B2.6 Space-Based Navigation Systems and Services
New and emerging systems for satellite-based position, navigation and timing will be presented, including ionospheric applications.

**Chair:** R.A. Liddicott  
The Aerospace Corporation — UNITED STATES

**Rapporteur:** Stéphane Géron  
The Johns Hopkins University Applied Physics Laboratory — UNITED STATES
B3 HUMAN SPACE ENDEAVOURS SYMPOSIUM

The symposium addresses all aspects of human space endeavours including the design, development, operations, utilisation and future plans of space missions involving humans. The scope covers past, present and future space endeavours.

Co-Chair

John H. Rollin
National Aeronautics and Space Administration (NASA)/Johnson Space Center – UNITED STATES

Co-Chair

Maria Stella Lavitola
e.V. (DLR) – GERMANY

UNITED KINGDOM

Rapporteur

S.P. Korolev Rocket and Space Corporation

Igor V. Sorokin

(UNITED STATES)

B3.1 Overview Session (Present and Near-Term Human Space Flight Programmes)

This session will provide an overview for researchers and papers presented in this symposium to present current and near-term human space flight programmes and their applications being developed to support them, and other human space flight programmes including those under development at commercial ventures. Technical papers to be presented are expected to portray the latest development of these programmes.

Co-Chair

Gale Mitra
EADS Astrium – THE NETHERLANDS

John H. Rollin
National Aeronautics and Space Administration (NASA)/Johnson Space Center – UNITED STATES

Narayan Willmunder
Deutschen Zentrum für Luft- und Raumfahrt e.V. (DLR) – GERMANY

B3.2 How Can We Best Apply Our Experience to Future Human Missions?

This session shall provide a forum for the exchange of the experience of previous human space flight missions like Apollo, Skylab, Soyuz, Skylab, MIR, Space Shuttle and ISS, and provide insight into how this information can be best used for designing future missions. Technical papers to be presented are expected to show the direct relationship between past missions and their potential influence on newly designed missions. Special attention will be given to cost reduction efforts with enhanced crew and vehicle safety.

Co-Chair

Dr. John R. M. Audilling
Chairman for Luft- and Raumfahrt e.V. (DLR) – GERMANY

Sergey K. Derevyanchikov
EADS Astrium Space Research & Production Space Center – RUSSIA

Rapporteur

Gene Kin
Rock–Sci washington, DC – UNITED STATES

B3.3 ISS Utilisation

This session will address utilization of the International Space Station, providing the opportunity to discuss achievements, plans and outlook of ISS utilization, involving current and future crews. The session aims to present results of the ISS operations with an emphasis on experience exchange with current and future space activities and research. Topics covered are: technical and industrial applications and engineering research and technology demonstrations, as well as use of ISS not best for exploration. Appropriate forms of discussion include: individual presentations, workshop and panel discussions. In addition to discussions on ISS operations and research results, the session will include the opportunity for the presentation of papers on future space station utilization.

Co-Chair

Maria Victoria Bellutta
Thales Alenia Space Italy – ITALY

Kevin Foley
The Boeing Company – UNITED STATES

Rapporteur

Shannon Ryan
Spaceline Science and Technology Organization (SSTO) – AUSTRALIA

B3.4 Sustainable Operation of the ISS – Joint Session of the Human Space Endeavours and Space Operations Symposia

This session will address key challenges and other solutions related to operations of the International Space Station, in support of its future role. Topics to be discussed include recent operational problems and solutions, cost reduction for affordability, new and proposed facilities or equipment, and ground segment operations and planning. Also included would be topics such as logistics and logistics planning, transportation, sustainment, and the geopolitical value as a tool for promoting international cooperation.

Co-Chair

Maria Victoria Bellutta
Thales Alenia Space Italy – ITALY

Ralph L. Lautman
European Space Transportation – GERMANY

Rapporteur

Bob Chesney
European Space Transportation – GERMANY

B3.5 Astronauts: Those Who Make It Happen

This session is designed to review and discuss issues related to a key element of human missions: the astronauts. Papers are solicited covering topics such as how to train astronauts, astronaut safety, decision making process during space flight, action at contingency situations, astronaut selection, roles and responsibilities, and tasks and activities associated with the preparation, operations, return and debriefing of astronauts. This session also welcomes papers concerning the role of humans, robotics and intelligent systems and the ways in which multi-disciplinary teams and organisations are engaged in the process of human spaceflight mission planning and operations.

Co-Chair

Igor V. Sorokin
S.P. Korolev Rocket and Space Corporation

Alan T. DeLuna
The John Hopkins University – UNITED STATES

Rapporteur

Dr. Nobuhiro Asami
Japan Aerospace Exploration Agency (JAXA) – JAPAN

B3.6 Joint Session on Human and Robotic Partnerships to realise Space Exploration Goals

This session will present papers on new systems and technologies for future human space system exploration missions, and role of human and robotic partnerships in areas such as human surface mobility systems (rovers), habitat/infrastructure construction, robotic assistants, and personnel activities such as sample returns, in situ plant growth and food and fuel production demonstrations. This session also welcomes papers concerning the roles of humans, robots and intelligent systems are likely to evolve in the coming years and the corresponding impact on complex mission design, implementation, and operations.

Co-Chair

William R. Gross
National Aeronautics and Space Administration (NASA) – UNITED STATES

Christoph Sallaböger
Airbus Corporate Company – AUSTRIA

Rapporteur

Wolfgang Weigand
The European Space Agency – GERMANY

Alexandros Kritselis
International Space University (ISU) – GERMANY

B3.7 New Technologies, Processes and Operating Modes Enabling Future Human Missions

This session is designed to address the potential evolution of key human missions, perhaps driven by new affordability and sustainability requirements. Papers are solicited that address how space technology is being shape the future of technologies, logistics, processes, procedures, etc. to enable future human space mission objectives that will include exploration, commercial initiatives, ventures, and industrial processes.

Co-Chair

Markus Moell
European Space Agency (ESA) – THE NETHERLANDS

Ludwig Schütz
Centre National d’Etudes spatiales (CNES) – FRANCE

Rapporteur

Korean Aerospace Research Institute (KARI) – SOUTH KOREA

B3.8 Joint IAF/IISL Session on Policy and Law of Human Space Missions

This session hosts papers on topics related to legal and political aspects of international collaboration in human space mission programmes, such as the ISS, space law, and international cooperation in the space exploration. The session provides an opportunity for members of the IAF to discuss the latest regulatory framework. The session also examines the role of international law, especially the peaceful uses of outer space and the purpose and role of international cooperation in the exploration of space. It also considers the duration and partnership of the ISS programme and lessons learned from past collaborative programmes such as Intelsat or the Shuttle-Landmark programmes may be addressed.

Co-Chair

Ludovic Oudin
EADS Astrium Space Transportation GmbH – GERMANY

Lee Jann Lee
Loyola University Chicago – UNITED STATES

Rapporteur

Astrium Space Transportation – GERMANY

18 19

B4 SYMPOSIUM ON SMALL SATELLITE MISSIONS

B4.1 13th UN/IAG 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 brings together the needs that need to be satisfied and results achieved by developing nations through the use of small satellites. Technical papers are invited that address how to shape the future of small satellite operations and programmes, to be held in cooperation with UNOOSA as a possible implementation of module, reconfigurable, rapid systems. This symposium will be accepting submissions for oral presentations only.

Co-Chair

Rosita Mehta
National Aeronautics and Space Administration (NASA) – UNITED STATES

Alexa de la Gatta
Sunny Vision Technology 3D – UNITED STATES

Rapporteur

Rina Millet
CNES – FRANCE

B4.2 Small Space Science Missions

This session will address the current and near-term approved small/micro/nanosatellite missions whose objective is to address the returns in the fields of Earth science, solar science, interplanetary, planetary, astrophysics and astrophysical observations, and fundamental physics. Emphasis will be given to missions achieved, new technologies and concepts, and novel management techniques.

Co-Chair

Soren Kjellerup
The Johns Hopkins University – UNITED STATES

Devin J.P. Marcus
European Defence Agency – BELGIUM

B4.3 Small Satellite Operations

This session covers the planning, design, and operation of Small Satellite Operations, with emphasis on new missions with new business opportunities. The small satellite industry has the potential to revolutionise how space missions are designed and executed. Small satellites can provide a cost-effective, flexible and efficient way to access space and support a wide range of applications. This session will address the planning, design and operations of small satellite missions and the opportunities they offer. It will also address the challenges and risks associated with small satellite operations. This session will focus on the opportunities presented by small satellites, including their cost-effectiveness and flexibility.

Co-Chair

Peter M. Allan
University of California, Los Angeles – UNITED STATES

Karen McManus
University of California, Los Angeles – UNITED STATES

Rapporteur

Korean Aerospace Research Institute (KARI) – SOUTH KOREA

B4.4 Small Satellite Launchers

This session will present papers on the development and application of small satellite launchers. This includes the design, development, and operation of launchers for small satellites. The session will also address the challenges and risks associated with small satellite launchers, including their cost-effectiveness and flexibility.

Co-Chair

Alex da Silva Curiel
University of California, Los Angeles – UNITED STATES

Gi-Hyuk Choi
Korean Aerospace Research Institute (KARI) – SOUTH KOREA

Rapporteur

Lionel Suchet
European Space Agency (ESA) – GERMANY

18 19
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. This is achieved through dedicated launchers, orbiters, piggyback launches, and space propulsion technologies to reach final operational orbit. Topics of interest for this session include innovation in launchers, orbiters, piggyback systems, separation and dispersion systems, and small and space-qualified sub-systems. The session aims to design an efficient small satellite access to space and orbit change (e.g., propulsion systems). Invited lessons learned from various technical and programmatic approaches for a discussion of small launchers concepts and programs, please refer to section B5.3.

B4.6A Generic Technologies for Small/Micro Platforms

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

B4.6B Generic Technologies for Nano/Pico Platforms

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

B4.7B Small Distributed Space Missions

This session addresses the broad topic of training for operations. It includes training of ground operations, flight control, and flight personnel. It also includes topics related to the training and education requirements and plans for newcomers in the operations domain, including commercial space operators.

B6.1 Space Operations Symposium

This session will focus on the operations unique to human spaceflight. Papers may address any phase in the mission lifecycle from concept development, to ground operations, to flight (vehicle and ground segments), to recovery and post mission analysis.

B6.2 New Operations Concepts and Commercial Space Operations

This session addresses the broad topic of training for operations. It includes training of ground operations, flight control, and flight personnel. It also includes topics related to the training and education requirements and plans for newcomers in the operations domain, including commercial space operators.

B6.4 Flight Control Operations Virtual Forum

The session is a virtual forum (not a paper session) organized by the Space Operations Committee and the Workforce Development/Young Professionals Programme Committees. The forum targets hands-on flight control practitioners/pilots from multiple international organizations with objectives of sharing best practices, lessons learned, and issues.

B5 SYMPOSIUM ON INTEGRATED APPLICATIONS

This session will focus on innovative new missions, including new applications of space and non-space technologies and systems, and how they can be integrated to deliver solutions to specific missions. The session will include papers on topics such as ground and space-based systems for a variety of domains, including disaster management, climate change, environmental monitoring, education, health, etc.

B5.1 Integrated Applications End-to-End Solutions

This session will focus on innovative new missions, including new applications of space and non-space technologies and systems, and how they can be integrated to deliver solutions to specific missions. The session will include papers on topics such as ground and space-based systems for a variety of domains, including disaster management, climate change, environmental monitoring, education, health, etc.

B5.2 Tools and Technology in Support of Integrated Applications

This session will focus on innovative new missions, including new applications of space and non-space technologies and systems, and how they can be integrated to deliver solutions to specific missions. The session will include papers on topics such as ground and space-based systems for a variety of domains, including disaster management, climate change, environmental monitoring, education, health, etc.

B6 SPACE OPERATIONS SYMPSIUM

This session will focus on innovative new missions, including new applications of space and non-space technologies and systems, and how they can be integrated to deliver solutions to specific missions. The session will include papers on topics such as ground and space-based systems for a variety of domains, including disaster management, climate change, environmental monitoring, education, health, etc.

B7 H kickoff to the Moon

This session will focus on innovative new missions, including new applications of space and non-space technologies and systems, and how they can be integrated to deliver solutions to specific missions. The session will include papers on topics such as ground and space-based systems for a variety of domains, including disaster management, climate change, environmental monitoring, education, health, etc.
Co-Chair Rapporteur

Centre National d'Etudes Spatiales (CNES) — FRANCE

Gianmarco Radice

This theme discusses advances in orbital dynamics, orbit determination, and orbit control. It includes orbital dynamics associated with constellations and formation flying.

UNITED STATES

The Pennsylvania State University — D. Spencer

The theme covers design, operations and optimisation of Earth-orbiting and interplanetary missions, with emphasis on studies and experiences related to rockets, including rendezvous and docking.

THE NETHERLANDS

Eberhard Gill

and rockets, including rendezvous and docking.

Co-Chair Rapporteur

Alfred Ng

The emphasis of this theme is on the studies and application related to the guidance, navigation and control of Earth-orbiting and interplanetary spacecraft and rockets, including rendezvous and docking.

JAXA — JAPAN

Kazuya Yoshida

The focus of the session will be on space environmental effects and spacecraft protection. The effects of vacuum, radiation, atomic oxygen, space debris, and solar activity on the spacecraft, re-entry vehicles and small satellites. Advanced subsystems and design of future exploration missions will be covered considering issues arising from space environmental effects, spacecraft and launch vehicle system design, materials, and structures and microelectronics will be addressed.

Stellenbosch University — South Africa

Technology — CHINA

Naval Postgraduate School — M. E. Landry

The topics to be addressed include evaluation of analog versus test models for spacecraft and launch vehicle systems and subsystems e.g. propulsion systems, tanks, load introduction, primary structures, fluidic equipment, control surfaces; examination of both on-ground and in-space testing, launch dynamic environment as related to structural design, space vehicle development and launch vehicle verification as well as in-situ, sounding and acoustic vibration testing, and lessons learned.

Astrium Space Transportation — FRANCE

Thales Alenia Space France — FRANCE

The emphasis of this theme is on the studies and application related to the guidance, navigation and control of Earth-orbiting and interplanetary spacecraft and rockets, including rendezvous and docking.

Co-Chair Rapporteur

Anna Guerman

This theme discusses advances in spacecraft attitude dynamics and control, as well as attitude sensors and actuators. The theme also covers dynamics and control of multiple interconnected rigid and flexible bodies including tethered systems and space robots.

RAS — RUSSIA

Oleg Alifanov

The topics to be addressed include evaluation of analog versus test models for spacecraft and launch vehicle systems and subsystems e.g. propulsion systems, tanks, load introduction, primary structures, fluidic equipment, control surfaces; examination of both on-ground and in-space testing, launch dynamic environment as related to structural design, space vehicle development and launch vehicle verification as well as in-situ, sounding and acoustic vibration testing, and lessons learned.

Naval Postgraduate School — M. E. Landry

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C3 SPACE POWER SYMPOSIUM

Reliable energy systems continue to be key for all space missions. The successful future exploration and development of space depends on the research into and deployment of new, more affordable and more reliable energy sources of diverse types ranging from the very small to the extraordinarily large. Moreover, the continuous support of space activities by the public will require that these activities serve human needs in obvious ways. One visionary way to achieve the latter goal is to provide non-polluting, economical energy from space to terrestrial users.

Many missions are precluded by limitations on current propulsion technologies and systems. The session will explore concepts for new missions that can be carried out by advanced propulsion systems.

The Space Propulsion Symposium addresses sub-orbital, earth to orbit, and interplanetary exploration. The general areas considered include both chemical and non-chemical rocket propulsion, as well as electric propulsion and ion thrusters. The Symposium is concerned with component technologies, the operation and application to missions of overall propulsion systems and unique propulsion test facilities.

C3.4 Small and Very Small Advanced Space Power Systems

This session is dedicated to all aspects of small and very small advanced space power systems. The focus of the session is on power systems for small spacecraft, including micro and nano-satellites. The session includes theoretical as well as applied and experimental results, including advances in space power systems and concepts.

C3.5 Joint Session on Nuclear Propulsion and Power

This session, organized jointly between the space power and the Space Propulsion Symposium includes papers addressing all aspects related to nuclear power and propulsion for space applications.

C3.6 Propulsion System (1)

This session is dedicated to all aspects of nuclear rocket engines.

C3.7 Propulsion System (2)

This session is dedicated to all aspects of solid and hybrid propulsion.

C3.8 Specialised Technologies, Including Nanotechnology

This session is dedicated to all aspects of electric propulsion technologies, systems and applications. This includes theoretical and computational advances, as well as applied and experimental results. The session focuses on the impact of electric propulsion on space missions and applications.

C4 SPACE PROPULSION SYMPOSIUM

This session is dedicated to all aspects of advanced rocket systems. The Symposium is concerned with component technologies, the operation and application to missions of overall propulsion systems and unique propulsion test facilities.

C4.4 Electric Propulsion

This session is dedicated to all aspects of electric propulsion technologies, systems and applications.

C4.5 Hypersonic and Combined Cycle Propulsion

This session is dedicated to all aspects of hypersonic and combined cycle propulsion.

C4.6 Missions Enabled by New Propulsion Technology and Systems

This session explores concepts for new missions that can be enabled by specific advancements in propulsion and/or integration of various propulsion technologies and systems.

C4.7 Joint Session on Nuclear Propulsion and Power

This session, coordinated jointly between the space power and the space propulsion symposium includes papers addressing all aspects related to nuclear power and propulsion for space applications.
D1.3 System Engineering Tools, Processes and Training (1)

This session will focus on innovative space engineering methods, design techniques, tools, processes, and training that reduce the time and cost, and improve the quality of space system design. Of special interest are multidisciplinary methods, tools, and processes including modeling and simulation used to define system architectures to improve risk management, safety, reliability, testability, quality of life cycle cost estimates, and to improve the training of system engineers.

Co-Chair
Takashi Hasegawa
Japan Aerospace Exploration Agency (JAXA) — JAPAN

Rapporteur
Reinhold Bertrand
European Space Agency (ESA) — GERMANY

D1.6 System Engineering Tools, Processes and Training (2)

This session will focus on innovative space engineering methods, design techniques, tools, processes, and training that reduce the time and cost, and improve the quality of space system design. Of special interest are multidisciplinary methods, tools, and processes including modeling and simulation used to define system architectures to improve risk management, safety, reliability, testability, quality of life cycle cost estimates, and to improve the training of system engineers.

Co-Chair
Takashi Hasegawa
Japan Aerospace Exploration Agency (JAXA) — JAPAN

Rapporteur
Reinhold Bertrand
European Space Agency (ESA) — GERMANY

D2. Space Systems Symposium

D2.1 Launch Vehicles in Service or in Development

Review of current and planned launch vehicles, with a focus on launchers for small payloads. Includes innovative and reusable launch systems.

Co-Chair
Kevin Knuth
Boeing

Rapporteur
Janine van Pelt
Veeco Instruments Corporation — SWEDEN

D2.2 Launch Services, Missions, and Operations

Review of current and planned launch services and support, including economics of space transportation systems, financing, insurance. Emphasis will be on potential innovations in launch services.

Co-Chair
Kevin Knuth
Boeing

Rapporteur
Janine van Pelt
Veeco Instruments Corporation — SWEDEN

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

Discussion of existing, planned or near term advanced concepts for large and small rocket transfer cars. Discussion of current and near term transfer, entry and landing systems, sub-systems and technologies for accommodating crew and cargo in space.

Co-Chair
Kevin Knuth
Boeing

Rapporteur
Janine van Pelt
Veeco Instruments Corporation — SWEDEN

D3. Space Systems Architectures

D3.1 The Evolution of Space Systems Architectures

The session will examine space system architectures and their evolution over time, including both commercial and government-developed systems. The aim is to identify trends and commonalities in space system architectures that can inform the development of future systems.

Co-Chair
Richard Hunt
ESA

Rapporteur
Mike Acton
Centre National d’Etudes Spatiales (CNES) — FRANCE

D3.2 Lessons Learned in Space Systems

This session will cover experiences, both positive and negative, that have been encountered in space systems and how these experiences have been incorporated into future systems. The focus will be on lessons learned from real-world space systems, including both commercial and government-developed systems.

Co-Chair
Anja Boussias-Therrien
GEXIS — FRANCE

Rapporteur
Diederik van der Meer
European Space Agency (ESA) — THE NETHERLANDS

D4. Space System Development and Operations

D4.1 Space System Development and Operations — Part 1

This session will cover experiences, both positive and negative, that have been encountered in space systems and how these experiences have been incorporated into future systems. The focus will be on lessons learned from real-world space systems, including both commercial and government-developed systems.

Co-Chair
Anja Boussias-Therrien
GEXIS — FRANCE

Rapporteur
Diederik van der Meer
European Space Agency (ESA) — THE NETHERLANDS
This Symposium, organized by the International Academy of Astronautics will involve papers and discussion that traverse a wide range of highly valuable space technology and system management practices and tools that may allow a new paradigm, a “building block” approach, to be established among the spacefaring countries. Papers are solicited in these and related areas.

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

Rapporteur
William H. Siegfried
The Boeing Company — UNITED STATES

D.3.2 Systems & Infrastructures to Implement Future Building Blocks in Space Exploration and Development
The emergence of novel infrastructures and ecosystems will be needed to enable sustainable operation for future space exploration and utilization. These systems will need to be resilient and robust, enable access to space for both exploration and logistics; (2) infrastructure for affordable and reliable transportation in space, including access to lunar and planetary surfaces for robotic and supporting systems; (3) infrastructures that allow sustainable, 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.). Papers are solicited in these and related areas.

Co-Chair
William H. Siegfried
The Boeing Company — UNITED STATES

Rapporteur
Hans E.W. Hoffmann
ORBComm Inc — GERMANY

D.3.3 Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development
A visionary, far future concept that has received particular attention during the past two decades is that of the “Space Elevator” – a space access option that might, if successfully developed, enable extremely large-scale access to space at a low marginal cost. However, there remain numerous conceptual and technological challenges that must be overcome before the Space Elevator can be deemed technologically feasible, or economically viable. In support of an international cooperative approach, this session also invites reports on relevant recent R&D results, and will identify possible development strategies for Space Elevators and tethers.

Co-Chair
Peter A. Swan
Technology and Science, Inc. — UNITED STATES

Rapporteur
David Raitt
Peter A. Swan

D.4 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 will discuss the contributions in the far future of space activities to the solution of world challenges (e.g. energy, population…), and how the space systems development will support the understanding of the global societal issues. The session will also include the identification of the related technologies that need to be developed. World global challenges will be discussed and the possible contributions of space activities identified. The definition of a roadmap will be encouraged. Space-related issues including global climate change will be not covered in this particular session.

Co-Chair
Giuseppe Reibaldi
European Space Agency (ESA) — ITALY

Rapporteur
Jens Lassmann
Helsinki University of Technology — FINLAND
E1 SPACE EDUCATION AND OUTREACH SYMPOSIUM

This symposium deals with activities, methods and techniques for formal and informal space education at different educational levels, space outreach to the general public, websites, web-based developments, etc. Each of the themes in the symposium features a plenary key note speaker followed by presentation of selected papers. Symposium sessions may also include panel discussions.

When submitting abstracts for consideration, please note that:
• Papers should have clear education or outreach content - technical details of projects, even if carried out in an educational context, will not be sufficiently covered.
• Papers should clearly define their educational or outreach audience - what age groups will be included.
• More weight will usually be given to papers that clearly identify target groups, benefits, lessons learned, good practice and that include measures of critical success.

• Papers covering topics/articles 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 will result.

Co-Chair
Chair
Rapporteur

E1.1 Ignition - Primary Space Education
This session will focus on all aspects of primary space education, i.e. up to a student age of 11.
Co-Chair
Chair
Rapporteur

E1.2 Lift Off - Secondary Space Education
This session will focus on all aspects of secondary space education, for students of age 12-18.
Co-Chair
Chair
Rapporteur

E1.3 On Track - Undergraduate Space Education
This session will focus on all aspects of undergraduate space education.
Co-Chair
Chair
Rapporteur

E1.4 In Orbit - Postgraduate Space Education
This session will focus on all aspects of postgraduate space education.
Co-Chair
Chair
Rapporteur

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.
Co-Chair
Chair
Rapporteur

E1.6 Calling Planet Earth - Space Outreach to the General Public
This session will focus on activities that aim to promote awareness and understanding of space in the general public.
Co-Chair
Chair
Rapporteur

E1.7 New Worlds - Innovative Space Education and Outreach
This session will focus on new and non-standard methods of space education and outreach in non-traditional areas and to non-traditional target groups.
Co-Chair
Chair
Rapporteur

E2 Space Culture: Innovative Approaches for Public Engagement in Space
This session is organised by the IAC Technical Committee on the Cultural Utilisation of Space (IAC/CUS) and will focus on the activities of institutions such as museums, space agencies and non-profit organisations involving space that engage the cultural sector.
Co-Chair
Chair
Rapporteur

E2.1 42ND STUDENT CONFERENCE
Presentation of space-related papers by undergraduate and graduate students who participate in an international student competition.
Co-Chair
Chair
Rapporteur

CATALOGUE

Category coordinated by Chris Welch, International Space University (ISU) - FRANCE
E3.2 Data Policies in Support of Climate Change and Disaster Management Application

This session will focus on the presentation and discussion of current space policies, programmes and initiatives of national and international organisations. The session will place particular focus on space infrastructures that are critical for economic and quality of life activities.

**Chair:** Sergio Carnevale  
**Rapporteur:** Max Grimard

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe  
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E3.3 Space Economy: Valuing the Uses

**Chair:** Thierry Le Goff  
**Rapporteur:** Bertrand de Hauteclocque

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E3.4 Effects of Space Weather on GEO Satellites

**Chair:** Werner B. Balség  
**Rapporteur:** Bertrand de Hauteclocque

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E4.1 Student Conference – Part 1

Undergraduate and graduate level student teams present papers on any subject related to space sciences, industry or technology. These papers represent the work of the authors (three or more students). Students presenting in this session will compete for the most von Mises Medal Award. The guidelines for the student competition will be distributed from the session chairs to the authors after abstract acceptance.

**Chair:** Rachid Amekrane  
**Rapporteur:** Max Grimard

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E4.2 Student Team Competition

Undergraduate and graduate level student teams present papers on any subject related to space sciences, industry or technology. These papers represent the work of the authors (three or more students). The students presenting in this session will compete in the Student Conference – Part 2. The guidelines for the student competition will be distributed from the session chairs to the authors after abstract acceptance.

**Chair:** Sergio Carnevale  
**Rapporteur:** Max Grimard

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E5.2 Space Visualisation Tools - Effect on Societal Needs

This session welcomes papers on all aspects of the challenges of reimagining, sustaining, and growing accommodations for human habitation at diverse levels. In particular, this session will focus on applications that involve the use of space vehicles or space stations that orbit the Earth or are in geosynchronous orbit, the Moon's surface, the near-Earth orbit, and beyond. These space activities are fundamental to the global economy, making space a driver of innovation and development. The session encourages papers that explore the potential benefits of space-related activities, as well as the challenges and opportunities associated with them.

**Chair:** Werner B. Balség  
**Rapporteur:** Bertrand de Hauteclocque

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO

E5.3 Human Habitation Beyond Low Earth Orbit

This session welcomes papers on all aspects of the challenges of reimagining, sustaining, and growing accommodations for human habitation at diverse levels. In particular, this session will focus on applications that involve the use of space vehicles or space stations that orbit the Earth or are in geosynchronous orbit, the Moon's surface, the near-Earth orbit, and beyond. These space activities are fundamental to the global economy, making space a driver of innovation and development. The session encourages papers that explore the potential benefits of space-related activities, as well as the challenges and opportunities associated with them.

**Chair:** Werner B. Balség  
**Rapporteur:** Bertrand de Hauteclocque

**Speakers:**
- **Guido H. M. van den Heuvel**: ESA – Europe
- **Sergio Carnevale**: CEMTEC – Regional Centre for Space Science and Technology Education for Latin America and The Caribbean – MEXICO
Space as an Artistic Medium

Since the late 70s and early 80s a small group of artists has been exploring the potential of outer space as a medium for art. The application of space technology, materials, and data, coupled with an artistic vision, has created an art that is highly innovative and far removed from mainstream discourse. Examples of this innovative space art include satellite-based video installations, on-orbit painting, and urban light installations.

... (continued on next page)
MISSION SUCCESS. A JOURNEY DRIVEN BY INNOVATION.

We could tell our story by the numbers; 66,000 engineers, scientists and technologists, supporting 4,000 mission-critical programs in 75 countries. Lockheed Martin’s innovators and creative thinkers define our capabilities. They bring unparalleled experience and accomplishments to the skies and to the battlefields, as they answer our 21st century challenges in cyber security, energy and climate change, healthcare, and transportation. Driving innovation, and providing affordable and relevant global security solutions for our company and the world, is all a question of how. And it is the how that Lockheed Martin delivers.
Instructions to Authors

Abstract Preparation
Format
• Abstracts must be written in English
• Abstracts length should not exceed 400 words
Content
• Tables or drawings are not allowed in the abstract
• Formulas can be included using the toolbox 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 at www.iafastro.org.
• If it is the first time you submit an abstract on our website, you will need to register yourself.
• 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 where you want to submit your abstract
• Type-in the title and content of your abstract in the related fields
• Choose your presentation preference: oral presentation only, poster presentation only, oral or poster
• Indicate if the material is new and original and that it was not presented at a previous meeting.
• Indicate if the attendance at the IAC 2012 to deliver the paper and present it is assured.

Note:
• An abstract can be submitted to only one Technical Session

Abstract Selection
Submitted abstracts will be evaluated by the Session Chairs on the basis of technical quality and relevance to the session topics. Selected abstracts may be chosen for eventual oral or poster presentation – any such choice is not an indication of quality of the submitted abstract. Their evaluation will be submitted to the Symposium Coordinators, who will make acceptance recommendations to the International Programme Committee which will make the final decision. Please note that any relevance to the Congress main theme will be considered as an advantage.

Paper and Presentation Submission
• Details on how to prepare and submit your final paper as well as your presentation material will be available on www.iafastro.org by mid-April.
• Authors having a paper accepted for an oral presentation will be offered a presentation slot of duration of 10 to 20 minutes.
• Authors having a paper accepted for a poster presentation will be asked to prepare and bring an A0 poster to the Congress.

International Astronautical Federation (IAF)
The IAC proceedings will be distributed as a DVD to all regular Congress participants. More information about the IAC paper archive is available on www.iafastro.org.

International Academy of Astronautics (IAA)
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.

International Institute of Space Law (IISL)
Authors should follow the above instructions for the submission of their abstracts. In addition to the IAC Proceedings DVD, the papers of the Colloquium, along with other materials, will be published in the Proceedings of IISL. Authors who qualify may request 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.

DEADLINES

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Please make sure to check the IAF website regularly to get the latest updates on the Technical Programme!
Space in Italy

Italy has a very long history of achievement within the space industry. From Giulio Costanzi, who wrote before the First World War of orbital navigation and nuclear propulsion, to Gaetano Arturo Crocco who helped to develop the gravity assist technique vital for use by all solar system exploration probes, Italian scientists have been vital to the modern development of space travel.

Under the leadership of Luigi Broglio (1911-2001), the unanimously recognised father of Italian astronautics, Italy became the third country in the world – in 1964 – to build and operate a satellite in orbit around the Earth. It also was the first country to deploy an equatorial launching pad, the San Marco, and to conduct successful experiments in launching from it.

As one of the earliest countries to be engaged in space exploration, Italy became a founder and key partner in both the European Launcher Development Organisation and the European Space Research Organisation. These two would later merge to form the European Space Agency (ESA).

Since 1988, the Italian Space Agency (ASI) has been coordinating and promoting Italy’s activities in the field of astronautics. It has a key role at the European level as the third contributor country to ESA.

The importance of Campania in aerospace technology is evidenced by the presence in the region of prestigious universities, the numerous research facilities and the close interconnection between the industry and R&D.

The tradition of research and technological innovation sees CIRA (Italian Centre of Aerospace Research) as the key player and includes INAF, ENEA, CNR, the Regional Centres of Expertise (MARS, AMRA, CERIC, New Technology, Technapoli), and the consortium of private SME companies such as ALI, SAM and CHAIN.

Prof. Luigi Carrino
President, Campania Aerospace Research and Network

NAPLES – THE CITY

Naples is a city full of life that for about three millennia has become a special and important capital for Mediterranean culture. It is world famous for its artistic contribution, natural beauty and long history.

According to the ancient Greeks and Romans, the origin of Naples is connected to the legend of the beautiful goddess Parthenope. The city is still full of monuments from those ancient times.

This former regal diva has three royal palaces, a superlative archaeological museum, art collections spanning from the classics to Jeff Koons, and an ancient centro storico bursting with secret frescoed chapels and citrus-filled cloisters. Here, restaurants are family heirlooms.

Matching other global centres, Neopolitans can boast world-class design, trendy bars and cool clubs. Here though, the cutting edge lives side by side with the Naples of neorealist film director Vittorio de Sica’s imagination.

A film star in its own right, the fabled Amalfi Coast rolls out to the south. Lush cliffs plunge into creamy-blue seas and chic’s coastal towns read like a celebrity roll call. Across the Bay of Naples sits bewitching Capri, home to a neon-blue grottos and holidaying superstars.
But like the city’s native thin-crust pizzas, there is more beneath the surface.

Naples is Italy’s fourth-richest city. It is the world’s 91st richest city by purchasing power, with an annual GDP of $43 billion. Were Naples a country, it would have the world’s 68th biggest economy, approaching the size of that of Qatar. Naples is a major cargo terminal, and the port of Naples is one of the Mediterranean’s biggest and most important. The city has experienced significant economic growth since World War II.

Furthermore, Naples lies at the heart of the Campania region’s aerospace and astronautics sector and has been since the 1930s. Of recent company licences issued, according to statistics from the European Patent Office, 55% were in the field of high technology, and the city has about 100 enterprises dedicated to the aeronautics sector.

In Naples you can find important research centres, two world-class universities and faculties of aerospace engineering, a science park, dedicated technological districts and the Italian Space Agency, ASI.

The ability to innovate, cooperate and network have been the key to the economic success of the area which is still growing faster than the Italian national average - about 8% per year.

Naples – truly a city of the past looking strongly to the future.

CAMPANIA – THE REGION

Campania is the region in southern Italy whose capital is Naples. The region has a population of around 5.8 million people, making it the second-most-populous region of Italy; its total area of 11,930 square kilometres makes it the most densely populated region in the country.

The region has a dense network of road and motorways, a system of maritime connections and an airport at Naples which connect it rapidly to the rest of the country and world.

Campania is rich in culture, especially in regards to gastronomy, music, architecture, archeological and ancient sites such as Pompeii, Herculanum and Paestum. The name of Campania itself is derived from Latin, as the Romans knew the region as campania felix, which translates into English as «fertile countryside».

While still notable for its agriculture, industry is now especially well-established in the zones around Naples and Salerno. Companies such as Olivetti came to prominence especially after the end of the Second World War and the region has continued to specialise at the high-end of technology. The services sector makes up 78% of the region’s gross domestic product.