



INTERNATIONAL
ASTRONAUTICAL
FEDERATION

IAF HIGHLIGHTS

2024



*Connecting @ll Space People
for a sustainable future*

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Abbreviations

3G	Geography, Generation, Gender	JAXA	Japan Aerospace Exploration Agency
AEB	Brazilian Space Agency	JPL	Jet Propulsion Laboratory
AI	Artificial Intelligence	JWST	James Webb Space Telescope
AIAA	American Institute of Aeronautics and Astronautics	LCNS	Lunar Communication and Navigation Service
ALCE	Latin American and Caribbean Space Agency	LCRD	Laser Communications Relay Demonstration
API	Application Programming Interface	LEO	Low-Earth Orbit
ASI	Italian Space Agency	LTS	Long-term Sustainability
CLIODN	Committee for Liaison with International Organisations and Developing Nations	MMoP	International Meeting for Ministers and Members of Parliaments
CNSA	China National Space Administration	MMX	Martian Moons eXploration
COSO	Committee of Sponsoring Organizations	MTG	Meteosat Third Generation
COPUOS	Committee on the Peaceful Uses of Outer Space	NASA	National Aeronautics and Space Administration
CSA	Canadian Space Agency	NEO	Near-Earth Object
CNES	Centre National d’Etudes Spatiales	NLP	Natural Language Processing
DART	Double Asteroid Redirection Test	NOSA	Norwegian Space Agency
DLR	German Aerospace Center	NSIL	NewSpace India Limited
EO	Earth Observation	OSAM	On-orbit Servicing, Assembly, and Manufacturing
ESA	European Space Agency	PNT	Positioning, Navigation and Timing
ESOC	European Space Operations Centre	PPP	Public-Private Partnerships
EVAs	Extravehicular Activities	QKD	Quantum Key Distribution
FAA	Federal Aviation Administration	R&D	Research and Development
GNSS	Global Navigation Satellite System	SAR	Search and Rescue
GPS	Global Positioning System	SDGs	Sustainable Development Goals
GRC	Governance, Risk and Compliance	SDR	Software Defined Radio
HSF	Human Spaceflight	SLS	Space Launch System
IADC	Inter-Agency Space Debris Coordination Committee	SOCA	Space Operations Committees Alumni
IAF GNF	Global Networking Forum	SpS	Special Sessions
ISEP	IAF Space Economic Platform	SRM	Solid Rocket Motor
ISO	International Organization for Standardization	STEM	Science, Technology, Engineering and Mathematics
ISRO	Indian Space Research Organisation	SWOT	Surface Water and Ocean Topography
ISS	International Space Station	TC	Technical Committee
ISU	International Space University	UN	United Nations
ITU	International Telecommunication Union	WG	Working Groups

Welcome Message



Clay Mowry

*President,
International Astronautical
Federation (IAF)*

As we reflect on 2024, I am proud to share how the International Astronautical Federation (IAF) continues to evolve alongside the expanding global space community. This year, we were delighted to welcome 73 new member organizations, bringing our total membership to 563 organizations from 81 countries. This remarkable growth underscores our shared commitment to advancing collaboration across the space sector.

Throughout the year, the IAF has hosted an array of impactful events, demonstrating the diversity of our activities and the strength of our community. From the IAF Spring Meetings in Paris to the International Space Forum in Bahrain and culminating in the record-breaking 75th International Astronautical Congress (IAC) in Milan.

The 75th IAC reached unprecedented heights, drawing over 11,200 participants from 120 countries. Making it not only the largest IAC ever but also one of the most diverse gatherings of space people in our galaxy. The congress also boasted an extraordinary exhibition space of 11,500 m² with 166 exhibitors. This historic IAC is leaving an impressive legacy, demonstrating the magic of having our community gathering in one place, from all over the globe and unite around the shared passion for space.

In this edition of the IAF Highlights, I am delighted to introduce the IAF Logbook - a new initiative that captures the Federation's engagements and contributions to global space advocacy throughout the year. This project brings to life the incredible journey of connecting and collaborating with governments, industry leaders, academics, and civil society at key international events. Through these efforts, we continue to address emerging challenges, advocate for sustainability, and promote equitable access to space.

Looking ahead, 2025 promises to be an exciting year for the IAF. In May, we invite you to the Global Conference on Space Exploration (GLEX 2025) in New Delhi, India, from 7 - 9 May. GLEX 2025 will provide a unique platform to share insights on space exploration policies, programmes, and challenges, with a record-breaking 1,275 abstracts submitted from 57 countries. Later in the year, we will gather in Sydney, Australia, for the 76th International Astronautical Congress from 29 September to 3 October 2025. Under the theme "Sustainable Space: Resilient Earth," IAC 2025 will explore critical topics, including sustainable space activities, Earth-focused applications, and humanity's future in space. This IAC will particularly highlight advancements in the Asia-Pacific region, promising an unforgettable experience in one of the world's most iconic cities.

Finally, I would like to thank you for your continued support and enthusiasm for the IAF's mission and wish you all the best for a prosperous 2025!

IAF 2024

Events Overview



IAF General Assembly Report 2024

The International Astronautical Federation General Assembly has gathered during the International Astronautical Congress, IAC 2024 in Milan, Italy in two sessions (Monday, 14 October 2024, and Friday, 18 October 2024).

2024 Elections of IAF Officers

Four new Vice-Presidents have been elected by the General Assembly:



Amal ALBINALI, Director of Strategic Planning and Projects at the National Space Science Agency (NSSA), has been appointed as IAF VP for Education and Workforce Development.



Samaddin ASADOV, Chairman of the Board at Azercosmos Space Agency of the Republic of Azerbaijan, has been appointed as IAF VP for Science and Academic Relations.



Enrico PALERMO, Head of the Australian Space Agency, has been appointed as IAF VP for Space Agency Relations and will oversee and support our Heads of Agency events including the Global Space Leaders' Summit.



David SPENCER, Vice President for Publications at the American Astronautical Society (AAS) and Senior staff Member at the Aerospace Corporation has been appointed as IAF VP for IAF Global Networking Forum.

One incoming President has been elected:



Gabriella ARRIGO, Director International Affairs, Italian Space Agency (ASI), has been elected as IAF Incoming Vice President.



Selection of Host City for IAC 2027

The IAF General Assembly at its second session on 18 October 2024, selected Poznań, Poland as Host City for IAC 2027. The Hosting Organization is the European Space Foundation, an IAF member since 2021.

IAF Finance

The IAF has also approved the **final accounts 2023** and **Auditor's Statement 2023** and the **revised budget and preliminary accounts 2024** and the **Proposed Budget 2025**.



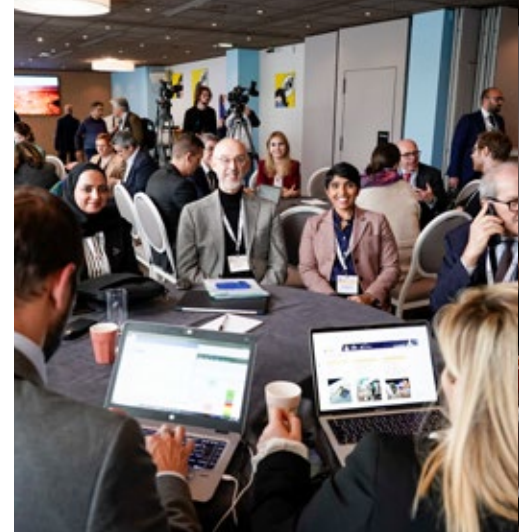
New IAF Members

The IAF General Assembly also approved the applications of **73 new Member Organizations**. With this, the IAF Membership comprises **563 Member Organizations** from **81 countries**, bringing 6 new countries in the Federation Members’ community, Armenia, Chile, Kazakhstan, Malta, Oman and Philippines, re-confirming IAF’s position as a truly global Federation.

The New IAF Members are:

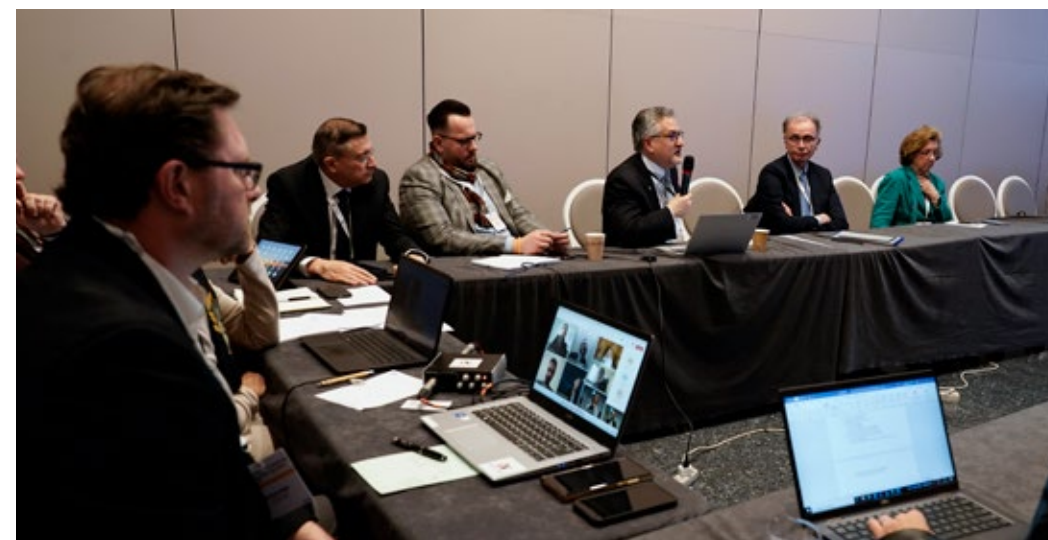
Organization	Category	Region	Country
Advanced Space	Space Industry	North America	United States
Aerospace Valley	Associations and Professional Societies	Europe	France
AGH University of Krakow	Universities	Europe	Poland
AIPAS – Association Of Italian Space Enterprises	Associations and Professional Societies	Europe	Italy
Akula Tech	Space Industry	Oceania	Australia
ALATYR	Space Industry	Europe	France
Alpha Impulsion	Space Industry	Europe	France
Angelantoni Test Technologies Srl	Space Industry	Europe	Italy
Armenian Aerospace Agency	Space Agencies / Space Offices	Asia	Armenia
ASELSAN	Space Industry	Europe	Türkiye
Astra-Terra Ltd.	Space Industry	Europe	United Kingdom
BIOSEC SOLUTIONS LIMITED	Space Industry	Africa	Nigeria
Boryung Corporation	Space Industry	Asia	Republic of Korea
Budapest University of Technology and Economics	Universities	Europe	Hungary
Center for Space Commerce and Finance	Associations and Professional Societies	North America	United States
Czech Aerospace Research Centre	Research and Development Organisation	Europe	Czech Republic
Designers in Space Community	Associations and Professional Societies	Europe	United Kingdom
Ecosmic s.r.l.	Space Industry	Europe	Italy
Edge Aerospace	Space Industry	North America	United States
EllipSpace	Space Industry	Asia	China
EURO2MOON	Associations and Professional Societies	Europe	Luxembourg
Everlight Space	Space Industry	Asia	China
Exobotics Ltd	Space Industry	Europe	United Kingdom
Faculty of Electrical Engineering and Information Technology of Slovak University of Technology in Bratislava	Universities	Europe	Slovakia
FOSSA Systems	Space Industry	Europe	Spain
Fundación Cydonia	Space Industry	Latin America & Caribbeans	Colombia
Ghalam	Space Industry	Asia	Kazakhstan
Gran Sasso Science Institute	Universities	Europe	Italy
Organization	Category	Region	Country
HAVELSAN	Space Industry	Europe	Türkiye
Indian National Space Promotion and Authorization Centre (IN-SPACe)	Space Agencies / Space Offices	Asia	India
Indian Space Association (ISpA)	Associations and Professional Societies	Asia	India
Intella S.r.l.	Space Industry	Europe	Italy
International Alliance of Aerospace Information Industry Ltd.	Associations and Professional Societies	Asia	Singapore

Organization	Category	Region	Country
Ionosphere institute	Space Industry	Asia	Kazakhstan
iSaisei Corporation	Space Industry	Europe	Italy
KazSat	Space Industry	Asia	Kazakhstan
Korea Electrotechnology Research Institute	Research and Development Organisation	Asia	Republic of Korea
Korea Testing Laboratory	Research and Development Organisation	Asia	Republic of Korea
Malaysia Space Industry Consortium (MASIC)	Associations and Professional Societies	Asia	Malaysia
MARS Exploration Pvt Ltd	Space Industry	Asia	India
MISI - MOROCCAN INITIATIVE FOR SPACE INDUSTRY	Associations and Professional Societies	Africa	Morocco
Moonshot Space	Space Industry	Asia	Israel
Nara Space	Space Industry	Asia	Republic of Korea
Oman National Space Center, Advanced Technology and AI	Space Agencies / Space Offices	Asia	Oman
Open Lunar Foundation	Research and Development Organisation	North America	United States
Orienspace Technology	Space Industry	Asia	China
Philippine Space Agency (PhilSA)	Space Agencies / Space Offices	Asia	Philippines
PIESAT Information Technology Co.,Ltd.	Space Industry	Asia	China
Polish Space Industry Association	Associations and Professional Societies	Europe	Poland
Qosmosys	Space Industry	Asia	Singapore
Rakia Mission	Space Industry	Asia	Israel
Russian Academy of Sciences	Research and Development Organisation	Europe	Russia
Sant’Anna School of Advanced Studies	Universities	Europe	Italy
SARsatX	Space Industry	Asia	Saudi Arabia
SATELIOT	Space Industry	Europe	Spain
Science Malta	Research and Development Organisation	Europe	Malta
Organization	Category	Region	Country
SETI Institute	Research and Development Organisation	North America	United States
Shenzhen MagicCubeSat Technology Co., Ltd.	Space Industry	Asia	China
Space Centre Australia	Space Industry	Oceania	Australia
Space Entrepreneurship Institute	Research and Development Organisation	Europe	Poland
Space Products and Innovation (SPiN)	Space Industry	Europe	Italy
Spacely Chile	Space Industry	Latin America & Caribbeans	Chile
Starbound Space Solutions	Space Industry	Oceania	Australia
STARS International University	Universities	Asia	Uzbekistan
Swissmem	Associations and Professional Societies	Europe	Switzerland
TRANSPACE TECHNOLOGIES PVT LTD	Space Industry	Asia	India
Turkish Technology Team Foundation	Associations and Professional Societies	Europe	Türkiye
TY-Space Technology (Beijing) Ltd.	Space Industry	Asia	China
UNIO Enterprise GmbH	Space Industry	Europe	Germany
University of Padua	Universities	Europe	Italy
Vast	Space Industry	North America	United States
VENTURI SPACE	Space Industry	Europe	Monaco
Wenchang International Aerospace City Administration	Space Industry	Asia	China



IAF Spring Meetings 2024

26 – 28 March 2024 | Paris, France



From 26 – 28 March 2024, the Bureau and members of the International Astronautical Federation (IAF) gathered in Paris, France for its annual Spring Meetings. Various events took place during the three days, including the selection of abstracts for IAC 2024; IAF “3G” Diversity events; committees’ meetings including two sessions of the IAF Bureau; and IAF GNF sessions.

The IAF Global Networking Forum featured inspiring sessions on Europe’s Space Ambition, EURO2MOON and all the IAF upcoming events. This was followed by the traditional IAF Cocktail.





International Space Forum at Ministerial level

Manama, Kingdom of Bahrain | 2 July 2024



6th International Space Forum at Ministerial level (ISF)

– The Gulf Chapter

Launched in 2015, under the auspices of the IAF Vice President for Science and Academic Relations, the International Space Forum represents an annual gathering at Ministerial Level aiming to encourage a global discussion and debate on the necessity of promoting a greater involvement of local communities in space activities and programmes, with the ultimate goal of finding better and local space solutions to global challenges.

Following the first International Space Forum in Trento (Italy) and the following regional Chapters focusing on Africa region (Nairobi, 2017), the Latin America region (Buenos Aires, 2018), the Mediterranean region (Reggio Calabria, 2019), the Central America and Caribbean region (Panama City, 2023), the Gulf Chapter facilitated open and productive discussions on the wish to increasingly involve all potential players, including Academia and Universities, of the region in space programs and activities, so to create new opportunities and means to better address local challenges.

The success of such a meeting begins with its preparation but can be truly measured only by its participation and the engagement of the attending delegations. In this respect, this year was truly remarkable, and we would like to express our sincere thanks to all the delegates who joined us Manama. A total of 15 countries from the region and beyond, and 13 Space Agencies and International Organizations from all over the world, took part in the Forum. The involvement of various actors from government, space agencies, universities and technical institutions shows that these entities are aware of the major role that space must play in supporting the further development of the region.

During the Forum, discussions on earth observation, space exploration, and space policies highlighted the crucial need to harness space technologies for socio-economic development, foster international cooperation, and promote the sustainable and responsible use of outer space to preserve the Gulf region's rich natural resources.

Given its unique geographical location and natural elements, the Gulf region stands as an exceptional resource that requires protection, and the application of space technologies is vital in achieving this goal.

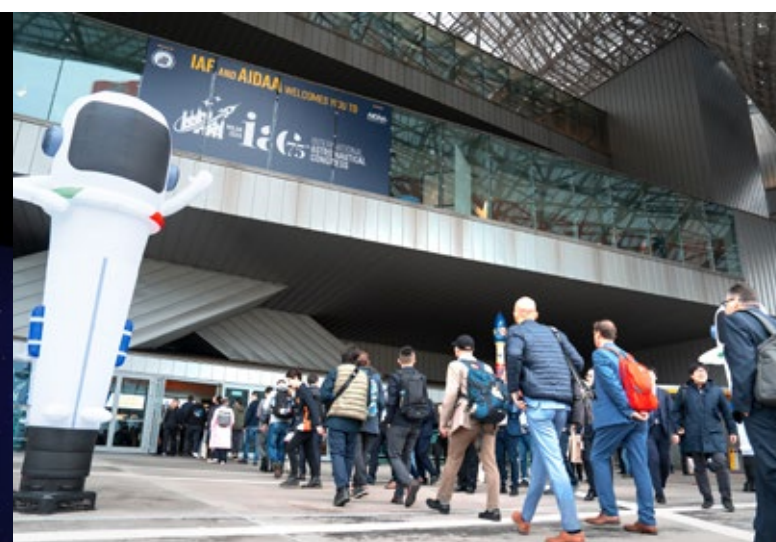
These and many more topics, were widely discussed during the Forum and were brought to light by the statements of the delegations. We hope that the International Space Forum will inspire new forms of cooperation and partnership, not only in the Gulf region, but throughout the whole world.





International Astronautical Congress

14 - 18 October 2024 | Milan, Italy



IAC 2024

Opening Ceremony

In a city where Leonardo da Vinci once sketched his visionary flying machines, over 11,000 space professionals from 120 nations gathered on Monday for the opening of the 75th International Astronautical Congress (IAC), marking a historic assembly of space professionals. The congress, themed “Responsible Space for Sustainability,” commenced in the heart of Milan, paying homage to the city’s rich aerospace legacy.

Italian art historian Jacopo Veneziani set the tone with an emotional tribute, stating, “Right here in Milano, more than 500 years ago, the young Leonardo da Vinci studied the flight of birds and devoted himself to designing flying machines.” This poignant connection between Renaissance aspirations and contemporary space exploration resonated deeply with attendees.

Clay Mowry, President of the International Astronautical Federation (IAF), emphasized the unprecedented scale of this gathering. “This is the largest gathering of space professionals in our solar system,” he declared, announcing that nearly 11,000 delegates would participate, with public attendance expected to elevate total participation to approximately 15,000.

The congress signifies several remarkable milestones in space exploration. Roberto Cingolani, CEO of Leonardo Spa, heralded this era as a “renaissance of space,” characterized by unparalleled collaboration between the public and private sectors. “I think space is now facing a new renaissance,” Cingolani remarked. “This is not only because we are advancing in technologies, but also because big companies and private individuals are entering the game.”

Teodoro Valente, President of the Italian Space Agency (ASI), highlighted the congress’s commitment to inclusivity, emphasizing initiatives designed to support participation from emerging space nations. “We are especially proud that this year’s IAC is truly inclusive, with representation across geographic diversity and generational impact,” Valente stated, noting special programs aimed at enabling participation from Africa and Latin America.

The opening ceremony took an innovative turn with the announcement of a time capsule project by master of ceremonies Camila Raznovich, an Italian television presenter. This initiative will send recordings from the congress to astronauts aboard the International Space Station, symbolizing the vital connection between Earth and space.

Wanda Díaz-Merced, an astronomer renowned for her work in multisensory astronomy, offered a compelling perspective on making space science more accessible. “As a scientist, I have been working tirelessly to establish multisensory perception as an autonomous part of data analysis in astrophysics,” she explained, challenging traditional approaches to astronomical data analysis.

The ceremony’s prestigious awards segment was co-presented by Asanda Ntswana, Acting Managing Director of Earth Observations at the South African National Space Agency (SANSA). Ntswana proudly announced the IAF World Space Award winner: “As a vice president of the International Astronautical Federation, I am honored to announce that the World Space Award for 2024 goes to the Indian Space Research Organization (ISRO) for Chandrayaan-3.”



ISRO Chairman Sreedhara Somanath accepted the award, reflecting on India’s remarkable space journey: “It’s a journey we started in 2007, conceiving the first-ever mission to the Moon... I think this changed the perception of further exploration on the Moon, not only from India but around the world.”

The event featured prominent Italian astronauts, including Samantha Cristoforetti, the first Italian woman in space and ISS commander, who shared her personal connection to Milan: “This is my very first IAC... this is the city I was born in.” Her colleague Luca Parmitano, the first Italian to command the ISS, offered a poet’s perspective on viewing Earth from space: “The words simply do not exist... my recommendation to the public would be that next time we should send a poet to invent new words.”

Two IAF Excellence in International Cooperation Awards were presented. The first recipient, Gabriella Arrigo of the Italian Space Agency (ASI), emphasized the importance of global collaboration: “Throughout my professional life, I’ve been committed to fostering international space cooperation... Always believing in the power of dialogue as the primary tool for progress.”

The second award went to Michael Gold of Redwire, who highlighted space exploration’s unifying power

amid global challenges: “Nothing, and I mean nothing, brings humanity together like space exploration and development. Whatever challenges the world may face, let space be the torch that lights up the night.”

The ceremony also introduced ESA Reserve Group astronauts Andrea Patassa and Anthea Comellini, representing the next generation of space explorers. Comellini shared her personal connection to the venue: “I’m an alumna of Politecnico di Milano, where my passion for space was ignited.”

In his closing address, Erasmo Carrera, President of the Italian Association of Aeronautics and Astronautics (AIDAA), underscored the historic significance of hosting the congress in Italy during its “Aerospace Italy 2024” year. He announced record-breaking participation with “more than 11,000 participants... across the globe, over 20,000 square meters of exhibition space showcasing the cutting-edge technologies and innovations of more than 500 companies.”

The ceremony concluded with a powerful reminder of the space sector’s broader mission, encapsulated in Carrera’s reference to the IAF motto: “Astronautica ad pacem hominumque progressum.” ■





IAC 2024 Plenaries



One-to-One with Heads of Agencies

At the opening plenary of the 75th International Astronautical Congress, leaders from the world's major space agencies convened to share their visions for humanity's future in space, emphasizing the vital themes of sustainability, international cooperation, and responsible exploration. In a series of candid conversations, they highlighted both the remarkable achievements and the pressing challenges facing the global space sector.

Moderated by Clay Mowry, President of the International Astronautical Federation (IAF), and Tanja Masson-Zwaan, IAF Vice President, agency heads detailed ambitious plans for lunar exploration, climate monitoring, and debris mitigation, while underscoring the growing importance of commercial partnerships in achieving these goals.

"Our passion for space exploration is not merely our profession," stated Teodoro Valente, President of the Italian Space Agency (ASI), in his opening remarks. "The space economy has emerged as a pivotal force propelling the advancement of the global economy." Valente emphasized the need to effectively communicate the significance of space applications to both the general public and policymakers.

The session revealed a strong consensus among space powers regarding the urgent need to address orbital sustainability. Josef Aschbacher, Director General of

the European Space Agency, announced that over 100 organizations have now signed ESA's Zero Debris Charter, committing to the responsible removal of satellites from orbit at the end of their operational lives. "I'm quite impressed and quite surprised actually how big the interest in this charter is," Aschbacher remarked, noting that signatories include major commercial players like Amazon. This initiative represents a significant step toward tackling the growing challenge of orbital debris.

Bill Nelson, NASA Administrator, reaffirmed the United States' commitment to international partnership in lunar exploration through the Artemis program. "We're going back to the Moon. Not just to go to the Moon—we did that a half-century ago," Nelson emphasized. "We're going to a different part of the Moon, in a different way, with our international partners and our commercial partners." He outlined plans for the first lunar landing under the Artemis program, scheduled for late 2026, and emphasized the program's role as a stepping stone to eventual Mars exploration.

The success of international cooperation was evident in several significant achievements highlighted during the session. Hiroshi Yamakawa, President of the Japan Aerospace Exploration Agency (JAXA), celebrated the recent successful landing of the SLIM spacecraft on the lunar surface, calling it "a great milestone for us to the next steps." He detailed JAXA's contributions to the Artemis



“Our passion for space exploration is not merely our profession”

program, including the development of a pressurized lunar rover, and highlighted the agency's commitment to commercial space development through Japan's new Space Strategy Fund.

Sreedhara Somanath, Chairman of the Indian Space Research Organisation (ISRO), fresh from receiving the World Space Award for India's Chandrayaan-3 mission to the lunar south pole, outlined ISRO's ambitious plans. "We would like to continue the program of going to the Moon with serious missions, possibly with a view to developing the capability to land humans on the Moon by 2040," he stated. Somanath also announced India's own initiative for debris-free space missions, targeting implementation by 2030.

The growing role of commercial partnerships and new space actors was emphasized by Lisa Campbell, President of the Canadian Space Agency. "International collaboration is in our DNA at the Canadian Space Agency (CSA)," Campbell noted. "It allows us to focus on our strengths, but also to achieve incredible things with our partners." She highlighted Canada's contributions to lunar exploration, including the Canadarm3 robotic system for the lunar Gateway and the historic selection of Canadian astronaut Jeremy Hansen for the Artemis 2 mission around the Moon.

In a highlight of the session, Guoping Li, Chief Engineer of the China National Space Administration (CNSA), showcased lunar samples recently returned by the Chang'e-6 mission from the far side of the Moon. Li announced that China's upcoming lunar missions would welcome international participation, noting that the Chang'e-8 mission, planned for 2028, would accommodate "around 200 kg as a scientific payload" from international partners. He also outlined China's ambitious planetary exploration plans, including missions to Mars and Jupiter by 2030.

Climate change emerged as a crucial concern for all agencies. Campbell highlighted Canada's particular challenges: "The last two summers brought the most extreme wildfires that the country has ever seen. We're on the front lines of that issue, and we recognize that the knock-on effects of these blazes are not only in our country." She announced new initiatives, including WildFireSat, a dedicated satellite for wildfire management, and emphasized the importance



of international collaboration in addressing global environmental challenges.

The session, skillfully managed by Christian Feichtinger, IAF Executive Director, showcased the space sector's evolution toward greater inclusion and diversity. Campbell led a powerful moment recognizing women in the audience, emphasizing the importance of removing barriers to participation in the space sector. "Surely, if any sector can figure out that you need to get rid of barriers so that you can bring in all of the ideas, it should be the space sector," she asserted, highlighting various initiatives to increase representation in the space industry.

The leaders' discussions revealed a space industry in transformation, balancing traditional government programs with commercial partnerships while confronting challenges from orbital debris to climate change. Their message was clear: the future of space exploration will be built on international cooperation, commercial innovation, and sustainable practices.

As Nelson poignantly observed in his closing remarks, drawn from his own spaceflight experience: "When you look at Earth from the window of a spacecraft, as you orbit the Earth, I did not see religious division, I did not see racial division, and I did not see political division. What I saw as I orbited the Earth was that we are all in this together. We are all citizens of planet Earth."



Responsible and Sustainable Space Exploration: Moon to Mars

As humanity sets its sights on returning to the Moon and eventually reaching Mars, leaders from the world's premier space organizations gathered at the International Astronautical Congress to tackle a pressing question: How can we ensure space exploration remains sustainable and inclusive?

The second plenary session of IAC 2024, titled "Responsible and Sustainable Space Exploration: Moon to Mars," brought together space agency heads and industry leaders to discuss the challenges of maintaining responsible practices beyond Earth's orbit. The timing proved particularly relevant, as recent events on the International Space Station highlighted the complexities of space operations and international dependencies.

Aarti Holla-Maini, Director of the United Nations Office for Outer Space Affairs, opened the discussion by referencing a recent situation involving two astronauts who stayed longer than anticipated on the ISS. "Besides reminding us that space exploration is still extremely complex, dangerous, risky, and obviously expensive, this scenario provides a great example against which to measure how we might approach future space exploration activities," she

“One to mean a sustained presence, like how are we going to make this work long term?”

like how are we going to make this work long term? And then it's also referred to in the aspect of the way we apply it here terrestrially," she explained. Melroy emphasized the importance of redundancy, noting that "the idea that if people want dedicated communications capability... what's critical is that we have a set of standards interoperability."

The role of emerging space nations emerged as a central theme. Teodoro Valente, President of the Italian Space Agency, highlighted Italy's approach through initiatives



said, adding that "within the next five years, we could so easily see this kind of scenario on the Moon."

The discussion revealed a fundamental tension between rapid advancement and responsible development. Pam Melroy, NASA's Deputy Administrator, addressed this by distinguishing between two interpretations of sustainability in space. "One to mean a sustained presence,

like the Matei Plan for Africa. "We will discuss, we will continue to discuss with them, not for them, together with them," he emphasized, describing successful collaborations like Italy's long-standing partnership with Kenya through the Malindi base.

Roberto Cingolani, CEO of Leonardo Spa, brought a sobering industry perspective to the discussion. "We're not



so free to do what we want, because as you know, there are geopolitical balances to respect in Europe,” he explained. He emphasized that while space exploration represents “the pinnacle of human knowledge,” early stages won’t be driven by profit: “You don’t do this for money at the beginning, at least.”

Didier Schmitt, the European Space Agency’s Strategy and Coordination Group Leader for Human and Robotic Exploration, detailed ESA’s forward-thinking approach. “We have now started an initiative to have a few small missions around the Moon and Mars in the range of 50 to 80 million, launch included,” he said, adding that “there is immense interest for small countries to participate.”

Erasma Carrera, President of the Italian Association of Aeronautics and Astronautics, stressed the importance of education and talent development. “Brilliant minds

are everywhere,” he noted, calling for more structured programs to engage emerging space nations. He suggested incorporating these initiatives into existing frameworks: “Why do we not write in the Artemis Accords something related to this point?”

The discussion frequently returned to the challenges of coordinating multiple systems around the Moon. With various communication and navigation systems being planned, concerns about congestion emerged. “The Moon is one-sixth the size of Earth. It cannot support so many systems,” Holla-Maini warned. Schmitt revealed ESA’s ambitious plans: “We have the Pathfinder in preparation... our next flagship around Mars is really centered on communication and navigation capabilities.” He emphasized the need to think beyond current challenges: “We think solar system Internet is the next way ahead.”

The session highlighted the complex balancing act facing the space community: maintaining momentum in space exploration while ensuring sustainability, fostering international cooperation while protecting national interests, and promoting commercial development while establishing responsible practices.

Looking to the future, the panelists offered varying perspectives. Cingolani provided a realistic assessment: “We’ll be struggling like today. We know exactly where we have to go, but how we arrived there is unclear yet.” Valente offered a more optimistic view: “We will be on the Moon... we have very important technology now, which is already developed and deeply impacting our technology.”

The plenary concluded with a special ceremony presenting the inaugural Broglio Medal to Ernesto Valerani for his pioneering contributions to human spaceflight. The award highlighted Italy’s journey in space exploration, from a time when, as Valerani noted, “it was impossible to believe that we could participate in the exploration” to becoming a leader in space station module construction. As humanity prepares for its next giant leap, the consensus among leaders is clear: success will require unprecedented levels of international collaboration and a shared commitment to sustainability, all while ensuring that space exploration benefits humanity as a whole.



New Lunar Frontiers: How The Non-Space Industry Is Unlocking Future Markets

As humanity enters what many are calling a “lunar revival,” leaders from non-traditional space sectors gathered at the International Astronautical Congress to showcase how their expertise could transform life beyond Earth, challenging conventional notions of what space exploration can be. Moderated by Charlotte Nassey, Senior Government Affairs & Policy Officer at ispace Europe, the third plenary session of IAC 2024, titled “New Lunar Frontiers: How The Non-Space Industry Is Unlocking Future Markets,” brought together innovators from pharmaceuticals, nuclear power, design, and agriculture to discuss their vision for a sustainable lunar presence. Their message was clear: the future of space exploration requires expertise that extends far beyond traditional aerospace engineering.

“Wherever we go, humans have to survive and live,” stated Jay Kim, CEO and Chairman of Boryung, a Korean pharmaceutical company. Kim, whose grandfather founded the company as a pharmacy after the Korean War, is now leading investments in space healthcare, including Axiom Space’s private space station project. “My grandfather hates me,” Kim quipped, humorously acknowledging the challenge of convincing traditional pharmaceutical leadership to embrace space ventures. However, he emphasized that addressing human health challenges in space will necessitate solutions from established medical expertise: “Fundamentally improving the understanding of our body itself will produce technology that we have never seen before.”

Barbara Belvisi, CEO of Interstellar Lab, shared her journey from venture capital to space agriculture, highlighting the stark contrast between American and European approaches to space innovation. “The company Interstellar would not exist without the support of NASA,” she revealed, describing how European skepticism initially forced her to seek backing in America. Her company is now preparing to

send a rose-growing greenhouse to the Moon in a mission dubbed “Little Prince,” scheduled for 2027. “What happened with Starship a few days ago is completely changing the game of space exploration,” Belvisi noted, suggesting that Mars missions might precede the establishment of permanent lunar bases.

The challenge of making space more habitable was central to the discussion. Octave De Gaulle, Director of Spade Agency, demonstrated this through his work on a space-worthy champagne bottle, which initially drew skepticism but revealed deeper truths about human needs in space. “Being able to enable a ritual of conviviality, that is something very humane,” he explained. “When you are in the worst possible condition and you tend to forget that you are human and become part of a machine, this is far more precious than what we can imagine.” The technical challenges were substantial, involving not just containing the liquid but preserving the entire ritual of sharing champagne, from pouring to experiencing its complex aromas in zero gravity.



“Nuclear for space exploration brought a whole sort of new angle and a new set of people into our business.”

Power generation emerged as a crucial enabler for lunar ambitions. Jake Thompson, Director of Novel Nuclear & Special Projects at Rolls-Royce, outlined plans to deploy micro-reactors on the lunar surface by the early 2030s. “Nuclear power is the most energy-dense form of power on the planet and in space,” Thompson noted, drawing parallels between submarine and space applications. He highlighted the regulatory challenges ahead: “How do you regulate nuclear in space? This is one of the challenges around the sustainability of nuclear in space.”

The session highlighted how non-space industries are bringing fresh perspectives to long-standing challenges. Belvisi emphasized the importance of finding terrestrial applications: “You cannot build a space company if you rely only on governmental programs.” She pointed to the need for a “killer application” that could generate billions in revenue to attract more investment to the space sector, while noting the unique collaborative nature of the space industry compared to other sectors.

The discussion revealed an emerging ecosystem where traditional boundaries between space and non-space industries are blurring. “It’s not an industry, it’s a new domain,” Kim insisted, highlighting how space exploration



necessitates expertise from multiple sectors. This convergence has also proved beneficial for recruitment, with Thompson noting how the space nuclear program has attracted new talent to Rolls-Royce: “Nuclear for space exploration brought a whole sort of new angle and a new set of people into our business.”

In a moment of historical irony that underscored the unifying power of space exploration, Belvisi shared how space collaboration had helped heal old wounds, revealing that her grandfather had once attempted to assassinate De Gaulle’s grandfather. “Let’s clear our grandfather’s karma and show that even though they hated each other, we’re going to drink champagne in space, in a garden,” she said, emphasizing how space exploration can unite former adversaries.

The panelists’ ventures, from space-ready champagne to lunar greenhouses and nuclear reactors, paint a picture of lunar development far removed from the stark, utilitarian visions of the past. Their work suggests that successful space exploration will require not just technological innovation but a deep understanding of human needs and experiences. As Belvisi noted, looking toward the future: “I think the five coming years are going to be crazy, and I’m very excited.”

As humanity prepares to return to the Moon, these non-traditional players are ensuring that we don’t just survive in space, but truly live there, bringing with them the full spectrum of human experience and expertise from Earth. Their presence at the congress signals a dramatic shift in how we approach space exploration, suggesting that the next giant leap for mankind will be taken not just by aerospace engineers, but by a diverse coalition of innovators from across all industries.



Value of Resources: Recipe for In-Situ Resource Utilization on Space Frontiers

At the fourth plenary session of the International Astronautical Congress, leaders in space resource utilization painted an ambitious vision for humanity’s sustainable presence in space, while acknowledging the considerable technical and economic hurdles that lie ahead. The session, titled “Value of Resources: Recipe for In-Situ Resource Utilization on Space Frontiers,” brought together experts from major space agencies and research institutions to discuss the critical role of extracting and utilizing resources from the Moon and Mars—a practice known as in-situ resource utilization (ISRU).

“ISRU encompasses everything from prospecting to product,” explained Gerald B. Sanders, Lead for In-Space Resource Utilization at NASA. “You have to understand where the resources are, and once you know that, you can acquire them, process them in one way or another, and then deliver a product to the customer.” Sanders emphasized that ISRU is inherently multidisciplinary, incorporating robotics, processing, navigation, and power systems.

The session highlighted recent breakthroughs, particularly the successful demonstration of oxygen production on Mars

through NASA’s MOXIE experiment aboard the Perseverance rover. Jeffrey Hoffman, Professor at MIT and former NASA astronaut, who served as Deputy Principal Investigator for MOXIE, underscored its historic significance: “For the first time, MOXIE actually demonstrated ISRU. We really extracted usable resources from another planet.”

The economics of space resource utilization emerged as a central theme. Transporting resources from Earth to Mars is prohibitively expensive—requiring approximately 15 tons in Earth orbit for every ton landed on Mars. This reality drives the push for ISRU, particularly for critical resources like oxygen, water, and construction materials. The demonstration showed that producing oxygen from the Martian atmosphere is viable, though scaling up remains a significant challenge.

Europe is making significant strides in this field, with Luxembourg emerging as a hub for space resources innovation. “Our mission is to be a world-leading center of excellence in the science, technology, and business of space resources,” said Kathryn Hadler, Director of the European Space Resources Innovation Centre (ESRIC). Launched in November 2020, the center runs the world’s first accelerator

“The great thing about getting oxygen out of the atmosphere is that it’s everywhere. It doesn’t matter where you are”





program dedicated to space resources, attracting startups globally to develop innovative solutions.

ESRIC's approach reflects a growing recognition that space resource utilization requires both technical innovation and commercial viability. "We are interested in supporting and attracting the best companies and ideas from all over the world, really bringing them into the dynamic Luxembourg space resources ecosystem," Hadler explained, emphasizing their global inclusion policy.

Italy is advancing ambitious projects in resource extraction technology. Simone Pirrotta from the Italian Space Agency (ASI) detailed their Oracle project, which aims to demonstrate oxygen extraction from lunar regolith using carbothermal reduction. "This process has several advantages," Pirrotta explained. "It's agnostic with respect to the composition, mainly regolith composition, so we could land almost anywhere." Targeting a 2028 launch, the project represents a significant step toward practical resource utilization on the Moon.

The experts emphasized that while the Moon serves as a crucial testing ground, Mars presents unique challenges and opportunities. "The great thing about getting oxygen out of the atmosphere is that it's everywhere. It doesn't matter where you are," noted Hoffman, discussing why oxygen extraction was prioritized for Mars demonstration. However, accessing water resources on Mars remains a significant challenge, with most known deposits located at high latitudes or deep underground.

The discussion, moderated by Jun Shimada, Lead for ISRU Research at JAXA, highlighted the increasing commercial interest in space resources. Sanders noted a significant shift in NASA's approach over his 39-year career: "In the beginning, it was very much NASA in charge of everything... But over time, we've seen a big change with the idea of bringing in commercial partners." This evolution has led to more public-private partnerships and purely commercial missions.



The session also addressed the crucial role of academic research in advancing ISRU technologies. Hoffman emphasized the unique position of universities: "The thing about academic research is that you have the freedom to explore new ideas, to try out new processes, new chemistry, and physics, without having to worry about whether it will make an immediate profit."

Environmental responsibility emerged as a key consideration. Sanders highlighted NASA's growing focus on understanding and mitigating potential environmental impacts: "Responsible space activities and responsible ISRU are things that we're spending a lot more time trying to understand." This includes assessing the effects of venting gasses and generating dust during operations.

Looking toward the future, Hadler identified uncertainty as one of the sector's biggest challenges: "We're trying to do everything at the same time. We're looking at construction, power, extraction of oxygen, water, manufacturing, and repair—all of these aspects, developing technologies, concepts, and architectures, all at once."

For those interested in joining the space resources community, two major upcoming events were announced: Space Resources Week in Luxembourg (May 19-21, 2025) and the 25th anniversary Space Resources Roundtable in the United States in June 2025. Both events will provide platforms for further discussion and collaboration in this rapidly evolving field.

As humanity stands on the cusp of establishing a permanent presence beyond Earth, the message was clear: space resource utilization isn't just about technical capability—it's about creating sustainable, responsible, and economically viable approaches to living and working in space. The success of these efforts will depend on continued international collaboration, commercial innovation, and a careful balance between ambitious goals and practical limitations.

Intelligent Space: Big Data, Advanced Algorithms, and Autonomous Robotics in Space



At the 75th International Astronautical Congress, the fifth plenary session titled "Intelligent Space: Big Data, Advanced Algorithms, and Autonomous Robotics in Space" showcased industry experts envisioning a future where intelligent systems play a crucial role in humanity's expansion into space. Held on the congress's traditional diversity day, the session brought together voices from technical, human factors, and policy backgrounds to address the challenges and opportunities presented by autonomous space systems.

Ewan Reid, founder and CEO of Mission Control Space Services and session moderator, guided the discussion, drawing on his experience as a former NASA mission controller who led the team responsible for sending the first deep learning AI to the Moon. The timing of the session was particularly relevant, as Reid's company was preparing to announce a new AI mission later that day.

The panel highlighted the rapid evolution of the space industry toward autonomous operations, driven by necessity rather than choice. Shreya Santra, Assistant Professor of Space Robotics at Tohoku University, emphasized the critical role of modular, reconfigurable robots in future space exploration. "We know that we cannot send a lot of payloads into space. It's very expensive and challenging," she explained. "So the way forward is modularity, where we can send modules that can reconfigure and perform the tasks they are designed for." Her vision includes robots collaborating with astronauts to construct habitats and infrastructure, adapting to both their environment and assigned tasks.

“Space is a beautiful and inspiring place, but make no mistake, it is a hostile environment”

The human element of space exploration was a focal point of the discussion. Golda Nguyen, a PhD candidate at the Massachusetts Institute of Technology working at the intersection of bioastronautics, behavioral science, and human-centered AI, provided crucial insights on supporting astronaut mental health during long-duration missions. "Space is a beautiful and inspiring place, but make no mistake, it is a hostile environment," Nguyen emphasized. She highlighted the communication delays to Mars, which can stretch up to 40 minutes, making Earth-based support impractical in emergencies and necessitating autonomous support systems.

Jack Naylor, a PhD candidate at the Australian Centre for Robotics at the University of Sydney, addressed the technical challenges of implementing autonomous systems in space. "Developing onboard computing capabilities that are safe and reliable, capable of processing data and making

decisions, is critical,” he explained. Naylor’s work focuses on enabling robotic systems to perceive and interact with their environment under complex conditions, drawing parallels between challenges faced in space and terrestrial applications.

Kirk Hovell, Co-founder and Chief Technical Officer of Obruta Space Solutions, shared his expertise in spacecraft proximity operations and docking. He outlined a future where hundreds of spacecraft would dock daily, necessitating autonomous systems for safety and efficiency. “If we want to create a bustling economy of goods and services interacting in space, we need autonomy for three main reasons: safety, scalability, and bandwidth,” Hovell explained. He emphasized that traditional human-controlled operations would be impractical at such scales.

The legal and regulatory framework emerged as a crucial consideration. Dimitra Stefoudi, Assistant Professor at Leiden University’s International Institute of Air and Space Law, addressed the complex relationship between technological advancement and regulation. “The law is moving very slowly compared to technology,” she noted, advocating for a balanced approach using standards and guidelines rather than binding laws in rapidly evolving areas. When asked about liability for autonomous system failures, Stefoudi emphasized the need for traceability: “We need guidance to ensure accountability and responsibility.”

The session also tackled important questions about diversity and inclusion in space operations. An audience member raised concerns about English-language interfaces potentially excluding non-English speakers in future space operations. Nguyen responded by highlighting the importance of co-design and cultural considerations in developing human-machine interfaces, suggesting that tools should be tailored to individual crew members while maintaining a shared understanding across international teams.

Big data emerged as a foundational element for advancing autonomous capabilities. Hovell emphasized its critical role: “If we want autonomous robots and advanced algorithms, we need big data. Big data is the foundation upon which those other two items are trained and built.” The panel discussed strategies for managing the enormous volumes of data generated during space operations, with Hovell noting that some operators prefer to keep data onboard, processing it locally and sending only insights back to Earth.

The discussion frequently returned to the themes of modularity and sustainability in space systems. Naylor suggested that modular systems could revolutionize space maintenance: “If something breaks, we don’t just need to go up and fix the whole spacecraft. Maybe we just swap out a component and slot a new one in.” This approach could dramatically reduce costs and improve the sustainability of space operations.



As the session concluded, the panelists agreed that while the challenges of implementing intelligent systems in space are significant, they are essential for humanity’s future in space. The discussion made it clear that success will require a careful balance between autonomous capabilities and human oversight, supported by appropriate regulatory frameworks and international cooperation. As space activities become increasingly commercialized and diverse, the insights shared during this plenary session suggest that the future of space exploration will be shaped by our ability to successfully integrate intelligent systems while maintaining human agency and fostering international collaboration.

Observing the Earth, Serving our Societies: Space in the Age of Climate Change

At the sixth plenary session of the 2024 International Astronautical Congress, leaders from prominent space agencies and organizations convened to discuss the increasingly crucial role of satellite technology in tackling climate change. Titled “Plenary 6 – Observing the Earth, Serving our Societies: Space in the Age of Climate Change,” the session showcased how space-based observations are being transformed into actionable insights for decision-makers around the globe.

Moderated by Laurence Monnoyersmith, Head of Sustainable Development at CNES, the discussion highlighted the growing collaboration between space agencies, scientific institutions, and end-users in the development of climate monitoring tools. Florence Rabier, Director General of the European Centre for Medium-Range Weather Forecasts (ECMWF), detailed her organization’s processing of an impressive 100 million daily observations from over 100 satellite data streams to generate accurate weather forecasts and climate models. “Digital twins of the Earth system... offer a high degree of realism,” Rabier

stated, emphasizing how these advanced models facilitate the testing of various climate scenarios.

A central theme of the session was the transformation of satellite data into practical information for users. Giovanni Sylos Labini, CEO of Planetek Italia, noted the increasing demand for rapid data analysis, explaining that his company has been “developing a concept that translates space design into service in Earth observation design.”

Andrea Taramelli, the Italian National Delegate to the European Commission Copernicus User Forum, highlighted the importance of understanding diverse user needs. “The final end user doesn’t need the data; they need the information to make informed choices,” he noted, underlining the vital role of intermediaries who convert raw data into actionable insights.

Michael Ford, NOAA’s Chief Scientist for Environmental Satellites, discussed his agency’s approach to user engagement, particularly in responding to extreme



“The final end user doesn’t need the data; they need the information to make informed choices”

weather events. “Our processes influence how we plan our satellite missions and construct our ground systems,” Ford explained, emphasizing NOAA’s focus on developing applications that connect directly with emergency response systems.

Simonetta Cheli, Director of Earth Observation Programmes at the European Space Agency, outlined ESA’s comprehensive efforts in climate monitoring. “ESA is at the forefront in terms of the number of missions planned and in operation to support climate change overall,” she stated, referencing the agency’s involvement in meteorological missions, Copernicus programs, and scientific initiatives like Earth Care.

Philippe Baptiste, Chairman & CEO of CNES, stressed the significance of international collaboration and shared responsibilities. “You want to share the data... but you also want to share the risk and the cost,” Baptiste remarked, citing successful partnerships such as the SWOT mission with the United States for sea level monitoring.

Roberto Formaro, Director of the Engineering and Technologies Directorate at the Italian Space Agency, emphasized ASI’s commitment to addressing specific regional challenges, particularly in the Mediterranean. “It’s important to provide the right answer at the right time,” Formaro said, describing ASI’s transition from a generational to an evolutionary approach in mission design.

The session highlighted key advancements in space-based climate monitoring, including the use of artificial intelligence and machine learning for satellite data processing, the creation of sophisticated digital Earth twins for climate modeling, and new platforms aimed at enhancing accessibility to satellite data for users worldwide.

Particular attention was given to the Space for Climate Observatory initiative, which now encompasses over 30 countries and 50 signatories, demonstrating a global

commitment to utilizing space technology for climate action. This initiative has led to the development of approximately 100 applications adaptable for various regions.

The discussion underscored how space agencies are moving beyond mere data collection to ensure that information reaches those who need it most. This includes developing standardized data-sharing formats, user-friendly platforms for data access, and establishing direct connections with local communities and decision-makers.

As climate change continues to pose significant challenges, the role of the space sector in monitoring, understanding, and addressing its impacts is increasingly critical. The collaboration among space agencies, research institutions, and private companies showcased during this session indicates that a coordinated global response to climate change is not only achievable but is already in progress.

The speakers noted that while substantial progress has been made in developing Earth observation capabilities, the real challenge lies in ensuring these advanced tools and data reach the individuals who need them most—from local government officials to emergency responders and urban planners. As these systems evolve, they will play a pivotal role in helping communities worldwide adapt to and mitigate the effects of climate change.

Looking ahead, the panelists outlined several ambitious initiatives to further enhance climate monitoring capabilities, including NOAA’s next-generation fire detection system, ESA’s expanding network of Earth observation satellites, and ASI’s innovative “living lab” concept that brings together users, institutions, academia, and industry to design future missions. This emphasis on rapid response and evolving technology reflects the space sector’s commitment to providing timely, accurate data for climate action, marking a new era in Earth observation where space technology is a crucial ally in the global fight against climate change.



New Opportunities Benefit Human Space Flight on Earth, in Space and Beyond

“By conducting studies not only aboard the space station but also during parabolic flights, we can experiment with a larger number of subjects to prepare for future spaceflight”



As the global space community enters a new era of exploration and collaboration, the completion of China’s Tiangong space station in late 2022 has opened unprecedented opportunities for international research in microgravity. With three astronauts currently aboard and plans for lunar missions on the horizon, China’s space program is rapidly evolving from a national endeavor into a platform for global scientific cooperation. At the seventh and final plenary of IAC 2024, titled “New Opportunities Benefit Human Space Flight on Earth, in Space and Beyond,” leaders from space agencies and research institutions worldwide gathered to discuss the future of human spaceflight and the expanding role of international partnerships.

Moderated by Mengyun Chen, Acting Director of the International Cooperation Center at the Chinese Academy of Sciences, the session highlighted China’s emergence as a major player in human spaceflight and its increasing openness to international collaboration.

In a video address, Lin Xiqiang, Acting Director General of the China Manned Space Agency, emphasized the

rapid progress of China’s space program. “Since 2023, we have conducted three crew rotations, two cargo resupply missions, and five spacewalks,” he stated, noting that the Chinese space station has already hosted nearly 200 experiments.

The United Nations Office for Outer Space Affairs (UNOOSA) has played a key role in facilitating international access to the Chinese space station. Andrew Peebles, External Relations Officer at UNOOSA, highlighted the importance of such cooperation: “These Access to Space for All initiatives have proven to be successful hooks for kickstarting or enhancing the space ecosystems and economies of countries around the world.”

Ming Li, Chairman of the Science & Technology Committee of the China Academy of Space Technology, presented details of China’s lunar ambitions, describing a complex mission architecture involving two launches per mission and multiple rendezvous operations in lunar orbit. “Let’s work together and make it happen,” Li said, extending an invitation for international participation in China’s lunar program.



The scientific capabilities of the Tiangong space station were outlined by Hongen Zhong, Deputy Chief Designer of the Space Utilization System at the China Manned Space Agency. “We plan to conduct over 1,000 research projects in 10 years,” Zhong stated, highlighting facilities for research in life sciences, materials science, and fundamental physics.

International collaboration is already yielding results. Serene Perilli from the Italian Space Agency described Italy’s extensive experience with microgravity research and outlined new experiments headed to space. “We worked closely with our scientific research and industrial community to identify the significant gaps we need to address to enable future human space exploration,” she explained.

The role of parabolic flights in preparing for space missions was emphasized by Vladimir Pletser, Director of

Space Training Operations at Blue Abyss. Drawing on his experience with both European and Chinese space agencies, Pletser demonstrated how these flights provide crucial opportunities to study human physiology in microgravity. “By conducting studies not only aboard the space station but also during parabolic flights, we can experiment with a larger number of subjects to prepare for future spaceflight,” he noted.

An example of successful international cooperation was presented by G. Zummo, CEO of In Quattro, who detailed the Baridi Sana project—a collaboration between Italian and Kenyan researchers to develop advanced cooling systems for space applications. Scheduled to launch to the Chinese space station in 2025, this project exemplifies China’s commitment to including developing nations in space research.

Hui Sun, Director of the Division of International Organization Programmes at the Chinese Academy of Sciences’ Bureau of International Cooperation, emphasized the academy’s role in fostering international collaboration. “CAS places great importance on international cooperation with our partners, aimed at addressing shared challenges related to green, sustainable, and inclusive development,” he said.

The session revealed China’s strategic approach to space diplomacy, using its space station as a platform for international engagement while pursuing ambitious national goals such as lunar exploration. The speakers repeatedly emphasized that cooperation opportunities are open to both established space powers and emerging nations, with a particular focus on developing countries.

The presentations underscored how international space cooperation is evolving beyond the traditional partnership model exemplified by the International Space Station, with China positioning itself as an alternative partner for space research and exploration. This shift comes at a crucial time as the ISS approaches its planned retirement in the early 2030s, potentially making the Chinese space station an increasingly important platform for international research.

The session demonstrated that while China pursues its own national space objectives, including human lunar landings, it views international cooperation as a vital component of its space program. This strategy appears to be yielding results, with multiple international experiments already underway aboard the Tiangong space station and more planned for the future.

As the conference concluded, it was evident that China’s space program has entered a new phase, characterized by increasing openness and international engagement while maintaining ambitious national goals. The success of this approach could have significant implications for the future of international space cooperation and human space exploration.■



IAC 2024

Highlight Lectures



Euclid Mission:
Unveiling the Universe

At the 2024 International Astronautical Congress, the highlight lecture titled “Euclid Mission: Unveiling the Universe” showcased groundbreaking insights from leading scientists involved with the European Space Agency’s transformative Euclid space telescope. This mission, dedicated to mapping the cosmic web, aims to unravel the enigmatic mysteries of dark matter and dark energy.

Pierre Casenove, the French Euclid Contributions Project Manager at CNES, opened the session by reflecting on the mission’s profound significance. “When we showcase such a tremendous image, it also makes us proud and gives a sense of what we do on a daily basis,” he remarked, highlighting the recently released deep-field images that have captivated both the scientific community and the public.

Valeria Pettorino, the Euclid Project Scientist at ESA, emphasized the fundamental questions driving this mission. “We know that luminous matter—atoms, stars, and us—accounts for at most 5% of the total energy content

of the universe,” she explained. “The rest constitutes the dark universe.”

With a budget of \$1.5 billion, the Euclid telescope, launched on July 1, 2023, represents one of the most ambitious efforts to comprehend the 95% of the universe that remains elusive to scientists. Positioned 1.5 million kilometers from Earth at the second Lagrangian point, the spacecraft is equipped with what Pettorino described as a remarkable camera system: a 600-megapixel imaging device operating at temperatures as low as minus 180 degrees Celsius (minus 292 degrees Fahrenheit).

The scale of the mission is unprecedented. In just the initial weeks of its nominal survey, which commenced on February 14, 2024, Euclid has already mapped approximately 1,500 square degrees of the sky—around 12% of its planned six-year survey that will ultimately cover one-third of the celestial sphere.

Professor Henk Hoekstra of Leiden University, who leads key aspects of the data analysis, underscored the technical challenges involved in the mission. “It takes more than a village to study dark energy,” he stated, noting that over 3,500 individuals from multiple countries are collaborating on the project.

The complexity arises from the subtle nature of the phenomena under investigation. “Even though dark matter and dark energy make up 95% of the universe, the effects



they impart on what we observe—the photons collected by our telescope—are very subtle,” Professor Hoekstra explained.

The mission faced early hurdles, including unexpected light contamination from reflected sunlight in initial images. However, the team swiftly adapted the telescope’s orientation to mitigate the issue, necessitating a comprehensive replanning of the survey strategy while upholding the telescope’s stringent stability requirements.

What distinguishes Euclid is not only its hardware but also its software infrastructure. Professor Hoekstra revealed that the data processing systems alone represent an investment of approximately 200 million euros and comprise over 1.5 million lines of code distributed across nine data centers globally.

Preliminary results are already reshaping our understanding of the cosmos. In one early release cluster image, scientists identified galaxies ranging from 100 times brighter than the Milky Way to those 4,000 times fainter. The telescope’s precision allows it to resolve individual globular clusters in distant galaxies and detect the subtle distortions in spacetime caused by dark matter’s gravitational effects.

Pettorino noted the mission’s impressive data collection rate, stating, “We are currently receiving more than 100 gigabytes per day from Euclid.” Over its six-year mission, the telescope is expected to gather tens of petabytes of data, creating what she referred to as “the finest map of the universe ever made.”

The project’s first major data release is set for March 2025, when scientists will unveil results from the initial 53 square degrees of deep-field observations at a major symposium



in the Netherlands. These observations are anticipated to yield unprecedented insights into galaxy formation, dark matter distribution, and the nature of dark energy.

The Euclid mission marks a new era in cosmological research, merging cutting-edge imaging capabilities with advanced data analysis techniques. As Professor Hoekstra noted, “Euclid is in many respects also a software telescope,” underscoring the growing importance of computational power in modern astrophysics.

The implications of Euclid’s findings could revolutionize our understanding of fundamental physics. The telescope’s capacity to map the cosmic web—representing the large-scale structure of matter in the universe—over the past 10 billion years may address critical questions about gravity and whether Einstein’s theory of general relativity requires revision at cosmic scales.

The project exemplifies the increasing sophistication of international scientific collaboration. With thousands of scientists and engineers engaged across 17 countries, Euclid stands as one of the most complex and ambitious scientific endeavors ever undertaken, all aimed at elucidating the darkest mysteries of our universe.

As the mission progresses with its survey, the scientific community eagerly anticipates the influx of data that will help unlock the secrets of the invisible forces shaping our cosmos. The project’s successes thus far indicate that we are on the brink of a new golden age of cosmological discovery, where the dark universe may finally begin to reveal its secrets.

Viewing the freshwater crisis from space: A world of drought and flood extremes

At a time when floods and droughts increasingly threaten communities worldwide, the 2024 International Astronautical Congress's second highlight lecture provided critical insights into how satellite technology is transforming our understanding of Earth's water challenges. The session, titled "Viewing the Freshwater Crisis from Space: A World of Drought and Flood Extremes," offered a comprehensive examination of the intersection between space technology and water resource management.

Professor Paul Bates of the University of Bristol addressed a packed audience, moderated by Maria Fabrizia Buongiorno, Director of Technological Research at Italy's National Institute of Geophysics and Volcanology. He painted a sobering picture of the global water crisis. "Global flood losses over approximately a 20-year period affect on average about 75 million people a year," Bates reported, citing annual damages of around US\$40 billion. The impact of droughts is even more severe, with damages reaching US\$124 billion between 1998 and 2017. "These are probably gross underestimates," Bates emphasized, noting that global databases typically capture only the largest events.

Recent disasters underscore the magnitude of the challenge. The 2022 floods in Pakistan, which claimed 1,700 lives and submerged nearly 10% of the country, highlighted the devastating potential of extreme weather events. "These are incredible amounts of water falling," Bates noted, describing rainfall accumulations exceeding 1,000 millimeters over just two and a half months.

A significant advancement in monitoring these events came with the December 2022 launch of the Surface Water Ocean Topography (SWOT) satellite mission, a collaborative effort between NASA, CNES, the Canadian Space Agency, and the UK Space Agency. "For the first time, we really have the majority—almost all major elements—of the water cycle being measured from space," Bates explained.

The SWOT mission represents a new era in water monitoring capabilities, measuring over 200,000 river reaches and nearly 6 million lakes globally every 10 days. This comprehensive coverage provides unprecedented insights into water movement across the planet. "Imagine if you're Canada, Finland, or one of these northern countries with vast numbers of lakes," Bates remarked. "I'd hesitate to think how many level gauges were installed on Canadian

lakes prior to the advent of SWOT. With SWOT, we're going to have access to millions."

Climate change is amplifying these water-related challenges in complex ways. While extreme rainfall is increasing almost everywhere, its impact on river flows varies significantly by region. "Even though we're expecting more rain, sometimes that increased rainfall falls on drier ground because the intra-event periods are drier, leading to more evapotranspiration," Bates explained.

The lecture highlighted how multiple satellite systems collaborate to monitor various aspects of the water cycle. The GRACE (Gravity Recovery and Climate Experiment) satellite system tracks changes in total water storage by measuring minute variations in Earth's gravity field. In parallel, the Global Precipitation Measurement Mission provides rainfall data at 10-kilometer resolution every 30 minutes, while the SMAP (Soil Moisture Active Passive) satellite monitors soil saturation levels critical for flood prediction.

However, Bates emphasized that satellite technology alone cannot address these challenges: "The intermittency of floods and droughts poses a real challenge for satellite providers. A combination of satellite data and computer models is necessary to make progress. Space technology is not going to solve this on its own."

Looking ahead, Bates identified several critical areas for improvement, including enhanced measurement of evapotranspiration and more accurate terrain data. Current satellite elevation data has meter-level errors, whereas airborne systems can achieve 10-centimeter accuracy. "If we're considering forecast models for hydrology, then improving our ability to measure precipitation from space would be a significant advance for regions lacking robust ground data," he stated.

The presentation also addressed essential questions about data accessibility for developing nations. While most NASA

and ESA satellite data is freely available, partnerships with organizations like the World Bank are vital for making advanced analytics accessible to vulnerable regions. "For about 20 of the most deprived, war-torn, and difficult countries, the data we've commercially created is now available for free," Bates noted.

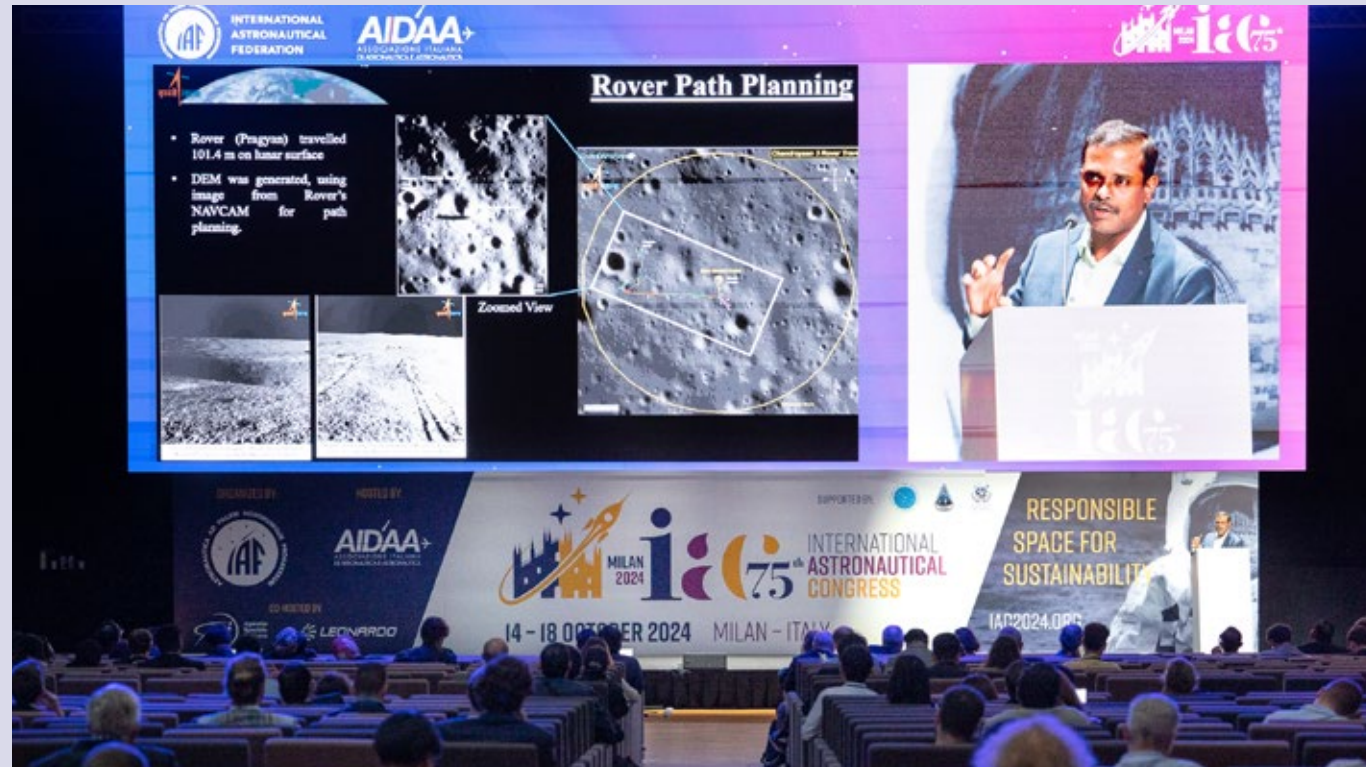
The session concluded with a discussion on rapid response capabilities for ongoing events. Bates stressed the importance of data quality over speed: "My experience with rapidly developed flood extent maps shows that the quality is often problematic. We need to focus not so much on rapid mapping, but on quality mapping."

As global water challenges intensify, the integration of satellite technology with advanced modeling techniques offers new possibilities for understanding and managing these risks. While significant challenges remain, the field is advancing rapidly, promising improved capabilities for monitoring and responding to water-related disasters worldwide.

“The intermittency of floods and droughts poses a real challenge for satellite providers. A combination of satellite data and computer models is necessary to make progress”



New Frontiers in Lunar Exploration: Chandrayaan-3 Mission & beyond



In the third and final highlight lecture of IAC 2024, Indian space officials unveiled an ambitious roadmap that extends from their recent lunar triumph to plans for human missions to the Moon, highlighting India's rapidly expanding role in global space exploration. The final highlight lecture of the congress, titled "New Frontiers in Lunar Exploration: Chandrayaan-3 Mission & Beyond," showcased India's technological achievements and strategic vision for space exploration over the next two decades. Moderated by Christian Feichtinger, the session brought together key figures in international space exploration to discuss India's remarkable progress in lunar endeavors.

Clay Mowry, President of the International Astronautical Federation, opened the session by emphasizing the historic significance of India's accomplishments. "It's an amazing accomplishment to see people cheering in the streets after this," Mowry remarked, referring to the successful Chandrayaan-3 landing. "They've announced their intentions not only to pursue human spaceflight with the Gaganyaan system but also to build a space station and to land on the Moon in 2040."

The centerpiece of the lecture was a comprehensive presentation by Veeramuthuvel Palanivel, Project Director of Chandrayaan-3 and Group Director of Spacecraft

Systems Engineering at ISRO. Palanivel provided an unprecedented look into the technical innovations that enabled India's successful soft landing on the Moon's south polar region. "We were the first country to reach the higher southern latitude region, which is 70 degrees south latitude," Palanivel explained, detailing the mission's groundbreaking achievements. His presentation revealed how ISRO developed new technologies specifically for the challenging landing, including a laser Doppler velocimeter for precise navigation and enhanced propulsion systems capable of variable thrust from 400 to 800 Newtons.

The mission's success was built on extensive testing and simulation. ISRO created artificial lunar landscapes and conducted helicopter-based sensor trials to validate their landing systems. These preparations paid off when Chandrayaan-3 achieved what Palanivel described as a "pinpoint landing," missing its target by only 170 meters in one direction and 300 meters in another—remarkable precision for a lunar landing.

The scientific discoveries from the mission have already begun to reshape our understanding of the Moon's south polar region. The mission's instruments detected significant temperature variations in the lunar soil, with surface temperatures around 50 degrees Celsius dropping to minus 10 degrees Celsius just 80 millimeters below



“The rover takes a picture with the navigation camera and sends it to the ground through the lander. We do path planning on the ground.”

the surface. The mission also confirmed the presence of various elements, including aluminum, sulfur, and titanium, while discovering evidence of a previously unknown buried crater approximately 160 kilometers in diameter.

One of the mission's most innovative aspects was its rover operations. The 25-kilogram rover successfully traversed 1.4 meters across the lunar surface, conducting experiments and avoiding hazards through a semi-autonomous control system. "Unlike the lander, the rover operates semi-autonomously," Palanivel explained. "The rover takes a picture with the navigation camera and sends it to the ground through the lander. We do path planning on the ground." This careful approach enabled the rover to navigate safely while collecting valuable scientific data.

The mission concluded with a spectacular demonstration of ISRO's engineering prowess: a "hop" experiment where the lander briefly lifted off the lunar surface again. This unplanned test, conducted in the mission's final hours, proved crucial technologies needed for future sample return missions.



Looking to the future, Palanivel outlined ISRO's ambitious plans for upcoming missions. Chandrayaan-4, a sample return mission, will attempt to bring back three kilograms of lunar material from depths of up to two meters. This complex mission will require two launches of India's LVM3 rocket and multiple docking operations in both Earth and lunar orbit. Following this will be Chandrayaan-5, a joint mission with Japan's space agency JAXA, featuring a larger lander and a 350-kilogram rover capable of traveling up to one kilometer across the lunar surface.

These missions are just stepping stones toward India's broader space ambitions. ISRO has laid out a comprehensive timeline that includes establishing the Bharatiya Antariksha Station (Indian Space Station) by 2035 and achieving a crewed lunar landing by 2040. "Beyond that, it is again an expansion phase where sustainability is very important," Palanivel stated, describing plans for permanent lunar stations and regular Earth-Moon transportation systems.

The presentation highlighted India's rapid emergence as a major player in space exploration, demonstrating both technical capability and strategic vision. The success of Chandrayaan-3 has not only boosted national pride but has also positioned India as a key participant in the international effort to establish a permanent human presence on the Moon.

As the session concluded, it became clear that India's space program has evolved from its humble beginnings to become a formidable force in the global space community. The roadmap presented at IAC 2024 suggests that India is not just participating in the new space race—it's helping to lead it. ■

Late Breaking News I

Chang'E Mission Highlight Report: Mankind's First Lunar Farside Sampling Return

In a landmark moment for space exploration, China has achieved humanity's first-ever sample return mission from the lunar far side, unveiling unprecedented insights into the moon's mysterious hidden landscape and opening new frontiers of scientific discovery.



At the International Astronautical Congress, Chinese space officials revealed the remarkable details of the Chang'e 6 mission, a 53-day journey that has dramatically expanded our understanding of lunar geology and solar system evolution.

"Deep space is vast, and human exploration is infinite," declared Guoping Li, Chief Engineer of the China National Space Administration (CNSA), capturing the mission's profound significance. Li emphasized that the successful mission represents more than a technological triumph—it is a testament to international collaboration and humanity's insatiable curiosity.

The mission targeted the South Pole-Aitken Basin, a colossal impact crater spanning 2,400 kilometers on the moon's far side—the largest and oldest known impact site in the solar system. This strategic choice was no accident. As Feng Guan, Director of the Lunar Exploration and Space Engineering Center at CNSA, explained, the

region's unique geological characteristics offered a rare window into the solar system's primordial history.

"Scientists believe that sampling in this region with the possibility of obtaining samples from 4 billion years ago is expected to achieve new understanding of the early impact history of the Solar System," Guan told the assembled international audience.

The Chang'e 6 spacecraft executed a complex mission profile that reads like a choreographed dance of precision engineering. Launched on May 3rd from the Wenchang Space Launch Center, the mission deployed multiple components including an orbiter, return capsule, lander, and ascender. On June 2nd, the lander touched down on the lunar surface, using innovative drilling and shoveling techniques to collect 1,935.3 grams of lunar material.

What makes these samples extraordinary is not just their origin, but their potential. Preliminary analysis reveals



intriguing characteristics: the lunar soil exhibits a looser structure, with particles suggesting a complex mixing of different source materials. Compared to previous Chang'e missions, these samples show distinct mineralogical variations that could unlock secrets about the moon's geological evolution.

The mission was also a beacon of international cooperation, carrying scientific payloads from the European Space Agency, including instruments to detect negative ions and study lunar surface interactions. This collaborative spirit was emblematic of the broader vision articulated by the Chinese space leadership.

Looking forward, China is not stopping with this milestone. The CNSA has ambitious plans for future lunar exploration, including the Chang'e 7 and Chang'e 8 missions, which aim to survey the lunar South Pole's environment and test resource utilization technologies. Even more ambitiously, they are laying groundwork for an International Lunar Research Station, a proposed collaborative hub for scientific exploration.

In the words of Feng Guan, echoing a sentiment from Chinese President Xi Jinping, "Chang'e belongs not only to China but to all of humankind." This mission

“Deep space is vast, and human exploration is infinite”

represents more than a national achievement—it is a collective step towards understanding our cosmic neighborhood.

As Christian Feichtinger, Executive Director of the International Astronautical Federation, noted with a touch of poetic symbolism, the mission seemed blessed from the start: exactly 30 seconds before the launch, rain poured down, and 30 seconds after liftoff, the skies cleared—a celestial sign of the mission's promise.

The lunar far side samples are now on Earth, promising to unveil chapters of cosmic history long hidden from human understanding. In retrieving these ancient fragments, China has not just explored a new frontier—it has expanded the very boundaries of human knowledge.



Late Breaking News 2: Unveiling of a new cosmic vision from Euclid

At the second late breaking news session at the International Astronautical Congress, European Space Agency (ESA) leaders revealed an unprecedented glimpse into the universe's hidden dimensions, showcasing the transformative potential of the Euclid space telescope. Hosted by Christian Feichtinger, the session marked a pivotal moment in astronomical research, presenting a revolutionary mission designed to map the largely invisible landscape of dark matter and dark energy that comprises 95% of our universe.

Josef Aschbacher, ESA's Director General, set the stage by emphasizing the mission's profound significance. "The quest to answer some of the very fundamental questions about our cosmos is what makes us all very human," he declared, highlighting Euclid's ambitious goal of creating the most comprehensive three-dimensional map of the universe ever conceived.

Launched in July 2023, the Euclid mission represents a quantum leap in our ability to understand cosmic

structures. The telescope's unique capabilities—detecting extremely faint light, photographing vast areas of the sky in a single shot, and delivering crystal-clear vision—have already overcome significant technical challenges, including a critical decontamination procedure that restored the telescope's optical performance.

Carole Mundell, ESA's Director of Science, provided stunning context for the mission's scale. "To fully appreciate the image we released tonight," she explained,



“I cannot stress the amount of collaboration and friendship that is required to overcome the challenges to deliver such an iconic space mission”

“you would need 16,640 high-definition TV screens.” The mosaic released during the session represents just 1% of the planned six-year survey, yet it already captures 14 million galaxies and 100 million cosmic sources.

The mission's ambition is staggering. By the survey's conclusion, scientists will have studied an estimated 8 billion galaxies, creating an unprecedented window into the universe's structure and evolution. The telescope's infrared and optical detectors will generate a comprehensive 3D map stretching back 10 billion years of cosmic history.

Beyond mere imaging, Euclid is transforming astronomical research methodologies. Mundell emphasized the revolutionary integration of machine learning and artificial intelligence, which are now essential in processing the telescope's immense data. “No longer can astrophysicists like myself look at an image and do some science on it,” she noted. The team now uses advanced algorithms to remove over 100,000 subtle light artifacts, revealing previously invisible cosmic details.

The collaboration behind Euclid is equally impressive. The mission represents a massive international effort, involving 2,500 scientists working over 15 years, more than 2,000 industrial personnel, and close collaboration with NASA. The project is projected to generate 170 petabytes of data, which will be shared with researchers worldwide.

The images unveiled during the session reveal extraordinary cosmic phenomena. Mundell highlighted dramatic galactic interactions, including instances where gravitational forces tear stars from their original galaxies and scenarios of supermassive black holes colliding, potentially generating ripples in the fabric of spacetime.

Aschbacher emphasized the mission's technological innovation, particularly the use of silicon carbide—a unique material that makes space telescopes robust and thermally stable under extreme space conditions. This technological advancement represents more than scientific exploration; it symbolizes tangible progress in space sciences that can benefit society.

The Euclid mission arrives at a critical moment in our understanding of the universe. By investigating dark matter and dark energy—the mysterious components that make galaxies spin and drive the universe's accelerated expansion—scientists hope to resolve fundamental questions about cosmic structure and evolution.

As the mission progresses, the first comprehensive data release is anticipated in spring 2025. The potential discoveries are boundless, promising to reshape our comprehension of the cosmos and our place within its vast, intricate framework.



The session concluded with a sense of collective achievement and anticipation. Mundell's closing remarks captured the essence of the moment: “I cannot stress the amount of collaboration and friendship that is required to overcome the challenges to deliver such an iconic space mission.”

Euclid stands as a testament to human curiosity, technological innovation, and our relentless pursuit of understanding the universe's deepest mysteries.

Late Breaking News 3:

Ariane 6, right first time! How did we succeed?

At the third and final late breaking news session, a panel of distinguished European space experts unveiled the intricate story behind the July 9th launch that marked a new chapter in space transportation. The session, moderated by Aline Decadi of the European Space Agency (ESA), was a masterclass in how meticulous planning, cross-national collaboration, and audacious innovation can transform a complex technological challenge into a resounding triumph.

“Despite inherent challenges, Ariane 6 succeeded on its first attempt, showcasing European engineering excellence,” Decadi proclaimed, setting the stage for a deep dive into one of the most significant aerospace achievements of 2024.

The Ariane 6 program represents a remarkable feat of European cooperation, involving 13 countries and over 300 suppliers. François Deneu, Ariane Group’s Launcher Development Director, emphasized the unprecedented

collaborative spirit: “This is not just producing hardware, this is also producing software, and developing capabilities across an entire continent.”

The rocket’s development was a testament to strategic industrial planning. Factories were developed as early as 2017, with production facilities established across Europe – from Italy’s booster structures to Germany’s integration factories, and Belgium’s actuator production. This distributed approach wasn’t just about manufacturing; it was about creating a pan-European technological ecosystem.

The rocket’s design embodies cutting-edge innovation. Pier Domenico Resta, ESA’s Head of Launch System and Engineering, highlighted the “right first-time” philosophy that guided the entire development process. This approach meant eliminating risks early, conducting comprehensive system-level tests, and maintaining a streamlined decision-making process.

A standout innovation is the upper stage’s remarkable capabilities. “We’ve developed not just an upper stage, but an orbital stage,” Deneu explained. The Vinci engine can reignite in orbit, allowing unprecedented mission flexibility. An auxiliary power unit (APU) enables complex maneuvers, transforming how satellites can be deployed.



“We’ve developed not just an upper stage, but an orbital stage”



The team’s commitment extended beyond technological achievement to environmental stewardship. The transportation ship Canopy, used to move launcher components across the Atlantic, represents a maritime revolution. By utilizing wind-assisted propulsion, it reduces fuel consumption by 30% and significantly cuts carbon emissions.

Olivier Bugnet from CNES (France’s space agency) emphasized the launch complex’s environmental design. “We made brave choices to minimize energy use,” he noted, such as avoiding air conditioning in the massive mobile gantry and implementing sophisticated water treatment processes.

The launch wasn’t merely a technological demonstration but a commercial and scientific milestone. Ariane 6 already has 30 missions in its backlog, with two-thirds commercial and one-third institutional. It can deploy satellites for communication constellations, scientific missions, and even launch multiple payloads with unprecedented precision.

“We provide a very reliable and high-quality service,” Deneu stated. “The customers are there, and they want to fly on Ariane 6.”

The maiden flight wasn’t without its complexities. During the second phase of the launch, the team deliberately tested systems to their limits, gathering critical data. A minor issue with the APU’s reignition was quickly understood and will be addressed in future launches.

Looking ahead, reusability is on the horizon. Resta acknowledged this is the industry’s “mantra,” with ESA already preparing technological groundwork through projects like Prometheus. However, he cautioned that reusability isn’t just about landing stages but developing comprehensive refurbishment infrastructure.

The Ariane 6 launch represents more than a successful rocket deployment. It symbolizes European technological collaboration, strategic foresight, and an unwavering commitment to pushing the boundaries of space exploration.

As Decadi concluded the session, the message was clear: this is not the end of the story, but just the beginning of a new era in European space technology.

“Long live Ariane 6,” Deneu declared, capturing the collective sentiment of an entire continent’s aerospace community.



Monday
14 October 2024

In a series of wide-ranging discussions at the International Astronautical Congress's Global Networking Forum on Monday, leaders from across the space industry explored challenges and opportunities in space cuisine, public-private collaboration, and institutional investment, highlighting the increasingly multifaceted nature of space exploration and commercialization.

IAC 2024

IAF Global Networking Forum (IAF GNF)



The day began with the first IAF GNF session, “Italians do eat better: a space menu for a healthy body and mind,” where experts discussed how Italy’s culinary heritage is shaping the future of space food. Colonel Walter Villadei, an Italian Air Force engineer and recent Axiom-3 mission crew member, emphasized the social importance of meals in space. “Food is not just a commodity,” he noted. “It’s an opportunity for being together, even in space.” His firsthand experience aboard the International Space Station (ISS) lent particular weight to his observations about the crucial role of shared meals in maintaining crew morale and cohesion during long-duration missions.

The session, co-moderated by Italian Space Agency (ASI) researchers Marta Del Bianco and Micol Bellucci, showcased innovative approaches to space food technology. The discussion highlighted how Italian cuisine’s diversity and nutritional balance make it particularly well-suited for space missions. From freeze-dried olive pate to specially prepared parmigiana, the presenters demonstrated how traditional Italian dishes are being adapted for space while maintaining their cultural significance and health benefits.

Antonio Gattulli, Sales Director at Sudalimenta s.r.l., shared his company’s fascinating journey into the space sector, which began with a chance meeting with NASA in 2007. “We selected black olives pate because olives have great nutrition facts, starting from its content of polyphenols and phytochemicals,” he explained. This intersection of tradition and innovation exemplified the session’s broader theme of leveraging cultural heritage to solve modern space challenges.

Looking toward future long-duration missions, Giorgia Pontetti, CEO of Ferrari Farm, discussed the psychological benefits of space agriculture and the potential of hydroponic systems for growing fresh vegetables in space. “Taking care of plants can improve the brain, can improve the morale of all the crew,” she noted, emphasizing the dual benefits of fresh produce and therapeutic gardening. The session also addressed practical challenges, from menu fatigue to the complexities of eating in microgravity, including innovations like the ISSpresso machine, which enabled the first authentic Italian espresso in space.



“This entire golden age of commercial space that we’re experiencing is because of public private partnerships”



The second IAF GNF session, “Driving Innovation Through Collaboration: Public-Private Partnerships in Space,” moderated by Sarwat Nasir of The National, revealed how collaboration between sectors is reshaping the future of space activities. Ibrahim Al Qasim, Director General of the UAE Space Agency, emphasized the importance of human capital development in the UAE’s space strategy, pointing to successful initiatives like the Emirates Mars Mission as evidence of effective public-private collaboration.

Hervé Derrey, President and CEO of Thales Alenia Space France, discussed the industry’s dramatic shift toward service-based business models, emphasizing the need for clear risk-sharing arrangements between public and private partners. Mario Grotz, Chairman of the Board at the Luxembourg Space Agency, provided valuable historical context, noting that “Luxembourg was one of the first countries which really was focusing on commercial space.” He detailed the nation’s strategic development of instruments to support companies from research through commercialization.

Mike Gold, Chief Growth Officer at Redwire Space, delivered what many considered the day’s most passionate endorsement of public-private partnerships, declaring, “This entire golden age of commercial space that we’re experiencing is because of public private partnerships.” He cited achievements ranging from SpaceX’s landing technologies to biomedical breakthroughs on the ISS as evidence of successful collaboration.

The day concluded with “The Institutional Investor Gap in Space (and How to Close It),” moderated by Carissa Bryce Christensen, CEO of BryceTech. The session revealed a striking disparity in space investment patterns.

Mike French, founder of Space Policy Group, presented data showing that while venture capital accounts for approximately 70% of space investment, private equity represents only 5%, suggesting a significant untapped potential for institutional investment.

Alessandro Izzo, Director at the European Investment Bank, highlighted a particular challenge facing European space companies: while they often succeed in early funding rounds, they struggle to secure later-stage capital. “We actually do not have the depth of deep pocket funds that



are capable of funding these mega rounds,” he explained, though noting the sector’s surprising resilience in recent investment trends.

Jay Kim, CEO of Boryung, offered valuable insights from Asia’s perspective, particularly regarding investment in space stations and infrastructure. His experiences highlighted the need to reframe space infrastructure investments in terms familiar to traditional investors. Agnieszka Łukaszczyk, Founder and CEO of hiALtitude Consulting, emphasized the critical need for market-focused thinking, observing that many companies prioritize technological innovation over market considerations.

Key themes emerging from the day’s sessions included the increasing importance of human factors in space exploration, from nutrition to psychological well-being; the critical role of public-private partnerships in driving innovation; and the ongoing challenge of attracting institutional investment to the space sector. The discussions highlighted how space exploration has evolved beyond purely technical challenges to encompass a broad range of human, commercial, and financial considerations.

As missions grow longer and venture further from Earth, success will depend not just on technological innovation, but on creating sustainable business models, maintaining crew well-being, and developing robust funding mechanisms. The forum demonstrated that while the space industry has made significant progress in areas like food technology and public-private collaboration, challenges remain, particularly in attracting institutional investment. However, the diversity of perspectives and solutions presented suggested that the industry continues to adapt and evolve to meet these challenges.

Tuesday
15 October 2024

Tuesday featured five IAF Global Networking Forum (GNF) sessions tackling pressing issues within the space sector. Topics ranged from metaverse applications in space exploration and sustainable lunar operations to Earth observation for sustainability, personal journeys through adversity, and the future of commercial space stations.

The first session, “Lunar City: A Metaverse Platform for Space Operations,” was moderated by Anilkumar Dave, CEO of Lunar City SrL. This session showcased an innovative virtual reality platform designed to enhance space exploration. Panelists included Francesco Cupertino, Rector of Polytechnic of Bari; Cesare Lobascio, Space Exploration Lead at Thales Alenia Space Italia; and Francesco Santoro, Program Manager at ALTEC Spa.

Cupertino emphasized the platform’s potential to engage and inspire students, stating, “To attract a larger audience, we must speak their language.” Developed over two years using Unreal Engine, the platform features detailed virtual replicas of space modules, such as the Columbus module and future lunar habitats. Lobascio highlighted its ability to accelerate space system development through remote collaboration, while Santoro explained ALTEC Spa’s role in processing real-time space data for the platform. The live demonstration showcased the virtual spaceport’s interactive features and real-time capabilities. Lunar City’s future plans include expanding the platform with haptic interfaces and direct astronaut interactions, marking a significant step toward democratizing space access.

The second session, “A Collaborative, Water-Based Lunar Vision,” was moderated by Rob Chambers, Director of Strategy for Exploration at Lockheed Martin. He introduced the company’s vision of a lunar economy centered around water, emphasizing that “water is not a marketable product” but a critical infrastructure element. The panel

included Laurie Chappel, Senior Director of Business Development at MDA Space, who discussed detailed plans for autonomous robotic systems, and Roberto Provera, Director of New Initiatives at Thales Alenia Space Italia, who detailed progress on the European Argonaut cargo lander and lunar habitation systems.

Nuclear power emerged as a focal point, with Kate Kelly, Director of Space & Emerging Programs at BWXT Advanced Technologies, discussing advancements in nuclear thermal propulsion through the DRACO program. Jake Thompson, Director of Novel Nuclear & Special Projects at Rolls Royce, noted, “Nuclear is hard and space is hard; together, they’re really hard,” as he described their work on space-based nuclear reactors. The session emphasized international collaboration and infrastructure standardization, with all panelists affirming that their vision is grounded in current development efforts rather than speculative futures.

The third session, “Protecting Our People and Planet: The IRIDE Constellation as a Catalyst for Sustainability,” was moderated by Simonetta Di Pippo, Director of SEE Lab at SDA Bocconi School of Management. Opening remarks from Raffaella Lugini, Chief Sustainability Officer at Leonardo Spa, emphasized the program’s vital role in safeguarding the planet for future generations. Simonetta Cheli, ESA’s Director of Earth Observation Programmes, provided detailed insights into the €1 billion IRIDE program, which will deploy 68 satellites for monitoring environmental changes and natural disasters. Massimo Comparini, Managing Director of Leonardo’s Space Business Unit, highlighted innovations enabling the production of two satellites per week at a new Italian facility.



“If there’s no market, there’s no competitor”

Aarti Holla-Maini, Director of UNOOSA, addressed the need for accessible Earth observation data, stating, “Member States have overwhelmingly expressed that they can’t afford or access it.” Teodoro Valente, President of the Italian Space Agency, outlined plans to share IRIDE data with emerging nations, particularly through a new regional Earth observation center in Kenya. The program, set to begin launches in early 2025, represents a significant advancement in Italy’s space capabilities and its commitment to addressing climate change through space-based solutions.

The fourth session, “TED Talk: Triumph Over Trials – Personal Journeys Through Adversity,” was moderated by Kyle Acerno, CEO of Exobiosphere. This inspiring session featured industry leaders sharing their personal stories. Nobu Okada, Founder and CEO of Astroscale, recounted his company’s groundbreaking efforts in space sustainability, including capturing the first image of space debris despite initial skepticism. Eleanor Morgan, Space Habitation Program Manager at Lockheed Martin, described her transition from military aviation to space habitation development, sharing valuable insights from her experience in a 45-day NASA isolation study.

Sven Meyer-Brunswick, Principal at Alpine Space Ventures, likened the ups and downs of the space industry to the Munich Oktoberfest rollercoaster, providing unique perspectives on raising capital and taking companies public. Daniella Bezdán, Head of Green Space Center, shared her remarkable journey from a refugee center to becoming a pioneer in space biology, asserting that “no experience can replace discipline.” Okada’s reflections on market skepticism resonated deeply, as he remarked, “If there’s no market, there’s no competitor,” demonstrating how perceived obstacles can become competitive advantages.

The fifth and final session, “Space Stations 2.0: Opportunities in Commercial LEO Destinations,” was moderated by Giorgio Saccoccia, Senior Advisor to ESA’s Director General. The discussion focused on the urgent need to establish commercial space stations ahead of the International Space Station’s retirement in 2030. Max Haot, CEO of Vast, announced ambitious plans for Haven-1, a privately funded space station launching next year, alongside Haven-2, a more extensive nine-module station planned for 2032. Mike Gold, Chief Growth Officer at Redwire, highlighted the national security implications, stating, “Countries and companies that master microgravity will lead both economically and in national security.”

Jay Kim, CEO of pharmaceutical company Boryung, emphasized the potential for pharmaceutical R&D in microgravity, sharing insights into current research progress. Bob Lamboray of the Luxembourg Space Agency discussed his country’s commercially driven space strategy and its role in fostering international collaboration. The panel identified key success factors, including public-private partnerships and the necessity



for multiple commercial space stations to stimulate competition. Redwire’s current achievements in printing cardiovascular tissue and developing improved insulin crystals in microgravity were highlighted as concrete examples of the potential for space-based manufacturing.

Tuesday’s five IAF GNF sessions offered a comprehensive exploration of emerging technologies, lunar exploration, Earth observation, personal resilience, and the commercialization of low Earth orbit. The discussions underscored the space sector’s ongoing evolution towards greater commercial engagement, international collaboration, and technological innovation. From revolutionary virtual reality platforms to ambitious commercial space station plans, the panels demonstrated how public-private partnerships and cross-sector collaboration are shaping the future of space exploration and utilization. Whether developing sustainable lunar infrastructure, deploying advanced Earth observation systems, or establishing commercial space stations, the sessions highlighted the critical importance of international cooperation and innovation in advancing humanity’s presence in space.

Wednesday 16 October 2024

Wednesday showcased five panels at the IAF Global Networking Forum (GNF), where industry leaders gathered to explore the vital role of space technology in tackling urgent global issues, particularly climate change, environmental protection, and making human spaceflight more inclusive. The sessions highlighted innovative strategies and the interconnectivity of our planet and the cosmos.

The day began with the session titled “Climate & Environmental Action and Sustainability,” moderated by Fani Kallianou De Jong, Principal Manager at the European Bank for Reconstruction and Development (EBRD). Notable participants included Simonetta Cheli, Director of Earth Observation Programmes at the European Space Agency (ESA); Alessandra Zampieri, Director at the European Commission’s Joint Research Centre (JRC); and Alessandro Izzo, Director at the European Investment Bank (EIB). The panel emphasized the critical role of Earth observation satellites and space-based data in combating climate change, from tracking greenhouse gas emissions to optimizing renewable energy deployment and supporting precision agriculture. Izzo highlighted the financial sector’s increasing awareness of the importance of space data, stating, “We need to change the paradigm of thinking regarding sustainability and data related to sustainability.”



The discussion also spotlighted ESA’s upcoming CO2 monitoring mission set for 2026-27, showcasing successful collaboration among space agencies, research institutions, and financial organizations. Zampieri noted that achieving the European Green Deal goals will necessitate an annual investment of €114 billion, while Cheli discussed ESA’s development of digital Earth twins to anticipate future environmental shifts. This session reaffirmed the essential role of space-based solutions in Europe’s ambition to become the first zero-emission continent by 2050.

The second session, “The World Breathes: Restoring the Amazon,” moderated by Agnieszka Łukaszczyk, CEO of hiALtitude Consulting, focused on how satellite technology and international cooperation can drive rainforest conservation. Rodrigo Leonardi, Director of the Brazilian Space Agency, shared insights into Brazil’s



“We need to change the paradigm of thinking regarding sustainability and data related to sustainability”

36-year history of monitoring Amazon deforestation from space. Irene Benito, Director of Government Affairs at Planet, highlighted the success of daily satellite imagery in combating illegal deforestation, noting a 55% reduction in illegal activities in Brazil during the first year of the program.

The session also recognized Norway's commitment to forest conservation, with Christian Haugliehanssen, Director General of the Norwegian Space Agency, announcing plans to extend their tropical rainforest program until 2035. Tom Greenwood from Iceye discussed how radar satellite technology complements optical imagery, enabling consistent monitoring of the Amazon regardless of weather conditions. The panel concluded with a call for enhanced international collaboration ahead of COP30, scheduled for 2024 in Belém, Brazil, emphasizing the necessity for a unified global effort to safeguard vital ecosystems.

The third session, "A New Era in Human Presence: NASA's Strategy to Advance Microgravity Science, Technology, and Exploration in Low Earth Orbit," featured NASA Deputy Administrator Pam Melroy, who outlined a comprehensive strategy for maintaining a human presence in space beyond the International Space Station's planned deorbit by the decade's end. Melroy detailed a three-pillar approach focusing on science, national posture, and inspiration, stating, "Microgravity allows us to peer beyond gravity... into second and third order effects." This strategy encompasses 12 draft goals and 42 objectives, underscoring the importance of international cooperation and commercial partnerships.

In the fourth session, "The Global Space Economy, International Organizations and Emerging Communities: Challenges and Opportunities," Dr. Sreedhara Somanath, Chairman of the Indian Space Research Organisation, opened the discussion by highlighting India's rapid growth in the space sector, which has expanded from one company in 2014 to over 200 today. Moderated by Pieter Van Beekhuizen, the panel featured discussions on democratizing space access. Rodrigo Da Costa, Executive Director of EUSPA, projected that the space market could double to €600 billion by 2033. Aarti Holla-Maini, Director of UNOOSA, emphasized the importance of

capacity building in developing nations, while Junichi Sakai from JAXA discussed Japan's Kibo-Cube program, which facilitates space access for emerging countries.

Hazuki Mori from the World Economic Forum articulated a vision for a \$1.8 trillion space economy by 2035, stressing the significance of technology convergence. Dr. Sherif Sedky, CEO of the Egyptian Space Agency, showcased Egypt's emergence as a regional space hub through the establishment of a new 123-acre space city. This session underscored the collective commitment to expanding access to space and the vital role of international collaboration in fostering sustainable space ecosystems.

The final session of the day, "Accessibility of Human Spaceflight," moderated by Ersilia Vaudo, ESA's Chief Diversity Officer, focused on the journey toward inclusivity in space exploration. The conversation revealed promising outcomes from ESA's Fly! feasibility study, indicating no technical barriers preventing astronauts with physical disabilities from participating in missions. Daniel Neuenschwander, ESA's Director of Human and Robotic Exploration Programmes, stated, "The real challenge was much more about the shift of mindset," emphasizing the need for changing perceptions to enhance inclusivity. John McFall, ESA's first astronaut candidate with a physical disability, shared the rigorous adaptations required for space missions. Paul Bate, Chief Executive of the UK Space Agency, echoed the importance of viewing space exploration as a beacon of hope and inspiration, highlighting how astronauts galvanize excitement not only for their countries but for all of humanity. The panel concluded with calls for increased data sharing between space agencies and commercial entities to further enhance inclusivity in space exploration.

Overall, the GNF sessions on Wednesday presented a compelling narrative about leveraging space technology to address some of the most pressing challenges our planet faces. From climate action to rainforest conservation, human spaceflight, and the evolving space economy, these discussions underscored the importance of cross-sector and cross-border collaboration. Looking ahead, the commitment to inclusive and sustainable space exploration will be crucial for shaping a better future for all.



Thursday 17 October 2024

Thursday featured seven IAF Global Networking Forum (GNF) sessions exploring critical themes in the space sector, including generative AI's role in strategic risk management, space sustainability through circular economy principles, student innovation in global space challenges, human health in space exploration, space policy and governance, and advanced lunar landing technologies. The sessions highlighted emerging trends such as AI's complementary role in aerospace, the urgent need for sustainable operations, international collaboration, and the increasing importance of young researchers.



The first IAF GNF session, "Leveraging Generative Artificial Intelligence (GenAI) for Enhanced Strategic Risk Management in Aerospace Sustainability," convened industry leaders at the IAF International Astronautical Congress. Moderated by Maria Gabriella Sarah from ESA's Strategy Department, the panel explored AI's impact on risk management. Christopher Geiger of Lockheed Martin discussed their proprietary large language models for risk identification. Massimo Comparini of Leonardo emphasized AI's role in human-machine cooperation for lunar missions. Dr. Adam Abdin from CentraleSupélec raised concerns about current AI reliability, stating that existing systems "are not actually good enough for reliability and risk assessment" in aerospace applications.

The discussion took a turn toward ethical considerations when NASA's Counsel for Ethics, Adam F. Greenstone, advocated for industry self-regulation rather than waiting for government oversight, stressing the space industry's unique role in signaling societal values. Mariella Graziano, Executive Director at GMV Space Systems, shared insights on implementing AI in knowledge management and proposal generation, highlighting the challenge of data availability. The session concluded with a unified vision of AI as a complement to human intelligence, particularly in critical space operations and risk management.

The second session, "Pioneering Space Circular Economy for Space and the Earth," moderated by broadcast journalist Katy Haswell, addressed sustainability challenges. Patrick Neumann, Founder and Chief Scientist of Neumann Space, showcased innovative technology that transforms space debris into propellant. Andrea Vena, ESA's Chief Climate and Sustainability Officer, emphasized the importance of redesigning spacecraft with sustainability in mind, particularly in the reuse of rare earth materials for solar panels. Charity Weeden, NASA's Associate Administrator for Technology, Policy, and Strategy, pointed to the International Space Station's successful water reclamation system as a model for lunar missions. Cédric Balty, Gateway International Program Manager at Thales Alenia Space France, outlined his company's three-pillar approach to sustainability. The session underscored the urgency of addressing space debris and the potential for in-orbit servicing and manufacturing.

The third session, "Inspiring Change: AIDAA Student Team Challenge for Global Sustainability," marked a historic first for student engagement in space innovation. Moderated by Muhammad Asad of Prince Mohammad Bin Fahd University, the event showcased 23 teams selected from an initial pool of 70 applicants across three continents. Enrico Zappino, Executive Project Manager of AIDAA, highlighted the initiative's global reach. The



competition culminated in awards presented to three finalist teams: Wonder Mercury from Costa Rica won for their medical assistance rover concept, while teams from Germany's ASTRAEUS and Italy's DIANA secured second and third places, respectively. AIDAA President Erasmo Carrera, alongside PhD students and evaluation committee members Francesca Bracaglia and Marianna Valente, emphasized the unprecedented nature of the student-focused challenge. Special recognition awards were also given, including the Voice of ISE 2024 Community Award to Thurst from Italy and the Sustainability Pioneer award to Star Five from the Netherlands, showcasing the increasing role of young researchers in addressing space sustainability challenges.

The fourth session, "2024 Humans In Space – Multiplanetary Human Life Enabler," discussed the future of human health in space exploration. Clay Mowry, President of the International Astronautical Federation, opened the session, highlighting record-breaking attendance of over 11,000 delegates. Jay Kim, CEO of Boryung, outlined his company's vision as a multiplanetary human life enabler. Moderated by Jack Lim, the panel brought together experts from European space agencies to discuss advances in space healthcare research. Dr. Jens Jordan, Director of the DLR Institute of Aerospace Medicine, emphasized making low Earth orbit "a safe place to live and work." Audrey Berthier, Executive Director of MEDES, detailed her institute's 35-year history in space physiology research. The panel highlighted emerging challenges in space healthcare, with Dr. Jonathan Scott of the European Space Agency discussing the unique medical challenges of upcoming Gateway missions. Dr. Serena Pezzilli from the Italian Space Agency shared insights from recent Axiom-3 mission experiments, focusing on age-related diseases and isolation effects. Boryung announced a new orbital launch funding structure providing up to \$250,000 for space experiments.

At the fifth session, "Heads of Think Tank: Quo Vadis Space Sustainability," experts gathered to discuss the balance between economic opportunities and environmental responsibility in space operations. Moderated by Financial Times Space Industry Editor Peggy Hollinger, Jamie Morin, Executive Director of the Center for Space Policy and Strategy at The Aerospace Corporation, emphasized the need for tiered regulatory

approaches. Ikuko Kuriyama, Visiting Researcher at Japan's Institute for Future Initiatives, highlighted Japan's strategic approach through public-private partnerships. Hermann Ludwig Moeller, Director of the European Space Policy Institute, stressed the importance of viewing space sustainability as both a prerequisite for economic growth and a catalyst for innovation across sectors. The discussion turned global when Hebe Romero Talavera, Member of the Center for Aerospace Research of Paraguay, emphasized space sustainability's potential to drive development in emerging space nations. Experts agreed that immediate action is necessary, with progress achievable through industry best practices and cooperation among like-minded nations.

In the sixth session, "Achieving Unified Global Governance for Civil Space Exploration," global space leaders addressed the need for unified governance. Moderated by Mike Gold, Chief Growth Officer at Redwire, the panel included Aarti Holla-Maini, Director of the United Nations Office for Outer Space Affairs; Frederic Nordlund, Head of the European and External Relations Department at ESA; and Guoyu Wang, Dean of the Academy of Air, Space Policy and Law at Beijing FutureSpace Space Technology Institute. They discussed harmonizing international space policies, focusing on the Artemis Accords and International Lunar Research Station initiatives. Nordlund emphasized ESA's commitment to transparency in lunar exploration activities. The panel stressed the urgency of international cooperation, with a shared vision for future collaboration.

The seventh and final session, "Innovative Lunar Lander Technologies for Sustainable Exploration," gathered leaders from four lunar missions to share their visions for sustainable lunar returns. Moderated by NASA Chief Technologist A.C. Charania, Tim Crain, Chief Growth Officer of Intuitive Machines, emphasized high-impulse thrust management's critical role in lunar landings. JAXA's Professor Masaki Fujimoto detailed Japan's SLIM mission's pioneering pinpoint landing technology. P. Veeramuthuvel, Project Director of ISRO's Chandrayaan-3, discussed the mission's throttleable engines and landing gear mechanisms. Astrobotic's Vice President Dan Hendrickson shared lessons learned from their propulsion system challenges. The panelists outlined a vision for regular lunar operations and sustainable infrastructure, emphasizing key challenges such as lunar night survival and standardized interfaces.

The seven IAF GNF sessions at this year's International Astronautical Congress demonstrated the space sector's multifaceted approach to future challenges. From leveraging generative AI for risk management to pioneering circular economy principles, empowering student innovation, and advancing human health in space, the discussions underscored a unified vision of space exploration. Panelists emphasized that realizing the full potential of the space sector will require unprecedented collaboration across nations, industries, and organizations, embracing innovative technologies while committing to ethical, sustainable, and inclusive exploration.

Friday 18 October 2024

During the final four IAF Global Networking Forum sessions of the 75th International Astronautical Congress, space leaders converged to explore three critical dimensions of humanity's cosmic frontier: the imperative of global communication and public engagement, the evolving landscape of space investment in Europe, and the fundamental interplay between space sustainability and security. From highlighting the transformative potential of space technologies to addressing systemic challenges in funding and responsible orbital practices, these sessions underscored the urgent need for collaborative, forward-thinking strategies that can translate complex space endeavors into tangible benefits for our planet and future generations.

In a compelling dialogue about space communication, industry leaders gathered for Friday's first GNF session, "Bridging Worlds: A Compelling Conversation on Communications Between Space and Earth for a Sustainable Future," moderated by Aarti Holla-Maini, Director of the United Nations Office for Outer Space Affairs. The session highlighted the critical need to better communicate space benefits to the general public, with Dennis Stone, President of World Space Week Association, reporting that their annual celebration reached "over a billion people" through 16,000 events worldwide. Camille Bergin, known as "Galactic Gal," emphasized the importance of engaging younger generations who prioritize sustainability, noting that "the next generation cares so much more about our planet than ever before."

The discussion featured diverse perspectives, including Philip Plantholt, General Manager of Spire Global, who stressed the importance of demonstrating space technology's practical applications in addressing climate change. Candace Johnson, a pioneer behind SES and various space initiatives, shared historical insights about satellite communication's role in bridging divided communities. Jennifer Warren, Vice President of Regulatory Affairs & Public Policy at Lockheed Martin, concluded the session with a special presentation of a World Space Week lapel pin that flew on NASA's Artemis 1 mission, symbolizing women's contributions to space exploration. Key themes emerged around the need to move beyond industry silos, engage broader audiences, and communicate space's practical benefits in tackling Earth's challenges, particularly climate change and sustainable development.

In the second GNF session, "Full Value Chain of Space Investing in Europe," industry leaders addressed critical gaps in space investment across the continent. Moderated by Lorenzo Scatena, Secretary General of Fondazione E. Amaldi, the panel highlighted Italy's position as a key player in European space innovation while exposing

“The next generation cares so much more about our planet than ever before”



significant challenges in private capital allocation. Claudia Pingue, Head of Technology Transfer Fund at CDP Venture Capital SGR, emphasized Italy's strategic advantages, noting that "Italy is the third country in Europe for space manufacturing" with over 4,000 active companies in the market. Matteo Cascinari, General Partner at Primo Space Venture Capital Fund, pointed out the scarcity of later-stage investors willing to provide €10-20 million funding rounds for maturing space companies.

The discussion revealed a transformative shift in how private equity views the space sector, with Michele Gallo, Partner and Managing Director at Alcedo SGR, citing that

the global space sector is now worth \$470 billion, with 77% in commercial applications. Giorgio Mariani, Head of Corporate and M&A practice at Deloitte Legal, offered crucial insights into the timing of seeking investment, cautioning entrepreneurs about the complexities of public listings versus private investment. The session highlighted the urgent need for increased private capital involvement in European space ventures while acknowledging the progress made through public initiatives like CDP Venture Capital's €5 billion asset management program. The upcoming European Commission's Listing Act, set to be enforced in late 2024, was identified as a potential catalyst for increased space company IPOs, marking a turning point for the industry's funding landscape.

In the third GNF session, "The Intertwined Relationship of Space Sustainability and Security: How They Are Both Needed to Make Space Safe and Predictable for All," industry leaders and experts emphasized the inseparable connection between space sustainability and security. Victoria Samson, Chief Director of Space Security and Stability at Secure World Foundation, moderated the discussion, highlighting how debris creation and irresponsible behavior in space affect all stakeholders, regardless of their capabilities or alliances. Almudena Azcárate Ortega, Lead Space Security Researcher at UNIDIR, emphasized that "space sustainability and security are not two things that are apart from each other... You're not going to be able to have a sustainable space environment and, to a certain degree, not even a sustainable Earth environment if you do not achieve space security."

The panel, which included Aya Iwamoto, Vice President of Strategy and Policy at Astroscale, and Kerri Mertz, Director of International Business at Slingshot Aerospace, focused on several critical themes: the impact of space debris on commercial operations, the importance of responsible behavior in space, and the growing role of commercial actors in promoting space sustainability. The discussion highlighted recent international efforts to prevent destructive anti-satellite testing, with 37 countries now committed to avoiding such tests. Particular attention was paid to emerging space actors and non-spacefaring nations, emphasizing that space services are essential to human life on Earth and that threats to space systems disproportionately affect nations with limited space capabilities. The session underscored the necessity of a global approach to ensure space remains accessible and usable for all stakeholders over the long term.

In the final IAF GNF session of the congress, veteran astronauts and space experts convened for "IAF – ASE Astronaut Panel: #NORISKNOFUN - Keeping Human Spaceflight Safe," moderated by Reinhold Ewald, President of the Association of Space Explorers. The diverse panel featured ESA astronaut Luca Parmitano, Lockheed Martin's Tony Antonelli, Turkish Space Agency's Tuva Cihangir Atasver, ESA reserve astronaut Anthea Comellini, JAXA's Akihiko Hoshide, and private astronaut Eytan Stibbe. They delved into the complexities of risk



management in human spaceflight. A standout moment came when Parmitano challenged conventional thinking about fear and risk, stating, "I completely separate risk and fear. Those are two things that don't belong in the same bag for me... Knowledge is the antidote to any fear."

The panel highlighted several critical themes for the future of space exploration, including the growing challenge of orbital debris, the importance of spacecraft ergonomics, and the need for enhanced international collaboration. Comellini emphasized the necessity of better tracking smaller space debris, while Hoshide discussed the unique challenges of deep space missions to the Moon and Mars, where quick returns to Earth won't be possible. Notable concerns were raised by Stibbe about the increasing amount of space debris, citing "130 million pieces of metal flying around Earth at 28,000 kilometers per hour." The discussion concluded with calls for improved safety measures, including enhanced crew medical support and better monitoring of the space environment, as human spaceflight ventures beyond low Earth orbit.

In conclusion, the discussions held during these GNF panels at the 75th International Astronautical Congress emphasized the interconnectedness of communication, investment, sustainability, and security in the space sector. As humanity pushes further into the cosmos, it is essential to foster collaboration among nations, industries, and organizations to address these challenges comprehensively. The insights shared by leaders and experts underscore the need for innovative approaches that can effectively harness space technologies for the betterment of life on Earth, ensuring that the exploration and utilization of space benefit all of humanity now and in the future. ■



IAC 2024 Special Sessions



Monday

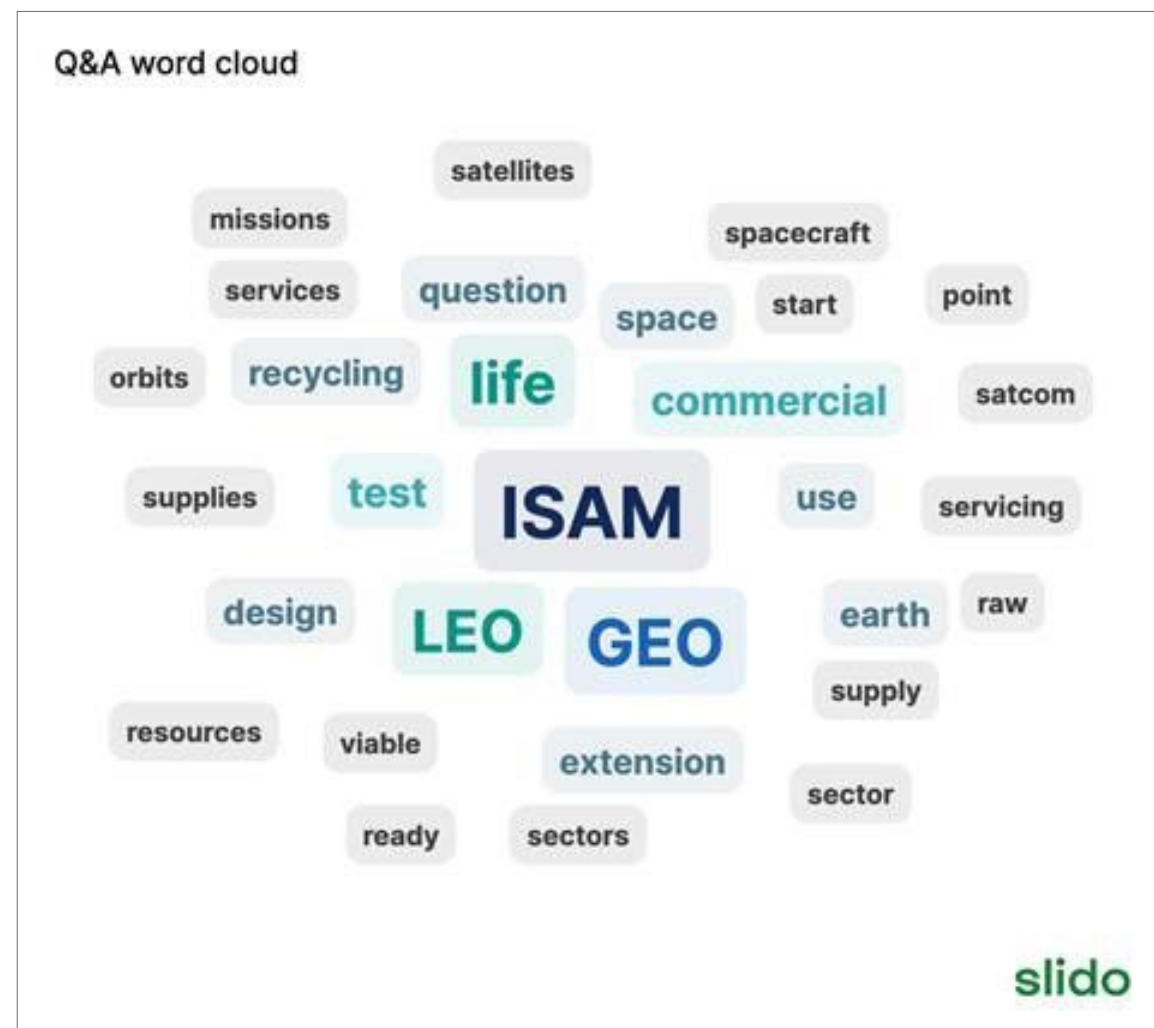
14 October 2024

In-Space Servicing Assembly & Manufacturing (ISAM) – Shaping a Future Safe, Secure and Sustainable Space Ecosystem

On the first day (14.10.2024) of this year's IAC in Milan, the German Space Agency at DLR together with TAS France hosted a special session on ISAM (In-Space Servicing, Assembly, Manufacturing). In the first panel the institutional needs of international agency representatives (ESA, NASA, JAXA, EU, CONFERS) were discussed. In a second step industry representatives (Arkisys, Astroscale, Northrop Grumman, iBOSS, dOrbit, TAS) discussed the potential of the topic and how industry and academia plans to respond to identified needs. More than 200 participants and extremely positive

feedback on the format and content made the session a great success. This once again proves the increased importance of the topic of ISAM: the session allowed to outline the shape of a future space ecosystem in which the ISAM capabilities will be state of the art, and servicing, assembly, and sustainability will be the cornerstone for space exploitation and exploration.

After each panel the audience had the chance to ask the panelists questions. The following word cloud is based on these questions:



Monday

14 October 2024

Very Low Earth Orbits (VLEO) – Development and Engagement of the Growing Community of Interest towards Sustainable Lower Altitude Operations

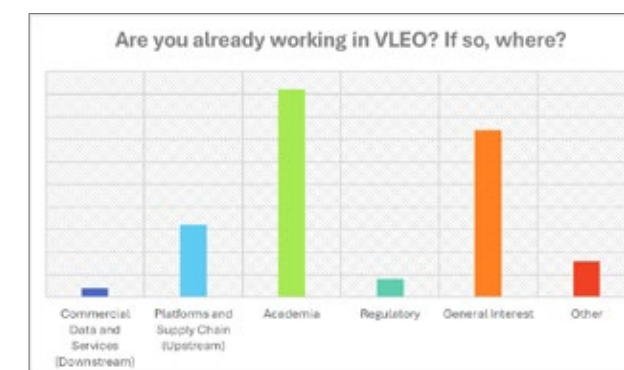
This special session, attended by over 110 participants, brought together the diverse community of stakeholders interested in very low Earth orbits (VLEO).

Nicholas Crisp (University of Manchester) opened the session with an introduction to VLEO, the key applications that are driving the growing interest in this orbital regime, and the technology development that is aiming to support its realisation. Tying into the theme of this year's IAC "Responsible Space for Sustainability", Crisp also discussed the advantages of VLEO, including the assured end-of-life deorbit, ensuring low risk of orbital collisions and long-term resilience of the environment.

A survey of the audience provided insight on their interest in VLEO and their vision for it in future space industry. The sentiment in the room was largely optimistic, envisioning exploitation of the advantages of VLEO for high-resolution Earth observation missions, global communications, and scientific missions. However, practical challenges of operating in this environment were also noted.

The session continued with highlight talks from experts and leaders from across the academic and industry community:

- Constantin Traub (University of Stuttgart) on Fundamental Research for VLEO under the ATLAS Collaborative Research Centre.



- Peter Roberts (University of Manchester and CASA Space Technologies) on drag mitigation and novel coatings for VLEO.
- Tommaso Andreussi (Sant'Anna School of Advanced Studies) on drag compensation technologies including electric propulsion and atmosphere-breathing electric propulsion (ABEP).
- Vincenzo Stanzione (Sitael), Russell Hills (Thales Alenia Space), and Frank Preud'homme (Redwire Europe) bringing a commercial perspective and introducing proposed mission concepts and in-orbit demonstrators for VLEO.

Contributions from the audience were also invited and included Kreios Space (developing ABEP technology) and LeoLabs (interested in tracking the first commercial VLEO satellites).

The session ended with discussion of the key challenges and pathways towards successful VLEO adoption, including in-orbit demonstration missions and technology synergies.



Tuesday
15 October 2024

Plant Cultivation in Space for Food Production and Resource Regeneration: Opportunities, Constraints, and Advances in Technology

With the rise of commercial and touristic space missions, the need for efficient cultivation systems has become increasingly relevant. Discussions within the special session emphasized the need of effective management of limited resources, with participants exploring techniques such as hydroponics and aeroponics, which minimize water use and enhance nutrient delivery, both essential for successful plant growth in microgravity. Experiments conducted on the International Space Station (ISS) and other space missions have demonstrated the feasibility of plant cultivation, providing valuable scientific information on plant responses and optimizing cultivation systems. A highlight of the special session was the demonstration of an adaptive vertical farming prototype that optimizes resource use (light, water, and nutrients) in the constrained environment of the ISS.

The special session identified several promising research directions, including genetic modifications to enhance plant resilience in space conditions, the development of automated systems for monitoring and maintaining

plant health, and studies on plant-microbe interactions to improve growth efficiency. A strong theme throughout the discussions was the necessity for interdisciplinary collaboration among botanists, engineers, and space scientists to expedite the development of these technologies. Participants advocated for public-private partnerships to foster innovation and investment in space agriculture, recognizing that such collaborations can accelerate progress. Additionally, aligning space farming technologies with sustainability goals emerged as a central concern, ensuring that systems not only support long-duration missions but also contribute to resource regeneration.

In conclusion, the special session brought together researchers and industry experts who underscored the urgency and potential of space agriculture as a solution for food security in future space exploration. The collaborative spirit and innovative ideas shared during the event promise to advance our capabilities in cultivating plants beyond Earth, paving the way for successful long-term missions.



Tuesday
15 October 2024

Orbital Debris Remediation – Accelerating Active Debris Removal



The growth of orbital debris has spurred international efforts in debris remediation. Debris remediation can take many forms, but one mainstream approach that has garnered attention over the decades is active debris removal (ADR). ADR serves to remove a massive intact derelict space object to prevent it from colliding with another space object and creating thousands of lethal fragments. Despite the growing population of intact derelict objects (i.e., abandoned rocket bodies and non-operational payloads) in orbit, ADR is still in the developmental stages. This special session was established to catalyze a global dialogue by addressing specific questions about how to best “make ADR an operational reality.” The fishbowl dynamic chosen for this gathering allowed participants to provide their own options for consideration live and on-line. Over 100 people from five continents participated in this event.

The five dimensions considered as potential enablers for ADR were Diplomatic (international governmental dialogue), Legal (treaties and laws), Economic (financial innovation), Programmatic (contracts and procurement), and Technical (analytic and engineering). The economic dimension was voted as the most important to be solved.

Each participant also voted on the primary action(s) needed to advance ADR into an operational enterprise in each of the five domains. The actions deemed most important to empower progress of ADR operations were:

- China, Russia, and US must agree to jointly pursue remediation of massive derelict objects they have abandoned;



- Eliminate unconditional liability for ADR operators when removing hardware;
- Establish ADR insurance as requirement;
- Government space programs should release tenders to an international pool of ADR providers funded by fees levied on all future space launches; payment based on debris-generating potential removed;
- Prove mathematically that doing nothing will cost more than executing ADR missions.

Appreciating the contribution from the audience, the session concluded with a better understanding of spectrum management. Radiofrequencies and related regulations remain pivotal for the space sector, playing a significant role in space sustainability.

Tuesday

15 October 2024

The Next Technology Breakthrough to Drive Transformational Space Science Discovery

Space technologies are typically invented to address specific challenges in mission implementation, measurement capability, or operations. On rare occasions, however, they can also be introduced to inspire new ways of thinking about the broad range of science questions that can be posed, as well as the mechanisms through which they can be addressed.

Charles Norton, Deputy Chief Technologist of NASA JPL, organized this special session to dynamically engage participants to explore what the next technical breakthrough may be to enable transformational space science. It began with a keynote presentation from Travis Brown of NASA JPL on “The Legacy of the

Ingenuity Helicopter”, highlighting how this technology breakthrough has fundamentally changed how future Mars exploration missions may be proposed. Ingenuity laid the foundation for how previously inaccessible regions such as rapid and long traverses through deep canyons, or cooperative and autonomous multi-spacecraft observations, could expand our scientific reach in the future.

The organizer then led a panel discussion with A C Charania, NASA Chief Technologist; Agnes Mestreau, ESA/ESTEC Head of Systems Engineering; Massimiliano Pastena, ESA Scout Systems Manager; and Travis Brown, Team Lead Mars Helicopter Project, to share experiences observing past technological breakthroughs, and ideas on what will come next. Past breakthroughs spanned single photon detectors for deep space optical communications, to precision formation flying, to bulk metallic glass gears for extreme environments. Future topics included melt probes to detect biological signatures at Ocean Worlds, virtual satellites, AI/ML edge-based mission design, and others.

The session closed with lively interaction from participants to propose the next technology breakthrough. Quantum sensing was very popular, but others included fusion and solar sail-based interstellar propulsion, quantum and outer planet-based optical communication, and space interferometry.



Wednesday

16 October 2024

Sustainable Cities and Communities: Which Role for CubeSats?



The session titled “Sustainable Cities and Communities: Which Role for CubeSats?” explored how CubeSats could enhance sustainable urban development by integrating space technology with urban planning tools like Digital Twin Cities and the urban metaverse. This interdisciplinary approach merged aerospace engineering with urban sustainability, focusing on how CubeSats—small, cost-effective satellites—could aid in monitoring and managing urban infrastructure, transportation, and environmental resilience. The session aimed to highlight CubeSats’ potential to address complex urban challenges through high-frequency, multi-dimensional data, thereby contributing to the Sustainable Development Goal 11 for resilient, sustainable cities.

Given the pressures of urbanization and population growth, urban digital twin models and metaverse applications were presented as increasingly valuable for governments and businesses. These tools allow for comprehensive and dynamic data management, essential for informed decision-making in rapidly evolving urban spaces. CubeSats are shown to support this need by expanding data volume, flexibility, and sensor network distribution, offering new possibilities for real-time urban monitoring.

The session was structured as a Campfire, beginning with two talks. M.A. Brovelli highlighted CubeSats’ potential in promoting urban sustainability through case studies on environmental impact. CubeSats provide innovative tools for urban monitoring, tackling issues such as air pollution, flood management, 3D mapping, green space optimization, urban temperature, informal settlements, and socio-economic and hydrological analysis. M. Lavagna followed with insights on CubeSats’ growing capabilities in data provision, showcasing operational case studies.

Participants (Betty Charalampopoulou, Andrea Taramelli, Deodato Tapete, Miriam Gonzalez, Cecilia Sciarretta, Nathalie Ricard, Giuseppe Borghi, Riccardo Benvenuto, Silvia Natalucci, Luca Soli, Giuseppe Tomasichio) from diverse backgrounds - Earth Observation, Space Economy, academia, and governmental agencies—then engaged in moderated discussions, sharing ideas and identifying opportunities for CubeSats to complement large satellites in urban monitoring. Expected outcomes included an increased awareness of heterogeneous space architectures, new data strategies, and contributions to digital twin implementations.

Wednesday
16 October 2024

AI-enabled Self-Reliant Design, Construction, and Operations of Adaptable Deep Space Habitats

Generative AI techniques such as Large Language Models (LLMs) and computer-aided visual design have recently exploded in popularity, with models such as ChatGPT, Midjourney, and Autodesk Fusion raising questions and concerns about the safety of these models alongside their rapid development. However, these tools have the potential to be mission-enabling in deep space, where astronauts may need to improvise tools, rework their existing equipment, or adapt to their changing environment. This session gathered engineers, scientists, operators, and other stakeholders to discuss the use cases, challenges, opportunities, and ethics of these advanced technologies in the context of human spaceflight.



The session opened with an introduction to generative AI provided by the present session organizers, Valentina Sumini and Annika Rollock. Listeners were invited to share what AI for human space exploration meant to them, and these ideas were gathered together in a real-time word cloud. Over 125 responses were received, including terms like 'autonomy,' 'efficiency,' 'early detection,' and 'safety.' However, the audience also expressed concerns about incorporating this type of AI into human missions.

Following this exercise, the session facilitators each provided an introduction to their own area of expertise (robotics, habitat design, sustainable design and creativity, mission design and operations, computational design and construction) before splitting into breakout sessions. Each breakout reflected a broad diversity of participants including researchers, architects, engineers, and scientists. Topics of discussion ranged from the intricacies of using generative AI for computational design, the role of the AI agent as a team member, the effects that AI will have on future mission ops, and the way that AI may contribute to sustainable habitat design. Overall, this session provided a valuable platform for an interdisciplinary examination of both the transformative potential and critical challenges of integrating generative AI into future human spaceflight missions, and highlighted the need for continued research, collaboration, and discussions as this technology continues to evolve.



Photo: Guillermo Trotti, Valentina Sumini, Melodie Yashar, Sandra Häuplik-Meusburger, Dava Newman, Annika Rollock, Daniele Florenzano

Wednesday
16 October 2024

Responsible and Sustainable Advances in SAR Mission and Technology



This Special Session initiated a strategic discussion on a more responsible and sustainable development of advanced Synthetic Aperture Radar (SAR) Missions and Technologies.

Guy Seguin introduced the benefits of SAR missions, which include critical monitoring, surveillance, and disaster response as well as key information on climate change impacts.

Pier Bargellini presented the progress of ESA Sentinel-1 with the forthcoming launch of Sentinel-1C, the development of Rose-L and of the Next generation of Sentinel-1 satellites.

Francesco Longo explained how Synthetic Aperture Radar is "A Perfect Match" for Italy monitoring needs by presenting the evolution of COSMO-SkyMed, of innovative SAR concepts and the IRIDE program.

Paul Rosen presented the NASA-ISRO SAR mission with a launch planned for early 2025 and the prospects for the continuity of L-band surface deformation and change measurement.

Alexander Kaptein presented a perspective on the Contribution of Commercial Radar Services and pointed governance issues, market grow, and positioning of present commercial ventures.

Ornella Bombaci presented a ThalesAlenia approach to SAR Constellations for Sustainable Development as used for the NIMBUS platform to minimize the environmental footprint.

Toshihiro Obata presented Synerspective Business approach for Sustainability and Advances in SAR Technology by using a Micro-Satellite constellation approach with analysis solution.

After the presentations the facilitators Matteo Emmanuelli and Annamaria Nassisi, invited the audience to provide their view on SLIDO.com on Challenges and to ask questions to the panelists. Ten challenges were identified, and nine questions asked.

The panelists discussed questions of governance and frequency protection, enhanced need for harmonization and the use of multi-Frequencies as well as the survival of a commercial market in Europe outside Copernicus and IRIDE. A report was provided to the November's International Coordination Group meeting.

Guy Seguin concluded by appreciating the contribution from the audience and the panelist and the need for SAR strategic development discussions.

Thursday
17 October 2024

Space Supporting A World Of 8 Billion People



With projections indicating a global population of 9 billion by 2037, the session highlighted the role of space technologies, such as Earth Observation (EO), Global Navigation Satellite Systems (GNSS), and satellite communications, in addressing global challenges. Against a backdrop of rising global populations and environmental challenges, experts from diverse fields gathered to explore how innovations in space can contribute to sustainable development, disaster resilience, and Earth observation.

Key presentations showcased diverse perspectives on leveraging space technologies for global challenges. Andrew Peebles from the UN Office for Outer Space Affairs (UNOOSA) discussed the multilateral vision of the

Space2030 Agenda, stressing the importance of scaling space solutions to meet worldwide needs. Dr. Chiara Solimini from the European Union Agency for the Space Programme (EUSPA) highlighted the roles of Copernicus and Galileo in climate action and sustainability, examining both the potential of the EU Space Programme (Galileo and Copernicus) and the challenges to effective data usage. Her presentation underscored the transformative impact of satellite advancements. Meanwhile, Marco Chini from the Luxembourg Institute of Science and Technology focused on using remote sensing for disaster management, particularly in flood mapping with Copernicus Sentinel-1 data and discussed the potential of integrating commercial satellite data to enhance monitoring capabilities. Together, these presentations illustrated the vast potential of space technologies in tackling complex global issues.

Throughout the session, participants engaged in interactive polls, reflecting on urgent issues space data and services could address—like climate change, water management, and disaster response—and explored ways to strengthen public-private collaboration. Audience responses emphasized transparency, accessibility, and cross-sector partnerships as key to maximizing space technologies' impact on global well-being.

In closing, participants shared takeaways about the urgency of collaboration and the need for greater awareness of space data's societal benefits. The session underscored the transformative potential of space technology for sustainable development.

Thursday
17 October 2024

Empowering Tomorrow's Space Visionaries: Exploring Multidisciplinary Pathways to Space Exploration

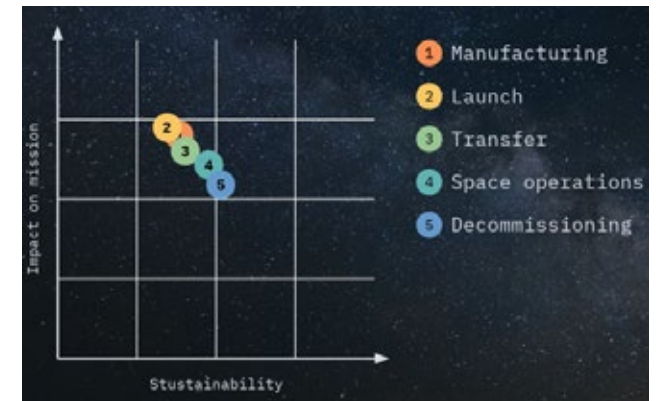
The Special Session organized and moderated by Giuseppe Governale, was inspired by the Space Exploration and Development Systems (SEEDS) specializing master. SEEDS alumni, supporting industries, and agencies collaborated with Politecnico di Torino, ISA-Supaero, and the University of Leicester to discuss sustainable space exploration through the mission concepts developed within the program.

Featuring keynote speakers like Maria Antonietta Perino from Thales Alenia Space Italia, Marco di Clemente from the Italian Space Agency, and Giorgio Saccoccia from the European Space Agency, the session combined expert insights with interactive roundtables. Challenging SEEDS mission concepts were used as case studies, and mentimeter was employed throughout the session, allowing over a hundred participants to share feedback and discussion outputs in real-time.

The main discussion outcomes underscored funding and cost as top challenges, closely followed by *debris*, *logistics*, and *safety*. Analyzing sustainability across mission phases, participants identified manufacturing and launch as the least sustainable, signaling a need for improvements in both materials and processes.

Proposed solutions to make space exploration more sustainable included a strong emphasis on *reusable spacecraft*, *international collaboration*, and *space debris reduction*. Open-ended suggestions highlighted ideas like *multi-purpose designs*, *sustainable energy sources*, and *low-weight inflatable structures*. Interestingly, many participants recommended prioritizing feasibility over sustainability for missions that require groundbreaking advances, suggesting that certain trade-offs may be necessary for ambitious exploration goals.

The session concluded with a strengthened SEEDS network and a collective commitment to advancing sustainable space exploration. The positive turnout and engaged discussions underscored the value of interdisciplinary collaboration and the pivotal role of the SEEDS program in shaping the next generation of space professionals.



Thursday
17 October 2024

It's Full of Stars: Storytelling for Space Outreach

Getting the facts, possibilities and impact of space exploration across to the general public and other stakeholders has perhaps never been as important as now. One way to help achieve this is through storytelling in various forms. The purpose of the workshop “It’s Full of Stars: Storytelling for Space Outreach” was to acquaint the participants with different storytelling techniques, mediums and case studies and most importantly to help them develop and brainstorm their own ideas for space outreach.

Julie Nováková shared the case study of *Life Beyond Us*, a book connecting readers with astrobiology through science fiction stories paired with fact articles; Daniela de Paulis highlighted how she was able to reach wide audiences across the globe in *A Sign in Space* by engaging them in one of the greatest stories that could happen to humankind; Andrea Brunello introduced science-inspired theatre as an effective outreach method and showed the role of emotion in learning; Valentin Ivanov explained how to weave human stories even through more technical popular science texts; and Giovanni Poggiali emphasized the need to understand your audience and tailor the message accordingly. After these short introductions to the workshop theme, Julie and Daniela engaged the participants in thinking about what information they want their audiences to learn and retain, and what emotions they wish to convey to facilitate this.

Finally, each table engaged in a brainstorming session, semi-guided by Daniela and Julie, to create and polish ideas for outreach and educational projects.

The participants started and discussed many valuable ideas on how to connect people and familiarize them with topics ranging from light pollution to orbital debris. Furthermore, those who wished to remain in touch were given the opportunity, so that collaboration beyond the scope of the workshop - vital in today’s world and resonating with the theme of the IAC - could be achieved.



Thursday
17 October 2024

Interactive Workshop on Space Sustainability: Defining Space Sustainability, Together



The Special Session on Space Sustainability at IAC 2024 engaged participants in defining space sustainability through diverse perspectives and interactive discussions. An opening mentimeter poll revealed that attendees associate space sustainability with responsibility, longevity, equity, and ethical duty.

Discussions across different tables addressed varied aspects of defining space sustainability. The capacity table examined orbital capacity but did not reach a consensus on a capacity-focused definition. At the legal/policy table, participants considered policies to address present and future generational needs, highlighting the necessity of global collaboration and standardized frameworks. The communications and media table advocated for a holistic approach, integrating social sciences, business, and advocacy, and proposed a definition emphasizing balance between technological progress, natural heritage, and societal well-being. The corporate sustainability table explored the intersection of environmental and societal goals focusing on prioritizing human well-being, highlighted challenges and the need for an inclusive space sustainability definition. Finally, the technical table discussed metrics for a Long-Term Sustainability framework but faced difficulties in achieving agreement. Overall, the session underscored the need for a multifaceted approach that integrates capacity, policy, technical considerations, corporate responsibility, and international cooperation.

Collective Findings:

- Sustainability in space cannot exist without sustainability on Earth. This requires developing space products and services in alignment with best practice social and environmental standards, from human rights to occupational health and safety, eco-design, and environmental management—both within space organizations and throughout their supply chains;
- Environmental and social aspects are inseparable; addressing one without the other is not true sustainability;
- Sustainability is inherently forward-looking, with a focus on long-term impact;
- Sustainability is constantly evolving, shaped by advancements in science, data, and technology that enhance our understanding of challenges and opportunities;
- Sustainability is a global issue that demands global collaboration and cooperation.



Friday
18 October 2024

Geoinformation Technologies for Sustainable Development (GIT4SD): Promoting Responsible Space Data Analysis in Emergency Response

The special session titled “Geoinformation Technologies for Sustainable Development (#GIT4SD): Promoting Responsible Space Data Analysis in Emergency Response” focused on raising awareness about the use of geoinformation technologies in emergencies. It highlighted their role not only in promoting sustainable urban development but also in promoting the development of new cartographic skills. This two-part event, led by Alina Vizireanu and Sona Guliyeva, aimed to enhance participants’ understanding of how satellite data can inform disaster response, support critical planning and contribute to achieving the UN Sustainable Development Goals.



The first part of the session welcomed a panel discussion on “Geospatial Technologies for Emergency & Disaster Mitigation – An Academic and Industry View”, facilitated by Fidan Behbudova. Prof. Piero Boccardo introduced the IRIDE project, Copernicus Emergency Management Services (EMS), and the Space It Up! project, demonstrating their role in rapid disaster mapping in Italy. Dr. Ozan Kara shared insights into satellite-based damage assessments during the Türkiye-Syria earthquake response, and Dr. Najam Abbas discussed the importance of GIS education for disaster preparedness, drawing from Pakistan’s experience. The discussion concluded with an engaging Q&A session.

The second part of the session provided a practical focus on the “Restless Earth” workshop organised by the British

Cartographic Society (BCS), led by Alina Vizireanu and Sona Guliyeva. This workshop was particularly significant, as it showcased the BCS’s commitment to advance cartographic education. Participants learned more about the real-world disaster mapping through the case study of the Sendai Tohoku Earthquake and Tsunami.

The special session addressed the importance of multidisciplinary collaboration, accessible GIS education, and responsible data practices in the development of disaster resilience while emphasising the transformative potential of space data in addressing global challenges. As satellite data becomes increasingly vital in disaster response, it must be used to improve response times, provide actionable insights, and ultimately save lives.



Friday
18 October 2024

A Hard Working Sol on Mars: a Governance Role-Play



The special session “A Hard Working Sol on Mars” aimed to outline the shortcomings of the existing system of space law and space diplomacy, while more and more new actors, public and private ones, are populating the spacescape with their respective economic interests. The form assumed by the SpS was a role-play, involving the audience. Each speaker represented a role (a big space power; an emerging state based on Mars, not signatory of any treaty; a mega-corp owning an extraction outpost on Mars; a movement for independence of all Martian outposts and for protection of red environment). Everything is set in an imaginary future space dispute, in 2075, concerning aspects of the economic model to be implemented amongst Martian human communities, in a context of development of residential settlements and industrial activities. In the

imagined international conference convened on Mars by the UN to try and reach a consensus on the problematic issues, the role-play focused on imaginary amendments to art. 2 OST, each speaker proposing his/her own point of view:

- Not to change art. 2, according to the big space power;
- Recognizing the principle of self-government of permanently installed settlers, entitled to manage extraction, exploitation and commerce of space resources, according to the Martian movement of autonomous settlements;
- Limiting the principle of non-appropriation of celestial bodies only to terrestrial entities, according to the new-born Martian state;
- Affirming legality of property rights on space resources and of related ‘safety zones’ for their extraction, according to the company.

After the presentation of the different points of view, the public, organized in groups of imaginary stakeholders supporting the various speakers, interacted with them, suggesting how to carry out the negotiations. Thus, the space power decided to join forces with the company, and the Martian movement with the Martian state. The public was finally called to vote between the two merged proposals, and most of the stakeholders preferred the Martian joint statement. ■



14th IAF International Meeting for Ministers and Members of Parliaments



In a gathering that underscored the growing intersection of space technology with global environmental challenges, ministers and parliamentarians from across the world convened at the 14th International Astronautical Federation's Meeting for Ministers and Members of Parliaments, hosted in Milan's historic Palazzo Pirelli. Andrea Mascaretti, Head of the Italian Space Economy Parliamentary Inter-Group at the Italian Chamber of Deputies and host country representative, emphasized the importance of this meeting in addressing these critical issues.

The meeting, part of the 75th International Astronautical Congress, marked what Clay Mowry, President of the International Astronautical Federation (IAF), called "the largest gathering I've seen in my years as President." Mowry set the tone for the conference by sharing a personal connection to climate challenges, citing recent devastating hurricanes in Florida that forced his own family members to evacuate. "With 18-foot floodwaters coming into the Tampa Bay region, it has a real impact on everyday life," he noted.

The urgent need to address space sustainability emerged as a primary concern, with stark statistics presented by Ahmad Belhoul Alfalasi, Minister of Sports and Chairman of the UAE Space Agency. "There are around 10,000 active satellites today, projected to reach 60,000 by 2030," he warned, noting that an estimated 130 million pieces of debris already circulate in Earth's orbit, presenting growing risks of collision and interference with critical systems.



This concern was echoed by Pierre Henriët, Deputy of France's National Assembly, who emphasized France's leadership in space debris legislation. "The growing quantity of debris is one of the major threats to the sustainability of space activities," Henriët cautioned, highlighting the need for international coordination in managing orbital traffic.

Teodoro Valente, President of the Italian Space Agency (ASI), emphasized the collective responsibility required for space sustainability. "No state or corporation can ensure alone the safety and sustainability of space activities," he stated, calling for enhanced international cooperation.

Italy, as the host country of this year's IAC, demonstrated its commitment to space sector development through various initiatives. Adolfo Urso, Minister for Enterprises and Made in Italy, outlined the country's vision for space sector leadership, while Federico Romani, President of the Council of the Lombardy Region, highlighted Italy's groundbreaking framework law on space, approved in June, positioning the country "at the forefront of major global players."

The growing complexity of space governance was addressed by Orsolya Ferencz, Ministerial Commissioner for Space

Research from Hungary's Ministry of Foreign Affairs and Trade. "With more than 90 nations now active in space, the pressure on the space environment is greater than ever before," she said, emphasizing the need for stronger international coordination mechanisms. In this context, Esther Basilia del Brio González underscored the importance of incorporating regional strategies alongside national aeronautical initiatives.

The meeting highlighted significant European investment in space-based climate monitoring. Simonetta Cheli, Director of Earth Observation Programmes at the European Space Agency (ESA), disclosed that Europe invests approximately €12 per citizen in space activities, with environmental and climate monitoring consuming about 30% of ESA's €7 billion annual budget. "Today, Europe is at the forefront in terms of the infrastructure available to support climate challenges and environmental challenges," Cheli stated.

The Arctic region emerged as a critical focus area, with Norwegian Parliament Member Lene Westgaard-Halle presenting alarming data about climate change impacts. "Temperatures up there are rising four times the global average," she warned. "What's happening in Norway is



happening to you. Melting sea ice, shrinking glaciers, thawing permafrost – it's dramatically changing the Arctic region and will dramatically change the world."

This sentiment was reinforced by Norway's State Secretary Tomas Norvoll, who emphasized that "In Norway, space is not merely a nice-to-have thing, it is a necessity," highlighting his country's commitment to becoming a low-emission society by 2050, with satellite data playing a crucial role in tracking progress.

The gathering showcased numerous regional space initiatives across Europe. Greece's Minister of Digital Governance, Dimitri Papastergiou, announced ambitious plans for "13 microsatellites covering applications from natural disaster monitoring to security and environmental protection." Latvia's contribution to environmental monitoring was highlighted by Janis Paiders, Deputy State Secretary of Education and Science, who described their excellence in forest monitoring through satellite data. "One of our main challenges is creating synergies between space solutions and climate action initiatives," he noted.

Estonia's approach to space sector development was presented by Erki Keldo, Minister of Economy and Industry, who discussed his country's implementation of a national space law. "Through innovation and collaboration, Estonia aims to lead the way in developing sustainable practices for space exploration," he said, emphasizing the importance of the Zero Debris Charter in fostering international cooperation.

Recent natural disasters provided compelling evidence of space technology's vital role in emergency response. Rodrigo Da Costa, Executive Director of the European Union Agency for the Space Programme (EUSPA), presented data on multiple emergency service activations across EU member states. "Space brings basically three key factors: availability, resilience, and accuracy," Da Costa explained. "For those on the field, be it the civil protection forces, police forces, or fire brigades, these elements are fundamental in a situation of emergency."

Spain's experience during the La Palma volcanic crisis demonstrated the practical application of these capabilities. Javier Maroto, First Vice President of the Spanish Senate, described how "The volcanic eruption in La Palma island was monitored and deeply studied through satellite data," showcasing the critical role of space technology in natural disaster response.

Poland's recent flooding response provided another practical example, as described by Waldemar Slugocki, Secretary of State and Chairman of the Polish Space Group: "We were able to provide every few hours a rapid update on the flooded area in Poland, delivering information to decision-makers in as little as 50 minutes from satellite pass."

The economic advantages of international collaboration were emphasized by several speakers. Türkiye's parliamentary representative, Zeynep Yildiz, cited specific

cost benefits: "The Galileo project will cost approximately 10 billion if developed independently, but costs reduced around 6 or 7 billion when made together with collaboration and cooperation."

The unique nature of the gathering was highlighted by Dominique Tilmans, Special Advisor to the IAF President, who noted, "This is the only meeting all over the world, across continents, where ministers and parliamentarians together exchange views on their space strategy and relevant space solutions."

As the space sector continues its rapid expansion, the Milan gathering may mark a crucial turning point in international cooperation for addressing global environmental challenges through space technology. The focus now turns to implementing these capabilities at national and regional levels, with an emphasis on practical applications that can help communities adapt to and mitigate the effects of climate change while ensuring the sustainable use of space itself.

The meeting concluded with a clear consensus: the future of space exploration and Earth observation must be built on international cooperation, with a strong focus on sustainability and environmental protection. As the gathering demonstrated, space technology has evolved from a tool of exploration to become an essential component of environmental stewardship and sustainable development on Earth.



The IAF Global Space Leaders Summit

The inaugural IAF Global Space Leaders Summit, organized by the International Astronautical Federation, took place on 15 October 2024 in Milan, during the 75th International Astronautical Congress (IAC 2024) week.



The IAF Global Space Leaders Summit made history by bringing together the largest group of space leaders represented by 60 heads of space agencies and offices from all over the world. around one table This landmark event provided a unique opportunity for global space leaders to unite and discuss critical issues in a cooperative spirit, specifically focusing on "Space Capabilities for Sustainability on Earth."

In recognition of the leadership demonstrated by the participants, the International Astronautical Federation presented the IAF Global Space Leaders Pin. This pin, featuring a moonstone, symbolizes excellence in leadership and is engraved with a unique serial number to honour the leader's esteemed role in the space sector.

The IAF is proud to have set a platform where leaders from both established space nations and emerging space countries could come together, each having the equal opportunity to address the global space leaders' community.

Feedback from esteemed participants underscore the importance of global cooperation.

"I look forward to the possibility of attending the second IAF Global Space Leaders Summit during IAC 2025 in Sydney, Australia, and continuing our work towards advancing space exploration and collaboration" – Mohamed E. Al-Aseeri, Chief Executive Officer, National Space Science Agency, Kingdom of Bahrain.

"Thank you, Christian! It was a pleasure to be gathered with fellow agencies and ministries" – Pam Melroy, Deputy Administrator, NASA, United States.

"Let me take the opportunity to thank you and your team for the organization of the IAF Global Space Leaders Summit and for the successful IAC in Milano! It is a pleasure to observe how the IAC has grown and how many new nations have become engaged in space in recent years. It is a true testament to the significance of space for our society and its impact on our daily lives" – Renato Krpoun, Head, Swiss Space Office, Switzerland.

The second edition IAF Global Space Leaders Summit will take place in Sydney on Tuesday, 30 September 2025 in conjunction with the 76th IAC.



The IAF International Astronauts Chapter

The IAF International Astronauts Chapter is a unique initiative organized by the International Astronautical Federation (IAF) to connect astronauts from around the world together with IAC delegates and the general public. The Chapter offers an exceptional opportunity for face-to-face meetings with space heroes, allowing them to share their experiences, expertise, and passion for space exploration. By inviting astronauts from both government and private sectors, the IAF brings space closer to the general public and creates an engaging platform for dialogue, education, and inspiration for the next generations of space explorers.

At the 75th International Astronautical Congress (IAC 2024) in Milan, the IAF International Astronauts Chapter was organized in partnership with the Association of Space Explorers (ASE) and the Italian Space Agency (ASI). A distinguished group of 25 international astronauts gathered in Milan for an action-packed week of space outreach activities, public interventions, and IAC 2024 discussions. These astronauts, representing a variety of backgrounds and profiles, participated in panels, technical tours, autograph sessions, and networking events, making a lasting impact on the space community.

The diverse group of astronauts included space veterans like Franco Malerba, the first Italian astronaut who made his first space flight in 1992 and active space stars like Luca Parmitano and Samantha Cristoforetti. The group also featured astronauts from the private sector and reserve astronauts who are currently preparing for their upcoming missions to space. These astronauts brought a wealth of knowledge, each showcasing their unique journeys, training, and vision for space exploration.



The IAF International Astronauts Chapter at the 75th IAC focused on the Congress's theme “*Responsible Space for Sustainability*”, highlighting the critical role astronauts play in advocating for responsible space practices. A series of panels and discussions, along with an intensive outreach program, aimed to inspire delegates and the public about the importance of sustainable space exploration.

As part of the IAF Global Networking Forum (IAF GNF), the IAF – ASE Astronauts Panel titled “*#norisknofun – Keeping Human Spaceflight Safe*” took place on Public Day, 18 October. The astronauts shared their insights on

the sustainable practices required to ensure the safety of human spaceflight. Their discussions highlighted the importance of collective and responsible action in safeguarding space for future generations. You can watch the full panel discussion on the [IAF YouTube channel](#).

IAC is not complete without the exciting autograph session with astronauts, and this year was no exception. It is truly a one-of-a-kind experience, as there is no other event where space professionals and general public can meet such a prominent group of astronauts in one place.



IAC Hosts Summit - Eleventh Edition

During an inspiring keynote, LIU Peng, Director of the Foreign Affairs Office of Hefei Municipal People's Government, inaugurated the Summit by unveiling Hefei's potential to host the world's premier global space event. Hefei (capital of China's eastern Anhui Province) is a place that nourishes talent and has blazed new paths toward innovation-driven development.

Hefei has a strong scientific research foundation and by 2030, plans to be the world's largest city in deep space. The place has entered the ranks of China's megacities and will become a new global center for deep space science and the headquarter of the International Lunar Research Station Cooperation Organization. Hefei is also one of the cities with the highest concentration of aerospace industry and one of the cities with the most frequent international exchanges and cooperation in the aerospace field. As fertile ground for entrepreneurship, economic development and innovation, Hefei combines all the requirements for an unforgettable and promising IAC in the future.

In the second keynote, Christian Feichtinger demystified the IAC Bid Process by clarifying the challenges and opportunities related to timely bids. The bidding process

for space events of such caliber as the IAC is a strategic lever for organizational growth, capability and leadership excellence for IAF Organizations which are planning to bid for an IAC. IAC Bidders are encouraged to encompass the orchestration of the bid process from initial assessment through to the final submission and get bid ready before the opening of the call for bidding. By adopting a holistic approach to bid preparation, IAF Members can transform their bidding process into a powerful engine for growth and success. Careful planning, a clear understanding of the IAC requirements and strategic execution of the proposal are imperatives behind competitive IAC bids proposals.

The panel discussion “A Multidisciplinary Perspective on Arising Opportunities and Challenges for Hosting the IAC” explored the various approaches for delivering stellar





IACs and demonstrated how strategies embracing diversity and sustainability have propelled the congress to unprecedented levels.

The Polish Bidding Team pitched its bid proposal for hosting the IAC in 2027 in Poznań – Poland’s fifth-largest city and one of the largest Polish centres of trade, industry, sports, tourism,

culture, and education. A perfect destination, a meticulously prepared bid, a motivated Team and a unifying theme “One Space. Shared Future” aimed to catch the interest of the IAF Members.



The final panel discussion was a powerful reminder that diversity is a process. The IAF Executive Director and the panelists featuring former IAF Presidents, the current IAF President and VP for Diversity initiatives shared their insights about how the Federation is breaking down barriers and how 3G+ values have emerged as an indispensable factor for progress and innovation at the IAF. Inclusion is not an illusion, but it needs work and commitment. We need to build a space community that feels accessible to everyone, transcend barriers and bias, and make our community members feel that they belong, are seen, heard, respected and valued, and that everyone can contribute to the space legacy. ■

IAF Public Speaking and Presentation Skills Lab



The IAF Public Speaking and Presentation Skills Lab (IAF PSLab), held on 13 October 2024 as an associated event of the 75th International Astronautical Congress, aimed at enhancing participants’ communication abilities in an international setting. Moderated by Matias Campos, CEO & Founder of Astralintu Space Technologies and Vice-Chair of the IAF Administrative Committee on Connecting Emerging Space ecoSystems (IAF ACCESS) and co-moderated by Alina Vizireanu, GIS Manager at Milton Keynes City Council. The workshop provided attendees with essential tools to present confidently, overcome stage fright, and navigate cultural differences.

Participants from all over the world, including students, young professionals, and other IAC presenters, attended the interactive session. The workshop included best practices for IAC communication, elevator pitch practice, and live feedback on lightning presentations. Attendees gained insights into effective public speaking techniques, the importance of body language, and how to engage their audience. This workshop was an invaluable opportunity for speakers, students, and IAC participants to boost their self-esteem and improve their presentation skills.



31st Edition of the UN/IAF Workshop on Space Technology for Socioeconomic Benefits

The Office for Outer Space Affairs of the Secretariat and the International Astronautical Federation (IAF) jointly organized the thirty-first edition of the Workshop on Space Technology for Socioeconomic Benefits, in cooperation with the Government of Italy. The Workshop was hosted in Milan, Italy, by the Italian Space Agency (ASI) from 11 to 13 October 2024.

The Workshop was held immediately prior to the seventy-fifth International Astronautical Congress, which was hosted at the Milano Convention Centre by the Italian Association of Aeronautics and Astronautics. The Office for Outer Space Affairs, IAF and ASI had jointly selected the theme “Space sustainability as a game changer for development”, which was aligned with the theme of the International Astronautical Congress, namely, “Responsible space for sustainability”.

The Workshop provided a platform for discussions between representatives of spacefaring nations and entities from other countries that wished to adopt policies and technical solutions already in use, so that the benefits offered by space activities would remain available to all in the long term.

A total of 210 individuals registered for the event; among them, 50 per cent were men, 48 per cent were women and 2 per cent preferred not to indicate their gender. In total,

59 per cent of those registered came from developing countries or economies in transition. Registration at the door was also provided, up to the maximum capacity of the available space, and 37 additional persons were able to join the event, at least in part, at the last minute, compensating to some degree for the 55 absentees among those registered. In total, 192 individuals attended the Workshop in person, which was the highest number of participants recorded for the event series.

The Director of the Office for Outer Space Affairs highlighted the need to make the space economy more environmentally friendly on Earth and in orbit as one of the pressing challenges currently facing the space sector. The subject of space sustainability had received the highest level of attention during the recent Summit of the Future, after which 193 States had adopted the Pact for the Future, which included an action to reinforce the role of the Committee on the Peaceful Uses of Outer Space, as new frameworks were required for space traffic





management, space debris and space resources, and the private sector and civil society needed to engage with intergovernmental processes.

In his welcome address, the President of IAF Clay Mowry recalled that the main theme of the International Astronautical Congress in 2024 was “Responsible space for sustainability”. The Congress would bring together more than 10,000 attendees in Milan and would be the largest gathering of space professionals in history, at a time of significant growth in space activities. He stressed that the core agenda of IAF was focused on sustainability, including sustainable investment, in order to foster expansion of the space sector.

The Executive Director of IAF Christian Feichtinger, noted that space applications were game changers in many sectors of the economy, from agriculture to transport and telecommunications. For such benefits to remain available, space activities need to remain sustainable. The Workshop would provide a platform to foster discussions on global and regional collaboration, and the International Astronautical Congress would provide the opportunity to engage with a wide range of professionals, from ministers and parliamentarians to students, engineers, young professionals and heads of agencies.

A networking activity was organized at the end of the each day, in which speakers and attendees could meet those working on the same topic to discuss their respective needs and the activities that they could undertake jointly.

In his concluding remarks, the representative of the Italian Association of Aeronautics and Astronautics, the Co-Chair of the International Programme Committee of the International Astronautical Congress in 2024, considered the synergies between the Workshop and the programme of the Congress. He highlighted that global collaboration remained essential to foster the development of space technology and its applications. Whenever technology was mature enough to be used, there were practical answers that could address, in a sustainable manner, many of the challenges discussed.

The IAF Vice-President for Developing Countries and Emerging Communities, Pilar Zamora, invited participants to take advantage of the opportunities offered by the International Astronautical Congress and to take an active role in the IAF committees, in which the topics addressed during the Workshop could be further discussed. She stressed the relevance of the Committee on Connecting Emerging Space ecoSystems (ACCESS) to facilitate knowledge transfer between well-established space agencies and newcomers from developing countries.



IAC 2024

Closing Ceremony



The 75th International Astronautical Congress (IAC) concluded on Friday with unprecedented attendance numbers and a ceremonial passing of the torch to Sydney, Australia, marking what leaders called a watershed moment for the global space community.

The closing ceremony, led by Christian Feichtinger, Executive Director of the International Astronautical Federation (IAF), celebrated a gathering that shattered all previous records. “We have reached unbelievable dimensions with the technical program and the number of delegates,” Feichtinger declared. “What happened this week is just unprecedented in the history of the IAF.”

The 2024 congress drew 11,200 delegates from 120 countries, transforming Milan’s convention center into what Clay Mowry, IAF President, called “the Space United Nations.” The statistics were staggering: 2,200 papers presented across 197 technical sessions, 24 Global Networking Forums, and 500 exhibitors spanning 20,000 square meters. “We’ve broken that record... 11,200 delegates coming to this convention. Really incredible. And when I mentioned diversity, this is from 120 countries around the world,” Mowry noted.

Asanda Ntisana, Vice President for Honours and Awards at the IAF Bureau and Acting Managing Director of Earth Observations at the South African National Space Agency, presided over the awards ceremony. “Several of these awards have already been awarded in the week,” she noted, before introducing a series of prestigious recognitions that highlighted the global nature of space achievement.

Erasmus Carrera, President of the Italian Association of Aeronautics and Astronautics (AIDAA), highlighted the congress’s remarkable inclusivity and youth engagement.

“We have reached unbelievable dimensions with the technical program and the number of delegates”



“What is magic here? I see many young people – 51% of the participants to this IAC were under 35,” he said, adding poignantly that “in some countries, the registration fee of IAC can be 4 to 10 times the monthly salary. So you can imagine how difficult it is. This is something I feel in this room, that people from far away are here and they really put a lot of passion.”

The ceremony featured several emotional moments, including the induction of new members into the IAF Hall of Fame. Edward Lu, former astronaut and current Executive Director of the B612 Asteroid Institute, offered a compelling vision of the future: “When asked to predict the future, most people overestimate the progress in the near term and underestimate the progress in the long term... I believe that one day there will be an IAC hosted somewhere other than planet Earth.”

Maria Antonietta Perino, Director of Space Economy Exploration at Thales Alenia Space Italia, reflected on her three decades with the Federation during her Hall of Fame acceptance. “I’ve been part of this family for more than 30 years and have enjoyed every single moment because I met so many wonderful people,” she said, visibly moved. “Much more than the award, I’m really moved by the many messages that I received from many of you.”

The ceremony recognized emerging talents through various awards. Davide Petrillo, IAF Vice President for

Education and Workforce Development, presented honors to young professionals under 35 who have made significant contributions to astronautics. Professor Bernelli Zazzera Franco of Politecnico Milano announced student competition winners, noting proudly, “We have winners from three different continents. Next year I would like to have five winners from five different continents. So please, I encourage all students to submit their best papers because we are willing to work and grade them and have winners, really, from all over the world. Maybe even from Antarctica next time.”

Giorgio Saccoccia, Senior Advisor to the Director General of the European Space Agency (ESA), celebrated his quarter-century of involvement while accepting his Hall of Fame induction. “I want to really share this with all the young professionals, all the students that are sharing the passion and also facing a long future in this career. I can only wish them to have the same level of satisfaction, return and fun that only this field can really give.”

The ceremony included recognition of pioneering educators and scientists. David Spencer, Professor at Pennsylvania State University, presented the Frank J. Malina Astronautics Medal to Professor Robert Twiggs, with Professor Klaus Schilling of the University of Wuerzburg accepting on his behalf. Ozan Kara, Senior Researcher at the Technology Innovation Institute, followed by announcing the Young Pioneer Awards,

celebrating “new voices and shared excitement of space exploration with next generations.”

Ivan Almar, former president of the Hungarian Astronomical Society, spoke with gravitas upon his Hall of Fame induction: “This is really an important award because it is for a lifetime work and it is also a great honor to be among the many people who are belonging to the Hall of Fame of IAF.”

A.K. Anil Kumar accepted a Hall of Fame award on behalf of S. Somanath, Chairman of the Indian Space Research Organization, highlighting India’s growing influence in the global space sector and conveying Somanath’s “gratitude to IAF and its Bureau for their support for ISRO.”

The ceremony concluded with Jeremy Hallett, Executive Chair of the Space Industry Association of Australia (SIAA), unveiling ambitious plans for the 2025 congress in Sydney. “We’ll be exploring a theme of sustainable space, Resilient Earth,” he announced, adding that the congress would highlight “the whole of the Indo-Pacific space sector with expectations of significant contributions of not just Australia but India and China and Japan and South Korea, Thailand, Malaysia, New Zealand and many others.”



Throughout the week, the congress demonstrated the space sector’s evolution beyond traditional boundaries, incorporating discussions on agriculture, emergency management, smart cities, and telecommunications. The event’s success reflected the industry’s rapid growth and its increasing importance to daily life on Earth.

The Milan congress set new benchmarks for international cooperation and scientific exchange in the space sector, with its record-breaking attendance and unprecedented diversity of participants suggesting a bright future for space exploration and research. As the space community looks toward Sydney in 2025, the focus on sustainability and resilience underscores the growing recognition of space technology’s critical role in addressing Earth’s challenges.

The weeklong event culminated in a gala dinner, where participants celebrated not just the achievements of the past week but the promising future of international space cooperation. Mowry concluded the ceremony with a farewell to the host city and a nod to the next destination:

“Ciao, Milano. Good day, Sydney.”



IAF Astrodynamics Committee

Introduction

The Astrodynamics Technical Committee (TC) of the International Astronautical Federation promotes advances in orbital mechanics, attitude dynamics, guidance, navigation and control of single or multi-spacecraft systems as well as space robotics. The Astrodynamics TC was established more than four decades ago and currently includes 32 experts from academic and research institutions, industries and space agencies. The Astrodynamics Symposium is coordinated by the TC and conducted annually during the International Astronautical Congress.

Summary

This year's research in astrodynamics focuses largely on cislunar space and missions to Gateway (rendezvous, docking, gravity gradient effects, optimal trajectories connecting LEO, Gateway and LLO) and the lunar surface. Important efforts are devoted to provide optimal trajectories and develop autonomous navigation algorithms for missions to asteroids, comets and giant planet moons, and even intercept and collect small debris, such as the ejecta of the Didymos asteroids following the DART mission. Near-Earth projects follow traditional approaches for attitude and orbital control while employing more effective sensors and actuators. Many investigations focus on contingency plans for failure of reaction wheels on extended deep space missions. As a result of the development and implementation of satellite constellations and formations, small satellites play an increasingly major role and so does the study of the impact of miniaturization on payload performance resolution, photovoltaics-battery effectiveness and onboard computer power. The trend towards miniaturization applies to interplanetary missions as well. This translates into the need for a larger involvement of higher-fidelity models (e.g., circular restricted three-body problem, circular restricted four-body problem) in trajectory design.

Highlights

- NASA's Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) Cubesat completed its 100th revolution in a 9:2 lunar synodic resonant Near Rectilinear Halo Orbit (NRHO) on 4 September 2024. CAPSTONE is a technology demonstration mission orbiting in the NRHO planned for the Gateway mission. The 12U CubeSat is serving as a pathfinder mission for NASA's Artemis program.
- The Intuitive Machines IM-1 lunar lander launched on 15 February 2024 and landed near the lunar south pole a week later on 22 February 2022. Oriented 30° from the horizontal, IM-1 operated for approximately 6 days on the lunar surface.
- The ESA/JAXA Bepi-Colombo mission completed its fourth flyby of Mercury on 4 September 2024, passing at an altitude of 165 km, returning photos of the south pole back to Earth. Two more flybys of Mercury are planned this winter. The mission is currently experiencing technical problems with the electric propulsion system. It can currently only operate at lower thrust levels. The trajectory was re-designed and the Mercury orbit insertion is now delayed to November 2026 to account for the lower thrust available.
- NASA's Parker Solar Probe executed a trajectory correction manoeuvre on 26 August 2024, aligning the spacecraft for a final Venus flyby planned on 6 November. This flyby will enable the minimum solar distance of 6.1 million km, with a perihelion at this unprecedented altitude scheduled in December 2024.
- ESA's Jupiter Icy Moons Explorer (Juice) has successfully completed a world-first lunar-terrestrial flyby, using the gravity of Earth and Moon to send it Venus-bound. The closest approach to the Moon was at 23:15 CEST (21:15 UTC) on 19 August, guiding Juice towards the closest approach to Earth just over 24 hours later at 23:56 CEST (21:56 UTC) on 20 August. The inherently risky flyby required ultra-precise, real-time navigation, but is saving the mission around

100–150 kg of fuel. Since JUICE was coming so close to Earth, a conjunction assessment for collision avoidance with other spacecraft had been performed with teams on stand-by to execute an avoidance manoeuvre. The gravity assist flyby was flawless, using only a tiny fraction of the propellant reserved for this double assisted maneuver.

- JAXA's Smart Lander for Investigating Moon (SLIM) successfully made a pinpoint landing on the lunar surface on 19 January 2024 after completing a ballistic lunar transfer (BLT) to the Moon, landing within 10 m of its target. Despite a sideways landing, the spacecraft completed primary and secondary objectives, operating through April 2024, beyond its planned lifetime.
- Citizen scientists employed NASA Wide Field Infrared Explorer (WISE) telescope data, confirmed by ground-based telescope data, to identify a fast-moving object departing the Milky Way galaxy at about 2 million km/hour. The object is presumed to be a low-mass star or a brown dwarf. It may have reached its high velocity by an encounter with a binary black hole or by an explosion of a binary partner.
- In October ESA's HERA spacecraft will be launched on a SpaceX Falcon 9 to visit the binary asteroid Didymos – Dimorphos. The moonlet Dimorphos was impacted by NASA's DART mission on 26 September 2022 in a planetary defense demonstration. Hera will perform a detailed post-impact survey of the target asteroid. Demonstrating new technologies from autonomous navigation around an asteroid to low-gravity proximity operations, Hera will be humankind's first probe to rendezvous with a binary asteroid system.
- The Space Agency of the United Arab Emirates is developing an ambitious mission to explore the asteroid belt between the orbits of Mars and Jupiter. Known as the Emirates Mission to the Asteroids (EMA), the probe will fly past six asteroids at high relative speed, and in 2034 will release a lander on 269 Justitia.

Future Outlook

An ongoing NASA effort is exploring the architecture of a mission to the solar gravitational lens (SGL) focal region, targeting high-resolution imaging and spectroscopy of exoplanets. The mission envisions using solar sails and nanosatellite-class spacecraft to reach heliocentric distances of 650–900 AU, where a meter-class telescope could exploit the SGL's amplification to provide detailed multipixel images of exoplanets up to 100 light years away, allowing for the study of surface features and potential signs of habitability. This ambitious mission requires a Sun flyby using a controlled solar sail as well as

the development of techniques for navigation and motion control in the focal region.

Committee activities



The John V. Breakwell Memorial Lecture at IAC-24 will be delivered by Prof. Amalia Ercoli Finzi (Politecnico di Milano – Italy) during the Orbital Dynamics (2) session of the Astrodynamics Symposium. Prof. Ercoli Finzi is one of the leading experts on space missions at a national and international level. She held countless roles of responsibility at Politecnico di Milano and was called to contribute to numerous technical and scientific committees of the Italian and the European Space Agencies. The title of her Breakwell Memorial Lecture is Unique Orbits for Unique Space Missions.



Starting in 1997, the IAF Astrodynamics Committee organized the International Workshop on Satellite Constellations and Formation Flying (IWSCFF). The next edition of the event (IWSCFF 2024) will be hosted at Kaohsiung by the Taiwan Space Agency from 2 to 4 December 2024. This specialist workshop gathers experts and researchers from science, mathematics and engineering to discuss recent advances in the field of Astrodynamics applied to Satellite Constellations, Formation Flying and Proximity Operations. Details can be found at <https://iwsfff2024.conf.tw>.

IAF Commercial Spaceflight Safety Committee (CSSC)

Introduction

The present brief has been prepared to provide an outlook of the major areas onto which the CSSC focused from the first part of 2024.

It was a pleasure like every year to meet everybody in Paris for the Spring Meeting to network and set forth for organizing the 75th IAC Congress in Milan, Italy in October 2024.



Summary

SPACEPORTS: The European Spaceport Forum (ESF) is took place in November 28th and 29th 2023 in Braunschweig Germany; - The “European Commercial Spaceport Forum” (herein known as the “Forum”) brings together several European countries active in light spacecraft launch and suborbital flight. Its overarching objective is to work together to make Europe an attractive place for commercial launch services of light spacecraft in LEO and suborbital flights. The Last ESF took place on April 16th and April 17th 2024 at Cornwall Spaceport Facility, UK.

REGULATORY: Italy with effort led by ENAC is working on the regulation on construction and operations of Spaceports in the Italian Country and is currently focusing on Spaceport Fire Protection, Explosive storage and Toxic Hazards. Suborbital flight and air launch capabilities are of special interest to Italy, and in general Horizontal Take off and Landing multi purpose spaceports.

ESA is continuing the development of the Space Rider System with extensive participation of the Italian Aerospace Industry.

Italy is working on the Lunar City Platform, the first Metaverse Platform exclusively dedicated to Space, which will be presented during a dedicated IAC GNF in Milan. Lunar City will have several applications in education, training, payload support and general dissemination of the Space Culture.

FAA New Regulatory Guidance for Commercial Space Safety: FAA has issued 27 Advisory Circulars (AC) that provide one, but not the only, acceptable means of compliance with the various requirements of the commercial space licensing regulations. The FAA will consider other means of compliance that an applicant may elect to present.

The FAA holds workshops to provide a deep dive into the Part 450 launch and reentry licensing regulations. This is one of several FAA educational outreach efforts designed to help commercial space operators develop and submit a quality application to achieve a more expeditious license approval.

The FAA recently posted best practice guidance for commercial spaceport security recommending a layered approach. It was developed after the FAA and other federal agencies conducted threat and vulnerability assessments at FAA licensed commercial spaceports

SpaceLand is finalizing the first phase of its ambitious project to transform Mauritius into a tropical Center of Excellence for future-facing education and engagement in microgravity STEM open to All.

This initiative will leverage the unique ground and flight facilities being developed by the group on this paradise island, focusing on “spin-ins” from SpaceLand proprietary, self-funded Moon-to-Mars exploration-related engineering support initiatives. Final goal is to enhance the quality of life for the general population in Africa and the Indian Ocean, particularly addressing the daily needs of the less fortunate, thanks to the unique opportunities of the SpaceLand Center presented by the Head of State to the United Nations. Among SpaceLand primary objectives are the innovation of science-oriented tourism and the creation of new knowledge intensive jobs in Africa. In particular, this will be achieved through a multi-disciplinary Mars Habitat demonstrator, designed by SpaceLand senior engineers and architects also in charge of the 2026 Olympic Games: novel Mars-gravity laboratories, environments, facilities and tools will be provided to scientists, students, tourists and the general public to increase Space-awareness and inclusivity, also fostering open-door development of microgravity techno-sciences, small satellite aero- launching services, eco-sustainable housing construction ISRU methods and human longevity extension study projects.

Dawn Aerospace is continuing the development road map of Mk-II AURORA Project, currently in Phase 1; upgrades to supersonic flight are being evaluated, including

certification process, upgrade of engine test facility, new avionics suite, qualification of RCS Thrusters, expansion of DUTCH Offices. Tawhaki was introduced, a joint venture with New Zealand Government, to provide a national aerospace centre.

The DAC Aerospace District/Trans-Tech in Italy is keeping up with the development of the suborbital hypersonic HYPLANE project with high-altitude air-launch capability to inject 100 kg satellite into LEO. See both the following figures for Dawn Aerospace and Trans-Tech respectively:



Space Renaissance International, a “Space Philosophical Organisation” is shaping up and continues with the development of their goals and their mission to facilitate the development of mankind as an interplanetary society, with aspirations to see humanity grow to become an interstellar civilization.

Future Outlook

Increase the interest in Commercial Space Safety and the awareness of how this discipline is paramount to the development of Commercial Spaceflight; Increase the networking activities and foster mutual exchange of information and dialog, Monitor the current initiatives for commercial space access and their technological developments, Increase awareness on safety issues and provide advice to the community, On the wake of the very successful IAC Spring Meeting 2024, focus on preparation of a very successful IAC Congress in Milan in 2023.

Committee Activities

Foster mutual relationship and network with periodic teleconferences, try to engage young students in the Committee Activities providing support to their university CV development, support industry with recommendations in the specific field, attract more participants in the Committee, spread the word for IAC 2024 in Milano. Encourage attendance to events organized by the International Association for the Advancement of Space Safety. Cooperate with other technical committees to maximise efficiency.

IAF Committee on Planetary Defense and Near-Earth Objects (NEOs)

Introduction

Planetary defense is the term used to encompass all the capabilities needed to detect and warn of potential asteroid or comet impacts with Earth, and to prevent and mitigate their possible effects. A Near-Earth object (NEO) is an asteroid or comet whose orbit brings it within about 50 million kilometres of Earth’s orbit. The primary objective of the Technical Committee (TC) on Planetary Defense and Near-Earth Objects (NEOs) is to raise awareness among the global space community, particularly the IAC audience, about the ongoing work within the planetary defense community and to get more people, especially students and young professionals, interested and actively participating in the field.

Summary

Planetary Defense remains a hot topic with several missions in flight, in preparation, being planned, or being repurposed after the main mission has been successfully accomplished. Workshops, conferences, and scientific meetings are being held and outreach activities such as Asteroid Day on 30 June are taking place. The Double Asteroid Redirection Test (DART) team continues to analyze the data from the first flight demonstration of one technology to prevent an asteroid impact. NASA’s DART spacecraft intentionally slammed into Dimorphos the small moon of the binary asteroid Didymos, on 26 September 2022. A series of papers were published in summer 2024 (including some in the Nature and Science Groups) that exposed the current understanding of the outcome of the DART impact and

made predictions for what the ESA Hera mission will discover when reaching the Didymos system in fall 2026.

The United States held its fifth interagency tabletop exercise about planetary defense, which included—for the first time—international participants. The exercise emphasized international collaboration and coordination on planetary defense space missions, near-Earth object impact disaster preparedness, and public messaging.

Highlights

2024 marked the tenth anniversary of the first meeting of the International Asteroid Warning Network (IAWN), which is a worldwide collaboration that supports asteroid detection, tracking, characterization, and modeling in support of planetary defense.

This year also saw the conclusion of the NEOWISE (Near-Earth Object Wide-field Infrared Survey Explorer) mission. NEOWISE was a repurposed space-based infrared telescope that for more than ten years provided critical discoveries of and information about near-Earth objects.



Figure 1- The Hera team in ESA's cleanroom before transport of Hera to Florida for launch

In October 2024 (one week before the IAC in Milan), ESA's Hera mission launched and began its journey to the same binary asteroid system that saw the DART impact in September 2022. After the Hera spacecraft's rendezvous with the binary system at the end of December 2026, Hera will measure in detail the effect of DART's impact on Dimorphos, as well as the physical and compositional properties of the asteroid, including for the first time the asteroid's internal structure, which has great influence on the impact outcome. With DART, it will offer the first fully documented impact deflection test at the scale of an asteroid and improve greatly our understanding of the geophysics of near-Earth asteroids.

Future Outlook

The RAMSES mission is under study at ESA to perform a rendezvous with the asteroid Apophis before its close passage to the Earth on April 13, 2029, in order to characterize the properties of Apophis before and during the passage and observe possible surface change due to Earth tidal forces. The data can then be compared with those of NASA's OSIRIS-APEX mission taken shortly after the close passage, making it possible to observe long-term effects. RAMSES relies on the platform developed for Hera and, if funded, would help to demonstrate that we can rapidly implement a space mission. RAMSES launch needs to occur in April 2027 for a rendezvous, and such a development timeline is very short in current standards. Discussions are taking place with ESA delegations to get it funded so that we do not miss the unique chance to have a mission around Apophis while more than 2 billion people can observe it from the Earth in Western Europe and North Africa with naked eyes, something that only occurs once in a millennium.

NASA's next planetary defense mission, the Near-Earth Object (NEO) Surveyor telescope, continued to make progress toward a launch later this decade. NEO Surveyor is a dedicated, space-based telescope designed specifically to find NEOs that may be potentially hazardous to Earth.

A group is also proposing to the UN that 2029 officially becomes the international year of planetary defense. The proposal is under finalization and the decision should take place in 2024.

Committee activities

During the Special Session organized by the committee at IAC 2023 in Baku, Apollo 9 astronaut Rusty Schweickart announced the Schweickart prize, open to students globally who contribute to planetary defense. The committee is supporting this initiative.

<https://www.schweickartprize.org/>

Most Committee members are active in the Organizing Committee of the 2025 Planetary Defense Conference (PDC) which will be held May 5-9 in Stellenbosch, South Africa.

<https://iaaspace.org/pdc>

IAF Earth Observations Committee (EOC)

Introduction

Earth Observations has entered an era of high importance on international political and social agendas due to the twin threats of global climate change and biodiversity reduction. These developments have also demonstrated significant business value across a wide variety of commercially important applications, attracting new business from both established industries and entrepreneurial firms throughout the value chain. The rapid advancements in technologies, business models, and science are accelerating the value Earth Observations provide to society, especially as threats and impacts increase, offering actionable information for societal decisions. The global satellite community is growing rapidly, driven by the rising demand for Earth observation services, and pursuing Machine Learning (ML) and Artificial Intelligence (AI) to analyze massive amounts of data collected by EO missions, revealing insights through geospatial analytics that are crucial for resource management, urban planning, and more. The EO community is also growing beyond government agencies, with commercial companies and public-private partnership arrangements.

Summary

According to the [World Economic Forum](#), Earth observation (EO) technologies, utilizing data from satellites, aircraft, and ground-based sensors, have the potential to generate a cumulative economic value of \$3.8 trillion between 2023 and 2030. Key industries—agriculture, energy, government services, finance, mining, and supply chains—will generate 94% of this value by enhancing productivity, optimizing processes, and supporting sustainable practices. EO also has the potential to reduce global CO2 emissions by over 2 billion tons annually. To capitalize on this opportunity, increased collaboration and awareness are needed across the EO value chain, particularly as we approach critical global sustainability targets by 2030.

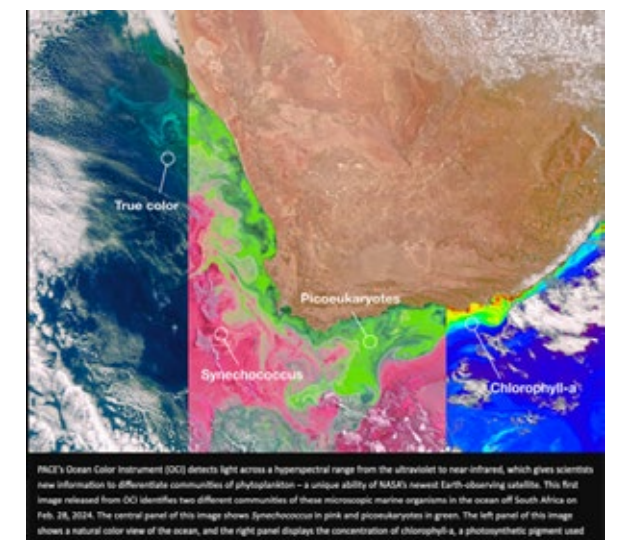
The IAF Earth Observations Committee (EOC) plays a key role in organizing, curating, and coordinating EO-related activities at the IAF, particularly through the Earth Observations Symposium during the IAC, which covers all aspects of Earth Observations from Science, applications, mission development to ground data-processing systems.

Latest Developments and Highlights

In 2024, Earth observation missions have seen several significant developments, reflecting advancements in technology, international collaboration, and the growing

importance of monitoring Earth's environment. Here are some of the key developments:

- **EarthCARE** (Earth Cloud, Aerosol, and Radiation Explorer): a collaboration between ESA and JAXA, launched in May 2024. The mission aims to improve understanding of the role that clouds and aerosols play in reflecting solar radiation back into space and trapping infrared radiation emitted from Earth's surface. This mission has garnered attention for its potential to provide insights into climate modelling and the Earth's radiation balance, which are critical for predicting climate change.
- **INSAT-3DS** was launched on 17 February 2024 off atop a Geosynchronous Satellite Launch Vehicle (GSLV). This ISRO meteorological satellite, is equipped with advanced payloads such as an Imager and a Sounder, and aims to enhance weather forecasting, disaster warning, and climate monitoring services in India. The Imager captures high-resolution images of the Earth's surface, aiding in cloud motion tracking, fog detection, and monitoring of land and ocean temperatures. The Sounder provides atmospheric profiles, including temperature, humidity, and ozone levels, essential for accurate weather prediction. INSAT-3DS plays a crucial role in improving the accuracy and reliability of meteorological services, supporting India's disaster management efforts, and contributing to climate research by offering real-time data on various atmospheric parameters.
- **PACE** (Plankton, Aerosol, Cloud, ocean Ecosystem) mission is a NASA satellite mission designed to advance our understanding of Earth's ocean and atmosphere. PACE aims to provide unprecedented insight into the health of our oceans, the composition of our atmosphere, and how they interact. The satellite

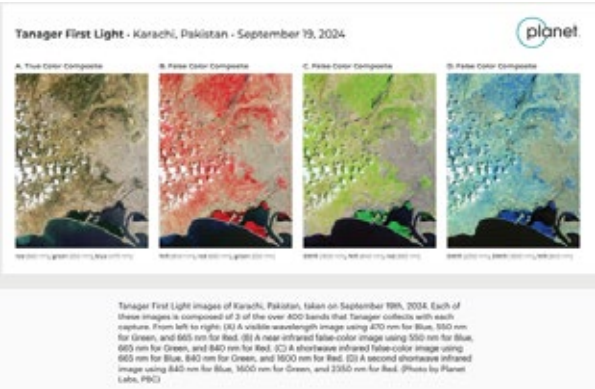


is equipped with a state-of-the-art hyperspectral radiometer, which can measure the colour of the ocean in more detail than previous missions. In addition to ocean colour, PACE also monitors aerosols and clouds, which play a crucial role in Earth's energy balance. PACE improves climate models, supports fisheries management, and enhances our understanding of how human activities impact the planet.

- **GHOST**, GHOST-4 and 5 were launched, on SpaceX's Falcon 9 rocket, from Vandenberg Space Force Base in California.
- **MethaneSAT** was successfully launched in March 2024. MethaneSAT is an American-New Zealand space mission launched in 2024. It is an Earth observation satellite that will monitor and study global methane emissions to combat climate change.
- **Sentinel-2C**, launched in September 2024, the third Copernicus Sentinel-2 satellite was successfully launched on a Vega rocket from Kourou, French Guiana.
- Space Assets advanced the US National Oceanic and Atmospheric Administration's (NOAA) mission to understand and predict changes in climate, weather, oceans, and coasts, to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources. On June 25th, 2024, NOAA launched its **Geostationary Operational Environmental Satellite (GOES)-19 satellite**, the fourth and final GOES satellite of this series. Following a successful on-orbit checkout of its instruments and systems, NOAA plans to put GOES-19 into operational service, replacing GOES-16, as GOES EAST. NOAA's next-generation geostationary satellite GeoXO had 2 contracts awarded by NASA on behalf of NOAA including the spacecraft bus and lightning mapper (LMX) by Lockheed Martin Corp. The JPSS-4 launch contract was awarded to Space Exploration Technologies Corporation (SpaceX) and is scheduled to launch in 2027. NOAA continues its Commercial Data Program for numerical weather prediction models and will acquire 3,000 near-real-time global navigation satellite system radio occultation (GNSS-RO) data profiles per day from Space Sciences and Engineering LLC (PlanetiQ) and Spire Global Subsidiary, Inc.
- **IRIDE Constellation**: Italy's IRIDE project, funded under the National Recovery and Resilience Plan, will feature a hybrid constellation of different satellites equipped with dedicated EO sensors, supporting national and European geospatial needs.
- **Maxar's Global Basemap**: Maxar unveiled an updated version of its global basemap, offering 30-centimeter resolution imagery, significantly improving upon previous versions.
- **CNES-ISA**: The CNES-ISA **VENUS** (Vegetation and Environment Monitoring on a New Micro-Satellite) mission, a joint project between the French space agency CNES and the Israel Space Agency (ISA), officially ended its mission after seven years in orbit.
- **Kinéis**: Launched the first 5 satellites of a planned constellation of 25 satellites dedicated to the Internet

of Things (IoT). The mission of Kinéis' Space IoT is to connect and locate any object, anywhere on the Earth's surface, guaranteeing data transmission in near-real time, at low bit rates, with minimal energy consumption.

- **Tanager-1 (Carbon Plume Mapper)**: Launched Tanager-1 on 16 Sep 2024, the first of a series of satellites being developed and deployed through a unique public-private partnership powered by philanthropy that brings together diverse technical, scientific, engineering and policy expertise to accomplish bold emission reduction objectives. The coalition, led by the nonprofit Carbon Mapper, includes JPL, Planet Labs, RMI and Arizona State University alongside philanthropic supporters.



Future Outlook

- **NASA-ISRO Synthetic Aperture Radar (NISAR)** Mission Preparation: The NISAR mission, a joint project between NASA and ISRO, has been a focal point of Earth observation discussions. Scheduled for launch in 2024, this mission is designed to provide detailed observations of land and ice dynamics, crucial for understanding climate change, natural hazards, and ecosystem disturbances. Technology Developments: In the past year, significant progress has been made in developing radar systems and satellite components, with anticipation building for its launch.
- **Copernicus CO2 Monitoring Mission (CO2M)**. Development Phase: The CO2M mission, part of the European Union's Copernicus program, has been under development, with a focus on monitoring anthropogenic CO2 emissions. This mission will be the first dedicated to tracking CO2 emissions on a global scale, aimed at supporting international efforts to reduce greenhouse gas emissions. International Collaboration: The mission has seen significant international interest, as it is expected to play a crucial role in global climate agreements and policymaking.

Committee activities

The IAF Earth Observation Committee (EOC) has planned a robust series of sessions for IAC 2024 in Milan, Italy, with

eight sessions to accommodate the growing interest. The committee will continue to support GEOSS in formulating and executing Plenary programs, Special Sessions and Global Networking Forums. The EOC continues to foster collaborations with the Group on Earth Observation (GEO) and the IAC Young Professionals Program (YPP) coordinating and developing opportunities for mutually beneficial activities and events to provide further engagement and foster growth in the next generations that is key for continued and sustained growth of the EO community.

For IAC 2025, the EOC will focus on climate change challenges, technological advancements, and the commercial EO sector.

The EOC has been actively involved in supporting follow-up to GLOC 2023. The EOC is also placing focus on AI and Machine Learning - the integration of AI and machine learning in processing EO data has become more prevalent, enabling faster and more accurate analysis of satellite imagery for various applications, including environmental monitoring and disaster management.

IAF Enterprise Risk Management Committee (ERMC)
Risk Management In Times of Uncertainties

Summary

During the IAF Spring Meetings in Paris in March 2024, the ERM committee discussed several topics linked to risk management development, in particular dealing with the use of Artificial Intelligence in the field of risk assessments and mitigation actions proposals.

The committee meeting gathered 25 people present at the venue in Paris & online, and addressed the future steps for IAC 2024 Milan 2024, including the elections of a Committee Chair and two Vice-Chairs.

Highlights

One of our members, Adam F. Greenstone, NASA's Agency Counsel for Ethics, delivered the keynote presentation for the Enterprise Risk Management Committee with the theme "Managing ethics, integrity, and reputational risks in the new space exploration environment":



Adam Greenstone

The Enterprise Risk Management Committee has been striving to advance its work in multiple aligned topics, including areas germane to sustainable space exploration. One such topic is the role of public integrity in the aggregate enterprise of space exploration, composed of

space agencies, other governmental space-related agents, established and entrepreneurial companies, international and research organizations, and other actors. A distinctive aspect of space exploration is the signalling power of space, which is used to leverage messaging by both governments and private entities. While the domain has high technical risks and costs, there are strong positive reputational rewards for perceived success.

A consequence of space's signalling power is that the people of the world are watching, with high expectations for what they want to see, including that humanity's involvement in space return great human benefit. This high path includes international norms of anti-corruption and propriety in public and private work, which must be followed to maintain citizen support for the public side of space exploration work, making space activity sustainable. A corollary of this is that a reputationally adverse event in space—whether it involves public integrity, private compliance, or adverse perception—can be expected to be seen and draw attention on Earth to an outsized audience and degree.

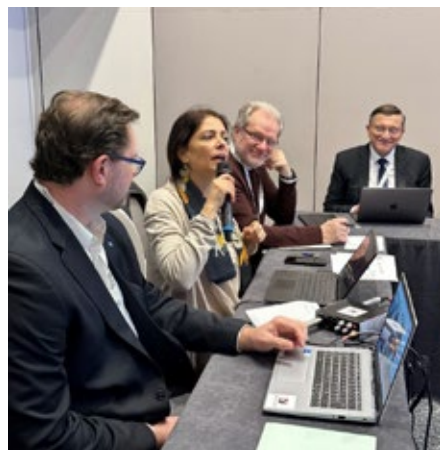
This has important implications for the management of risks to humanity's overall space exploration enterprise. For nations new to space exploration, it highlights the importance of government ethics in consonance with international norms. For private actors, it means doing business in ways that synchronize with government ethics rules, and not being at cross-purposes with them if they wish to maintain the related positive societal imprimatur. It also means articulating the organization's corporate purpose to maintain its space activities support.

Accordingly, the task of managing risk to ensure the sustainability of humanity's overall space exploration efforts varies among public and private entities, both collectively and individually. What is ultimately important

is that each actor sincerely considers from their respective vantage point what their role should be to chart space exploration's most beneficial and sustainable path.



Adam Greenstone presenting



ERM Opening

Future Outlook

The ERM committee had an open discussion, particularly regarding the role of the private sector, including observing the importance of individual and collective self-regulation by private exploration actors while legal, regulatory, and other norms for space exploration are still developing. The topic with the most interest was space-related insurance and associated safety standards. The committee will support continued discussion on the universalization of space insurance.

Committee activities

The committee concluded that it will be presenting at IAC 2024 jointly with the IRC (Industry Relations Committee) a proposal for a GNF session. Aligning with the IAC theme of "Responsible Space for Sustainability" a panel of recognized leaders representing industry, government, and academia will have an in-depth discussion focused on the emerging field of AI and how it reinforces managing risk, by all definitions, in their organizations. Panellists will explore the intersection of artificial intelligence and risk management within the aerospace industry, particularly concerning sustainability challenges such as space debris, Earth security from space, and safety and security of space assets, and they will explore the potential benefits and known challenges associated with integrating tools of AI into strategic risk management processes.

IAF Human Spaceflight (HSF) Committee

Introduction

The IAF Human Spaceflight (HSF) Committee will organize the Human Spaceflight Symposium (B3) at IAC 2024 in Milan, comprising a total of eleven sessions. The symposium invites papers on all aspects of ongoing and planned human spaceflight including the design, development, operations, utilization, and future plans of space missions involving humans. The scope covers private and government past, present and planned space missions and programmes in LEO and beyond. The Symposium also features discussions on preparations for the launch of new HSF capabilities and collaborative efforts of human and robotic systems and technologies. Special emphasis is applied to the peaceful use of HSF, fostering international cooperation, and the socio-economic benefit for all mankind, and positive returns for terrestrial use-cases.

- Governmental Human Spaceflight Programmes (Overview)
- Commercial Human Spaceflight Programmes
- Utilization & Exploitation of Human Spaceflight Systems
- Flight & Ground Operations aspects of Human Spaceflight - Joint Session of the IAF Human Spaceflight and IAF Space Operations Symposia
- Astronaut Training, Accommodation, and Operations in Space
- Human and Robotic Partnerships in Exploration - Joint session of the IAF Human Spaceflight and IAF Exploration Symposia
- Advanced Systems, Technologies, and Innovations for Human Spaceflight
- Human Space & Exploration

- Human Spaceflight Global Technical Session
- Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM Session A & Session B
- Late-Breaking Abstracts

Summary: Human Spaceflight in 2024 to date

- The Axiom Ax-3 launched to space on 18 January 2024 for a 21-day commercial orbital mission, including Türkiye's first astronaut, Alper Gezeravci
- On 27 February, ISRO announced its 4 astronaut-designates, 3 of whom will form the crew for the first Gaganyaan mission, and two of whom have been assigned to the upcoming Ax-4 mission, with Shubanshu Shukla as prime crew, and Prashanth Balakrishnan Nair serving as back-up. The first uncrewed Gaganyaan orbital test flight is slated for no earlier than December 2024
- NASA's SpaceX Crew-8 successfully launched to ISS March 4, 2024, including 3 NASA astronauts and 1 Russian cosmonaut
- Soyuz MS-25 launched Roscosmos cosmonaut Oleg Novitsky, NASA astronaut Tracy Caldwell-Dyson, and Belarus Space Agency spaceflight participant Maryna Vasileuskaya to the ISS on March 23, 2024
- A Long March 2F rocket carrying the Shenzhou XVIII spacecraft with three astronauts aboard blasted off from the Jiuquan Satellite Launch Center in Northwest China on April 25, 2024. This is the 32nd flight mission of China's manned space program and the third crewed mission during the application and development stage of China's space station.
- Virgin Galactic retired its Unity spacecraft after its 7th and final commercial spaceflight on 8 June, 2024. Virgin Galactic's new spacecraft, Delta has now entered manufacturing, and is expected to come online as early as 2026
- The International Institute for Astronautical Sciences announced its all-female commercial research crew, which will be its second suborbital commercial research spaceflight, to fly with Virgin Galactic aboard its Delta. The crew includes Dr. Norah Patten, who will become Ireland's first astronaut, Dr. Shawna Pandya (she is a member of the IAF Human Spaceflight Committee), who will become Canada's first commercial female astronaut, and Kellie Gerardi, who has previously flown as an IIAS astronaut
- Blue Origin completed two more suborbital commercial spaceflights with NS-25 and NS-26, including the launch of Ed Dwight, who officially became the oldest astronaut to launch to space at age 90
- Artemis 2 preparations continue for the joint CSA-NASA crew, with a targeted launch date no earlier than September 2025
- Axiom has announced that its Ax-4 mission has a targeted launch date of Spring 2025, including what will become India's second astronaut, Shubhanshu Shukla, and Hungary's third astronaut, Tibor Kapu
- Boeing Starliner completed its inaugural crewed test

flight to the International Space Station with NASA Astronauts Suni Williams and Butch Wilmore. Owing to ongoing technical issues with helium leaks and critical thrusters going offline, Starliner returned to Earth uncrewed, extending Williams and Wilmore's mission from 8 days to a targeted return date of February 2025 onboard of SpaceX's Crew Dragon spacecraft

- The Polaris Dawn all-civilian mission completed the first private spacewalk aboard the SpaceX Crew Dragon, marking the highest altitude humans have been to since Apollo at 1400km. This mission also marked the highest altitude any female astronauts have been to, with Crew Medical Officer Anna Menon and Mission Specialist Sarah Gillis, and the youngest astronaut to partake in a spacewalk (Sarah Gillis)
- On September 11, 2024, Expedition 71/2 saw the launch of Roscosmos cosmonauts Alexey Ovchinin and Ivan Vagner, and NASA astronaut Don Pettit to the International Space Station aboard a Soyuz MS-26, creating a new record for the greatest number of humans in orbit at 19, surpassing the previous record of 17
- We continue to see an increase in the number of commercial transport and resupply entities supporting human spaceflight, including SpaceX, Sierra Space, H-Star, and The Exploration Company
- The number of potential commercial LEO destinations continues to increase, with Axiom, Blue Origin, Voyager Space, Above Space, Vast, and Gravitics all proposing commercial space stations

Highlights

- The Polaris Dawn Mission successfully completed the first commercial spacewalk on September 12, 2024 in the new SpaceX commercial EVA suits. This spacewalk was also a successful demonstration of an EVA conducted in the absence of an airlock.
- The launch of Soyuz MS-26 on September 12, 2024, created a new record for the greatest number of humans in orbit at once, at 19, surpassing the previous record of 17 humans in space created the year prior



A member of the Polaris Dawn all civilian mission completes the taking part in the first private EVA (credit: SpaceX)

- Cosmonaut Oleg Kononenko, now the world's most experienced spaceman (5 flights, 1111 days in space),

first-time flier Nikolai Chub and NASA veteran Tracy Dyson (3 flights, 373 days in space) undocked from the International Space Station and returned to Earth on September 23, 2024, closing out a record-setting mission (374 days) with a picture-perfect landing in Kazakhstan. With the Soyuz crew back home, NASA and SpaceX are gearing up to launch astronaut Nick Hague and cosmonaut Alexander Gorbunov to the station aboard a Crew Dragon capsule on September 26, 2024

- Artemis II is currently scheduled for a lunar fly-by no earlier than September 2025
- Deep space is vast and infinite, while humanity's quest for knowledge is limitless. The follow-up Chang'e-7, Chang'e-8, Tianwen-2, and Tianwen-3 are in progress as planned. China will further conduct various forms of international exchanges and cooperation in the aerospace field, associated with both human and robotic spaceflight, based on equality, improving human welfare and promoting the construction of a global community of shared future for mankind in outer space.

Future Outlook

- Trends and areas of focus:
 - Increased interagency and commercial collaboration for future missions
 - Increased human presence in space
 - Increasing commercial destinations in LEO
 - Increasing commercial activities and applications in orbital spaceflight
 - Renewed commercial and agency interest in human lunar exploration
 - Increased interest in developing the cis-lunar economy

Committee activities

- Establishment of the subcommittee focused on Space Habitats
- Establishment of a Young professional working group to develop diversity, inclusion and the next generation of professionals for human spaceflight.

IAF Materials and Structures Committee

Introduction

The IAF Materials and Structures Committee was established more than three decades ago. The Materials and Structures Symposium, coordinated by the Committee, provides an international forum for discussing recent advancements and assessment of the latest technological achievements in space structures, structural dynamics, and materials, particularly in relation to space transportation, space vehicles, and orbital infrastructures. Currently, the IAF Materials and Structures Committee has approximately 40 members, with at least 30 actively involved in the annual organization of the IAC Congresses

Summary

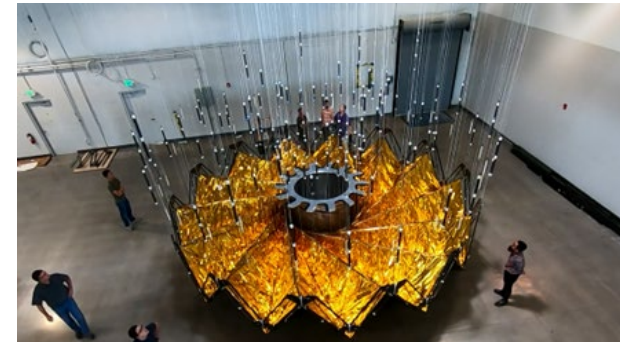
As in the entire space sector, the field of materials and structures is undergoing constant evolution and advancements. Over the last years, there has been a growing trend towards further miniaturization of satellites and the development of small launchers has been observed. Cost-efficient, sustainable and reusable space transportation solutions, as well as in orbit manufacturing and assembling technologies, have been discussed as prerequisites for the commercial use of the low Earth orbit (LEO) ecosystem. Lightweight design is continuously evolving through the use of new materials, new production technologies, and advancements in computational optimization methods. The evolution of

the Clean Space Initiative has been observed, featuring advancements in efficient structures, mechanism designs as well as robotic orbital support services. Eco-friendly designs and reusability are key factors in promoting clean space.

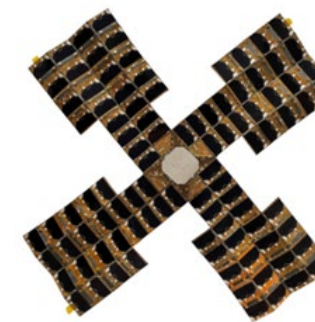
Highlights

Deployable and dimensionally stable structures:

The key technical developments in the field of deployable and dimensionally stable structures, over the last year, involve many structural systems, including origami-inspired designs that enhance compactness and reliability. These designs are being increasingly utilized in large structures of telescopes and antennas, including the NASA Starshade project, whose 10m prototype was deployed at the end of 2023, and small satellites, like CubeSats with deployable solar arrays and antennas of DCUBED. Other significant advancements include the realization of very large solar panels, such as the recently installed 14.2m-long solar arrays on the NASA Europa Clipper mission, which are the largest ever built for any NASA mission, and the largest ever produced for an interplanetary probe. Another promising deployable technology making strides is the concept of solar sail system, which reached a milestone on 29 August 2024, when the 80-square-metre solar sail aboard the NASA-developed Advanced Composite Solar Sail System (ACS3) successfully deployed.



Starshade. Credits: NASA.



Deployable Origami solar panel for Cubesat.
Credits: DCUBED.

Space Structures and Materials for Extreme Environment:

Advanced materials and structures designed for extreme temperature applications are essential for the storage of cryogenic propellants. Applications for space transportation and long-term storage require efficient thermal insulation.

Applications in the hypersonic range of the re-entry require efficient high-temperature resistant materials. This includes carbon-carbon and ceramic matrix composites, ultrahigh temperature-resistant ceramics, ablative materials, ceramic tiles, and other passive or active insulation concepts. Together, these materials and innovative structural concepts are vital for propulsion systems, launchers, hypersonic vehicles, entry vehicles, aero-capture and power generation. The full spectrum of material, design, manufacturing and testing aspects needs to be mastered.

Recently, interest in reusable launchers or stages has significantly increased, partly due to the emergence of various mega-constellations that require multiple launches. This demand has triggered new developments in innovative thermal protection systems and cryogenic insulation, focused on partial or complete reusability. Additionally, the renewed trend in space exploration toward the Moon, Mars, Ice Giants, and other planetary bodies is creating a need for materials that can withstand diverse and challenging environments in terms of temperature, pressure, and gas composition.

Thermal control:

Thermal control of spacecraft is always a challenging topic, not only for satellites but also for launcher upper stages with long ballistic phases.

Current research performed at the Moscow Aviation Institute on spacecraft thermal control systems promotes new types of heat pipes that can function effectively in any geometric position, both in the field of gravity and in zero gravity.

Future Outlook

New challenges and solutions in the industrialization of the launcher and spacecraft industry are emerging, driven by the seamless integration of digitalization, automation versatility, and artificial intelligence (AI). This convergence of technologies is propelling a new era of efficiency, reliability, and innovation, reshaping the design, manufacturing, and operation of launch vehicles. It promises to redefine the capabilities and economics of accessing space amid intense competition. A keynote on this topic will be given by Jean-Matthieu Guimard from ArianeGroup in the new session C2.7 of the IAF Materials and Structures Committee during the IAC in Milan 2024.

Current space exploration programs, both those underway and those announced, are increasing efforts and investments aimed at enhancing the protection of not only electronics, materials and structures but also, in the long-term, human life - an essential requirement for future manned missions. These considerations explain the growing interest and ongoing work related to various forms of protection in space against radiation and extreme environmental conditions.

In view of the above, it is clear that space manufacturing and extraterrestrial construction will become increasingly relevant in the future. In this context, in the Session C2.5 of the IAF Materials and Structures Committee, the *Paolo Santini's Memorial Lecture* will be given at the IAC 2024 in Milan by Dr. Raymond G. Clinton from NASA, the title of which is "In Space Manufacturing and Extraterrestrial Construction - How Did We Get Here? - Where Are We? - Where Should We Be Going? - THE CHALLENGE: Will We Be Ready?"

The Materials and Structures Committee is actively keeping pace with these transformative changes.

Committee Activities

The technical presentations presented at the Materials and Structures Symposium during the IAC Congresses have consistently attracted a large audience within the scientific community, making the Symposium one of the most popular at the IAC. In the coming year, the Materials and Structures Committee will propose some initiatives

to engage researchers and engineers from new emerging countries in the aerospace sector.

For the IAC 2024 in Milan, the Materials and Structures Committee has organized a collaborative technical

session C2.10 with the Space Power Symposium to foster interdisciplinary cooperation between different Symposia working on topics, for which synergies from different symposia can bring an added value.

IAF Space CommunicationS and Navigation Committee (SCAN)

Introduction

The Space Communications and Navigation Committee (SCAN) deals with all aspects of space-based systems, services, applications, and technologies for communication and navigation. This includes fixed, broadcast, high-throughput, mobile, optical, and quantum communications, as well as position, velocity, time determination and tracking for navigation. The Internet of Things (IoT), Machine-to-Machine (M2M) topics, and Artificial Intelligence (AI) / Machine Learning (ML) technologies related to communication and navigation are also in the scope of this committee.

Summary

Space navigation is undergoing rapid evolution as advancements in Global Navigation Satellite Systems (GNSS), Regional Navigation Satellite Systems (RNSS), and Satellite-Based Augmentation Systems (SBAS) drive improvements in positioning, navigation, and timing (PNT) accuracy and resilience. Major GNSS constellations, such as GPS, GLONASS, Galileo, and BeiDou, are continuously upgrading their systems with new capabilities, including enhanced signal structures, inter-satellite links, and expanded services. Meanwhile, regional systems like QZSS and NavIC are moving towards greater independence and improved functionality. These advancements are crucial in an era where the susceptibility of satellite-based PNT systems to disturbance, by jamming and spoofing, has become increasingly evident. Concurrently, research and development into alternative PNT technologies, such as Low Earth Orbit (LEO) satellite-based systems and terrestrial innovations, are gaining momentum to ensure reliable navigation services are available.

Space communications is developing rapidly due to its wide commercial and strategic applications. While wide beam and High Throughput Satellites (HTS) are still in-orbit, Medium Earth Orbit (MEO) satellites now provide backup capabilities that expand the applications. On the other hand, private communication services in LEO are no longer limited by voice and low-speed data. Mega-constellations like Starlink, designed to provide high-

speed internet to both enterprise and private use, are now capable of communicating directly with mobile devices. The new tendency is to build Very LEO (VLEO) mega-constellations to increase speed for mobile use and close gaps in terrestrial mobile networks by enabling direct-to-device connectivity. The map of users of mega-constellations has expanded. Intersatellite links, IoT and laser communication technologies are also being improved in order to expand multi-orbit communications systems, increase data speed and enhance automation for satellites and devices on ground, on water, and in the air.

Highlights

The current landscape of GNSS is marked by significant upgrades and expansions. GPS is in the process of launching its latest generation GPS-III satellites, featuring the new civilian L1C signal and other improvements. Galileo is progressing towards full deployment with a launch of 2 satellites on 28 April 2024 and 2 more planned for launch on 17 Sep 2024. The introduction of its next-generation Galileo 2.0 is expected to bring about increased accuracy and security through innovations such as inter-satellite links. BeiDou and GLONASS are enhancing their capabilities, with BeiDou introducing new services and GLONASS improving its signal diversity.

In addition to these GNSS advancements, the SBAS and RNSS sectors are witnessing the emergence of new systems and services. The expansion of QZSS to a 7-satellite constellation, the introduction of a Signal Authentications Service for QZSS in April 2024 and the inclusion of an L1 signal in NavIC underscore the trend towards more autonomous and interoperable regional navigation solutions. Furthermore, SBAS is evolving with dual-frequency, multi-constellation services (SBAS-DFMC) and high-accuracy systems (SBAS+), providing enhanced positioning accuracy and integrity. The growing reliance on GNSS has also led to the exploration of complementary technologies, such as utilizing LEO satellites for navigation or the development of quantum sensors, to ensure continuous PNT services even in challenging conditions.

One of the most remembered satellite communications

business news of 2024 is the SES announcement of Intelsat acquisition, both being top global telecom companies. This expands the multi-orbit capabilities of SES. SES Space & Defense partnered with Planet Labs (Planet), a provider of global daily Earth data using SES's O3b mPOWER satellite constellation in MEO and Planet's LEO flight-representative terminal in order to demonstrate data relay services for NASA. In the meantime, TTP is working with Surrey Satellite Technology Ltd (SSTL) to launch a new data relay terminal into space. The terminal can provide a constant link between LEO small satellites and Earth through a geostationary orbit (GEO) satellite relay. More GEO communications satellites are being developed and launched: CASC launched the second "High orbit internet satellite", Astranis is developing a "record-breaking" 50 Gbps Omega small satellite, and Thales will develop optical communication payload for Hellas Sat, while advancing its capabilities to deliver 1 Tbps capacity in collaboration with European agencies. New announcements from the field of optical and quantum communication are constantly arriving. On 16th August, the German quantum communication satellite, the QUBE was launched with SpaceX's Falcon-9 on the Transporter 11 mission. The aim of the research network "Quantum Key Distribution with CubeSat (QUBE)" is to develop and demonstrate core technologies for worldwide tap-proof communication using satellite-based quantum key distribution. The development of Eagle-1, the European Union's quantum communication satellite is ongoing with a planned launch date in 2026. Mynaric will develop Laser terminals for Finland-based ReOrbit's UKKO mission to demonstrate space-to-space and space-to-ground data transmission for Earth observation. Dutch research firm TNO and AAC ClydeSpace have successfully transferred data from a laser satellite communications terminal in space down to the optical ground station in The Hague at a maximum data rate of 1 gigabit per second. The Canadian-based Kepler has been working with a pair of prototype crafts and the automatic "cooperation" between telecom satellites is one of the main subjects. Another good example is the launch of Lockheed Martin's Pony Express 2 satellites to demonstrate the technology of mission automation and mesh networking for tactical communications.

Satellites' support of IoT brings new applications for consumers. Iridium is designing its initial Narrow-Band-IoT offering to support 5G Non-Terrestrial Networks (NTN) messaging and SOS capabilities for smartphones, tablets, cars, and related consumer applications. With the launch of its first LEO satellite constellation with 5G standards for IoT and 100% global coverage, satellite operator Sateliot is entering into the commercial phase.

Satellite constellations can be dedicated to specific areas of communications and navigation. Chinese automaker Geely Holding Group said it has launched 11 LEO satellites, as it expands its capacity to provide more accurate navigation for autonomous vehicles. Spire, in cooperation with Thales and European Satellite Services Provider (ESSP), will build more than 100 satellites that will collect Automatic

Dependent Surveillance-Broadcast (ADS-B) messages broadcast from aircraft.

While the number of Starlink satellites keeps growing and counts more than 6000 now, other mega-constellation projects are progressing as well. ESA secured an investment for IRIS2. China recently launched the first batch of satellites for a mega-constellation of 14,000. Amazon rescheduled beta-service of Kuiper to the next year.

While the number of satellites in LEO increases exponentially, MEO also becomes busy. SES has announced that O3b mPOWER, its second-generation software-enabled satellite system, is now operational. The recent trend in satellite communications direct-to-device services is becoming a reality.

SpaceX announced its Starlink unit successfully completed sending and receiving a text message using T-Mobile network spectrum through one of its recently launched direct-to-phone satellites. Many terrestrial broadband operators have already signed up for access to the satellites. Apple, which uses Globalstar's satellites, recently announced it is expanding satellite messaging beyond just emergency situations on the iPhone with iOS 18, and satellite messaging will be an option when cellular and Wi-Fi connections are not available. Omnispace is exploring how its proposed constellation of more than 600 LEO satellites could help connect phones and other devices subscribed to several mobile service providers.

In order to increase the capabilities of mega-constellations, companies are developing their VLEO systems. Redwire is one of them, with its Phantom spacecraft platform designed with Thales for ESA to stay below 300 km during 5 years of mission life. SpaceX also plans to significantly improve latency using VLEO. This will also help the enhancement of the direct-to-phone services. Some other operators create devices capable of connecting both to mobile and satellite networks. Thuraya Telecommunications Company revealed its new 'skyphone', a smartphone with satellite connectivity for consumers and businesses in dual mode.

Government and commercial customers are seeking innovative ground systems to communicate with large satellite constellations in LEO and with constellations that include spacecraft in different orbital planes. While L3Harris Technologies developed a compact Digital Beamforming Phased Array Antenna System, Requitech, a Swedish technology company, has unveiled the RESA L KA, a Ka-band multi-orbit land mobility terminal. Starlink has begun advertising community gateways as part of the business portfolio of Starlink services.

Future Outlook

As we look to the future, there will be a heightened focus on strengthening the resilience and accuracy of PNT. The incorporation of LEO satellite signals as "signals-

of-opportunity” or the deployment of dedicated LEO navigation constellations shows promise of enhancing in specific scenarios. This shift will require the development of new receivers and technologies capable of managing the diverse signals from existing GNSS constellations and emerging LEO-based systems. Additionally, the distinction between military and civilian GNSS applications may lead to further advancements in the civilian sector to ensure secure and dependable PNT services.

Noteworthy progress is also being made in deep space navigation, particularly with the development of the Deep Space Atomic Clock (DSAC-2), which aims to offer unparalleled timing accuracy for interplanetary missions. The ongoing initiatives to establish a Co-ordinated Lunar Time system and the advancements in NASA’s Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) highlight the increasing importance of precise navigation in cislunar space and beyond. As humanity prepares for more ambitious space exploration missions, these innovations will play a crucial role in enabling safe and efficient operations in increasingly intricate space environments.

The existing mega-constellations will continue to grow and upgrade, as more VLEO, LEO and MEO communication satellites will be launched. New capabilities provided by satellites may soon affect mobile

devices’ standard functions, as GPS receivers have been introduced once. Cooperation between satellite and mobile network providers may grow as well. As satellite operators are entering the multi-orbit business now, they may enter into the mobile communications area in future.

Committee activities

The committee approved updated session descriptions for IAC 2024 B2 symposium in Milan and improved the abstract selection process by helping authors to properly identify the specific session for their submission. The IAC 2024 will be the first B2 symposium after the re-organization of each session and the committee will monitor the situation and improve more for the next IAC.

The first IAF SCAN Webinar on “Perspectives of Satellite-Based Quantum Communications” was organized by the committee and held on 3 April 2024. The recorded video of the IAF SCAN Webinar is available online on YouTube.

The synergy between laser communication and optical fiber industries was discussed, and a workshop will be considered in the future. The committee will also consider a Plenary or Special session to bridge the PNT and Space communities, to be sponsored jointly with B4 Small Sats.

IAF Space Operations Committee (SOC)

Introduction

The Space Operations Committee is covering all aspects of human and robotic spaceflight missions and involves many organisations and industries across the globe, which are active in this field.

Summary

During its regular committee meetings member organisations and industries provided their report on the latest status.

ESA reported on the latest operations status of its missions:

- The Bepi Colombo mission completed its 4th Mercury swing-by despite some technical problems preventing its thrusters from operating at full power. The operations and flight dynamics team have designed a new trajectory accounting for these, which will lead to an expected final arrival at Mercury in Nov-2026.
- The Euclid space telescope, which is investigating the

- “dark universe” and which was launched on Falcon-9 in Jul-2023, has entered its 6 years routine survey phase. A seconds set of fascinating scientific early release observations were published in May-2024 (see below and https://www.esa.int/Science_Exploration/Space_Science/Euclid/ESA_s_Euclid_celebrates_first_science_with_sparkling_cosmic_views).
- The ESA-Japan earth science mission, EarthCare, was launched on Falcon-9 in May-2024 and is currently in commissioning. The objective of the mission is to study the role of clouds and aerosol with respect to solar radiation reflection and trapping of infrared radiation emitted by earth.
 - The Ariane 6.2 maiden flight took place on 9-Jul-2024 from French Guiana.
 - The Copernicus/Sentinel 2C mission (European Union/ESA) was launched successfully with the last Vega rocket on 5-Sep-2024. After a successful Launch and Early Operations (LEOP) phase the mission has now entered its commissioning phase.
 - One of the four Cluster II spacecraft has safely re-

entered the earth’s atmosphere by a targeted re-entry (see https://www.esa.int/Science_Exploration/Space_Science/Cluster/Goodnight_Cluster_brilliant_end_to_trailblazing_mission).

The remaining spacecraft will follow in the coming years. This marks the end of more than 2 decades of a unique science mission to explore the interactions between the solar wind and earth’s magnetosphere.



Figure 1 Euclid Early Release Observation #2 (6 different sky scenes)

JPL reported that

- **Voyager 2 turned off one instrument to save power.** Mission engineers at NASA have turned off the plasma science instrument aboard the Voyager 2 spacecraft due to the probe’s gradually shrinking electrical power supply. <https://www.jpl.nasa.gov/news/nasa-turns-off-science-instrument-to-save-voyager-2-power/>
- Getting ready for Europa Clipper launch:
 - » <https://www.jpl.nasa.gov/news/8-things-to-know-about-nasas-mission-to-an-ocean-moon-of-jupiter/>
 - » <https://www.jpl.nasa.gov/news/nasa-to-preview-europa-clipper-mission-to-jupiter-moon/>
- **NASA’s Perseverance Rover to Begin Long Climb Up Martian Crater Rim:** After 3½ years exploring Jezero Crater’s floor and river delta, the rover will ascend to an area where it will search for more discoveries that could rewrite Mars’ history.
 - » <https://www.jpl.nasa.gov/news/nasas-perseverance-rover-to-begin-long-climb-up-martian-crater-rim/>
- **NASA Mission Concludes NEOWISE Mission After Years of Successful Asteroid Detections:** The infrared NEOWISE space telescope relayed its final data to Earth before the project team at JPL sent a command that turned off its transmitter
 - » <https://www.jpl.nasa.gov/news/nasa-mission-concludes-after-years-of-successful-asteroid-detections/>

DLR reported their latest status:

- ESA, DLR, and Bavaria signed an MoU for support of the Human Exploration Control Center (HECC) in

Oberpfaffenhofen on 13-Mar-2024 and the transition from Columbus to Lunar Gateway operations. The federal state of Bavaria is investing 33 Mio. € in infrastructure and operational concepts there.

- LUNA, a unique analogue test facility for preparation and training of lunar robotic and astronautic exploration, has been inaugurated in Cologne, Germany, on 25-Sep- 2024.
- GRACE-C, the successor satellite mission in cooperation between NASA/JPL and DLR passed the ground segment (MOS) PDR with flying colors on 17-Sep-2024.
- Since Apr-2024, DLR GSOC is in preparation for the handover of satellite control of the “Heinrich Hertz” satellite (H2SAT) with full MIL KPIs on 1st of July 2025 from the LEOP/IOT control center.

The Eumetsat status is as follows:

The commissioning of the Meteosat Third Generation (MTG) I1 satellite is nearing completion, with the operational dissemination of Lightning and Image data and products planned for release to the user community before the end of 2024. This follows the development of an alternative ground-based calibration method due to a permanent anomaly with the on-board calibration mechanism. The launch of the MTG-S1 sounding mission is planned for mid-2025, and the second imaging satellite MTG-I2, providing a rapid scanning service planned for 2026.

EUMTSAT Polar System – Second Generation (EPS-SG) will consist of 3 pairs of 2 Metop Second Generation (Metop-SG) satellites operating in a sun-synchronous polar orbit at an altitude of 823-848km. Metop-SG satellites will provide high resolution observations of temperature, precipitation, clouds, winds, sea ice, aerosols, pollution, soil moisture, volcanic dust, and a multitude of other parameters, data critical data for forecasts and environmental monitoring. Metop-SGA1 is planned for launch in 2025 and Metop-SGA2 in 2026.

Sentinel-6B is planned to be launch in November 2025. This will initially fly in tandem with Sentinel-6A. The Copernicus Sentinel-6 mission measures global sea surface height, an observation crucial for climate monitoring. The data also are important for seasonal weather forecasts and ocean forecasts. Other instruments assess temperature changes in the troposphere and stratosphere and support weather forecasting.

Sentinel-3C is planned for launch in 2026 following on from Sentinel-3A and B. The Copernicus Sentinel-3 satellites observe global ocean colour, sea surface temperature and sea surface height. EUMETSAT operates the satellites, in cooperation with ESA, and delivers the marine data on behalf of the European Union.

CO2M satellites will be the main satellite component of a new European CO2 monitoring and verification support

capacity (CO2MVS) for monitoring global anthropogenic (human-made) CO2 and CH4 emissions. CO2MVS is being developed as part of the EU's Copernicus Atmosphere Monitoring Service. The first of the two CO2M satellites will be launched in 2026 and will operate for a minimum of 7.5 years. Both satellites will carry a near-infrared and shortwave-infrared spectrometer (CO2I) to measure atmospheric carbon dioxide and methane at high spatial resolution.

CNES reported on their missions:

Kinéis:

The launch of the first 2 batches of 5 satellites each of the Kinéis constellation by Rocket Lab's Electron rocket in New Zealand went perfectly well on June and September. The 10 nanosatellites (out of 25), each weighing 28 kg, are now at an altitude of 635 km where the Kinéis technical teams were able to take charge of them. 3 other launches of the Electron rocket are planned between end 2024 and early 2025 to deploy all of the 25 satellites in the constellation.

These first launches are the culmination of 4 intense years of work by the CNES teams, in close collaboration with those at Kinéis. CNES has developed the Control Center and the Flight Dynamics Facility, to imagine new operational concepts and then prepare the deployment and routine operations of the Kinéis constellation.

Kinéis is a satellite operator and global connectivity provider. The company, created in 2018 in Toulouse, inherits 40 years of expertise from the Argos system, founded by CNES and historically operated by CLS (Collecte & Localisation par Satellites), to develop reliable technology providing easy access to useful satellite data. Kinéis will locate and connect objects wherever they are on the planet. In doing so, it deploys all its technological innovation capabilities to bring together New Space and IoT.

The satellites are derived from ANGELS, the first French industrial nano-satellite designed by the company Hemeria in collaboration with CNES and put into orbit in 2019. The lifespan of the Kinéis constellation is 8 years.



SVOM:

The Franco-Chinese mission dedicated to gamma bursts observations, was successfully launched on June 22, 2024 by a Chinese Longue Marche 2C.

SVOM (Space Variable Objects Monitor) is a joint mission of the China National Space Administration (CNSA) and CNES that is set to observe gamma-ray bursts (GRBs) from a 625-km Earth orbit. GRBs are some of the highest-energy phenomena known in the universe, generated from the explosion of massive stars more than 20 times the mass of our Sun, and from the merger of compact objects like neutron stars or black holes.

The SVOM satellite is carrying four instruments, two of which were designed and built in France: ECLAIRs, a wide-field X-ray and gamma-ray camera; and MXT, a Microchannel X-ray Telescope. When ECLAIRs detects a GRB, the satellite will be repointed within minutes to precisely target the event so that instruments with a narrower field of view (MXT and VT) can observe it.

Alerts are relayed to ground in less than one minute whenever a burst is detected, via an alert network of 55 VHF stations deployed by CNES all along the tropical belt, indicating the location of the GRB in the celestial vault to cue large ground telescopes.

This synergy between ground and space systems, allied to the multi-wavelength observations, is what makes the SVOM mission so special for scientists.

It is a cooperation between the Chinese National Space Agency (CNSA), the Chinese Academy of Sciences (CAS), and the French space agency (CNES) which is in charge of the development of the French payload (the ECLAIRs and MXT instruments), the antenna network (alert system) and the French science center (located in Saclay). The French contribution is being developed in partnership with research laboratories at the IRFU research institute at CEA, the French atomic energy and alternative energies commission, and at INSU, the national institute of universe science, and IN2P3, the national institute of nuclear and particle physics, both attached to the national scientific research centre CNRS.



Highlights

ESA's mission to Jupiter and its icy moons (JUICE) which was launched in Apr-2023 on the second but last Ariane 5

flight performed a lunar and shortly afterwards earth fly-by (first of its kind) successfully on 19/20-Aug-2024:

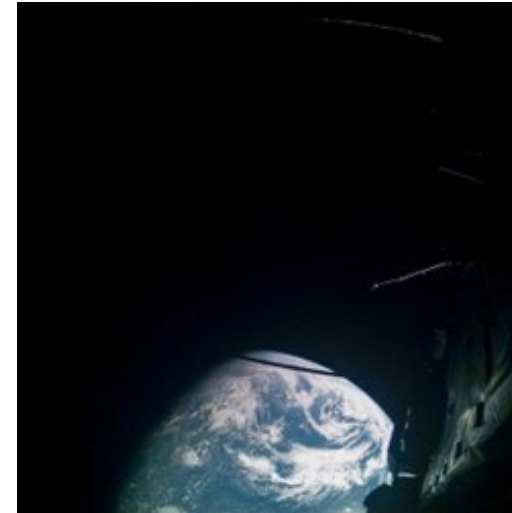


Figure 2 Picture taken by one of the JUICE monitoring cameras during the earth fly-by

Future Outlook

- The SpaceOps community is preparing for the upcoming **18th SpaceOps conference (Space Ops 2025)** taking place from 26-30-May-2025, in Montreal, Quebec, Canada.
- Several of the members are looking forward to launches of new missions:
- ESA's Hera mission (planetary defence) to the near-earth binary asteroid system Didymos in Oct-2024. Back in 2022 NASA's DART mission performed an Asteroid redirection test by colliding with the smaller Dimorphos asteroid in this binary system.
- The EU/ESA Sentinel-1C mission (earth observation) is planned to be launched in Dec- 2024.

Committee Activities

The IAF's Space Operations Committee pursues activities to encourage and strengthen collaboration between organisations globally on the subject of Space Operations and to highlight the challenges and opportunities of Operations across all lifecycle phases of space missions.

IAF Space Propulsion Committee

Introduction

The Space Propulsion Committee addresses sub-orbital, Earth-to-orbit, and in-space propulsion. All types of propulsion are of interest to the committee: chemical and non-chemical/electric propulsion, but also advanced, unconventional, or air-breathing propulsion. The symposium sessions organized by the committee during the yearly International Astronautical Congress include: liquid systems (2 sessions); solid and hybrid systems (2 sessions); electric propulsion (2 sessions); small satellite propulsion; nuclear propulsion and power systems; propellantless propulsion; air-breathing rocket propulsion; disruptive propulsion systems enabling new/visionary space missions.

The committee deals with component technologies as well as complete propulsion systems and their implementation in missions and spacecraft, but also welcomes discussions on dedicated test facilities and diagnostics for space propulsion testing. Special attention is given to New Space developments, including miniaturized propulsion systems for small spacecraft/launchers, or how combined technologies, such as chemical and electric propulsion, can be optimized for extending the range of feasible space missions.

Summary - Space Propulsion Highlights

In the **United States**, SpaceX has achieved impressive results in the flight test campaign of the Super Heavy Booster for the Starship program. The rocket, powered in its first stage by 33 **Raptor engines** (LOX-Methane, full-flow staged combustion cycle) for a maximum nominal thrust of 69.9 MN, and by 6 additional Raptor engines on the Starship spacecraft (second stage), has undergone three successful launches in 2024, after the initial partial failures of the 2023 launches. Meanwhile, the U.S. Space Force has granted a contract to a national research team led by the University of Michigan to advance space propulsion systems, aiming to combine high-thrust chemical propulsion with advanced electric propulsion, such as high-power Hall thruster powered by a nuclear microreactor.

Another very active country for propulsion in Latin America is **Brazil**, also thanks to the activities connected to the **Alcantara Launch Center**, which has recently been opened to commercial activities and will host the first orbital launch ever from Brazilian soil next year, with the planned maiden launch of the HANBIT-nano hybrid rocket from the company Innospace (South Korea). R&D activities on chemical propulsion are carried out in Brazil at the

University of Brasilia and DCTA (liquid, hybrid and ramjet engines), and at INPE (injectors and hybrid thrusters).



Starship launch in October 2024

In **Europe**, the Ariane 6 inaugural flight took place in July 2024 from the European Space Port in French Guiana, in the A62 configuration. With Ariane 6 now flying, Europe has closed the gap for access to space. The flight allowed for significant achievements in propulsion, such as: the first successful operation of two **P120C boosters** (4500 kN thrust) in lateral position around the liquid core stage; the first flight of the **Vulcain 2.1 engine** (LOX/LH2, 1370 kN thrust), derived from the Vulcain 2 heritage in Ariane 5; the first flight of the new **Vinci upper stage engine** (LOX/LH2, 180 kN thrust, expander cycle). The first flight of the A64 version, equipped with four P120C boosters, is expected in 2025. The Ariane 6 Block2 with enlarged payload capability, coming from the P160 booster (10% more propellant than P120C) and Vinci thrust increased to 200 kN, will be introduced in 2026.

At the DLR Institute of Space Propulsion in Lampoldshausen, within the project **LUMEN** (Liquid Upper Stage Demonstrator Engine), a 25 kN breadboard engine running on liquid oxygen and liquid methane in an expander-bleed cycle is being developed, with a **successful first hot fire test campaign** in March 2024. LUMEN is the first turbopump-driven engine developed and tested in Germany in the last 50 years. The engine is designed to meet the specific needs of industrial customers and is now fully operational and ready to accelerate future space propulsion innovations.



Ariane 6 FM1 lift-off

In **Asia**, after a first failed attempt in 2023, three successful launches of the new Japanese rocket launcher H3 took place in 2024, in its H3-22S version. This version of the

launcher features a new first stage including two **LE-9 engines** (LOX-LH2, 150-ton class), in parallel with two **SRB-3 boosters** (2.1 MN thrust).



Ariane 6 FM1 lift-off

In the field of **Electric Propulsion**, Advanced Propulsion Systems (Russia) completed the development of its electrodeless plasma thruster with magnetic thrust-vectoring (**MTVEPT**), launched for an extensive flight campaign onboard the HORS 3 satellite in November 2024. This thruster is capable of generating propulsive forces in three directions by means of magnetic steering, and is a direct follow-up to the successfully completed flight test campaign of the Bi-directional Electrodeless Plasma Thruster (BDEPT) on the HORS 1 satellite. Ongoing developments include a thruster with a close-ring-shaped gas discharge chamber capable of generating propulsive forces in six directions, expected to be demonstrated on the HORS 5 satellite in 2025. Brazil is another very active country in electric propulsion, with ongoing activities at the Federal University of Santa Catarina (numerical modelling of plasmas with a special focus on the Discrete Unified Gas Kinetic Scheme, DUGKS, as an alternative to PIC for the development of new systems), at INPE (development and testing of new Pulsed Plasma Thruster concepts, such as the two-stage PPT, TS-PPT, and the Variable Specific Impulse PPT, VSI-PPT), and at the University of Brasília (experimental and numerical investigation of Hall-Effect thrusters using permanent magnets, Helicon-based Ambipolar thrusters, Pulsed Plasma Thrusters, Resistojets, Arcjets and Hollow Cathodes).



MTVEPT operation during integration phase into HORS 3

Space Propulsion Highlights from the IAC 2024 and Future Outlook

The **IAC 2024** congress in Milan (Italy) has been an unprecedented success, breaking all records in terms of participants and submitted abstracts. The main highlights from the Space Propulsion symposium of the IAC 2024 include:

- » For **chemical propulsion**, Beihang University (China) presented the test results of a novel hydrogen peroxide electric pump for hybrid rocket engines, while the University of Naples Federico II (Italy) presented a number of numerical and experimental activities on innovative technologies for small-scale chemical propulsion for Cubesats, intended for future development and qualification of micro-propulsion units within the framework of the ALCOR program coordinated by the Italian Space Agency and, in particular, in the RODiO mission, a formation-flying cluster of Earth-observation Cubesats capable of orbital manoeuvring.
- » For **electric propulsion**, while conventional technologies are used as a basis for the development of a new type of propulsion systems (such as the Hall Effect thruster with high-frequency electric field, presented by the University of Tokyo, the HT100 thruster successfully tested in a flight campaign by Sitael SpA, or the microwave thruster designed by DLR for use with different propellants), significant attention is also given to the development of unconventional systems, including: the gridded ion thruster prototype with corona discharge propellant ionization developed by students of the University of Alabama in Huntsville (US); the solar-powered electric propulsion system for an asteroid hopping mission, presented by the Technology Innovation Institute (UAE); the pulsed cathodic arc thruster, pre-qualified for flight by NeumannSpace (Australia).
- » For **micro-propulsion**, a boom in flight testing is being experienced, providing valuable insights for the next development of new systems and encompassing the pathways of these developments. Some of the activities presented at the conference include: the work on electrospray thrusters from FOTEC (Austria), which reported the performance characterization of their ECLIPSE thruster, and from the MIT (US), which reported a study on the effects of micro-electrospray thruster operation on the electrical charging of a small satellite structure; an update on the micro-propulsion system based on Hall effect thrusters, under development at Berlin Space (Germany); an overview of the development process and experimental characterization of a multidirectional resistojet propulsion system for CubeSats, from Khalifa University (UAE); an overview on the cold gas propulsion system with thrust-vectoring capability for small satellites attitude control, under development at the Philippines Space Agency.
- » For **space nuclear propulsion**, University of Alabama in Huntsville (US) presented a study on

the Centrifugal Nuclear Thermal Rocket (CNTR), outlining strategies for developing a reference configuration and addressing the challenge of uranium vapour contaminating the propellant exhaust. If successfully implemented, with hydrogen as propellant, the CNTR propulsion system could achieve a specific impulse as high as 1800 s, enabling faster round-trip human missions to Mars. The CNRS (France) presented a detailed framework for designing Nuclear Electric Propulsion systems based on use cases proposed by the European Space Agency, aiming to meet requirements for medium- and long-term missions to Earth, Moon, and Mars orbits, as well as deep space exploration. The study evaluated the Heat Pipe Reactor for low-power applications and the Molten Salt Reactor for medium- to high-power scenarios.

Promising Achievements for Future Outlook

In November 2024, the **world's first successful test of an additively manufactured hydrogen peroxide/kerosene aerospike engine** has been performed by a team including TU Dresden, Łukasiewicz-ILOT, Fraunhofer IWS and ArianeGroup, within the **ESA-funded project ASPIRER**. The engine, designed for an operating pressure of 20 bar and a full-load thrust of 6 kN, has been demonstrated with multiple successful tests in both mono-propellant and bi-propellant modes.

In the field of **hybrid engines**, the ELS-R100 re-entry technology demonstration mission from Low Earth Orbit has been announced by Tohoku University, ElevationSpace Inc. and JAXA, and is scheduled for flight in 2026. The mission will employ a hybrid thruster for orbit transfer, based on a gaseous oxidizer and a multi-port solid fuel, which has demonstrated a significant number of stable firing tests during 2024, including vacuum firings. In July 2024 the Polish ILR-33 AMBER 2K suborbital rocket, using a main hybrid propulsion stage, was successfully launched from Andoya Space Center by **Łukasiewicz-Institute of Aviation**. It reached 101 km of altitude, demonstrating the capability of effective use of 98% hydrogen peroxide as oxidizer for space applications.

In the always dynamic field of **micro-launchers**, a particularly important achievement has been obtained by **HyImpulse**, a German company which **successfully launched** its SR75 rocket from the Koonibba Test Range in Southern Australia in May 2024, marking a significant milestone as the first privately developed commercial launch vehicle to achieve lift-off in Germany. The rocket is equipped with an innovative hybrid propulsion system using paraffin and liquid oxygen, and can carry payloads of up to 200 kilograms to an altitude of approximately 200 kilometers.

In November 2024, the Australian launch vehicle company **Gilmour Space** secured its orbital launch license. Its three-stage Eris vehicle uses hybrid rocket motors in its

two first stages and is under preparation for its maiden flight.

At the DLR Institute of Space Propulsion in Lampoldshausen, a team of researchers in the Combustion Dynamics Group of the Rocket Propulsion Technology Department has **successfully operated a rotating detonation rocket combustor** for the first time in Germany. The small-scale, capacitively cooled, annular copper alloy combustion chamber, developed in cooperation with ONERA, has an outer diameter of 68 mm and runs on oxygen/hydrogen or oxygen/methane.

Another Rotating Detonation Engine project is under-going in Japan, led by Nagoya University and JAXA. Within this project, a successful flight demonstration in space of a liquid propellant detonation engine has been conducted during the S-520-34 sounding rocket experiment in November 2024.

Committee Activities

The committee is currently made of 50 members from 16 countries, including 8 female members and 12 young professionals, with good distribution among geographical areas and categories (industry, Academia, agencies). In 2024, several new members have been welcomed in the committee: Masaki Adachi (Mitsubishi Heavy Industries, Japan), Lahib Balika (Thales Alenia Space, UK), Paolo Gessini (Brazilian Space Agency), Stefan Gregucci (Sitael, Italy), Justin Hardi (DLR, Germany), Stefano Mungiguerra (University of Naples Federico II, Italy).

The committee is not only active in the organization of the International Astronautical Congress, but also fosters synergies with other relevant space propulsion conferences, such as the EUCASS (European Conference for Aeronautical and Space Sciences) and the biennial 3AF/ESA Space Propulsion conference. The committee members are also active in knowledge dissemination to the space propulsion scientific community through the publication of papers and books.

IAF Space Security Committee

Introduction

Space security has become one of the key topics in any discussion concerning space. The need to strengthen long-term sustainability, safety and security in space is shared by all nations. It is in the collective interest of all peaceful spacefaring or space-using nations to encourage the responsible use of space and minimize orbital debris, in order to protect any in-orbit manoeuvring spacecraft from a risk of collision and to preserve the space environment.

At the same time, the peaceful use of Outer space, which prevailed in the past, is not to be taken for granted; we are facing a change of paradigm with a contested and conflicting space domain. Today, close approach and proximity operations by foreign objects of satellite-inspection class are already a reality.

We acknowledge the apparition of newcomers and the diversification of space actors, the arrival of large constellations and the multiplication of small satellites, leading to a growing complexity of space operations. There are also moves towards active debris removal (ADR), on-orbit servicing (IOS), rendezvous and proximity operations (RPO), which can be perceived as dual-use technologies. This combination of factors and trends brings many opportunities, but it also means increasing risks of collisions and interferences, as space will become more and more dense and congested.

In this fast-changing environment, with an increase in both the risks and threats in space, the question of Space Situational Awareness (SSA) and Space Traffic Management (STM) is of the utmost importance. Today, and in the future, we will need to be able to detect, identify, characterize, understand, analyze, attribute and verify what is happening in outer space. An awareness of the highly dynamic and increasingly complex near-Earth space environment appears to be essential to safeguarding space-based assets, ensuring access to space and contributing to the safety, security and sustainability of space in the long run.

The Space Security Committee focuses on a wide spectrum of topics concerned with security, safety and sustainability. More than a technical committee, the Space Security Committee is a high-level policy and strategy Committee welcoming highly distinguished speakers, and fascinating experts as well as researchers from around the globe. From national to international bodies and through multi-actors, the Space Security Committee offers a 360 degrees range of topics and discussions enlightening the space security community as well as the public on a topic that concerns us all.

Summary

In 2024, the Space Security Committee held a series of

impactful discussions with experts from various sectors. With the contribution of its high-level members and distinguished speakers, the Space Security Committee was able to discuss and exchange on a wide variety of topics, advancing the dialogue on space security challenges and solutions.

Indeed, in our last meeting in March, we had the honour to listen to **Pierre-Alain Voltz**, Minister of Foreign Affairs in France and GGE PAROS expert, who provided an update on the Group of Governmental Experts (GGE) on the Prevention of an Arms race in Outer Space (PAROS), emphasising a capability-based approach to preventing an arms race in space. This approach focuses on responsible behaviour and the creation of a framework that does not require the resolution of all disputes at once but acts as a stepping stone for future work. As explained by Mr Voltz, the GGE's work is seen as a useful foundation for further initiatives, with Open-Ended Working Groups (OEWGs) planned for 2025 and expected to build upon the GGE's efforts, helping to drive forward the development of comprehensive space security frameworks.

Additionally, **Dick Buenneke** from the US Department of State discussed the challenges and opportunities of the UN Open-Ended Working Group (OEWG) on space threats. He highlighted the importance of international cooperation, particularly between the US and France, in addressing the growing population of space objects and the risks they pose. In his presentation on the UN's processes and the OEWG, Mr Buenneke highlighted that space threats are becoming more sophisticated, especially in relation to rendezvous and proximity operations (RPO). On the topic of collaboration, Mr Buenneke also emphasises that commercial operators have a growing role in space security, given their increasing involvement in space activities, and called for further civil society and commercial entities cooperation to ensure that security measures evolve alongside the burgeoning space economy.

We also had the opportunity to listen to **Rodolphe Munoz**, Head of sector SSA/STM, DG DEFIS from the European Commission, who discussed the implementation of the EU Space Law, focusing on safety, sustainability and security. He outlined the EU's approach to harmonising national regulations, the upcoming regulatory proposals, and the goal of establishing binding and non-binding measures to enhance the resilience of space systems. Mr Munoz also touched on how the EU plans to align with global standards, using ISO and existing laws from other countries. The goal, as explained by Mr Munoz, is to ensure that all Member States apply the same requirements regarding space safety, sustainability and resilience to create a cohesive approach to space governance.

During the meeting in March, we also welcomed one of our newest members, **Richard DalBello**, Director of the US Office of Space Commerce, who shared an update on the Traffic Coordination System for Space (TraCSS), which seeks to relieve the US Department of defence

of responsibility for SSA coordination. TraCSS aims to provide basic SSA services and promote safer operations by encouraging US commercial SSA leadership and developing global SSA standards.

His presentation was followed by the one of **Victoria Samson**, Chief Director, Space Security and Stability, Secure World Foundation, and head of the IAF Task Force for security, who briefed the Committee on the IAF Task Force for Security. In particular, she highlighted how different task forces complement each other, and thus the importance of the dialogue between the task force and the IAF Space Security Committee.

Highlights

The Space Security Committee continues to lead global efforts to address the complex challenges related to SSA, STM, ADR, IOS, and RPO. Its work is central to supporting initiatives such as the GGE on PAROS and the two upcoming OEWGs in Geneva, as well as the WG LTS 2.0 in Vienna.

Additionally, the Committee's influence and reputation have been steadily rising, evidenced by the increasing number of experts and professionals wanting to become members. This ongoing interest shows that the Committee is a key platform for shaping global space security policies. By welcoming experts from different fields, the Committee continues to enhance its knowledge and broaden its scope. This diverse participation supports the Committee's ongoing efforts in space security and helps it contribute meaningfully to international initiatives aimed at protecting space for future generations.

Future Outlook

The Committee's focus in the coming years will be on monitoring, exchanging and advancing global cooperation in space security, i.e. the upcoming OEWGs, as well as the ongoing Working Group on Long-Term Sustainability of outer space activities. High-level speakers will continue to be invited to provide their expertise in space security from their perspective. The Committee will continue striving to find common grounds in the field of space security. Committee members will have the opportunity to engage into policy as well as technical matters of common interest. The Committee will maintain its close links to other committees and sub-committees of relevance. Representatives from emerging spacefaring nations are welcome to participate in the exchanges of the committee, as space becomes a critical infrastructure to all.

Committee Activities

The Committee will continue to actively contribute to the IAF Task Force on Space Security, which focuses on space stability and the intersection of security and sustainability. The task force is expected to continue launching webinars

and develop a more operational approach to space traffic coordination and SSA. Members of the Space Security Committee will provide input on potential activities and participate in the task force’s future meetings. At future meetings, the Committee will continue to invite presentations on emerging challenges in space traffic coordination, and the integration of commercial actors into space security frameworks, ensuring that the most pressing challenges are addressed, and that the Committee

remains a leading force in space security discourse. In particular, the topic of global coordination between existing and developing Space Situational Awareness systems in the different regions of the world to support space safety and sustainability will be regularly discussed. At the same time, the Committee will closely monitor the official, multilateral processes in both Geneva and Vienna where space security remains a key focus of international dialogue.

IAF Space Systems Technical Committee

Introduction

The Space Systems Committee addresses space systems as a whole from a system concept and system engineering perspective. The Committee’s aim is twofold. Firstly, to focus on the enhancement of system development and reliability, including collection of lessons learned, development of tools, processes and training in the field of systems engineering to further improve the efficiency, risk management, reliability and coordination across disciplines and all the functions necessary to build any space systems. Secondly, to highlight future developments, especially in the fields of innovative and mission-enabling technology, future system architectures and innovative and visionary system concepts.

Highlights

Space Systems are evolving fast, leveraging new technologies and architectures aiming not only to reach new frontiers, but also making it in a sustainable way. New applications, new business models and disruptive changes in the global space ecosystem all contributes to such evolution.

In 2024, the following trends were identified in what concern future architectures and innovative systems:

- Reducing resource usage and pollution on Planet Earth. Examples: space-based solar power, eco-design such as the combined service of space-based solar energy and climate engineering via orbiting solar reflectors
- Preservation of space environment and rational utilization of space resources. Examples: space circular economy, Active Debris Removal (ADR), In-Orbit Service and Manufacturing (IOSM), in-orbit recycling, reusable satellites.
- Withstanding the harsh space environmental effects caused by factors such as solar flares, cosmic rays, space debris, meteoroids, and lunar dusts.
- Reducing/minimizing side effects of space activities

on life on Earth. Those side effects include but are limited to pollution of optical astronomical observations, casualties caused by uncontrolled reentries and back-contamination of planetary missions.

In addition, the Committee registered an increased interest on Artificial Intelligence (AI) and cyber security in space. AI and cyber security are poised to massively shape future space systems. As an example, the European Space Agency (ESA) is engaged in studies for developing Cognitive Synthetic Aperture Radar (SAR) systems. Such systems, leveraging on-board processing hardware and advanced algorithms, would be able to analyse data on the fly and command autonomously acquisition of higher resolution pictures over areas of interest.

On the systems engineering side, Model-Based System Engineering (MBSE) methods in the space ecosystem continues to be of high interest and, in the long-term, as well time saving, even if their implementation remains a heavy task and tools are complex. In this regard, machine learning has been proven to optimise the design of mechanisms demonstrating the ability to generate feasible designs in a shorter period of time than the incumbent process. Moreover, large language models (LLMs) such as GPT-4 has been using to connect elements embedded in the requirements with artifacts described in the design description keep track of design changes throughout the life cycle.

One element of challenge is the difficulty in creating a systematic or complementary view of lessons learned out of a large number of engineering practices as most of the research currently available is based on single cases or very limited engineering practice.

Future Outlook

Among the many fields of focus and trends pertaining to Space Systems, very low Earth orbit (VLEO) missions was identified as one of the emerging and most interesting space systems. Therefore, the committee will make sure to

offer under D1.3 a space for authors working on VLEO to present their work at the next IAC in Sydney, Australia.

Committee Activities

The Committee welcomed four new members: Cristian Bank, Director Programme Preparation & Development at Eumetsat, Sybren De Jong, Senior R&D engineer Royal Netherlands Aerospace Centre, Ryan Demny Configuration Lead for Crew Lander at Blue origin and Daniel Wischert, Systems and Concurrent Design Engineer at ESA.

Moreover, the committee elected Matteo Emanuelli as Coordinator and Dr Mamatha Maheshwarappa as Co-Coordinator. Jill Prince, who has successfully led the committee for the past 6 years will remain as Co-Coordinator, while Reinhold Bertrand, and Tibor Balint, who held the post of Co-Coordination, are returning to become members after many years at the service of the committee.



Matteo Emanuelli is Program Manager for Earth Observation (with a focus on Synthetic Aperture Radar) at Airbus Defence and Space. In his role, he works specifically towards enabling Airbus’ next generation radar services and investigate how to implement new technologies and external data sources in a service-driven system of

systems. Matteo is also active on regulatory aspects of Earth observation, leading an international industry effort to protect remote sensing frequencies from interferences caused by deployment of future terrestrial mobile networks. Before joining Airbus, Matteo worked as senior systems engineer at Gomspace, where he designed and launched several small satellite missions.



Dr Mamatha Maheshwarappa is the Head of Research & Development within Office of the Chief Engineer (OCE) at the UK Space Agency. In her role, she is responsible for directing and overseeing the R&D activities for the Office and ensuring the OCE continue to deliver technical evidence to provide thought leadership at a range of national and international forums. Previously, as a Payload Systems Lead, she provided technical leadership on various UK Space Agency programmes and projects, by offering technical oversight/assurance. At RAL Space, she was the technical lead on SPEQTRE (Space Photon Entanglement Quantum Technology Readiness Experiment) satellite project. Mamatha has worked on transceivers for ExoMars and Lunar Polar Sample Return projects while at QinetiQ. She has a PhD in Software Defined Radios for Multi-Satellite Communications from the University of Surrey, UK. Mamatha is the co-chair of the Women in Aerospace-Europe (WIA-E) UK Regional Network representing UK Space Agency.

IAF Space Transportation Committee

Introduction

The objective of the Space Transportation Committee is to address worldwide space transportation solutions and innovations. In particular, the goals are:

- To foster understanding and cooperation amongst space business academicians and practitioners, through the creation, diffusion, and adoption of new knowledge (i.e., research exploration, from academics

to practitioners) and lessons learned (i.e., experience exploitation, from practitioners to academics)

- To build a worldwide network of communication and relationships between space business amateurs and professionals, by providing a forum of discussion, disclosure, creative thinking (i.e. brain-storming), and information sharing.
- To encourage, promote, and assist the development of newer members of the space community through IAC participation The corresponding activities are

devoted to different types of space transportation missions, systems (launch vehicle system and/or the propulsion stages, expendable or reusable, manned or unmanned) and to their safety and support operations.

The activities of the IAF STC include the following:

- Proposal and organization of IAC symposium and sessions, including identification of relevant space-related topics to be included in the Call for Papers
- Participation in the paper selection as IPC members
- Participation as IPC members (Chairs, Rapporteurs and Symposium Coordinators) - Organization of dedicated conferences, publications
- Participation in the IAF Committee Briefs and the annual IAF Highlights

Summary

The major development in the space transportation field is the increase in the size of launch vehicles like Starship, New Glenn, SLS that allow new missions in Low Earth Orbit but also to the Moon and to Mars. Another major trend is the consideration of the re-useability of launch vehicles.

Highlights

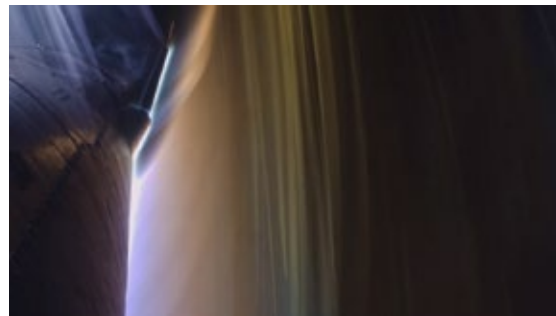
SpaceX

SpaceX completed Starship launches 2, 3, and 4 on November 18 2023, March 14 2024, and June 6 2024 respectively. Each successive launch demonstrated substantial steps forward in the development of the Super Heavy Booster and Starship upper stage. Flight 2 demonstrated the first stage separation using a hot staging technique but suffered a loss of the ship during its ascent burn. Flight 3 resulted in a successful completion of ascent objectives, with the Booster completing a boost-back burn and attempting a landing burn before the loss of the vehicle and Starship being lost on reentry. Flight 4 demonstrated both a successful ascent and successful entry for both the Booster and Ship, with both the Booster and the Ship completing soft water landings on the ocean (as planned). Notably for both flights 3 and 4, SpaceX was able to collect data during the reentry portion of the flight via direct connection of the Starship vehicle to SpaceX's Starlink constellation, enabling data rates that are unprecedented for space vehicle reentries.

SpaceX is underway in building a new factory for full-scale Starship production as well as a second launch pad at its privately owned and operated launch facility in South Texas in the USA.

While likely more relevant to human spaceflight committees, SpaceX also completed the Polaris Dawn mission which made history by accomplishing the first ever all civilian, private spacewalk and transiting higher than anyone since the Apollo missions in a private Dragon capsule.

Starship high-resolution video during reentry, data collected via Starlink.



Starship flight 3 launch:



Status of Andøya Spaceport

The construction of the spaceport for micro launchers in Andøya, Norway started in early 2022. The first construction stage is completed, the spaceport was officially opened in Nov 2023 and is now operational. The Initial Operating Capability includes the first launch pad, a launcher integration hall, and a temporary launch and mission control center. Andøya Spaceport received its Spaceport Operator License from the Norwegian Ministry of Trade and Fisheries in August 2024, paving the way for the imminent first test launch of the Spectrum launcher by our customer and partner ISAR Aerospace. Other launch operators are in talks with Andøya Spaceport which aims to host several launch operators at once.

CHANG'E-6 / Sample return from far side of the moon

From May 3rd to June 25th, China conducted the world's first sample return mission from the far side of the Moon. Chang'e-6, the twin sister of Chang'e-5 lunar probe, with a mass of about 8.35 metric tons, was launched by Long March 5 launcher to TransLunar orbit on May 3rd. It consisted of Lander, Ascender, Returner and Orbiter. After lunar orbit insertion, which was conducted by the Orbiter, the Ascender-Lander combination was separated from Returner-Orbiter combination. With the help of MagpieBridge-2 Data Relay Satellite, Ascender-Lander Combination successfully landed in Apollo Basin, which is located on the far side of the Moon. After collecting 1935.3 grams of lunar samples, the Ascender returned to Lunar Orbit. Then China conducted the world's second unmanned automatic rendezvous and docking on Lunar Orbit. Samples were transferred from Ascender to Returner, and

then Ascender was separated and deorbited. The Orbiter brought the returner to TransEarth Orbit. On June 25th, after separation from the orbiter, the Returner conducted a skip reentry and landed in China.



YANG Yuguang, vice chair of IAF STC, introducing Chang'e-6 mission on China Central Television's CGTN Channel

Future Outlook

In 2024, a state-owned company and a private of China completed their VTVL (Vertical TakeOff and Vertical Landing) test at Jiuquan Satellite Launch Center, respectively. Both test vehicles use the propellant combination of methane and liquid oxygen. LandSpace, the private company, adopted stainless steel on the fuselage of its Zhuque-3 test launch vehicle. Both tests reached the altitude of 10km and landed vertically on concrete pads. Grid Fins, cold gas RCS were also adopted for attitude control during descending. LandSpace announced that an orbital launch attempt will be conducted in 2025 and a recovery attempt will also be conducted at the same flight test.

Committee Activities

The committee is currently made of more than 70 members from all over the world including South America, Australia, North America, Europe and Asia. Only no member from Africa is currently given. A good distribution is given with a high number of female members and young professionals + students and also a good distribution among categories (industry, Academia, agencies).

The committee is not only active in the organization of the International Astronautical Congress, but also fosters synergies with other relevant space transportation conferences, and also tries to improve the exchange between the committee members through regular, committee

internal webinar sessions, the last one in September 2024 on SpaceX results. The next webinar is planned for Spring 2025.

It is also planned by the committee to improve its visibility in social media in the near future.

In 2024, the IAF Space Transportation Committee invited multiple colleagues from the IAF Community to attend programs on China Central Television's CGTN Channel. The topics covered but not limited to Earth-Moon Transportation System, new launch vehicles, Space Policies and space conferences.



Giuseppe Reibaldi, Martin Sweeting, Remco Timmermans,



Bernard Foing on CGTN



The IAF Logbook 2024



IAF Logbook:

Championing Global Space Advocacy

The International Astronautical Federation (IAF) is pursuing its steady efforts as a pioneering space advocacy body, representing the collective voice of the global space community and fostering collaboration among a plethora of stakeholders worldwide.

As part of its mission “Connecting @ll Space People” and as the organizer of the largest and most prestigious space events such as International Astronautical Congresses and Global Conferences, the IAF is invited annually to participate in key international and regional events, contributing with its unique and multidisciplinary perspective and expertise to shape the dialogue on space exploration, sustainability, and global governance.

To highlight the Federation’s key contributions towards space advocacy outreach, the IAF Logbook was launched.

The IAF Logbook brings a spotlight on the most pressing topics, including space diplomacy, global cooperation, sustainability in space and on Earth, and equitable access to space. By engaging with space leaders from government, industry, academia, and the civil society, the IAF plays an indispensable role through its efforts towards addressing emerging challenges and opportunities on behalf of the space community and ensuring that the global space agenda remains inclusive, collaborative, and impactful.

















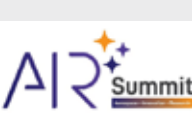


The Federation is looking forward to amplifying the voices of its members and driving progress toward a sustainable and prosperous space future for all.

Through the IAF Logbook, you can explore the extensive engagements of the International Astronautical Federation (IAF) in advancing space advocacy worldwide. Launched in 2024, the IAF Logbook builds upon the Federation’s longstanding global presence, capturing its active participation in key international events and discussions in addition to flagship International Astronautical Congress and IAF Global Conferences organized annually by IAF.

Inspired by the tradition of captains recording significant milestones during their journeys, the IAF Logbook offers a detailed chronicle of the Federation’s external activities. It highlights the involvement of IAF governance as speakers and contributors at major global forums, showcasing their efforts to address critical issues and foster collaboration within the space community.

While the IAF Logbook begins a new era of documentation in 2024, it reflects decades of IAF’s advocacy work, connecting diverse stakeholders and ensuring the most pressing topics in space remain at the forefront of global conversations. Join us in discovering how the IAF continues to shape the future of space cooperation.

2024

January	February	March
  	 	
April	May	June
  	 	
July	August	September
		  
October	November	December
	 	 



THE 16TH EUROPEAN SPACE CONFERENCE

23 – 24 January 2024
Brussels, Belgium

The 16th edition of the **European Space Conference** took place in Brussels, Belgium, under the theme “Fueling the European Space Ambition, Empowering a Vision”. The IAF President Clay Mowry delivered a keynote addressing the topic “The IAF’s mission in an evolving space environment” and focused on how the SIS agenda for 2022-2025 reflects the opportunities and challenges of a fast-paced and dynamic space sector. The IAF Vice President for Global Membership Development and Financial Matters Michal Brichta addressed industry professionals with a presentation “Why European Space needs its emerging ecosystems”.

The International Astronautical Federation organized a networking luncheon during which the IAF President Clay Mowry, the IAF Executive Director Christian Feichtinger, and the Director General of the European Space Agency (ESA) Josef Aschbacher welcomed the participants.



THE 19TH ILAN RAMON INTERNATIONAL SPACE CONFERENCE

29 January 2024
Herzliya, Israel

The IAF joined the annual **Ilan Ramon International Space Conference** to discuss emerging trends and innovations in the field of Space for climate applications, harnessing energy in & out of Space, cyber security in space, and new trends in the coming years in the Space ecosystem.

Among the topics of the conference: Israeli Space tech Innovation, M&A in Space tech, investment discussion; gateway to live, research and produce in space, and more.



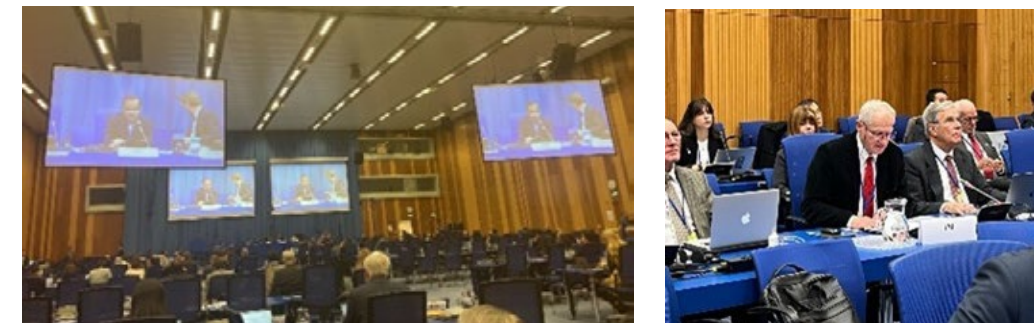
THE 61ST SESSION OF THE SCIENTIFIC AND TECHNICAL SUBCOMMITTEE (STSC) OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE (COPUOS)

29 January – 9 February 2024
Vienna, Austria

The IAF Delegation joined the 61st Session of the Scientific and Technical Subcommittee (STSC) of the Committee on the Peaceful Uses of Outer Space (COPUOS) on 5 - 6 February at UNOOSA's Headquarters in Vienna, Austria. The IAF congratulated Aarti Hola-Maini on her first STSC session in her new capacity as Director of UNOOSA and reported on the status of IAF activities including the preparations for the upcoming 75th International Astronautical Congress (IAC 2024) to be held in Milan and the Global Space Exploration Conference (GLEX 2025), New Delhi, India.

The IAF VP for International Relations Anil Kumar chaired the workshop of the Working Group on the Long-Term Sustainability of Outer Space Activities, during which we announced the topic for the IAF Symposium to be held in the framework of COPUOS in 2025. The event will be dedicated to the theme “Space for Climate Action” and will be an opportunity to capitalize on the findings and recommendations from GLOC 2023.

The IAF together with UNOOSA representatives and the IAC 2025 Host held their kick-off meeting for the 31st edition of the UN/IAF Workshop to take place in conjunction of the 75th IAC, in Milan.



THE 6TH SESSION OF THE UNITED NATIONS ENVIRONMENT ASSEMBLY (UNEA-6)

26 February – 1 March 2024
Nairobi, Kenya

The 6th session of the United Nations Environment Assembly (UNEA-6) was held under the theme “effective, inclusive and sustainable multilateral actions to tackle climate change, biodiversity loss and pollution”.

IAF Executive Director Christian Feichtinger contributed as a speaker of the high-level panel on “Forecasting the Future: The Power and Potential of Integrated Early Warning for the Environment”.

IAF highlighted the key opportunities and challenges for the space community in contributing to the global efforts to better understand and battle climate change through the use of space-based services and applications.



ANTALYA DIPLOMACY FORUM 2024

1 – 3 March 2024
Antalya, Türkiye

The **Antalya Diplomacy Forum** took place on March 1 - 3, 2024, under the auspices of H.E. Mr. Recep Tayyip Erdogan, President of the Republic of Türkiye, and on the initiative of the Ministry of Foreign Affairs of the Republic of Türkiye.

In its third edition, the Antalya Diplomacy Forum gathered heads of states and governments, ministers, diplomats, business leaders, academics, think-tankers, and youth and media representatives for an all-encompassing debate.

The overarching theme of this year's Forum was "Advancing Diplomacy in Times of Turmoil". It aimed to serve as a thorough reflection and the means for searching a peaceful way out of the turbulent period our world is going through.

The space diplomacy panel, titled "Space Diplomacy: Exploring New Opportunities," assembled a group of distinguished experts including Christian Feichtinger, IAF Executive Director, Dominique Tilmans, Special Advisor to the President on Parliamentarian and Ministerial Relations, and Alper Gezeravcı, the first Turkish Astronaut who recently returned from the historic Axiom Mission 3 (Ax-3).

IAF emphasized the significance of international cooperation for fostering a peaceful future in outer space. The speakers delved into the emerging field of space diplomacy, which has gained increasing importance in maintaining peace both on Earth and beyond. Additionally, they provided a comprehensive overview of the current state and prospects of space diplomacy, highlighting the importance of international collaboration, economic opportunities, inclusivity, education, and inspiring future generations for a peaceful and prosperous future in space.



THE 39TH SPACE SYMPOSIUM

8 – 11 April 2024
Colorado Springs, United States

At the **Space Symposium** in Colorado Springs, United States, the IAF had a strong presence with invited speakers and valuable contributions from IAF President Clay Mowry, IAF VP Global Networking Forum Steve Eisenhart, IAF VP Global Membership Development and Financial Matters Michal Brichta, IAF Executive Director Christian Feichtinger.

Clay Mowry contributed as an invited speaker at key events such as the Fusion Forum and Space Leaders Spotlight. Moreover, Clay joined forces with IAF Vice President of Global Networking Forum, Steve Eisenhart, at the New Generation luncheon. This gathering not only fostered discussions on emerging trends but also highlighted the IAF's commitment to nurturing young talent in the space sector.

Michal Brichta delivered a lecture titled "Nations to Watch", highlighting emerging countries in the space industry.

A standout moment was the special luncheon by IAF, dedicated to promoting IAC 2024 in Milan. The event drew a full audience, indicating strong interest and support for the 75th International Astronautical Congress.





THE 42ND INTER-AGENCY SPACE DEBRIS COORDINATION MEETING

16 – 19 April
Bengaluru, India

The **Inter-Agency Space Debris Coordination Committee (IADC)** serves as a global governmental forum dedicated to coordinating efforts concerning both human-made and natural debris in space.

Its core objectives include fostering the exchange of information on space debris research among member space agencies, facilitating collaborative opportunities in this field, reviewing the advancement of ongoing cooperative initiatives, and pinpointing potential strategies for debris mitigation.

During the 2024 meeting, S Somanath, Chairman of the Indian Space Research Organisation (ISRO) and Honorary Ambassador of the International Astronautical Federation (IAF), emphasized ISRO's clear agenda for space exploration and utilization.

Additionally, IAF Vice President on Relations with International Organizations Anil Kumar pledged to host and present the next Global Space Exploration Conference (GLEX 2025) in India, reinforcing the commitment to advancing international collaboration in space exploration efforts.



CHINA SPACE CONFERENCE

23 – 26 April 2024
Wuhan, China

Dedicated to celebrating China Space Day, the **China Space Conference** in Wuhan brought together delegates from around the globe to delve into the possibilities of space exploration.

As part of this significant gathering, the International Astronautical Federation (IAF) took the lead in forging partnerships and fostering cooperation among nations in the pursuit of space exploration. IAF Executive Director Christian Feichtinger unveiled new opportunities for collaboration with the Chinese Space Community. With a vision of unity and shared progress, the IAF welcomed Yu Xiaozhou, the forthcoming Vice Chair of the Space Universities Administrative Committee (SUAC), symbolizing a new step towards international cooperation in space academia.

During the conference, Christian Feichtinger attended the 2024 Flying to Deep Space International Science and Innovation Cooperation and Development Forum, where The Chinese Society of Astronautics and the Expace Technology Co., Ltd of CASIC presented a model of KZ-11 Solid Launch Vehicle. The IAF and CSA jointly organize the Space Universities CubeSat Challenge (SUCC). According to the plan, the payload of the international winning team of the 2nd SUCC will be launched into space by the KZ rocket in 2025.



CHANG'E-6 MISSION INTERNATIONAL PAYLOADS WORKSHOP

2 – 4 May 2024
Haikou, China

Following the IAF engagements meetings with potential partners, including YANG Guang, Director General of the International Cooperation Department of Shanghai Academy of Spaceflight Technology, and WANG Lin, Secretary General of Shanghai Society of Astronautics, in Shanghai, the IAF delegation, accompanied by WANG Yiran from the Chinese Society of Astronautics, proceeded to Haikou from May 2nd to 4th. They participated in the Chang'E-6 Mission International Payloads Workshop, witnessed the successful launch of Chang'E-6, and visited the Hainan Ecological Software Park.

The IAF recognized China's significant achievements in space programs and valued the contributions of Chinese members to the IAF's professional community. All parties expressed a commitment to further cooperation across multiple levels to advance space technology for the benefit of society.



impact'24 IMPACT 2024

15 – 16 May 2024
Poznań, Poland

At **Impact 2024**, leaders in innovation from various sectors came together to explore opportunities for creating a global digital future. The event offered a range of tracks, including industry 4.0, 5G, IoE, fintech, biotechnology & digital health, transportation, energy & environment, science to business, investments, and entrepreneurship.

On 16 May, the focus was on the space sector, with New Space companies pitching their ideas. Sharing the speaking opportunities with notable figures such as Michelle Obama and Nobel Prize winner Didier Queloz, IAF Executive Director Christian Feichtinger addressed the delegates on the topic of “Space Diplomacy: IAF Fostering Space Collaborations for a Sustainable Future” and participated in a moderated discussion “Building Space Business on Earth” together with Agnieszka Łukaszczyk, PLANET, Raphael Roettgen, E2MC Space, Justyna Redelkiewicz, EUSPA, and Łukasz Wilczyński, The European Space Foundation.



67TH SESSION OF THE UNITED NATIONS COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE (UN COPUOS)

19 – 28 June 2024
Vienna, Austria

During this session, on 24 June, the IAF took the floor, emphasizing its commitment to fostering long-term cooperation international cooperation in the field of space exploration and its peaceful, secure and safe utilization. This statement highlighted its dedication to facilitating collaborative efforts that transcend borders and promote innovative partnerships crucial for the sustainable development of space activities.



AEROSPACE INFORMATION INDUSTRY INTERNATIONAL ECOSYSTEM CONFERENCE

2 – 4 September 2024
Chongqing, China

The prestigious event brought together over 500 participants, including academicians, expert scholars, leading entrepreneurs, investors, and media representatives to foster a new cross-industry ecosystem for the aerospace information industry and discuss the high-quality global development of the BeiDou Navigation Satellite System (BDS).

At the Aerospace Information Industry International Ecosystem Conference, the IAF Executive Director emphasized the organization's commitment to uniting the global aerospace community and advancing international cooperation and knowledge exchange within the industry.





2ND INTERNATIONAL DEEP SPACE EXPLORATION CONFERENCE (TIANDU FORUM)

4 – 7 September 2024
Huangshan, China

The **Tiandu Forum** focuses on the engineering planning of China's deep space exploration and promoting in-depth cooperation on international Large-Scaled Science Project. The conference invites international space agencies and organizations around the world and Chinese authorities, space industries, institutes and universities together, as well as academicians, experts, and scholars in the field of deep space exploration and aerospace, to jointly discuss the development of deep space exploration in terms of national mid & long-term planning, cutting-edge technologies, academic achievements, international focuses and hot spots, domestic and international major projects, and international cooperation.

The IAF Executive Director delivered a statement on the IAF's activities connecting all Space People and its commitment to promoting exchanges and collaboration in the aerospace field among various countries.



5TH G20 SPACE ECONOMY LEADERS MEETING (SELM)

11 – 13 September 2024
Foz do Iguaçu, Brazil

The 5th **G20 Space Economy Leaders Meeting (SELM)** was held from 11 to 13 September 2024 with the theme “Space Economy and Climate Change: Challenges and Opportunities”.

The IAF delegation attended the 5th G20 Space Economy Leaders Meeting (SELM). This groundbreaking occasion paved the way for the highly anticipated inaugural IAF Global Space Leaders Summit on 15 October 2024, set to be the largest gathering of heads of agencies and offices.



UN CLIMATE CHANGE CONFERENCE (COP 29) “IN SOLIDARITY FOR A GREEN WORLD”

11 – 22 November 2024
Baku, Azerbaijan

COP 29, the 29th Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC), took place in Baku, Azerbaijan, from 11 to 22 November 2024. This event gathered world leaders, negotiators, businesses, scientists, youth, indigenous peoples, and civil society to advance collective climate action.

COP 29 Key priorities include securing new climate finance goals, enhancing national climate plans (NDCs), cutting greenhouse gas emissions, transitioning from fossil fuels, and building resilience to climate impacts.

The International Astronautical Federation, on behalf of its 563 members, expressed its endorsement of the COP29 Declaration on Green Digital Action and advocated for the inclusion of the following key point as a shared objective: Emphasize the pivotal role of space technologies as an enabler for sustainability, and in advancing the global green and digital transition.





AEROSPACE INNOVATION RESEARCH SUMMIT (AIR Summit)

19 November 2024
Hong Kong, China

The **Aerospace Innovation Research (AIR) Summit**, hosted by the Hong Kong Polytechnic University, highlighted Hong Kong's role as a dynamic hub for aerospace innovation and technology. The event brought together leaders from academia, industry, and government to showcase advancements and foster collaboration within the space sector.

IAF Executive Director Christian Feichtinger, delivered an opening speech emphasizing the important role of academia in shaping the future of space exploration. He celebrated Hong Kong Polytechnic University's contributions as an IAF Member since 2023 and encouraged participation in upcoming IAF flagship events, including GLEX 2025 in India and IAC 2025 in Australia. Christian Feichtinger's remarks underscored the growing importance of the Asia-Pacific region in the global space community.



GALAXY FORUM CHINA 2024

8 – 12 December 2024
Hainan, China

The **Galaxy Forum China 2024** took place from 8 – 12 December in Hainan. The event provided a dynamic platform for

dialogue and collaboration on advancements in space science, technology, and exploration. The forum highlighted the importance of global cooperation in tackling the challenges of space exploration and promoting scientific progress.

The International Astronautical Federation (IAF) proudly supported the forum, with a warm welcome and keynote address from the IAF Executive Director. Christian Feichtinger emphasized the IAF's commitment to fostering inclusivity and cross-border partnerships in space activities.

IAF Special Advisor Elena Feichtinger delivered a presentation celebrating the achievements of women in space exploration. The discussion highlighted the journey from the first woman in space to the growing representation of women in the sector today. This progress reflects the increasing commitment to fostering gender diversity and creating a more inclusive environment.



2024 INTERNATIONAL SYMPOSIUM ON THE
PEACEFUL USE OF SPACE TECHNOLOGY – HEALTH

IPSPACE 2024: SYMPOSIUM ON THE PEACEFUL USE OF SPACE TECHNOLOGY – HEALTH

10 – 13 December 2024
Hainan, China

IPSPACE 2024 focused on the transformative use of space technology. The event, themed “One Space, One Home,” brought together global experts to discuss space's role in advancing humanity's future and protecting Earth.

The IAF showcased the value of cross-sector collaborations, exploring how space technologies can intersect with industries like biopharming, pharmaceuticals, and nuclear energy to drive innovation and address pressing global issues. IAF Executive Director Christian Feichtinger expressed gratitude to the International Peace Alliance and co-hosts for organizing the event, reinforcing the IAF's mission of connecting people and ideas for a better future.





THE INTERNATIONAL ASTRONAUTICAL FEDERATION

Connecting @ll Space People

WHO WE ARE

Founded in 1951, the International Astronautical Federation (IAF) is the world's leading space advocacy body with 563 members from 81 countries including all leading space agencies, space companies, industries, research institutions, universities, societies, associations, institutes and museums worldwide.

Following its motto *"Connecting @ll Space People"* and its vision of *"a space-faring world cooperating for the benefit of humanity"*, the Federation advances knowledge about space, supporting the development and application of space assets by promoting global cooperation. As organizer of the annual International Astronautical Congress (IAC) as well as other thematic conferences and workshops, the IAF actively encourages the development of space activities for peaceful purposes and supports the dissemination of scientific and technical information related to space.

WHAT WE DO

- Promoting cooperation
- Advancing international development
- Sharing knowledge
- Recognizing achievements
- Preparing the workforce of tomorrow
- Raising awareness

THE IAF SECRETARIAT TEAM



The IAF Secretariat is a small dynamic team based in Paris, France. We work hard every day with unwavering enthusiasm to ensure a smooth coordination and management of all IAF activities and events.

BECOME A MEMBER

Membership in the IAF is open to all companies and organizations working in space-related fields.

If you are interested in becoming a member, please complete the "Application for IAF Membership" form (which can be found on our website: <http://www.iafastro.org/membership>) and send it together with your company's by-law, statutes and any other requested material to the IAF Secretariat.

CONTACT

100 Avenue de Suffren
75015 Paris
France

Phone: +33 1 45 67 42 60

Email: info@iafastro.org

Website: www.iafastro.org

The IAF Alliance Programme is open to all IAF Members and aims to deepen the involvement of IAF Members in the Federation, enhance the prominence and visibility of their role within the Federation, complement the traditional sponsorship opportunities with strategic long-term partnerships, assure the sustainability of IAF operations in the interest of its Members; further improve the quality of the Federation's activities, and strengthen the Federation by fortifying the one-to-one relationships with its Members.

IAF Alliance partners are guaranteed enhanced visibility on IAF promotional tools, enhanced presence at IAF Events, and the possibility to launch innovative projects!

Become an IAF Alliance Partner! Contact us at info@iafastro.org

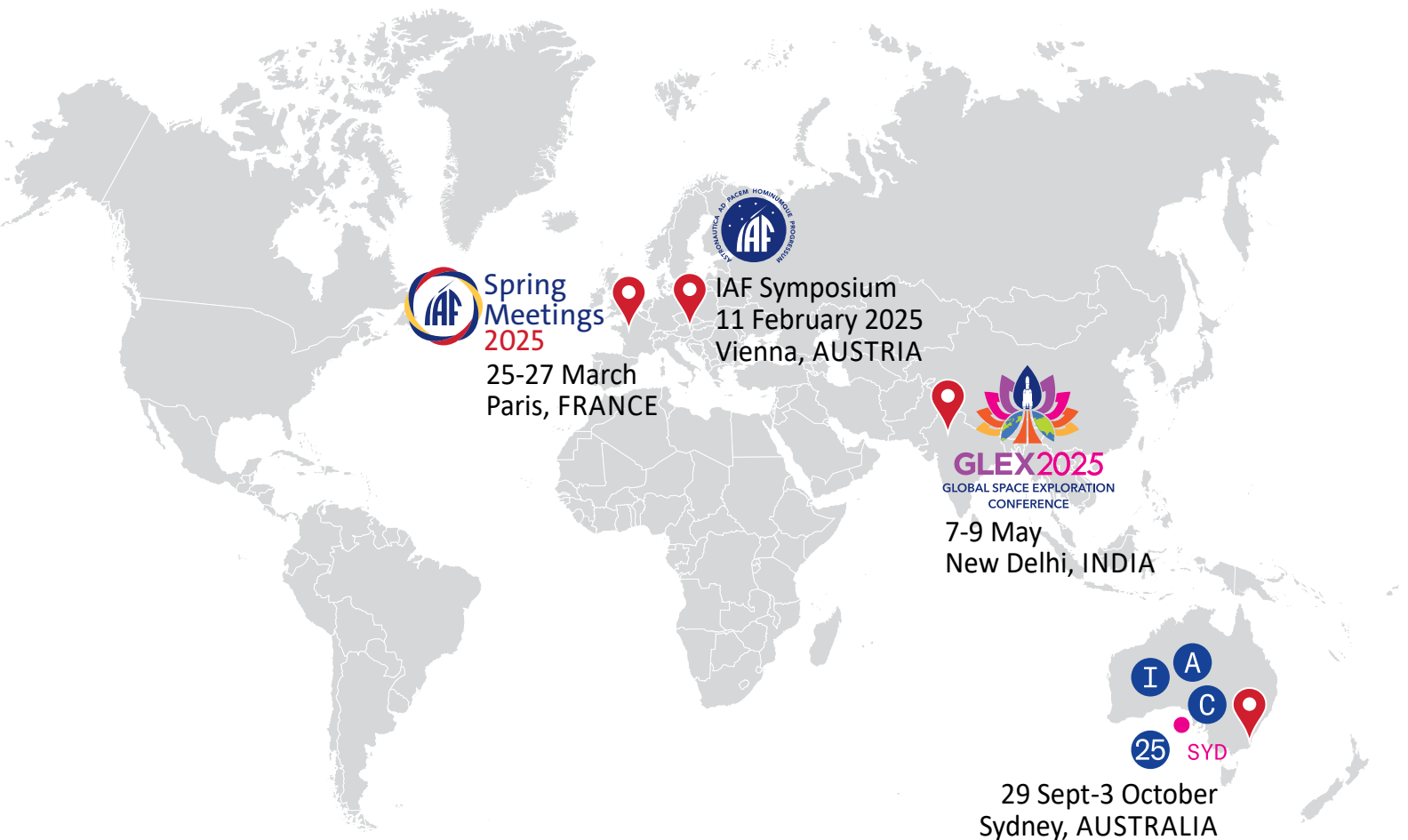


IAF Alliance Programme Partners:



IAF EVENTS 2025

*Connecting @ll Space People
for a sustainable future*



Be part of the conversation **@iafastro**

