

## IAF SPACE HABITATS COMMITTEE

### 1. Introduction

The Space Habitats Committee (SHC) aims, in co-operation with other IAF committees and symposia, to foster interest in the importance of building an international and interdisciplinary understanding of the issues and stakes raised by future space habitats (including settlements on celestial bodies and orbital infrastructures). The Committee gathers one of the most diverse interdisciplinary teams of experts among IAF members (engineers, architects, designers, crewmembers, social scientists, policymakers and space explorers) to consider the various dimensions of space habitation for innovative and inclusive initiatives. Partly thanks to its active partnership with SGAC representatives (among which some are members of the SHC), our committee has about one third of young participants (under 35 years old), including its chair, therefore complying with IAF plans towards Young Professionals. Moreover, the SHC has, since its creation in 2020, an increasing number of members and experts from a wide geographical diversity (over ten countries from four continents), including among experts whose institution was not an IAF member before they joined the committee.

### 2. Latest Developments

*Explain the latest developments and trends in your technical field of expertise.*

Plans are continuously under development for future Lunar and Martian exploration, which include within the current decade relatively well defined habitats concepts for Moon missions – such as the circumlunar station “Gateway” and some landers concepts –, all designed in the frame of scientific missions performed

by professionals. Newly developed spacecraft which will serve as habitats in the coming years include the Orion capsule and the Chinese space station.

At the same time, we observe fast growing development of private missions involving a wide range of habitation configurations as follows:

- The Crew Dragon capsule in autonomous flight for 4 people for 3 days;
- After 10 years without non-space professionals on board, the ISS will soon (starting this fall) serve again as habitat for private residents: a Russian film crew launching on Soyuz, a Japanese crew launching also on a Soyuz, an international crew launching on a Crew Dragon, an American film crew launching also on Crew Dragon, all of them in addition to the standard ISS professional crew <sup>1</sup>;
- The massive and voluminous StarShip will take 9 private passengers [around the Moon](#) within a few years, while [private space stations](#) will become operational.

These missions above present a variety of configurations in terms of: crew size, crew qualification, available volume, duration of the mission, type of mission and tasks. This implies mobilisation of multiple actors involved in the design, engineering, operability, training concepts and space analogues, all related to habitability, including also universities where teaching space architecture and design evolve accordingly fast.

Furthermore, the international award for space architecture organized by the [Fondation Jacques Rougerie](#) demonstrates the explosion of innovative and original ideas coming from all over the world, motivated by the perspective of expanding human life in outer space.

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<sup>1</sup> NASA and Axiom Space have signed an order for the first private astronaut mission to the International Space Station to take place no earlier than January 2022 (from: <https://www.axiomspace.com/news-and-media>).

Habitat design requirements include the design integration of technology for life support, designing for strict limitations in habitable volume, while providing maximum safety and strategies for future expansions and optimizations for possible variables in mission objectives. Complying with such needs also pushes the technological and scientific advancements on Earth challenges related to the design of sustainable living environments on Earth. Lessons learned from more than 20 years of permanent human presence onboard the ISS constitute a strong contribution to further space habitability development. Future habitats beyond LEO will also need to address the problem of radiation protection of the crew.

### 3. Breakthroughs

*Share any exciting breakthroughs, innovations or recent news in your technical field of expertise.*

There are a number of innovations and recent news in the field of Space Habitation. Private company transports astronauts to ISS and LEO on board of a new generation of highly automated and autonomous spacecraft. There is also increased development of new technologies in multiple connected fields (e.g., inflatable structures, use of urine for building processes, technology developments in ISRU applications for in-situ construction include advancements in 3-D printing and other regolith-based construction methods) with an emphasis on closed-loop thinking, and a multiplication of habitat concepts from a more diverse range of private companies and countries. Among other examples, recent success of extracting breathable oxygen from the Martian atmosphere inspires new ideas for supporting habitation on Mars.

### 4. Action plan for the year

*Describe the new projects and initiatives the committee is planning for the year.*

Regarding membership, the SHC will continue its action towards an increasing diversity and inclusivity within the IAF through the implication of under-represented experts – including in, but not limited to, Indigenous studies. The SHC will also continue to build up connections among members and their institutions, including by reaching out to leading experts whose institutions are not affiliated to the IAF for the benefit of innovative approaches to space habitats.

Secondly, SHC members will be part of a large range of upcoming events. In addition to the ‘Next Gen Day’ co-organised by SHC members at GLEX (June 2021), a few members will participate in GLEX via the organisation of/contribution to two GNF sessions (“GNF on Habitats”; “GNF on ISS Lessons Learned”) and technical presentations (e.g., EUROHAB). In addition to several technical presentations, Special Sessions proposed by SHC members have also been accepted for the IAC in Dubai (October 2021), including the SpS “Rethinking the sustainability and inclusiveness of space exploration through the design of space habitats” and “Gaming Out Conflict and Cooperation Scenarios in Lunar Surface Development”. Via these events and other workshops organised by some of its members in connection with space habitats, the SHC aims to prepare a dynamic framework to curate technical sessions as of the IAC 2022 in Paris.

From an organisational perspective, the SHC has started to implement best practices for a democratic and online coordination. Examples are the development of “task forces” dedicated to specific long-term projects that will make the committee an active platform to circulate cutting-edge ideas (e.g., on committee’s outcomes and scientific monitoring). SHC members contributing to these focussed initiatives will continue to work on this in the coming year.