

IAF SPACE HABITATS COMMITTEE (SHC)

1. Introduction

The IAF Space Habitats Committee (SHC) aims, in cooperation 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 (e.g., settlements on celestial bodies and orbital infrastructures). Besides diversity in terms of generation and geography, the SHC 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.

2. Summary

Plans are continuously under development for future lunar and Martian exploration, which include, within the current decade, habitats concepts for Moon missions – e.g., the circumlunar station “Gateway” and some landers concepts –, all designed for scientific missions performed by professional crews. Newly developed spacecrafts which will serve as habitats in the coming years include the Orion capsule and the Chinese space station.

Meanwhile, we also observe fast-growing development of private missions involving a wide range of habitation configurations, such as:

- The Crew Dragon capsule in autonomous flight for 4 people for 3 days;
- After 10 years without non space professionals on board, the ISS is currently serving again as habitat for private residents, benefiting from recent additions to the station such as the Russian Nauka module launched during the Summer 2021 (a Russian film crew and a Japanese crew using a Soyuz, an international private crew and an

American film crew launching on SpaceX’s Crew Dragon);

- Private crews orbiting the Earth with the Blue Origin’s New Shepard;
- NASA and Axiom Space have also signed an order for the first private astronaut mission to the International Space Station to take place no earlier than January 2022;
- 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 present a variety of configurations in terms of crew size, crew qualification, training, available volume, duration of the mission, type of mission and tasks. This implies mobilization of multiple actors involved in the design, engineering, operability, training concepts and space analogs, all related to habitability, including also universities where teaching space architecture and design evolves accordingly fast.

3. Highlights

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 on board 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. The past years have seen the development and exhibition of various ways to address the issues raised by future long-duration spaceflights, either professional or private, including via inflatable

and modifiable structures. Analog missions around the world, either commissioned and organized by space agencies or private actors, are more than ever important to test and analyze different habitability options.

4. Future Outlook

Until recently, humans in space were mostly professional astronauts and cosmonauts, from STEM, pilot or military backgrounds whose missions are determined by scientific and technological experiments. However, the commercial sector is now transporting civilians to space and space habitats will also increasingly include commercial astronauts and cosmonauts, as illustrated by the 'Summary' section. This raises questions on the status of civilians in space (including the rights and obligations of those civilians and appropriate governance mechanisms) and consequent updates in space law, but furthermore on the definition and design of space habitats in terms of life quality beyond the safety and operational aspects of professional crews' flights. Another important aspect of space habitats in the near future, especially for orbital habitats, will be the organization of their end of life considering space debris management.

5. Committee activities

The SHC held its elections for the 2021-2024 term during its IAC meeting in Dubai (29 October 2021). New members have been voted on in addition to several 'observers' interested in joining the Committee in the future, and Chair (Julie Patarin-Jossec) and Vice-Chairs (Olga Bannova and Sandra Häuplik-Meusburger) have been elected. In terms of scientific and political dialogue related to space habitats, SHC members have actively contributed to the IAC 2021 in Dubai either via technical papers and the organization of symposia, the participation in, and organization of Special Sessions, the participation in GNFs, and the participation in plenary events like astronaut panels. Some SHC members have also been actively part of the exhibition, for instance presenting prototypes of surface space habitats for future analog, Moon and Mars missions. Several new projects have been discussed among SHC members for the coming year, including:

- The creation of a working group/task force on governance issues related to space habitats

(introduced by E. Tepper), to further discuss new governance models better suited to future space habitats than the ISS' framework, including regarding the increasing commercial and long-term nature of human spaceflight.

- The organization of a dedicated session for SHC members' presentations as part of the 'Mars to Earth' 2022 conference (January 2022), organized by the Mars Planet organization (part of SHC membership).
- The organization of joint session(s) for the IAC 2022 in Paris with symposia in space architecture, space and society and system engineering — in addition to a keynote lecture in space architecture and eventual Special Sessions and/ or GNFs.
- The development of a new technical session for the IAC 2023 in Baku.
- The creation of an analog habitats group within the SHC to further work on analog-based habitability solutions, completing analog space habitats projects in partnerships with the UNOOSA.
- The development of a partnership with Padova University which, for its eighth centenary celebrations, will designate May 2022 as 'Space Month'.
- The organization of (side) events during the IAF Spring Meetings in March 2022 around space habitats.
- The discussion, and eventually the creation, of a hybrid architectural investigation of the concept of an 'orbital university' reflecting on what would be minimum necessary requirements for a habitat people would want to live in space.
- A collective and long-term reflection on best practices and processes benefiting an increasingly diverse membership, including (but not limited to) forms of participation in SHC and IAF activities for marginalized space actors (NGO representatives, artists, etc.).

All these initiatives are aimed to be undertaken by, or open to, members, experts and friends from a wide range of disciplines representing the multidisciplinary expertise of the IAF Space Habitats Committee. New memberships allow, and will allow in the coming year, new partnerships completing the above-mentioned projects.