Winter 2022

IAF MICROGRAVITY SCIENCES AND PROCESSES COMMITTEE

1. Introduction

This Committee Brief has been prepared to give an idea about the main subjects of the IAF Microgravity Sciences and Processes Committee that were presented at the IAC meeting in Paris in 2022. The IAF Microgravity Sciences and Processes Committee organized seven sessions with 63 oral presentations focusing on different aspects of the Microgravity Science. Session topics cover all microgravity science disciplines (material science, fluid physics, combustion science, and fundamental physics), current results and research perspectives, together with relevant technology developments.

2. Summary

The major developments of microgravity science relays on activities of Spaceflight vehicles. A limited variety of space-based laboratories can provide microgravity time from several seconds (drop tower, parabolic flights) to several weeks (the ISS). The difficulty of accessing these instruments is proportional to the duration of microgravity time.

Among the new laboratories coming into use and accessible to students and young professionals, who are interested in microgravity and are actively involved in this area, CubeSats should be noted. One of the students in A2.5 session presented not only the payload performance of the CubeSat, but also real scientific results.

The amount of data coming from microgravity experiments is huge and it takes from several months to several years to process them. For example, the overview of the results obtained in DECLIC-DSI facility in 2017-2018 have been presented in Paris. A new approach featured in some of the presentations is to explore how machine learning can help process the large amount of data coming from the ISS experiments.

Microgravity laboratories: Drop tower, Sounding rocket, Parabolic flight plane, and the ISS

3. Highlights

Long-duration exploration missions require on-demand fabrication, repair, and recycling capabilities for critical systems, habitats and maintenance. Manufacturing in open space and inside vehicle are getting important issues to investigate. A significant step towards a closed system is turning waste plastic into 3D printer filament to create new tools and materials. In one of the reports of session A2.2, the first step in the development of 3D printing in microgravity was presented, in addition to the numerical model, the authors conducted experiments in parabolic flight.

4. Future Outlook

Future trends in the coming years will be related to the preparation of missions to the Moon and Mars. In the microgravity science, an important attention will be paid to the challenges of materials processing such as regolith. The use of regolith as an in-situ natural resource for construction habitats and objects is desirable to reduce cost. Recent work has shown that lunar regolith can be processed using laser powder fusion, although this requires optimization.

Another important problem is that the regolith adheres to the camera and ranging equipment during the touchdown of spacecraft, and this leads to degradation of the equipment performance.

5. Committee Activities

To review and revise description and the content of the session, making them more clear and attractive for the future participants of the International Astronautical Congress (IAC).