



# IAF Committee Briefs

Winter 2024

## IAF SPACE EXPLORATION COMMITTEE (SEC)

### Introduction

This brief gives an overview of the major achievements and of the most promising development in Space Exploration in 2023, and of the perspectives for the next decade. The coverage of those topics at IAC 2023 is also elaborated.

### Summary

The year 2023 has been very productive for Solar System Exploration. Amongst the most exciting events, we can highlight the launches of ESA's JUICE mission to Jupiter and its icy Moons, of NASA's Psyche mission to the metallic asteroid Psyche. NASA successfully returned to Earth an ample collection of samples from asteroid Bennu within the frame of the Osiris Rex mission. With the success of ISRO's Chandrayaan 3 landing, India has become the 4th country to reach the surface of the Moon, where it deployed the small rover Pragyan which executed original scientific measurements over the entire daylight portion of a Moon Day. KARI started in January the operation of their pathfinder lunar orbiter, DANURI. JAXA launched their SLIM mission towards the Moon in September, and shall land with high accuracy a small rover in March 2024.

### Highlights

We are living through the age of mobile surface missions and sample return. The Chinese rover of the Tianwen 1 mission has navigated on Mars for a year between May 2021 and May 2022. NASA's rovers Curiosity and Perseverance are still active on Mars, whereas the helicopter Ingenuity has cumulated 2 hours of flight time over 66 flights in the tenuous Mars atmosphere. Several innovative mobility and surface navigation techniques were presented at the IAC.

Samples from asteroids Ryugu and Bennu are being analyzed by the best facilities across the world. CNSA

is preparing a similar asteroid sample, return mission for this decade, TianWen 2. We benefited at IAC 2023 from two exciting insights of JAXA's Phobos Sample Return mission to be launched next year, and of the associated wheeled rover developed by CNES and DLR. Mars Sample Return is also the focus of ambitious technological developments in China, in the US and in Europe. Two detailed presentations of the Capture, Containment and Return System under development at NASA, and of the Planetary Protection constraints that have driven its design, were also given at the conference. In the field of Planetary Defense, the successful impact of asteroid Dimorphos by NASA's DART probe has generated a set of effort intensive efforts to simulate the impact and recreate analytically the deviation that has been measured. ESA is finalizing the development of the HERA probe which will be launched towards Dimorphos next year to characterize its surface and interior, and make detailed observations of the impact crater. The following target for Near Earth Asteroid reconnaissance should be Apophis which will pass 31 000 km above the Earth on 13 April 2029. The Earth gravity will modify its trajectory, its spin parameters and possibly redistribute some of its surface material. Two exciting mission concepts dedicated to Apophis were presented at the IAC.

The Lunar exploration and its recent commercial dimension was very well covered at the IAC by a Late Breaking News (LBN) presentation of Chandrayaan 3, two plenary presentations, and on Highlight Lecture which described the failed attempt of a new Space actor, iSpace to land softly on the Moon and deploy a rover. However, successful lunar orbit insertion and maneuvers were executed, and the lessons learnt will be essential for their next mission. In addition, the 3 technical sessions on Moon Exploration at IAC provided a key insight on the technological development and missions in preparation. Moon Exploration is at the center of many Space Agencies, companies and academia' strategy which are developing a variety

of landers, rovers or technologies to support those missions. In addition, terrestrial experiments such as analog missions are also paving the way for human Moon Exploration targeted in the next years. In parallel of such endeavors, the industry is also organizing itself through associations or consortiums in order to provide flexible solutions to the market. We look forward to the next Moon landing attempts of Astrobotic on 24 December 2023 (embarking NASA's VIPER rover) and Intuitive Machines scheduled on 12 January 2024.

### **Future Outlook**

Mars Sample Return remains at the top of scientific priorities, both for geology and exobiology. We should know at the next IAC the new outline of the mission which is currently being re-considered by NASA and ESA. This campaign is now bound to happen at the beginning of the next decade. In the meantime, ESA will have launched to Mars in 2028 its Rosalind Franklin rover within the frame of the 2nd step of its ExoMars program.

The other major scientific priority, which is also very much supported by the quest for potential non terrestrial life, is the study of the icy Moons of the giant planets. Juice is on its way to the Jovian

system, and it will dedicate the end of its mission to Ganymede, in ten years from now. NASA's Europa Clipper will explore Europa in the same timeframe, and CNSA is preparing the Tianwen 4 mission towards Jupiter, Callisto and Uranus. Titan shall also be explored in the mid-30s by the Dragonfly rotorcraft under development at NASA, which will study prebiotic chemistry and extraterrestrial habitability.

### **Committee activities**

ESA's BepiColombo spacecraft has already flown-by Mercury three times, and will insert the Mercury Polar Orbiter around Mercury in December 2025, together with JAXA's probe Mio. Venus will be the target in the next decade of a probe that will characterize its atmosphere, and of a duo of orbiters. The Space Exploration Committee will encourage at the next IAC papers about these missions to the inner planets which have received little attention at recent conferences.

The Space Exploration Committee shall continue and extend its collaboration with the IAF Committee on Planetary Defense and Near Earth Objects, with the IAA Symposium on small satellite missions, and with the Human Exploration Committee.