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THOMAS PESQUET'S ALPHA MISSION: A COMPREHENSIVE NATIONAL CONTRIBUTION TO A
SUCCESSFUL ESA MISSION

Abstract

The ALPHA mission of ESA astronaut Thomas Pesquet took place from April 23rd to November 8th 2021 aboard the ISS, launching aboard SpaceX Crew-2 from Kennedy Space Center.

More than 200 experiments were conducted onboard by Th. Pesquet during his 6-month stay. Among them, about 30 payloads were operated from CNES/CADMOS (Toulouse, FR), and 12 of them were specifically developed and prepared by CNES/CADMOS for this ALPHA mission, as part of the French national contribution.

One of CNES/CADMOS strength lies in its long and dual expertise in developing and operating microgravity payloads. CNES/CADMOS built up on its experience and its success on PROXIMA mission (Thomas Pesquet first ESA mission from Nov.2016 to June 2017) to establish a program for the ALPHA mission advancing ambitious scientific, technological and educational objectives. It also reflected the large array of CNES expertise in various fields such as life science (physiology/neuroscience), physical/material science, life support, innovation/technology/advanced systems for exploration, and outreach.

For example, it featured an ultrasonic tweezers to remotely capture and move around small beads/droplets without physical contact, with numerous applications, from an astronaut tool to a scientific tool, or for non-invasive medical applications. Neuroscience was showcased in the Pilote experiment, combining a virtual reality headset and a haptic device to perform tele-robotic tasks (piloting and capture), with a dual scientific and exploration application. A sleep headband has also been tested and validated, as a "tech demo", to be used in a future sleep study for long-duration missions in microgravity environment. A new generation of protective containers has been developed and tested, to make them renewable and edible, in an effort to reuse these otherwise voluminous waste onboard. The first fiber-optic-based active dosimeter (Lumina) has been developed to measure ionizing radiation aboard the ISS for several years, with obvious interests in the frame of long-term exploration beyond Earth magnetosphere. Additionally, 2 student payloads were built and uploaded, as well as an outreach payload called "Blob", a fascinating unicellular space mold, which turned out to be a tremendous success in classrooms to promote science.

This paper aims at presenting CNES' ALPHA program and payloads in more details, from development to operations, future opportunities/evolutions, and the challenge to perform and manage this two-year teamwork in a high-visibility and intense pressure environment, in a pandemic era.