PoSSUM Space Science Experiments in Lunar and Microgravity Environments aboard the Falcon-20 Reduced Gravity Aircraft

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Project PoSSUM, international non-profit research and education organization, held its fifth parabolic flight campaign on October 2019 in collaboration with the National Research Council of Canada (NRC) in Ottawa. The primary objective of the flights was to evaluate the performance of a new life support system with Final Frontier Design's (FFD) commercial Intravehicular activity (IVA) spacesuit which was built as part of a NASA Flight Opportunities Program. The tests were performed aboard the NRC's Falcon-20 reduced gravity experimental aircraft. In addition to the IVA spacesuit tests, PoSSUM also conducted 19 other space science experiments, all of which were human tended payloads, including four designed by high school students as part of the PoSSUM 13 program.

Here, we provide an overview of the 20 payloads flown aboard the Falcon-20. The payloads span several fields including thermodynamics, fluid mechanics, robotics, virtual reality, food packaging, medical monitoring, electromagnetism, and bioastronautics. The experiments represent the research of participants hailing from North and South America, Europe, Africa and Asia, and as young as sixteen years old. Payloads were science experiments, technology demonstrations, or education outreach. While a majority of the payloads were developed for the weightless environment (zero-g), several were also performed in a lunar gravity environment to commemorate the Apollo 11 fiftieth anniversary of first human presence on the Moon.

Results from the payloads will be presented, including a description of the underlying physics and technologies when appropriate. Lessons learned from the flight campaign will also be presented. The main objective of the flight campaign was the validation of FFD's new life support system and this was successfully achieved. In addition, all researchers were able to gather data and results from their flown payloads. Areas of improvement include: 1) better year-round time management by PoSSUM of campaign logistics and of documentation submitted for human ethics review board approval, and 2) pre-inspection and approval of payloads by PoSSUM before the payloads shipped to the NRC for inspection.