



The PROJECT POSSUM NEWS

Winter 2017



PoSSUM Scientist-Astronaut Candidates test spacesuits in zero-G and while operating aircraft

PoSSUM Partners with the Space Foundation to host PoSSUM Academy in Colorado Springs



The Project PoSSUM News: Winter 2017

PoSSUM, an acronym for *Polar Suborbital Science in the Upper Mesosphere*, is a 501(c)(3) non-profit research and education organization that conducts research in our upper atmosphere and communicates the role of our upper atmosphere through its educational outreach programs.

Topics

- **Project PoSSUM Tests Prototype Spacesuit and Seat in Zero-G**
- **Space Foundation Partners with Project PoSSUM to host PoSSUM Academy in Colorado**
- **PoSSUM Team Tests Functional Control of Aircraft wearing Spacesuits**
- **Survival Systems and Project PoSSUM Partner to Provide Spacecraft Egress Instruction**
- **Project PoSSUM Graduates Eight Scientist-Astronaut Candidates along with first Advanced PoSSUM Academy class at Embry-Riddle.**

Project PoSSUM Tests Prototype Spacesuit and Seat in Zero-G

Project PoSSUM successfully completed the second phase of its microgravity spacesuit evaluations last November. The tests were designed to evaluate a prototype commercial IVA spacesuit designed by its partner Final Frontier Design of Brooklyn, NY. The tests, conducted at the National Research Council in Ottawa, Ont., were designed to evaluate a prototype seat along with the suit-seat interface and the operational envelope through a series of three zero-g flights. The tests also matured an in-flight suit pressurization system, communications system, and a biometric monitoring system.

Twelve Project PoSSUM graduates participated in the research campaign that occurred from 2-4 November, 2016. The spacesuit is continuing testing extending upon preliminary 'phase-one' tests that were successfully completed in October 2015. This time, a special spacecraft seat was designed and constructed by the PoSSUM Technologies Program and integrated to the aircraft. The recent tests evaluated this prototype seat and the suit-seat interface through a series of three zero-g flights while further maturing an in-flight suit pressurization system, communications system, and a biometric monitoring system. Suited test subjects included Dr. Shawna Pandya of Edmonton, AB., Heidi Hammerstein of Penbroke, GA., and Anima Patil-Sabale of San Ramon, CA.

“Our team was able to supply in-flight experimental data and qualitative feedback to both spacesuit and seat designers”, said test subject Heidi Hammerstein, “Working with Project PoSSUM team members and FFD’s spacesuit in microgravity trials is the realization of a career-long dream.”

Last January, the FFD proposal “Testing of a Novel IVA Space Suit” was selected by NASA’s Flight Opportunities Program and these tests served as an unpressurized ‘dry-run’ of the NASA-supported tests. The Falcon 20 aircraft was chosen for these tests because of its exceptional quality of microgravity that best approximates the space environment, as well as a cabin interior that best replicates several space vehicles being produced.



“The purpose of these tests is to increase our technology readiness level (TRL) through human testing in a high fidelity, relevant environment. The results will be used to validate pressurized suit performance under live, unpredictable conditions and further our milestone goal of obtaining flight safety approval from the FAA,” says Ted Southern, President of FFD.



PoSSUM Scientist-Astronaut Candidates comprise the spacesuit test team at the National Research Council in Ottawa, Ontario.

Space Foundation Partners with Project PoSSUM to host PoSSUM Academy in Colorado

The Space Foundation World Headquarters, located in Colorado Springs, CO, forged a partnership with Project PoSSUM to offer the PoSSUM Academy upper-atmospheric and astronautics education program, starting in May 2017. Based on the intensive Scientist-Astronaut program held at Embry-Riddle, PoSSUM Academy students learn about upper-atmospheric science and astronautics as they prepare for simulated suborbital missions to study noctilucent clouds.

Three PoSSUM Academy classes will be offered in May 2017 at the Space Foundation Discovery Center in Colorado Springs. PoSSUM team members will install a suborbital flight simulation facility, mission control room and a spacesuit operations facility complete with donning room and pressurization facilities. The simulation will simulate flight profiles representative of several of the manned suborbital spacecraft in design, such as Virgin Galactic’s Spaceship Two and the XCOR Lynx vehicles.

In addition to providing PoSSUM Academy courses, PoSSUM will lead the development of an interactive exhibit designed to educate Space Foundation visitors about upper atmosphere and provide an opportunity



to experience a virtual reality flight onboard a NASA balloon that the PoSSUM team will launch over Antarctica in December 2017 to study fine details of noctilucent clouds.

“The Space Foundation is extremely excited to be partnering with Project PoSSUM on this endeavor,” said Space Foundation Vice President – Education Byran DeBates. “The Project PoSSUM Academy combines the future of spaceflight with education — two areas in which the Space Foundation tries to communicate to the visitors of the Space Foundation Discovery Center. This training academy will give visitors the opportunity to see a live simulation in action with actual equipment being used. I can’t think of anything better that would inspire the next generation of explorers. We look forward to this partnership and the many careers it will inspire.”

The education component of PoSSUM is what is particularly unique. The PoSSUM Academy program that the Space Foundation will host is based on the PoSSUM Scientist-Astronaut Program, a specialized program that has drawn scientists, engineers and educators from 24 countries in all six continents to the Embry-Riddle Aeronautical University in Daytona Beach, Fla. Last April’s PoSSUM program brought NASA astronauts Dr. Don Pettit and Nicole Stott, who shared their experience observing these clouds from the International Space Station and communicating the science.

At the Space Foundation, PoSSUM Academy students will learn how to use PoSSUM instrumentation to perform the unique PoSSUM Noctilucent Cloud Tomography mission, much like the PoSSUM Scientist-Astronaut Candidates do. To effectively perform simulated missions, PoSSUM Academy students need to learn a lot about the science behind the mission as well as practical skills such as spacesuit and camera system operations.

“The PoSSUM noctilucent cloud tomography experiment is unique because it requires a trained operator; it’s as much of an art as a science as you simply can’t see the fine structures of interest from the ground, said PoSSUM Executive Director Dr. Jason Reimuller. “But it’s this human element that inspires people, and the diversity of human stories that become involved with the program create avenues to communicate the science to new communities. This is where our aeronomy community is failing; most people know very little about our upper atmosphere, but it’s the most sensitive part of our planet, and one of the best places to study things like global climate trends.”

PoSSUM Academy will be held at the Space Foundation Discovery Center for three weeks during May 2017, and is limited to a total of 24 students each week.

PoSSUM Team Tests Functional Control of Aircraft wearing Spacesuits

Project PoSSUM conducted its first in-flight evaluation of the Final Frontier Design (FFD) 3G IVA spacesuit in the cockpit environment on July 30, 2016. The test was conducted in a Mooney M20K aircraft, flown from Boulder Municipal Airport, and assessed the operational envelope and the ability of one wearing the suit to make fine controls of the aircraft.

Dr. Sarah Jane Pell is an Australian artist and explorer and also a graduate of PoSSUM Scientist-Astronaut Class 1601. During the flight, she evaluated the spacesuit while she performed a variety of in-flight maneuvers, including standard-rate turns and climbs, engine power adjustments, and landing gear and flap extension and retraction. The Mooney aircraft was chosen because the cockpit has a volume and an



operational envelope typical of existing spacecraft. Further, the aircraft's controls require significant dexterity to operate.

The test was conducted as part of the PoSSUM Bioastronautics Program, an opportunity available for PoSSUM Scientist-Astronaut and PoSSUM Academy graduates, and follows a ground evaluation test of the suit's interface with a spacecraft seat. The next stage of evaluations will be held in Ottawa, Ontario from 10-14 October 2016 where a team of 16 Project PoSSUM Scientist-Astronaut Candidates will evaluate the seat in microgravity and high-G conditions through a series of four parabolic flights, extending upon phase-one tests that were successfully completed in October 2015.



PoSSUM Scientist-Astronaut Candidate Dr. Sarah Jane Pell delivers a TEDx Melbourne talk while testing functional controls of the Final Frontier EVA spacesuit in a PoSSUM research aircraft while PoSSUM Spacesuit Technician Parker Rice monitors the pressurization system in-flight



Survival Systems and Project PoSSUM Partner to Provide Spacecraft Egress Instruction

Last October, Project PoSSUM forged a partnership with Survival Systems USA ('SSUSA') of Groton, CT to provide a unique course titled 'Spacecraft Egress and Rescue Operations', a professional-level course designed for space architects, astronautics professionals, and mission planners interested in the landing and post-landing phases of manned space missions. The partnership establishes PoSSUM as the exclusive provider of space training and space education services in partnership with SSUSA and the course will be offered through the non-profit astronautics research and education non-profit, Project PoSSUM, as part of the PoSSUM Bioastronautics Program.

"Contingency planning is seldom talked about publicly in the manned commercial space industry because commercial companies want to protect an image of safety. But access to space is risky and manned space vehicles and space architecture are always designed around credible contingencies", said ISS CEO Dr. Jason Reimuller, "Historically, contingency rescue planning has been based around international agreements supporting government-run space programs. But who will come to rescue a commercial crew after an aborted mission?"

The five-day course is the first professional education course on the landing and post-landing phase of manned spacecraft missions and focuses on vehicle and spacesuit design and egress procedures. Coupled with preparatory webinar-based instruction, the course will be offered each April at SSUSA's Groton, CT location, where immersive aircraft egress and sea survival components will complement the instructional material to provide an intuitive understanding to the design of operational procedures and egress systems.

"Integrated Spaceflight Services and their commitment to contingency planning in manned space missions is an ideal partner for Survival Systems to expand our mission of enhancing and preserving lives." said SSUSA CEO Maria C. Hanna. "I am thrilled by the potential impact the combined efforts, expertise, and resources will have on space mission safety and survivability."

Students will learn about nominal and contingency landing scenarios, post-landing planning, rescue and recovery architecture design, egress systems and operational procedures, deconditioning and post-landing survivability, generalized egress skills and emergency egress bottle use.

PoSSUM Graduates Eight Scientist-Astronaut Candidates along with first Advanced PoSSUM Academy class at Embry-Riddle

On October 15, Project PoSSUM graduated eight new Scientist-Astronaut Candidates as part of PoSSUM Scientist-Astronaut Class 1602 along with the first 'Advanced PoSSUM Academy' class.

"The diversity of this class demonstrates that global climate research and manned spaceflight are intrinsically international efforts", commented PoSSUM Executive Director Dr. Jason Reimuller, "This class brought students from Italy, Angola, India, and the United States"

Next up for the new PoSSUM graduates is an opportunity to evaluate spacesuits on zero-G parabolic flights in Ottawa, Ontario next month as part of the PoSSUM Bioastronautics Program. In this program, the students will learn about microgravity research campaign planning and operations while they evaluate prototype spacesuits, spacecraft seat concepts, suit/seat interfaces, and ingress and egress procedures.



Additionally, graduates will participate in educational outreach programs and technology development programs in preparation for suborbital research missions.

The PoSSUM Scientist-Astronaut Program is an intense training curriculum that covers atmospheric science, remote sensing, celestial mechanics, particle scattering, spaceflight physiology and PoSSUM instrument operations. At Embry-Riddle, students received comprehensive spacesuit training, mission simulation training, high-altitude and hypoxia awareness training, and aerospace physiology training with world-champion aerobatic pilot Patty Wagstaff. Graduates also received three Continuing Education Units in 'Suborbital Mission Operations' from Embry-Riddle.

The eight graduating candidates of Scientist-Astronaut Class 1602 include Avishek Ghosh of Strasbourg, France; Rossana Fernandes of Daytona Beach, Fla.; Karen Brun of Oscoda, Mich.; Pranit Patil of Panvel, India; Emerald Ainge of Boulder, Colo.; Hady Ghassabian Gilan of Verona, Italy; Dr. Diane Howard of Daytona Beach, Fla., and Alexander Horvath of Fairfax Station, Va. The Advanced PoSSUM Academy course brought students from Egypt, Portugal, El Salvador, and the United States.



PoSSUM Scientist-Astronaut Class 1602 graduates from Embry-Riddle on 15 October, 2016



Briefs

PoSSUM High-Altitude Balloon Cameras Ready for System Testing

PoSSUM camera systems that will fly as part of a \$1.4M NASA-funded experiment, the Polar Mesospheric Cloud Turbulence (PMC-Turbo) experiment have been constructed and are currently undergoing thermal and leak testing in Boulder, CO. The eight camera systems will be part of a two-week high-altitude balloon mission to study atmospheric dynamics that can be viewed in exquisite detail by imaging PMCs at very high resolution. The payload will also include a lidar system provided by the German DLR. PoSSUM works in partnership with GATS, Columbia University, and Integrated Spaceflight Services on the PMC-Turbo project.

Following the Antarctic campaign, PoSSUM plans to extend the balloon imagery obtained in Antarctica with high-resolution tomographic imagery and coordinated in-situ measurements of the upper atmosphere through use of next-generation commercial space vehicles as they become operational.

PoSSUM Scientist-Astronaut Candidates Prepare for Noctilucent Cloud research mission in High Level

PoSSUM Scientist-Astronaut candidates are planning to deploy to High Level, Alberta for a two-week mission to image noctilucent cloud structures from aircraft using a camera system designed and constructed for the PMC-Turbo mission. The flights will occur from 22 June through 3 July and image noctilucent clouds structures, when present; from altitudes of 23,000 ft. Airborne observations will be closely coordinated with space-borne observations from the AIM satellite and ground observations taken by PoSSUM ground observation teams.

New PoSSUM Mission Patch and Wing Design Released

PoSSUM Scientist-Astronaut Candidates now wear mission-unique name patches. Inspired from the NASA astronaut design, the new PoSSUM wings show a suborbital mission profile that transition through a noctilucent cloud structure, the baseline PoSSUM suborbital mission.

