

HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Commercial Human Spaceflight Programs (2)

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DEVELOPMENT AND EXECUTION OF A COMMERCIAL MANNED SUBORBITAL RESEARCH
PROGRAM FOR AERONOMY APPLICATIONS

Abstract

Overview: This talk will present Project PoSSUM and the first microgravity tests of a commercial IVA space suit.

Background: Noctilucent clouds (NLCs) are indicators of climate change and act as analogues of extraterrestrial weather phenomena. Since their discovery in 1885, the underlying physics of the formation and dynamics of NLCs remain unknown. NLCs form in the polar summertime at latitudes greater than 60° and at altitudes between 80 and 100 km, a region of the atmosphere that cannot be accessed by aircraft or satellites. The use of commercial reusable suborbital launch vehicles (rSLVs) enable tomographic imagery of small-scale NLC structures needed to elucidate the physics behind NLC formation. However, due to the dynamic nature of NLCs, a trained human operator is required to identify the features of greatest interest and gather the best remote sensing and in-situ data possible.

Objectives: 1) To produce 3D mesospheric models of NLCs tomographic imagery obtained through manned commercial rSLV missions. 2) To test complementary technologies including a variety of imagery and remote sensing instrumentation, and commercial Intra Vehicular Activity (IVA) spacesuits.

Methods: Project PoSSUM (Polar Suborbital Sciences in the Upper Mesosphere) is a US non-profit research program that trains citizen-scientists from 24 countries to conduct human suborbital spaceflight tomography missions. Graduates currently support PoSSUM airborne NLC research campaigns, a NASA-funded balloon campaign to study NLC micro-features over Antarctica in December 2017, and perform outreach supporting the aeronomy community through Space Foundation programs.

Project PoSSUM collaborates with Embry-Riddle Aeronautical University, Integrated Spaceflight Services, Final Frontier Design (FFD), the Southern Aeromedical Institute, the National Research Council (NRC) of Canada, and veteran NASA astronauts to provide PoSSUM scientist-astronaut candidates with academic, hands-on, and analogue training in the following areas (non-exhaustive list):

- Remote Sensing, Aerospace Cinematography
- Solar Mechanics, Atmospheric Scattering

- Spaceflight Simulation and Operations
- Aerospace Physiology, Life Support Systems
- Hypoxia Awareness and Mitigation
- High-G and 0-G Analogue Flights
- Crew Resource Management

Results: Over 60 scientist-astronaut candidates currently participate in Project PoSSUM. Development, testing, and operations' refinements continue as Project PoSSUM evaluates potential commercial human rSLV providers. A key component of the program has been the validation of the FFD commercial IVA space suit in microgravity aboard the NRC Falcon-20 aircraft. Lessons learned will be used to iterate the suit design and to implement a test seat platform for eventual visor-down, pressurized suit tests tests in microgravity flights funded through NASA's Flight Opportunities Program.