LUNAR EXOCAM 2021 PAYLOAD TEST FLIGHT REPORT

Jason Achilles Mezilis [(1)], Will Hovik [(2)], Kris Zacny [(2)], Dean Bergman [(2)], Jim Bell [(3)], Daniel C. Jacobs [(3)], Christopher McCormick [(4)], Matthew Adkins [(4)], Jnaneshwar Das [(3)], Harish Anand [(5)], Abdullah Masud [(5)], Lakshmi Gana Prasad Antervedi [(5)], Darwin Mick [(5)], Katrina Davis [(5)]; (1) Zandef Deksit Inc., Los Angeles CA info@zandefdeksit.com; (2) Honeybee Robotics, Altadena CA; (3) School of Earth and Space Exploration, Arizona State University (ASU), Tempe AZ (4) Interplanetary Initiative, ASU, Tempe AZ (5) DREAMS Laboratory, ASU, Tempe AZ

Introduction: In October 2020, the *Lunar ExoCam* development team was awarded a funding grant under NASA's Flight Opportunities program to advance payload Technology Readiness Level (TRL) towards future development for lunar surface implementation, with a flight on the Masten Space Systems Xodiac VTVL test vehicle. On Oct. 14th, 2021, two separate ExoCam camera / sensor payload modules successfully completed an in-flight ejection from the Xodiac rocket at a height of 25m and 15m, at the Masten launch facility in Mojave, CA.

Background: *Lunar ExoCam* is a payload suite being developed for recipients of the NASA-funded CLPS (Commercial Lunar Payload Services) lander program. It is a remotely deployable payload delivery system designed to capture 360º video imaging of a spacecraft landing from the lunar surface along with direct particle measurement of the regolith dispersion caused by the landing.

The ExoCam payload concept was initially presented at the 2019 Microsymposium 60 [1]. Initial mechanical systems design was supported in 2020 via internal R&D funding from Honeybee Robotics, leading to NASA funding through the Flight Opportunities program.

Presentation: This poster outlines results from the two tethered flights and final free flight test of the payload systems outlined below. It details mechanical system development as well as initial results from both the camera and particle sensor system. The presentation will also visually display computer pre-visualization imagery generated by a student team at Arizona State University (ASU). This imagery is contrasted against actual in-flight camera footage, for a side-by-side representation of the relative accuracy of the flight predictions.

Test Payload: This initial *Lunar ExoCam* flight test payload included a GoPro MAX 360º spherical field-of-view HD video camera and a 360º particle sensor system (created by another ASU student team). Both were encased within a CAMERA MODULE that was launched to the surface from a mounted EJECTION MODULE affixed to the Xodiac payload bay.

Other required systems not included in the initial test flight, but currently under development will include: battery-based power, sequencing and control avionics, near-field RF to support data transfer back to a lander, further ruggedized mechanical packaging to accommodate deployment from the lander, and thermal management during the Earth-Moon transit.

Fig. 1 below demonstrates the final iteration of one of the ExoCam Camera Modules prior to flight. Not shown is the Ejection System, mounted on the opposing side of vehicle payload bay (top) in preparation for launch.

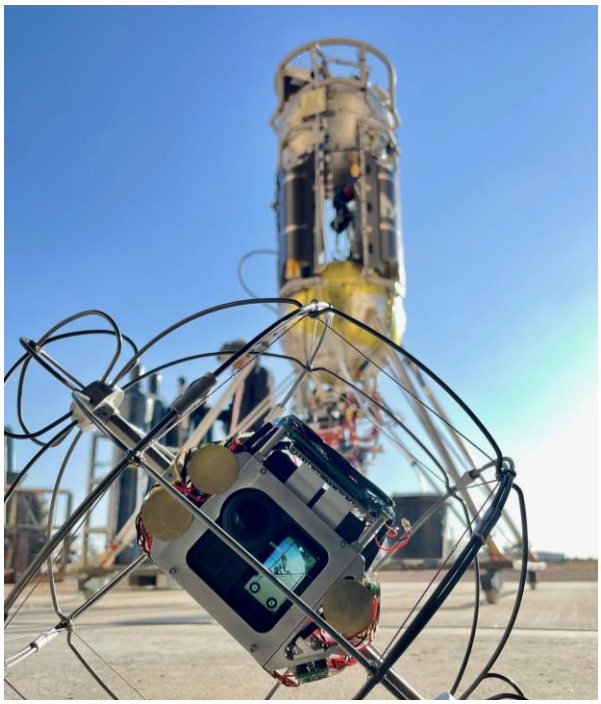

*Figure 1 – **Lunar ExoCam** test flight payload (foreground) pictured with Masten Space Systems **Xodiac** vehicle (rear)*

Acknowledgments: Bernice Yen, Steve Indyk (Honeybee Robotics); Jared Byron, Ruben Garcia, flight team at (Masten Space Systems); Jim Head (Brown University), Rex Ridenoure (IZUP / Ecliptic Enterprises Corporation)

References:

[1] Microsymposium 60: Forward to the Moon to Stay -- Undertaking Transformative Lunar Science with Commercial Partners; A workshop held 2019 Mar 16-17, Woodlands, TX; Organized by Dr. Jim Head and Dr. Carle Peters, Brown University.