



Cubesat Application for Planetary Entry (CAPE) Missions: Micro-Return Capsule (MIRCA)

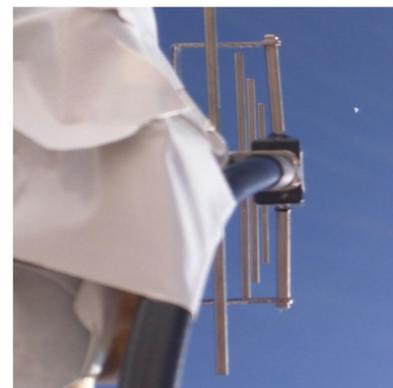
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Two successful 12-hour flights in near-space through day and night provide verification of concept prototype

On October 10 2015 and September 9 2017, the MIRCA entry vehicle prototype was successfully flown to ~31km altitude as a “piggy-back” payload onboard technology demonstration balloons launched from NASA’s CSBF in New Mexico. This completed verification of its avionics, including an Inertial Measurement Unit (IMU), single board computer, power conditioning and distribution system, UHF communications transceiver, on-board thermal sensor, (ground/air) telemetry acquisition system, flight software, and recovery systems, all critical steps in MIRCA’s development. Aerodynamic and parachute/deployment system verification will be completed in a future flight.



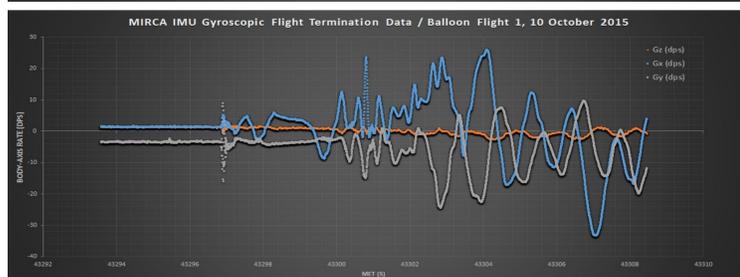
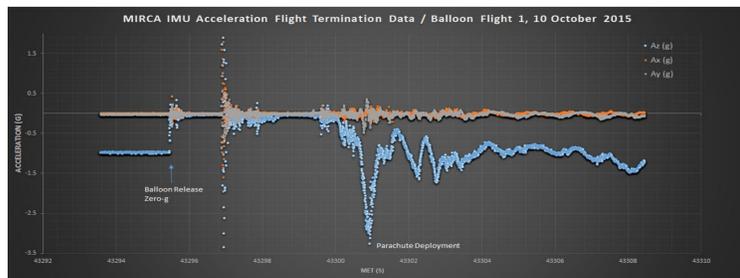
Gondola integration and compatibility test.



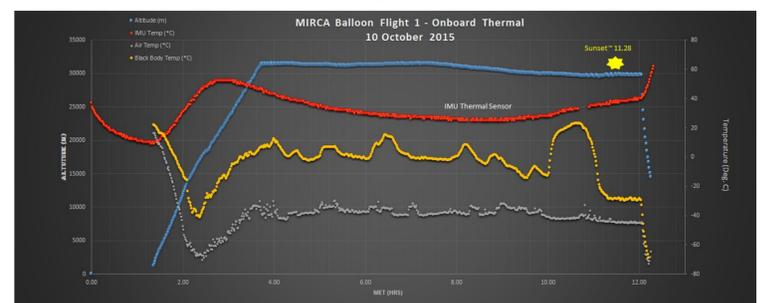
Flight telemetry test.



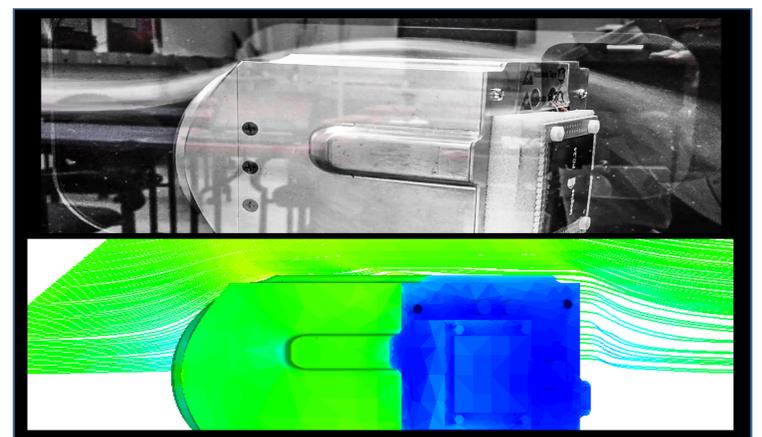
MIRCA on board balloon gondola ready for flight.



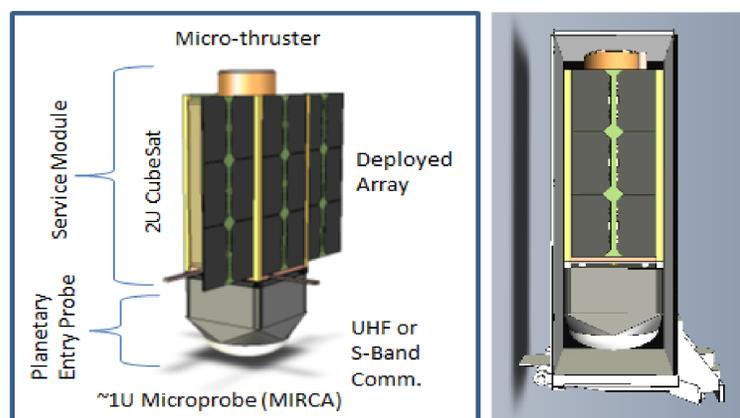
Acceleration and body rate data recreate vehicle dynamics. Shown are maximum axial (+Z-axis vertical) deceleration at about 3.3g after parachute deployment, and cyclic vehicle swinging under parachute (X and Y axes).



MIRCA internal temperature sensor shows stable thermal environment (red curve) at float altitude.



MIRCA in wind tunnel test at NASA WFF (shown at angle of attack $\approx 20^\circ$).



CAPE concept vehicle in its deployed configuration, and stowed in deployment system. MIRCA is at the bottom.



PI Jaime Esper (right) introduces MIRCA-1 to former NASA Associate Administrator for Science, Dr. John Grunsfeld (center), and to Astrophysics Division Director, Dr. Paul Hertz (left) - Ft. Sumner, NM (2016).

CAPE/MIRCA Goals and Objectives

- Develop a high-performing Cube-sat system which includes a propulsion module and miniaturized technologies capable of surviving atmospheric entry heating, while reliably transmitting scientific and engineering data.
- Use the Micro Return Capsule (MIRCA) as CAPE’s first planetary Entry Probe (CEP) flight prototype.
- Carry out flight verification of MIRCA’s avionics, software, and aerodynamics in a high-altitude balloon.

Applications

- The probe measurements could include: temperature, pressure, wind shear (and perhaps directional velocity, if combined with accurate tracking), net flux in visible and infrared channels, and perhaps some measurements of composition, especially for more abundant gas species (e.g. H₂O, CO₂ on Mars and Venus, CH₄ on Titan). These measurements would provide an important test of dynamical models of the atmosphere.