



SPEAR OF ARES

TUBE DEPLOYED REENTRY VEHICLE FOR MARS WEATHER STATION

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OBJECTIVE

To design and test a TDRV (tube deployed reentry vehicle) for potential use on Mars as a weather station. Testing of the prototype was accomplished through a high-altitude balloon drop. Specific interest was given to the flight dynamics of the payload.

VALUE PROPOSITION

We are testing a model payload on Earth for the sake of landing a model on Mars. This model will acquire valuable data for NASA that will inform further design of an atmospheric reentry vehicle.

REQUIREMENTS

Environmental Conditions:

- Temperature: -60°C to 30°C
- Pressure: 3 hPa to 1100 hPa
- Precipitation tolerant (IP43 Rating)

Form Factor:

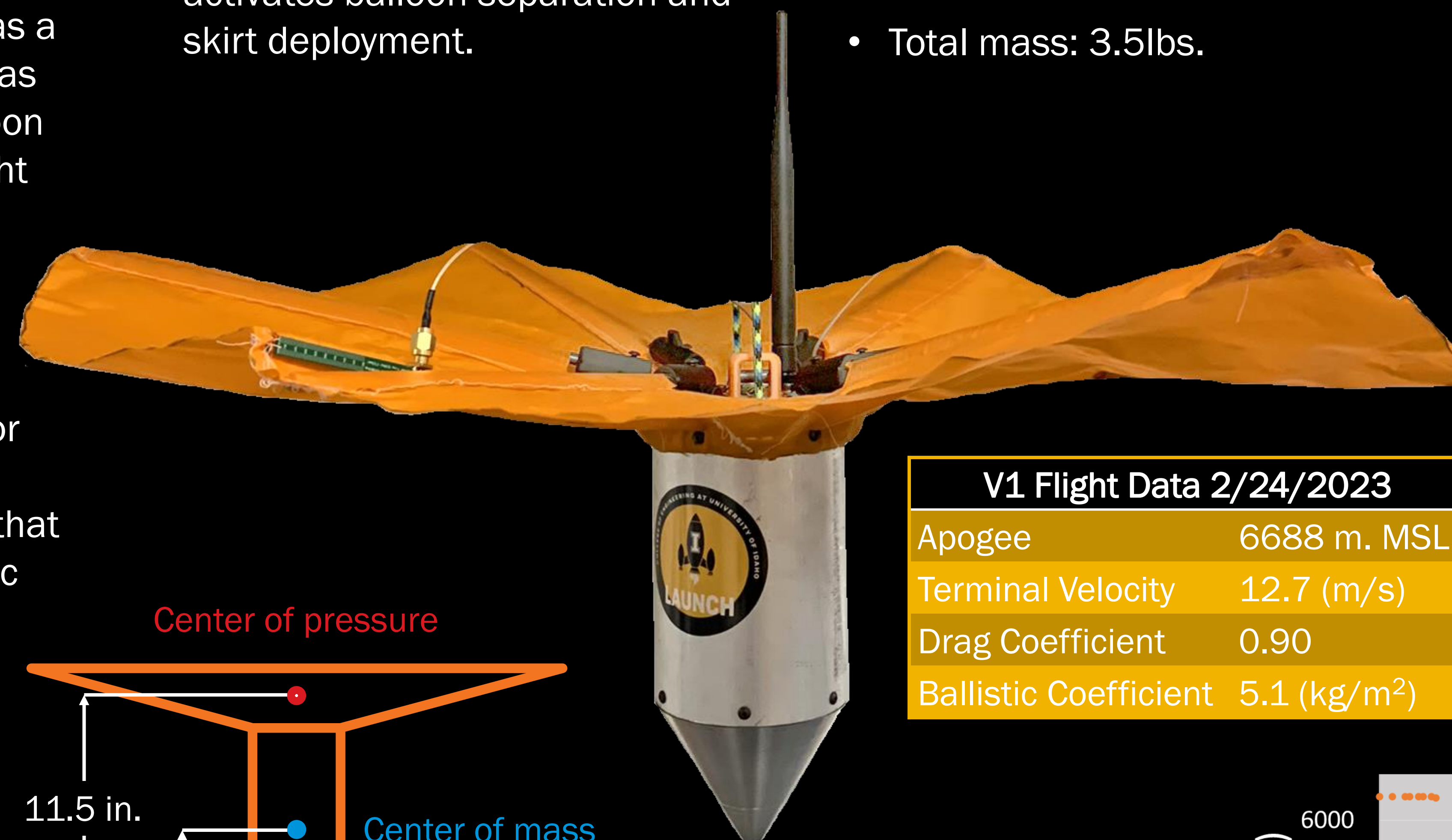
- 4" OD forebody, 6" length, 6 lbs. maximum.
- Survive impact from free fall.



Left to right: Tao Wang, Shujaea Aldousari, Jonathan Kopf, Michael Myers, Owen Blair, Kyle Rast, Steven Rougeux.

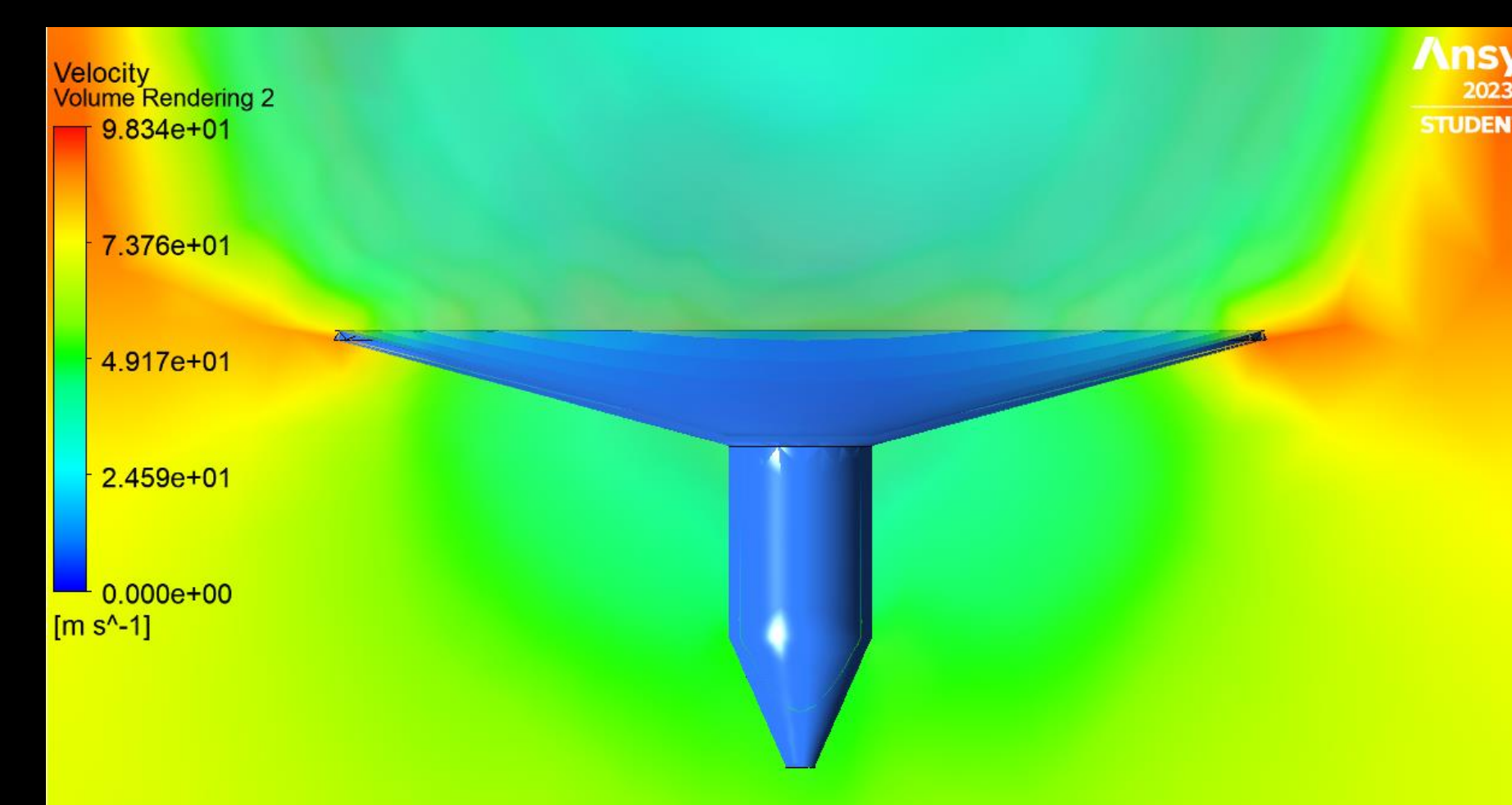
MECHANICAL DESIGN

- Spring-deployed drag skirt made of ripstop nylon and carbon fiber rods.
- Nichrome hotwire simultaneously activates balloon separation and skirt deployment.
- Aluminum nose and tube.
- Nylon skirt ring.
- PLA internals.
- Total mass: 3.5lbs.

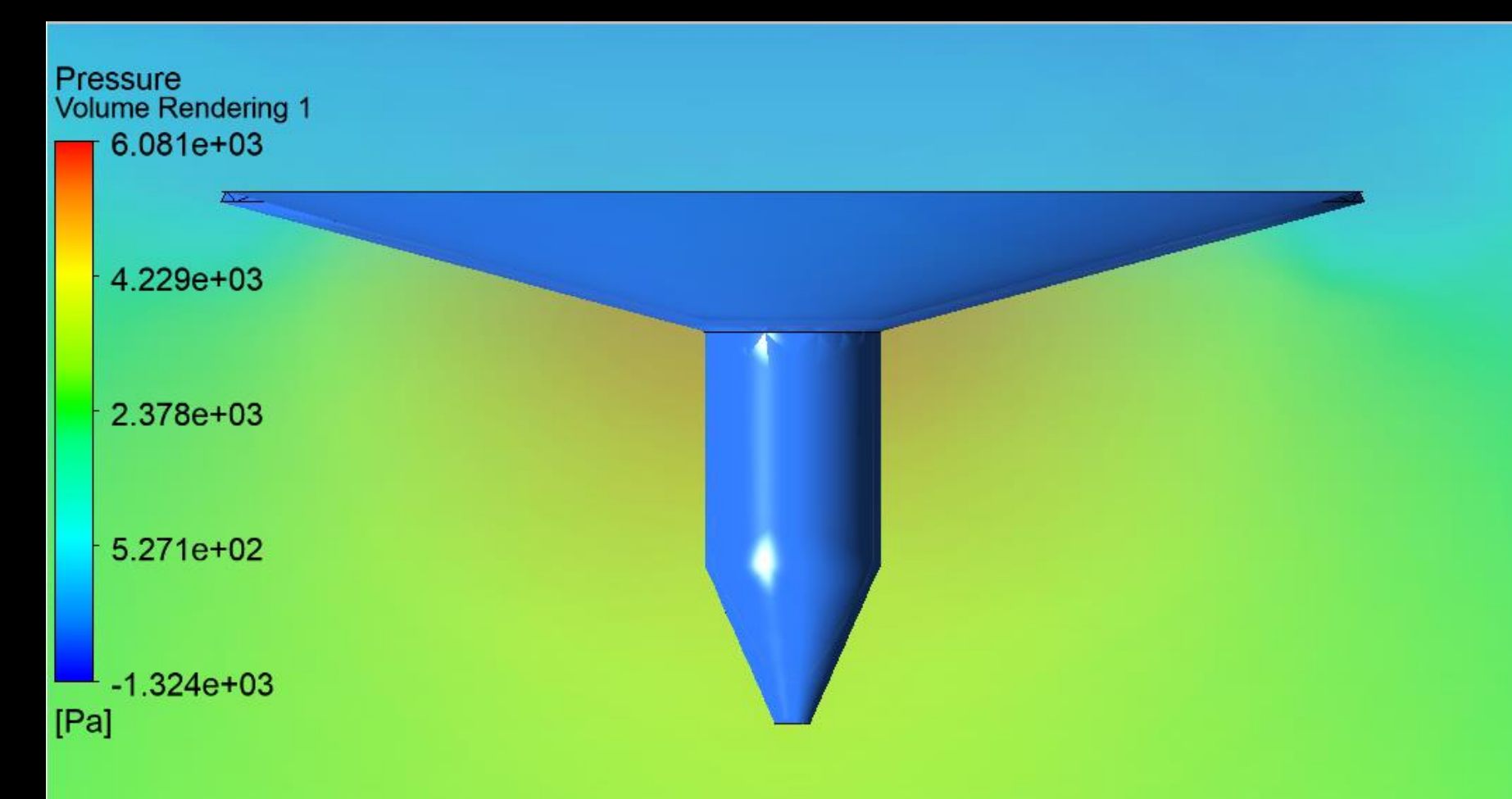


V1 Flight Data 2/24/2023	
Apogee	6688 m. MSL
Terminal Velocity	12.7 (m/s)
Drag Coefficient	0.90
Ballistic Coefficient	5.1 (kg/m ²)

SIMULATION

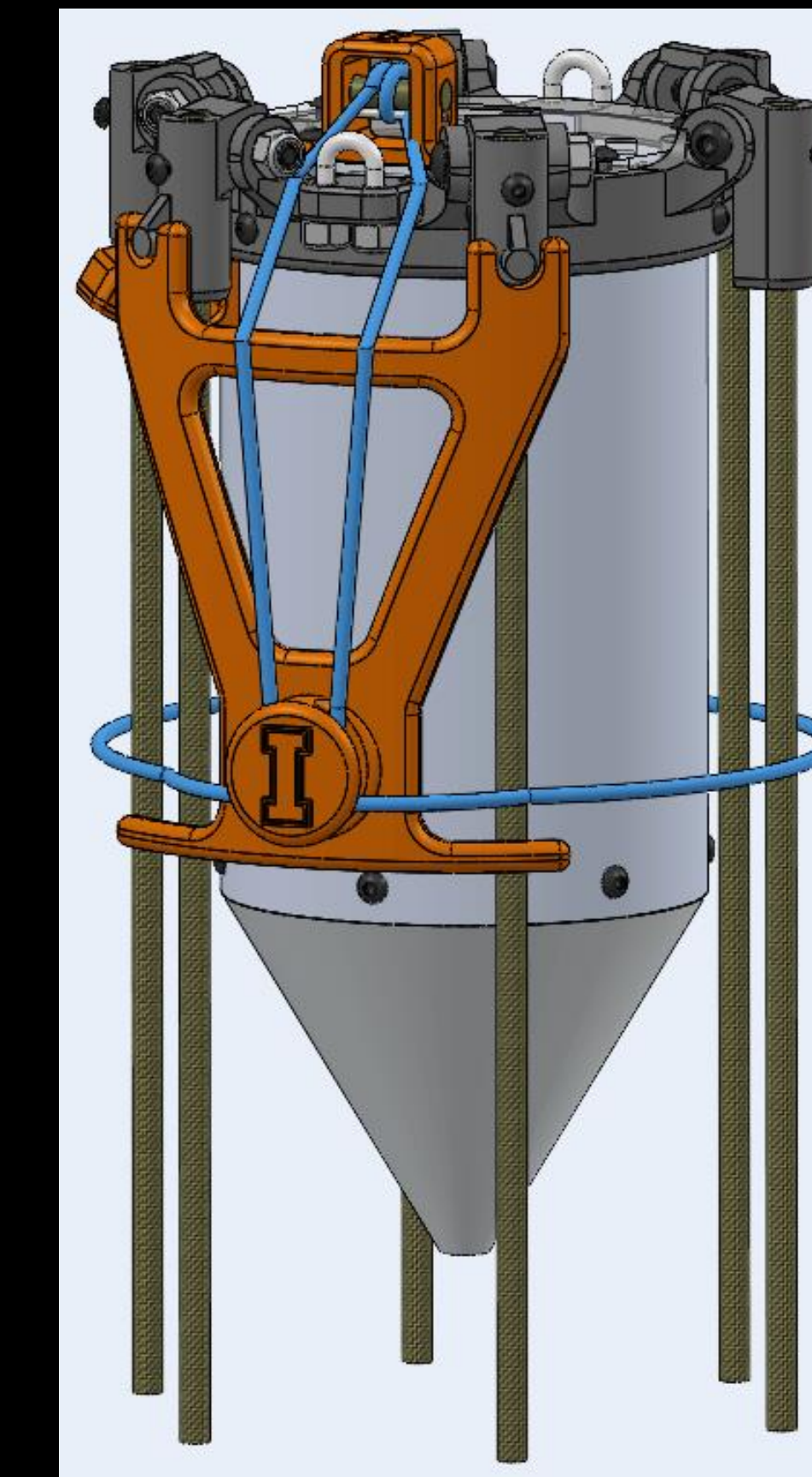


Velocity Contours for Payload Body

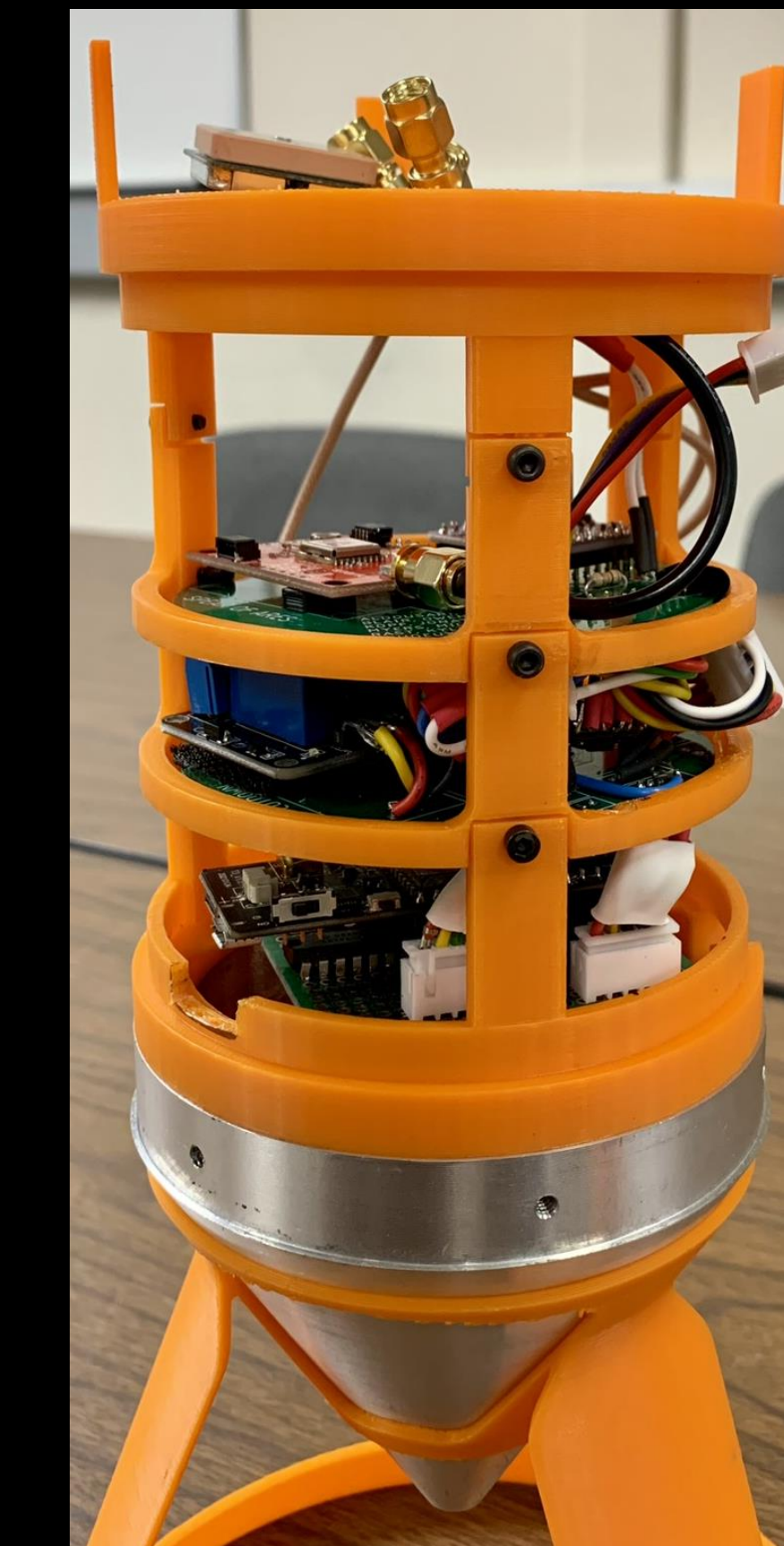


Pressure Contours for Payload Body

ASCENT CONFIGURATION



INTERNAL STRUCTURE

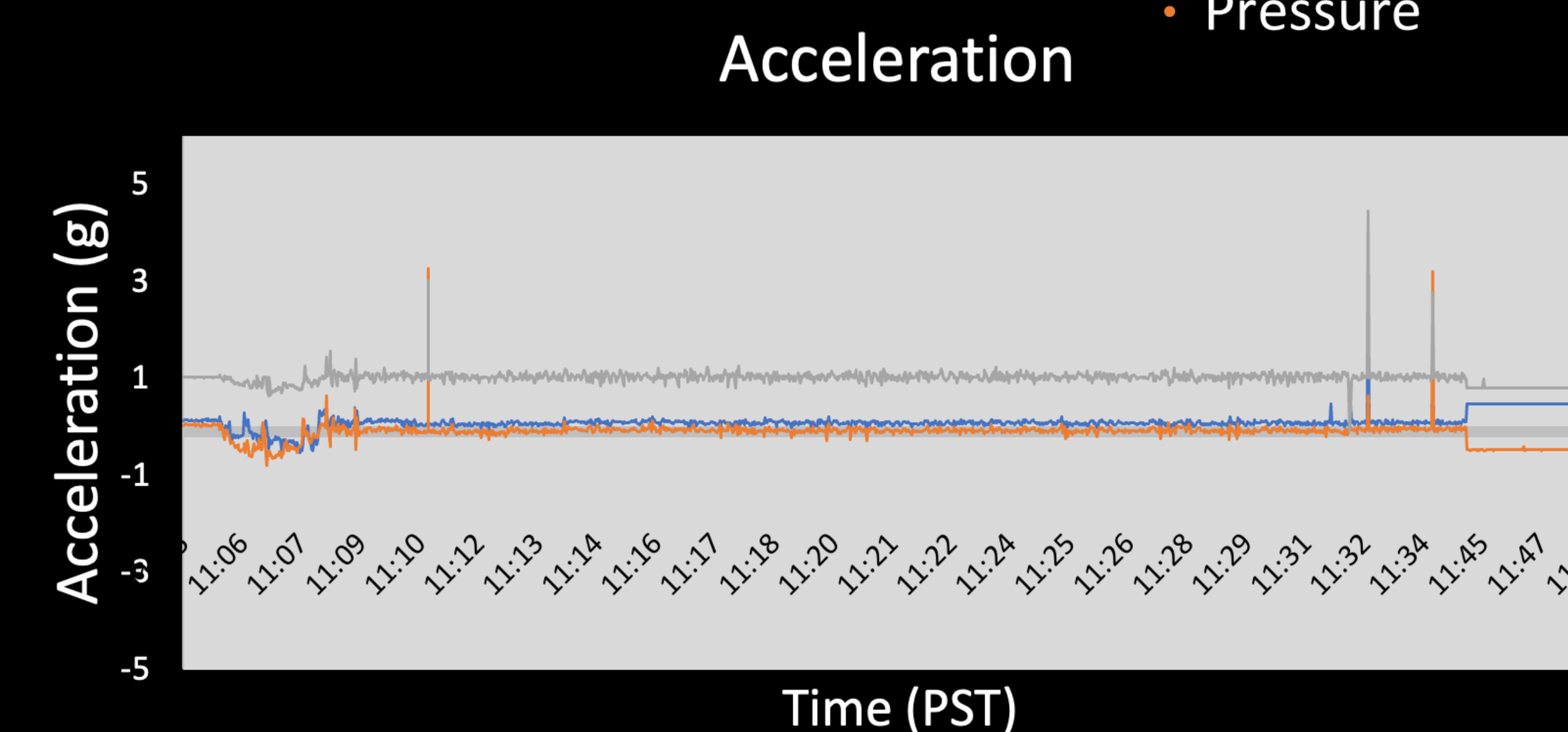
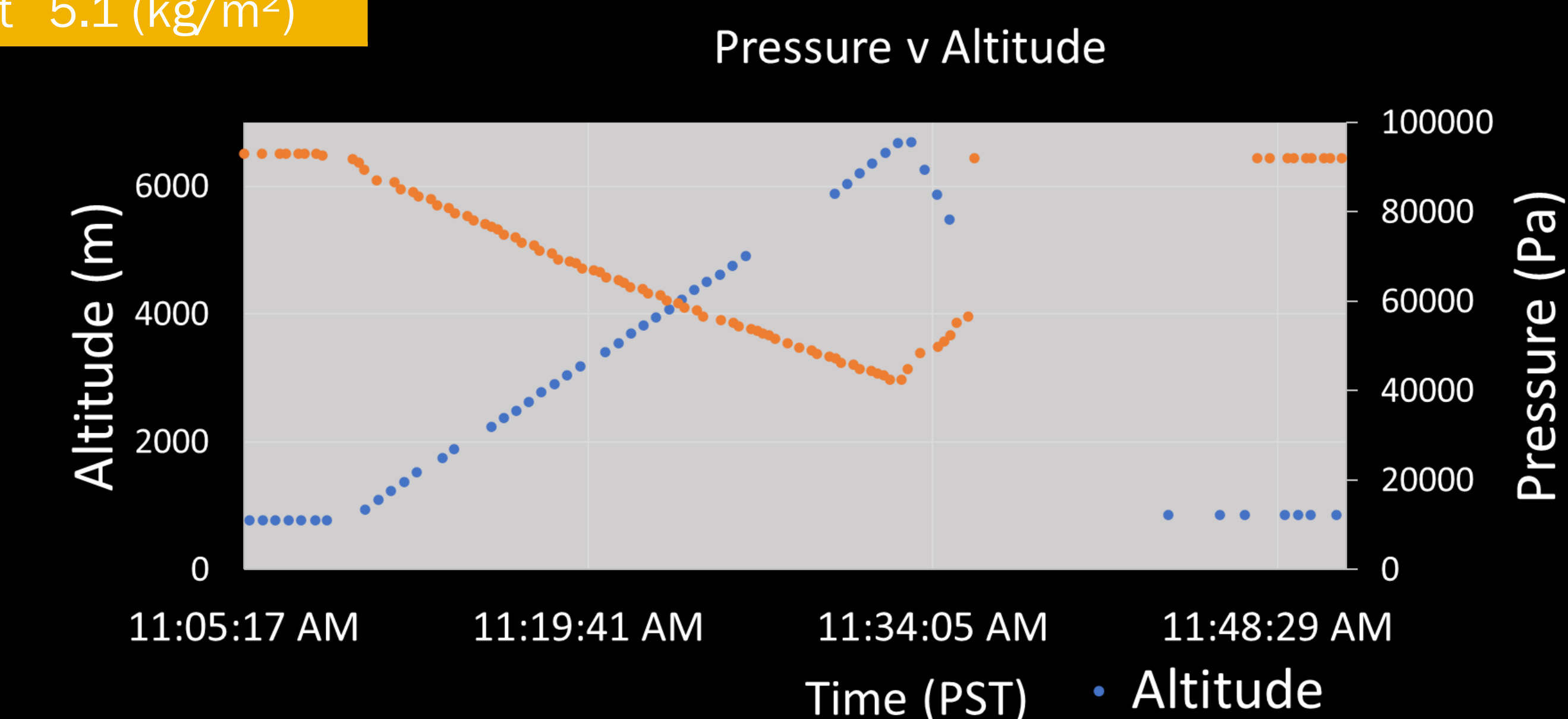


ELECTRICAL DESIGN

Version 1 used protoboards to connect all electronic equipment.

Version 2 used custom printed circuit boards and was made of 4 layers. 3 layers of printed circuit boards for internal electronics and one top intermediary layer to connect outside equipment. The internal structure for Version 2 also made the payload easier to assemble by mounting all the previously 'floating' components.

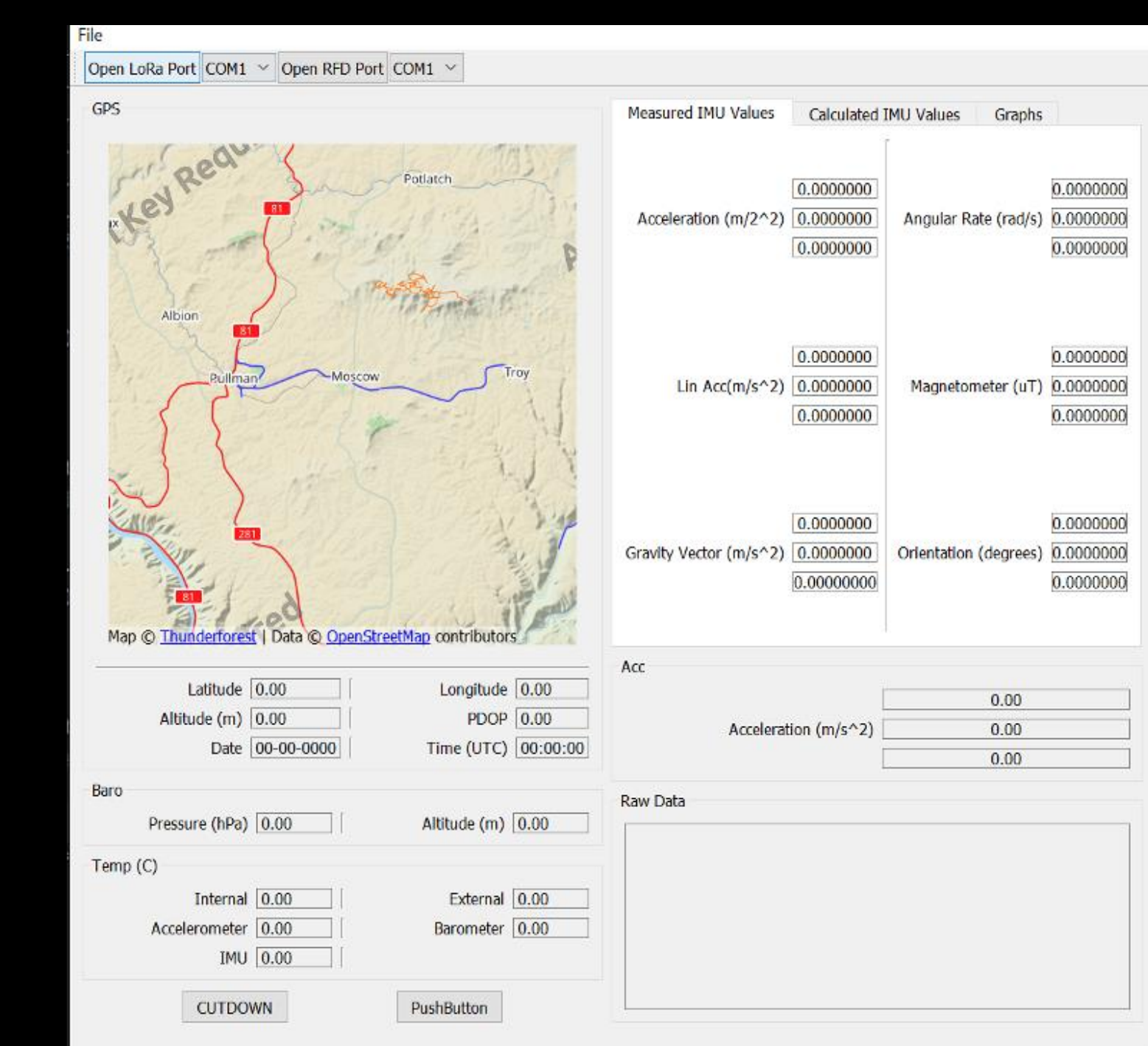
LAUNCH DATA



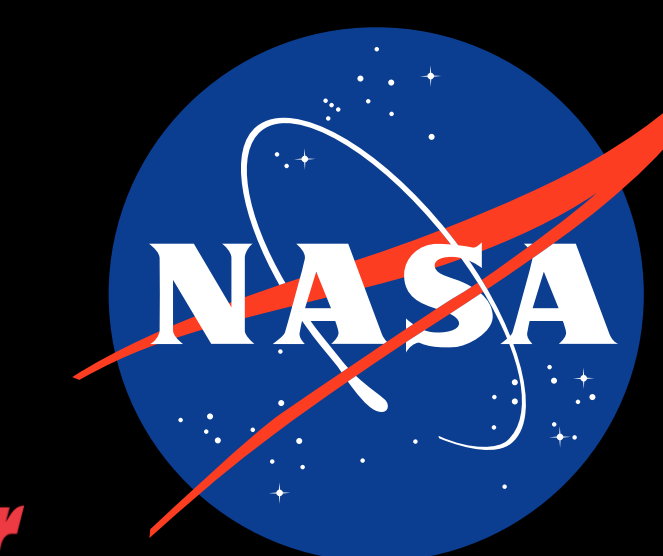
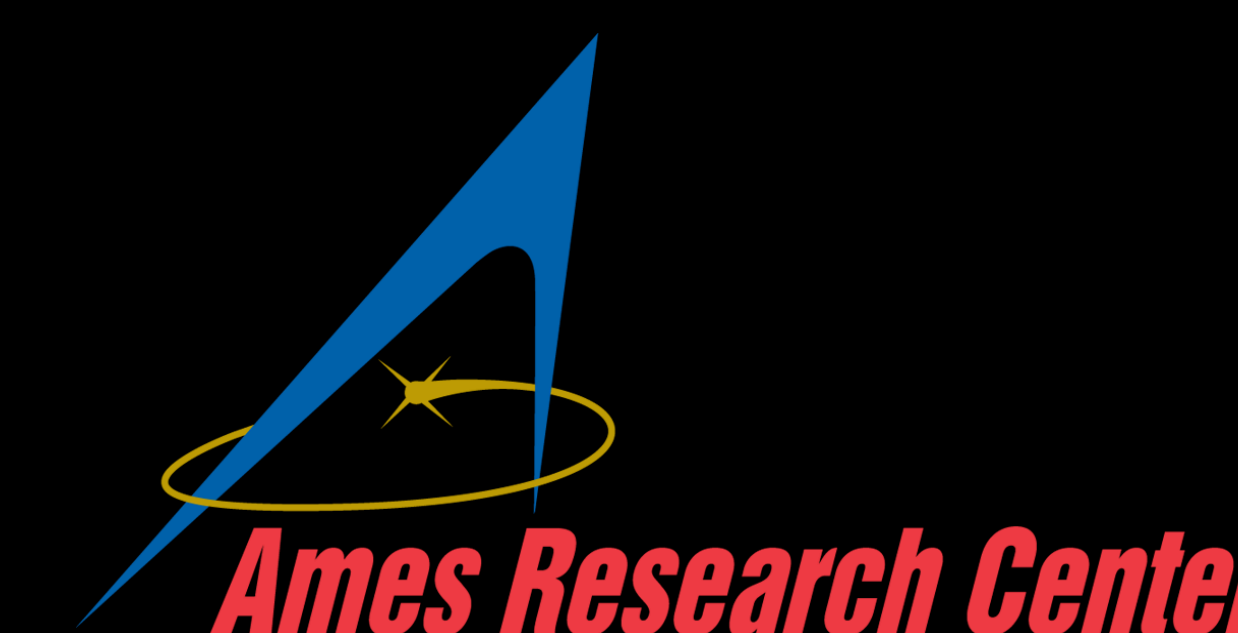
COMPUTER DESIGN

- Using ESP32 microprocessor running FreeRTOS.
- Inter-process communication follows a pub-sub (observer) model.

TRACKING GUI



ACKNOWLEDGEMENTS: MALACHI MOONEY-RIVKIN, MARCUS MURBACH, YACINE CHAKHCHOUKH, FENG LI



2023 Capstone Project