CubeSat Launch Initiative

Destination Space

PROBLEM STATEMENT

WCU's physics department and Destination Space have teamed up to create a NASA-certified CubeSat capable of detecting high-energy particles and determining its own directionality and global position relative to Earth. Success in this initiative could lead to continued CubeSat design at WCU with opportunities for future missions and partnerships.

This year the team's main challenges include integrating better communication and energy efficiency within the current design as well as designing a frame capable of housing these PCBs while also implementing a safe recovery procedure for the prototype to be launched.

REQUIREMENTS

#	Description
1	The CubeSat must be tested in a high-altitude balloon launch.
2	The CubeSat must detect and store muon detection data.
3	The CubeSat must be able to withstand launch vibrations and parachute landings.
4	The CubeSat must maintain communication and data transmission.
5	The CubeSat must abide by FAA regulation
6	The CubeSat must be recoverable from parachute landing.

CONCEPTS

This CubeSat was built as a plug-and-play platform to make subsystem integration simple and flexible. At its core is a Raspberry Pi 3B+, which manages all components and logs data. It connects to a RockBLOCK 9603 for Iridium satellite communication, a Waveshare environmental sensor to measure temperature, pressure, and humidity, and an Adafruit GPS Logger HAT for location tracking and onboard data storage. As well as the added camera that logs the pictures. The CubeSat also includes two scintillators designed to detect cosmic rays. When a particle passes through both detectors, the event is recorded and logged. The system's modular design allows for quick swapping or upgrading of parts, supporting fast development and testing.

FINAL DESIGN, APPROACH, PLAN

Electrical Design

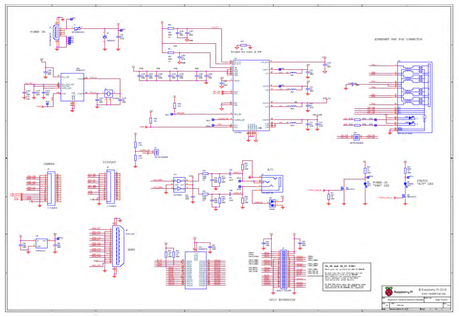


Photo Caption: Schematics provided by adafruit on the layout of the raspberry pi 3B+..

Mechanical Design

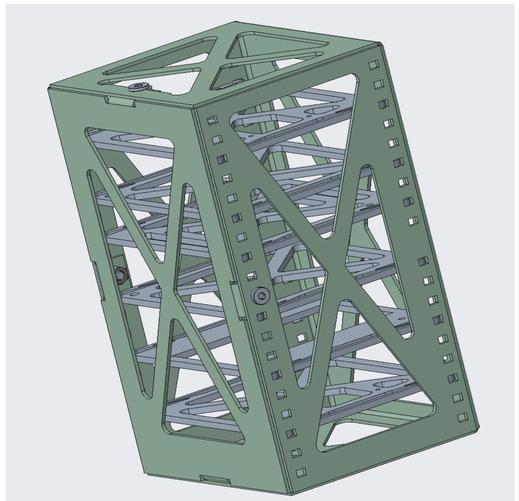


Photo Caption: CAD Modelling to show were sensors and other electrical components will be stored. This is a 2U cubesat.

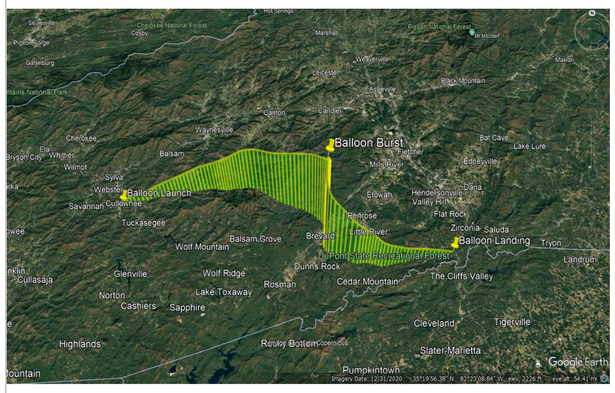
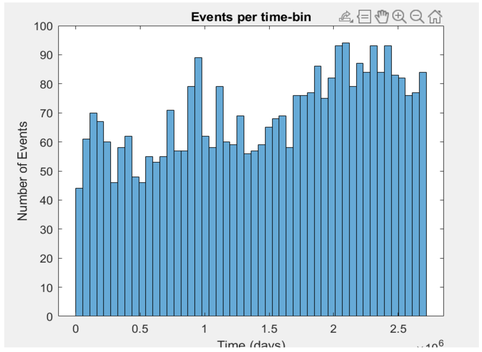


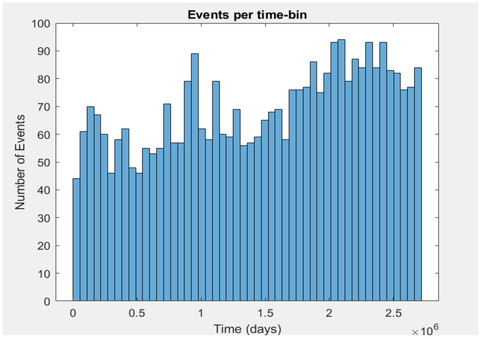
Photo Caption: The map above shows the simulated trajectory path of the CubeSat for its planned launch on May 3rd

RESULTS

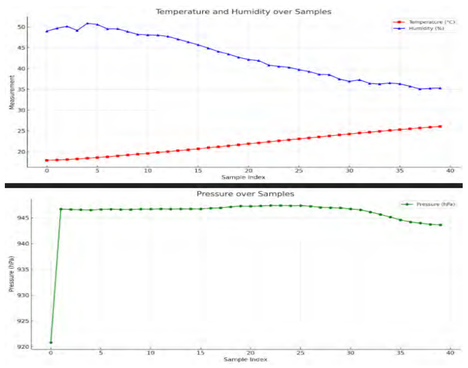
Scintillator 1:



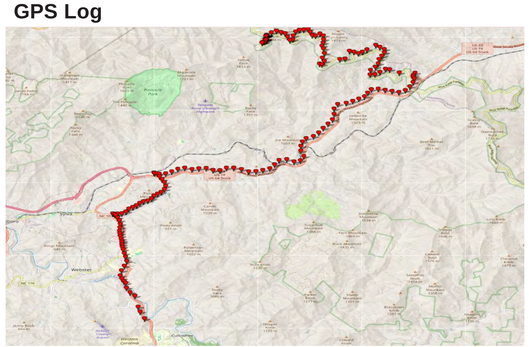
Scintillator 2:



Sensor Data



GPS Log



SUMMARY AND CONCLUSIONS

The CubeSat will launch in a weather balloon soon but from preliminary tests, the sensors are mostly functional. Muon events have been detected and recorded along with temperature data, geospatial data, orientation data, and pressure data. By the time of the balloon launch, the communications system will hopefully be functioning properly.

- From the Waterrock elevation test, the change in elevation from Sylva to Waterrock Knob did not seem to have a significant impact in muon detection rates or SIPM voltage.
- Further work will be necessary to ensure space grade durability of the mechanical and electrical designs including solar power for long term operation life and sturdy materials that can survive the harsh conditions of space.

FUTURE WORK

Future improvements will focus on strengthening communication by soldering all key connections to ensure more reliable data transfer. A custom aluminum case will be designed and 3D printed to provide better protection and durability. Before launch, the system will undergo thorough testing, including environmental and performance evaluations, to ensure reliability under real world conditions.

TEAM & ACKNOWLEDGEMENTS

- Mitchell Jeri (EE), John Peterson (EE),Kyler Watson (ME), Zachary Ebert (ME).
- Dr DeWayne Cecil (Destination Space), Dr Enrique Gomez, Dr Yanjun Yan

References

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