CubeSat
Destination Space

Western Carolina UNIVERSITY

PROBLEM STATEMENT

Over the past 20+ years, the State of North Carolina has not proposed a CubeSat to NASA's CubeSat Launch Initiative. Destination Space and Dr. Enrique Gomez tasked this Capstone team to develop a prototype CubeSat that includes necessary subsystems and assemble it into a modularized frame.

OBJECTIVES

- .Design & Build:
  - Command & Data Handling (CDH) Circuit
  - Communication Circuit
  - High Energy Particle Detector (DET) Circuit
  - Battery Housing & Power Protection Circuit
  - CubeSat Frame
- Test Circuitry
- Integrate subsystems together

REQUIREMENTS

| #	Description
1	Adheres to appropriate professional specifications
2	High Energy Particle Detector can detect one to four counts per second in Earth's atmosphere
3	Communication from the CubeSat's sensors to an SD card for data collection
4	Providing appropriate voltage to power the CubeSat's electrical systems
5	Building a frame that shells circuit boards from any environmental threats (heat, radiation, air, etc.)
6	Compact entirety of electronics into a 2U size CubeSat

VOLUMETRIC CONCEPTS
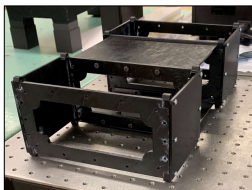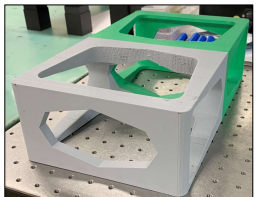
FINAL DESIGN & RESULTS

- **MECHANICAL DESIGN**
  - **2U CubeSat Frame**
  - **Circuit Sled** – Securely orients printed circuit boards within the frame. Mounted to the 2U CubeSat Frame
  - **Scintillator Housing** – Press fits the Detector Board to the Plastic Scintillator. Encapsulates the Scintillator to reduce light noise
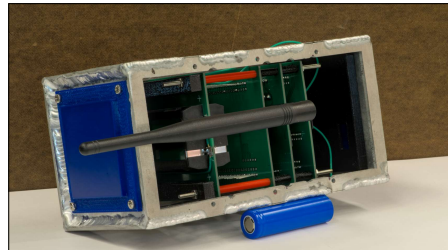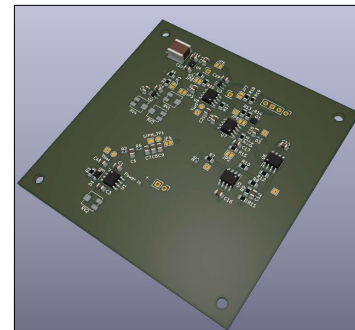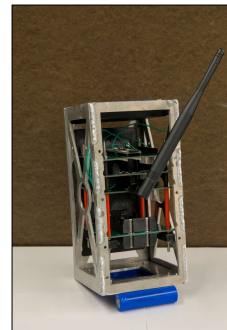

- **ELECTRICAL DESIGN**
  - **Command & Data Handling** – Records information from the detector board and sensor board. Handles communication between onboard systems.
  - **Communications** – Utilizes a LoRa transceiver for CubeSat to transmit data for long-range communications
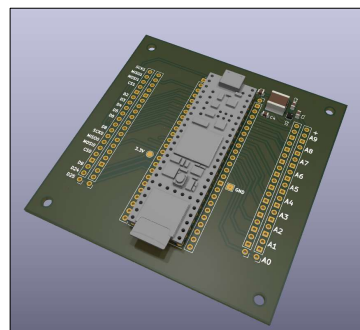
Command & Data Handling Board Render
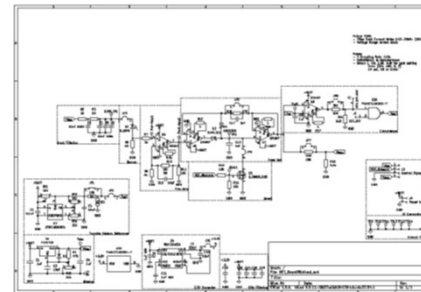

Detector Board Render

- **High Energy Particle Detector**
  - Utilizes a silicon photomultiplier and scintillator to detect particle with direction
  - An integrator, peak detector, and a comparator are utilized to make the signal readable and to handle coincidence logic
  - Simulation QR Code → (https://tinyurl.com/2626k3uf)

High Energy Particle Detector Schematic

SUMMARY AND CONCLUSIONS

The CubeSat Project is a multi-year Capstone Project. The deliverables completed this year lay the foundation for the remaining steps and should be used as guides for each subsequent project phase.

FUTURE WORK

- Mechanical Work
  - Complete Thermal Analysis using Low Earth Orbit Parameters
  - Verify Validity of the System
- Electrical Work
  - Correct the High Energy Particle Detector Circuit
  - Correct the MicroSD Card port on the Sensor Board
  - Verify the functionality of the Communications Circuit
  - Create a Battery Protection Circuit
- Testing
  - Test and Calibrate the High Energy Particle Detector Circuit
  - Test the Communications Circuit
  - Test and Verify the Integration of Systems via High Altitude Weather Balloon Flights

TEAM & ACKNOWLEDGEMENTS

- *Austin Caudle,* **Mechanical Engineer**
- *Nathan Eckhoff,* **Mechanical Engineer**
- *Jared Holland,* **Mechanical Engineer**
- *Drew Britt,* **Electrical Engineer**
- *Ian Green,* **Electrical Engineer**

- *Dr. DeWayne Cecil,* **Destination Space** Founder
- *Prof. Bob Twiggs,* **Chief STEM Mentor**
- *Dr. Enrique Gomez,* **Faculty Mentor**
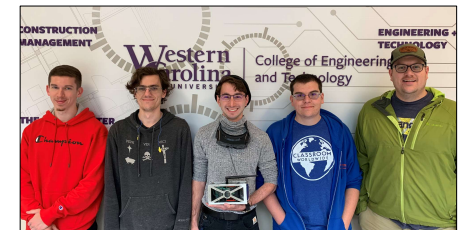
References

1. Destination Space Website QR Code (close right)
2. NASA CubeSat 101 Manual
3. WCU High Altitude Ballooning Website (far right)