

SWARM-EX Fall 2024 Mid-Semester Review

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Project Overview



SWARM-EX Mission

The **S**pace **W**eather **A**tmospheric **R**econfigurable **M**ultiscale **E**xperiment (SWARM-EX) is a National Science Foundation (NSF) sponsored CubeSat mission distributed across six colleges and universities in the United States.



Mission Objectives

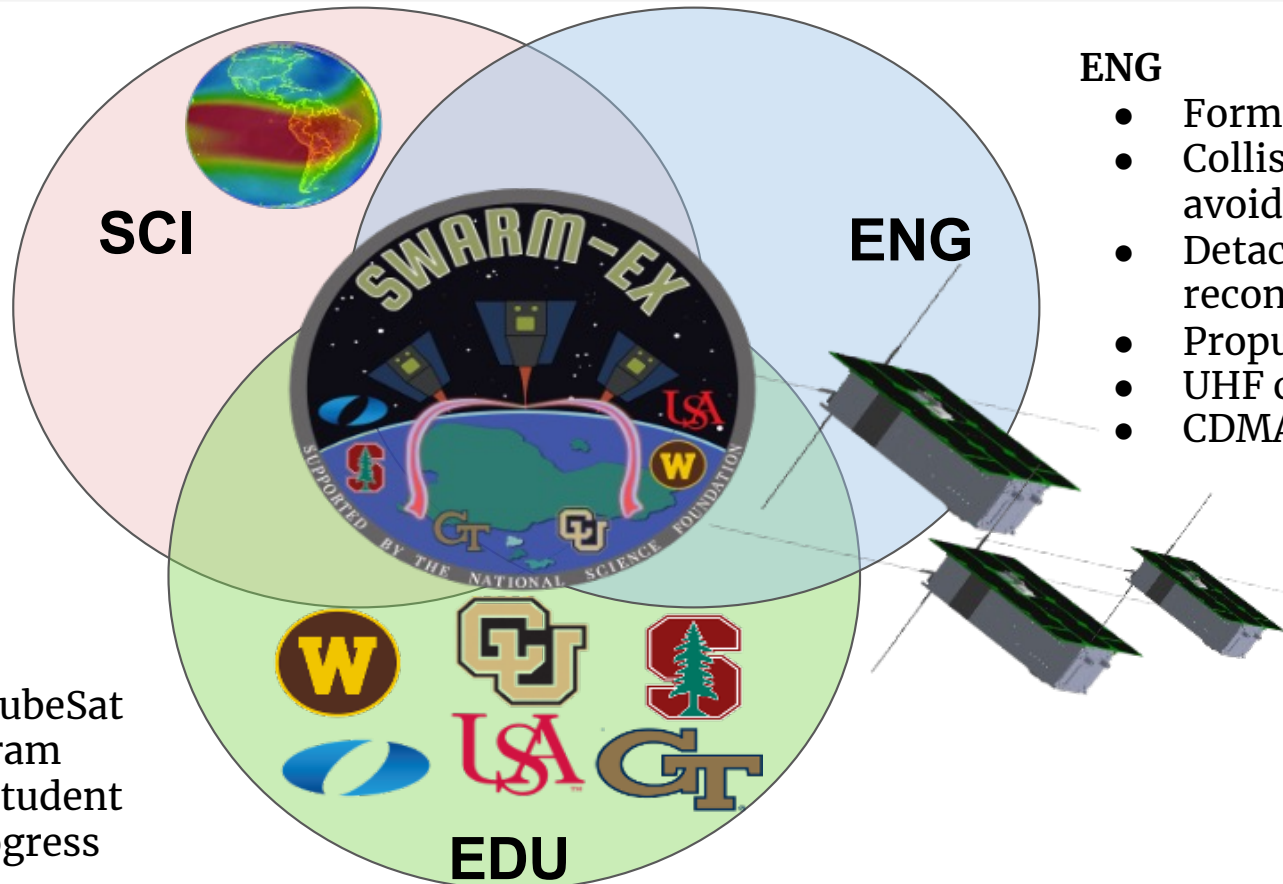


SCI

- Persistence and correlation in Equatorial Ionization /Thermospheric Anomaly (EIA/ETA) features
- Changes in EIA/ETA features that occur over timescales of <90 minutes

EDU

- Intercollegiate CubeSat Mentoring Program
- Efforts to track student engagement/progress

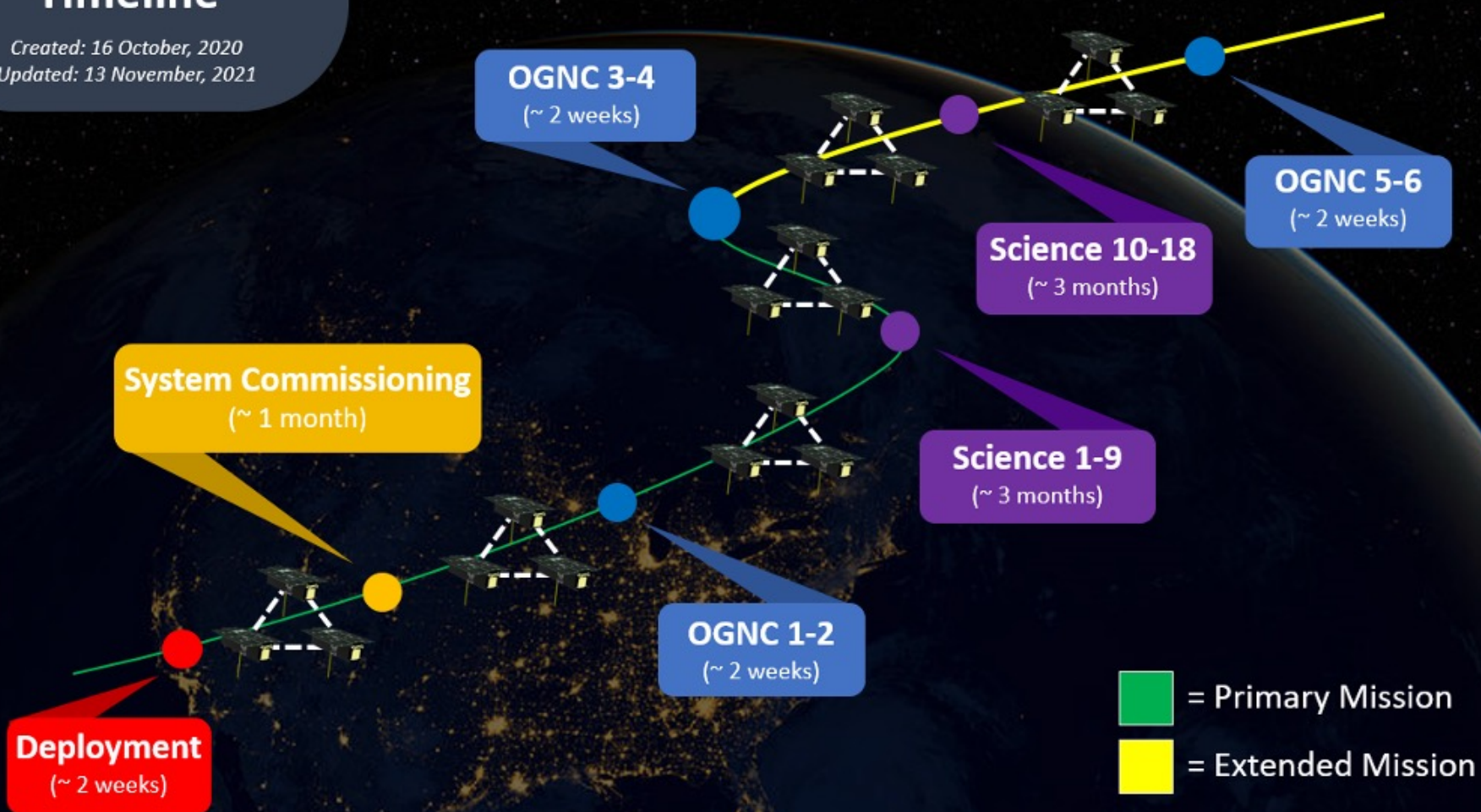


ENG

- Formation flying
- Collision avoidance
- Detach & reconnect
- Propulsion
- UHF crosslink
- CDMA downlink

SWARM-EX ConOps Timeline

Created: 16 October, 2020
Updated: 13 November, 2021



Principal System Requirements

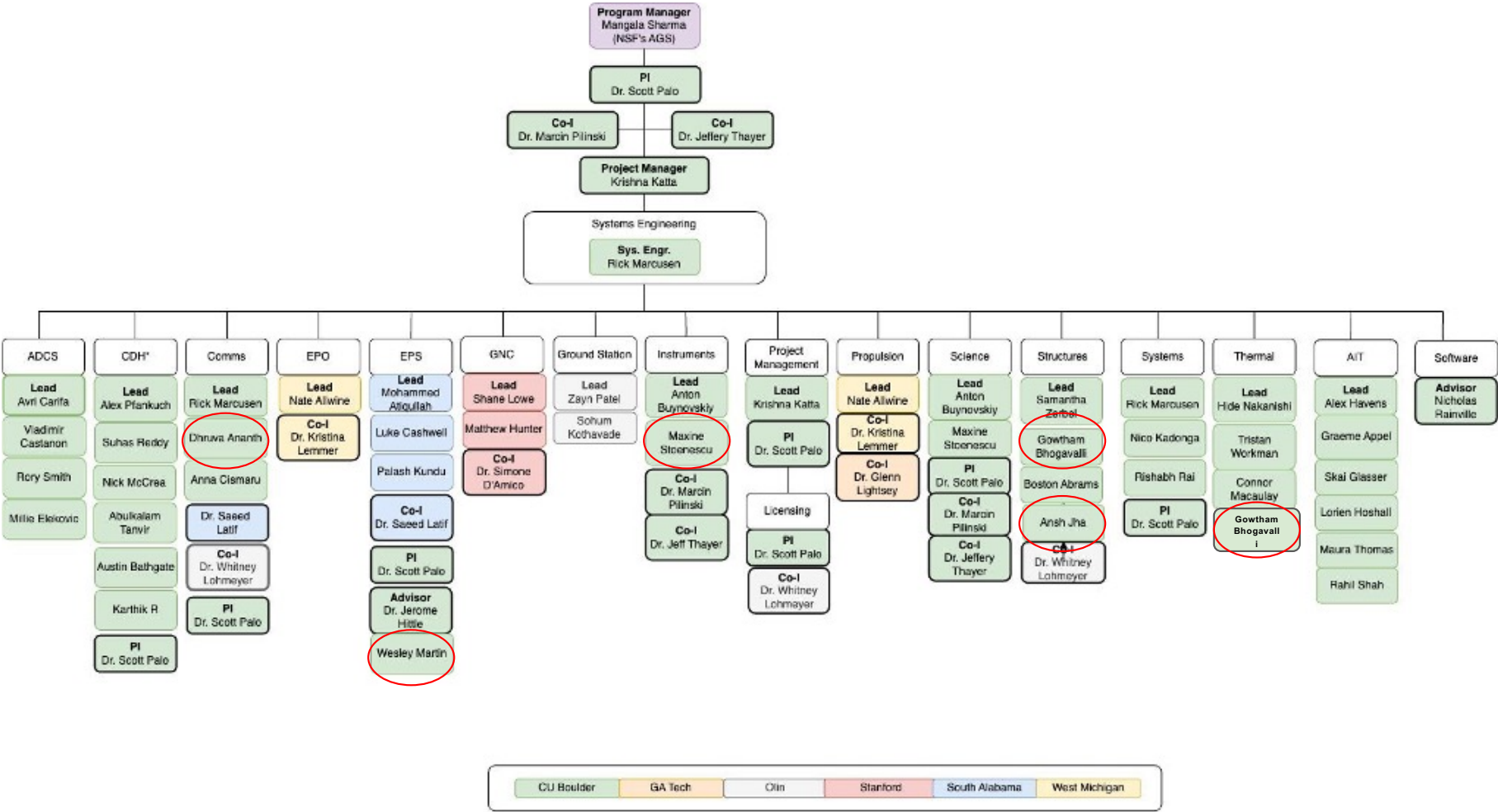
Req. ID	Requirement	Rationale	Parent
SAT-02	The CubeSat shall be designed to meet the selected dispenser specifications and requirements	CubeSat must meet dispenser specifications in order to fit, remain protected before deployment, and deploy properly.	Dispenser ICD
SAT-11	Uplink communications shall be encrypted .	NSA requirement as a result of propulsion.	NSA
SAT-15	The CubeSats shall have an operational on-orbit lifetime of approximately 8.5 months (150 days for primary mission, 100 days for extended mission).	The specified mission duration is required for accomplishing all mission objectives.	PSQ-1 & PSQ-2 (Persistence & Timescales)
SAT-17	The CubeSats shall have a power positive orbit configuration.	A power positive orbit configuration is required for achieving all mission objectives.	SAT-16 (Regulated Power)
SAT-32	CubeSat design shall adhere to the preferred practices listed in this document in the Preferred Practices tab.	Required for successful CubeSat development in accordance with the processes defined by the project's PIs.	PI



Project Organization



Full Team Org Chart





Fall 2024 Deliverables/Milestones



Comms: Deliverables & Accomplishments



Completed -

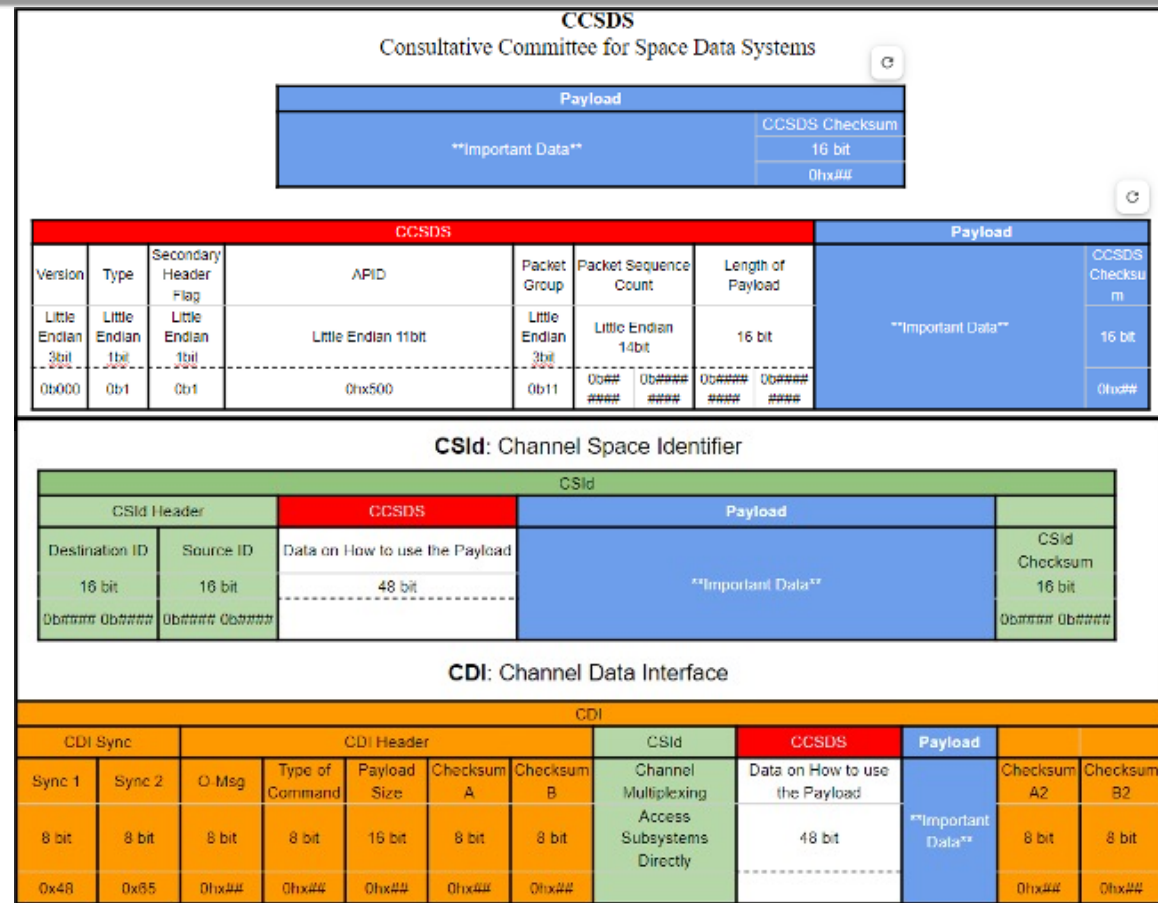
- CCSDS Packetization Study
- SWARM-EX packet structure update
- Establish Hydra + GNU Radio chain for SWARM-EX Code

In Progress

- Hydra structure and command listing
- Implementation of TTC For Hardline
- CDH Interfacing, Wired Mode Testing and Debugging
- GNU Radio Interfacing, Radio Mode Testing and Debugging

To Do

- Implementation of TTC For Radio Mode
- Electronics Stack interfacing (EPC and Comms.)
- Electronics Stack Interfacing (Rest of the Bus)

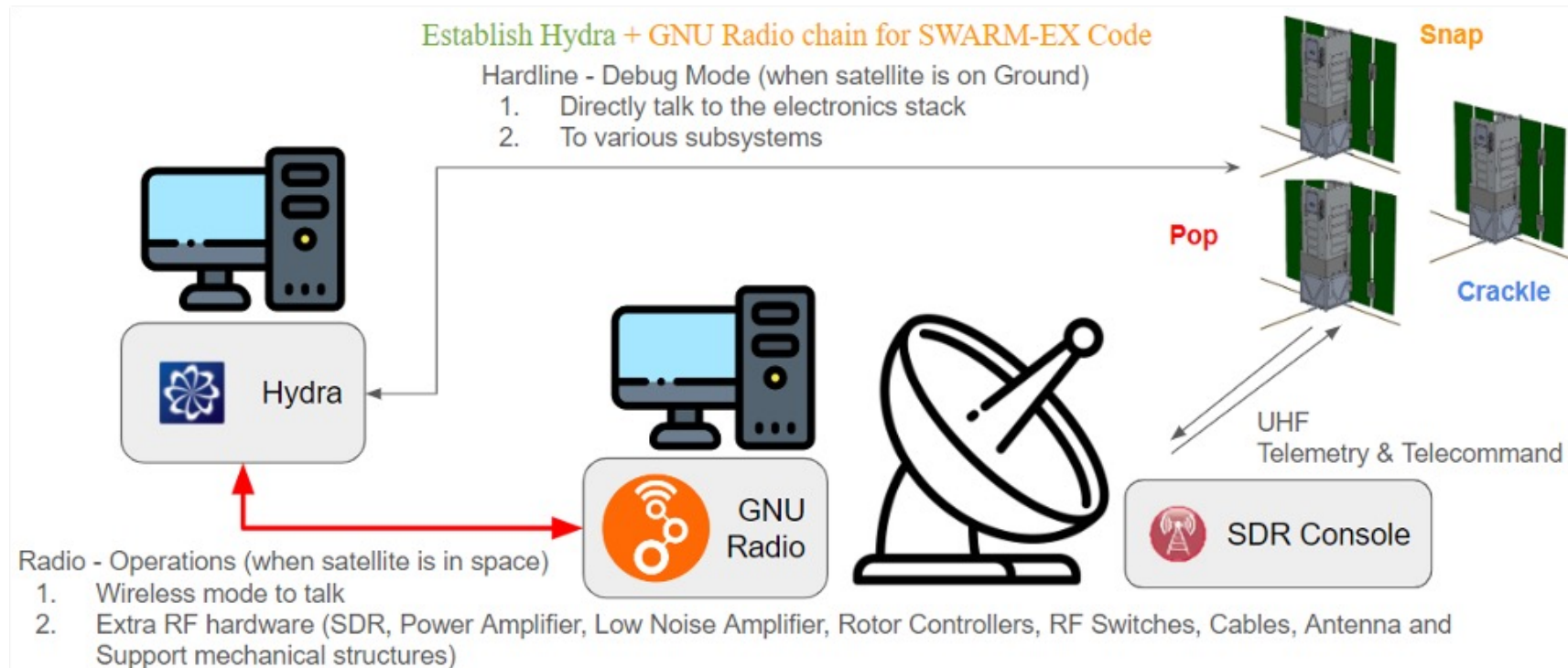


GND Station: Deliverables & Accomplishments



- **In Progress:** Setup and Operations of Ground Station

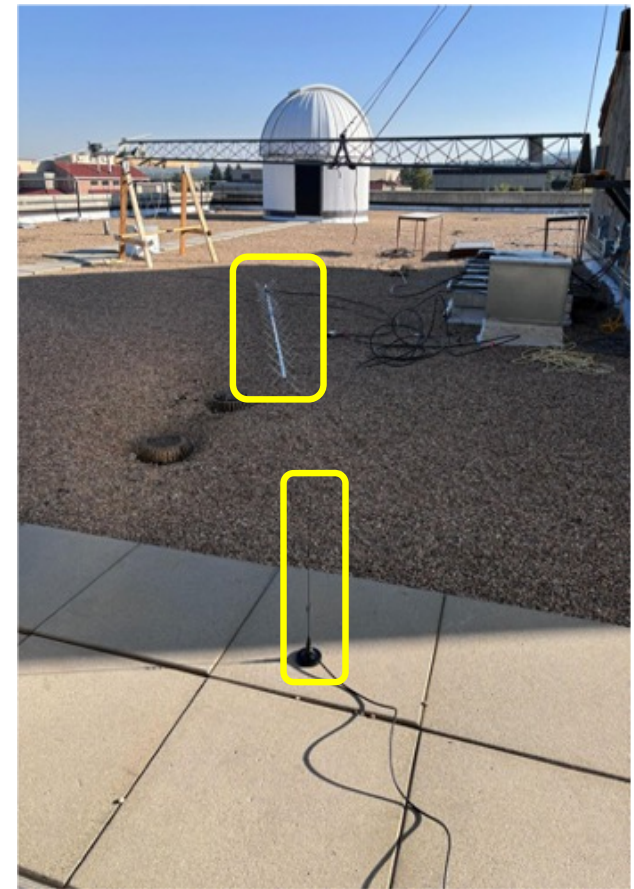
- **To Do:** Wireless Testing of the Complete Command Sequences



GND Station: Deliverables & Accomplishments



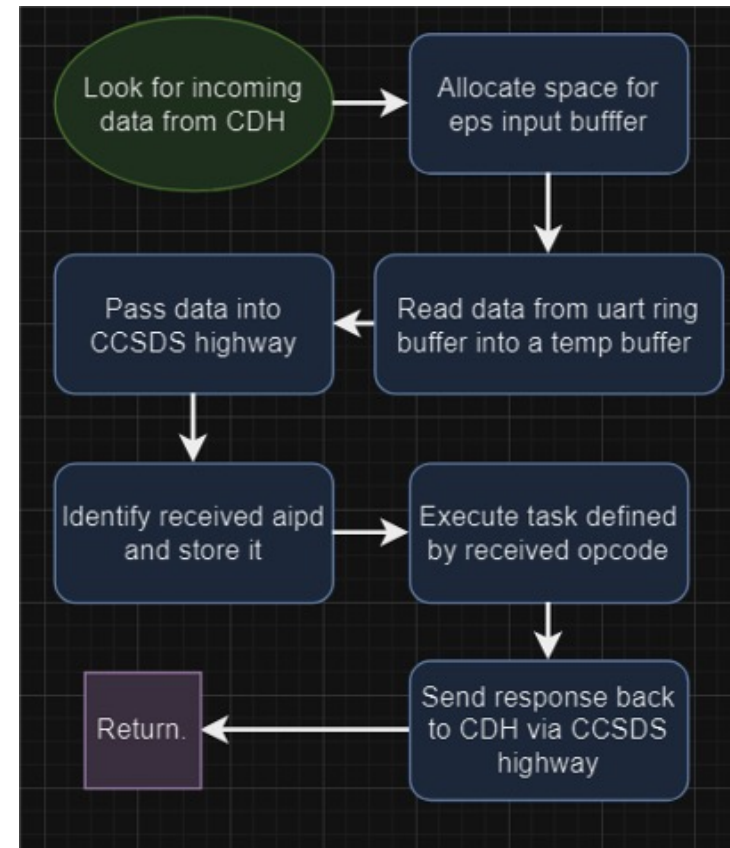
- **In Progress:** Setup and Operations of Ground Station
- **To Do:** Wireless Testing of the Complete Command Sequences



EPS: Deliverables & Accomplishments



- **Completed** - Onboarding
- **Completed** - Transfer EPS software from South Alabama to Boulder
- **In Progress** - Make CDH and EPS talk to each other
- **In Progress** - Make EPS commands functional
- **To Do** - Verify that EPS can properly communicate with CDH and execute its commands correctly (EPS CET1)
- **To Do** - Integrate EPS software with FlatSat for testing purposes



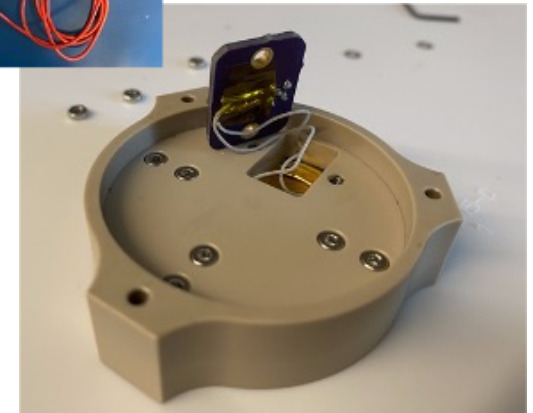
SCI/INST: Deliverables & Accomplishments



- **Completed** - I-SENSE Flight Unit Safe-to-Mate Testing
 - Compares resistances and voltages on all 3 board stacks to verify operability
- **In Progress** - Langmuir Probe Minimum Comms. Testing
 - Send commands to see if received properly
- **To Do** - FIPEX Flight Unit Safe-to-Mate Testing
- **To Do** - FIPEX Minimum Comms. Testing
- **To Do** - Magnetometer Minimum Comms. Testing
- **To Do** - Instrument Deck Full Assembly Procedure



Langmuir Probe MCT



Langmuir Probe

Structures: Deliverables & Accomplishments



- **Completed -**

- Onboarding and Documentation.
- Waterfall chart(plan for semester)

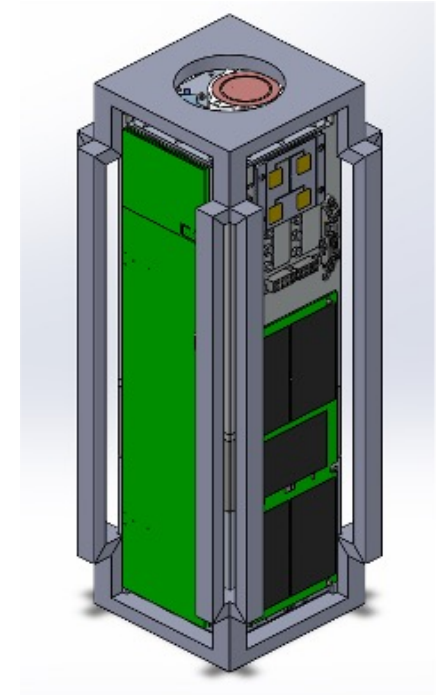
SWARM-Ex CubeSat CAD model

- **In Progress -**

- Flatsat Design/Fabrication
- Updating Assembly Instructions and CAD model after First dry run
- Designing the Mechanical Ground Support Equipment (MGSE)

- **To Do -**

- Conduct Finite Element Analysis (FEA)
- Decide wire routing and how to stake them down
- 3D printing components for Design review

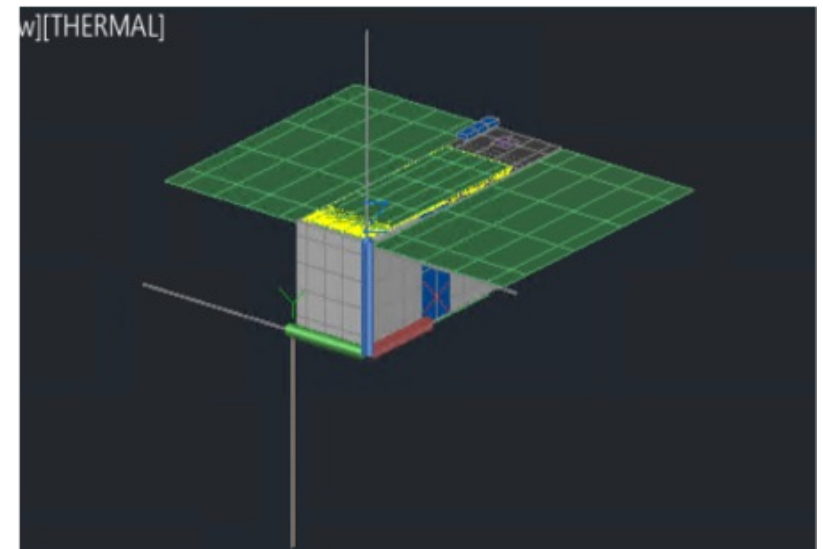


SWARM-Ex MGSE Model

Thermal : Deliverables & Accomplishments



- **Completed -**
 - Onboarding and Documentation.
 - Waterfall chart(plan for semester)
- **In Progress -**
 - Making updates in the existing thermal model to ensure consistency with the CAD model
 - Working towards designing high fidelity model.
- **To Do -**
 - To develop high fidelity model.
 - Thermal analysis on both cases
 - Hot and Cold Scenario



SWARM-Ex CubeSat Thermal model

Challenges



Onboarding and getting familiar with documents



Communication within team / Organizations



Underestimating Task



Schedule Shift

- All these challenges contribute to delays and make it difficult to complete tasks on time.



Thank You!



Questions?

