

DAPPER: The Delaware Atmospheric Plasma Probe Experiment

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Plasma and the Atmosphere

- What is Plasma
 - Ions
- Plasma in the Atmosphere
 - The Solar Wind
 - The Ionosphere
- Effects
 - Aurora
 - Satellites in LEO / F2
 - Carrington Event
- Need a Mission

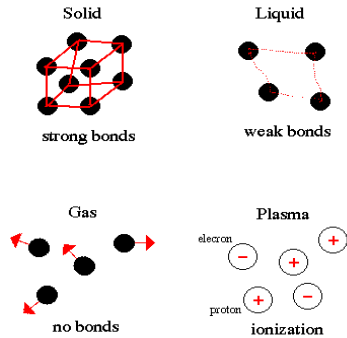


Fig 1: States of Matter

James Schombert, University of Oregon



Fig 3: DAPPER Text Logo

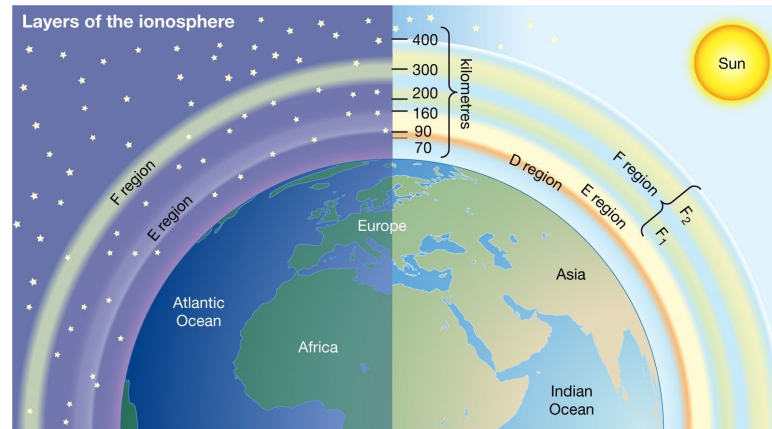


Fig 2: Layers of the Ionosphere

“layers of Earth's ionosphere”, Encyclopædia Britannica

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Mission Overview

- Funded Through NASA Grant*
- 3U CubeSat
- Approved Through NASA CSLI in 2024
 - ISS Deployment
 - Nearly Circular Orbit 420KM
- Mission Objectives:
 - Students
 - Mapping F2 Layer
 - Comparing Langmuir setups
- A Delaware First

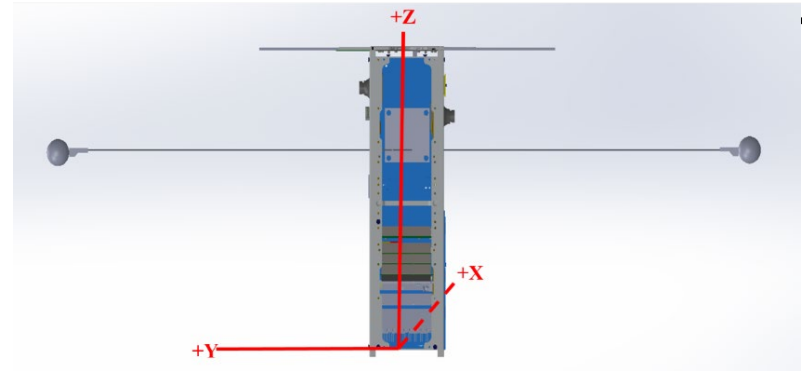


Fig 4: Deployed Configuration

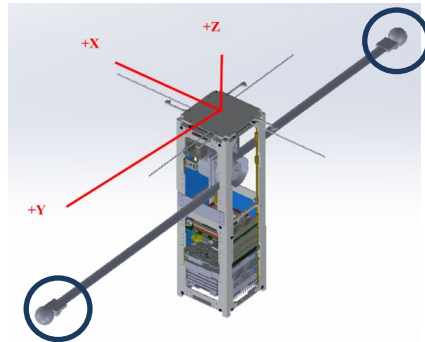


Fig 6:
Deployed
Isometric
Configuration

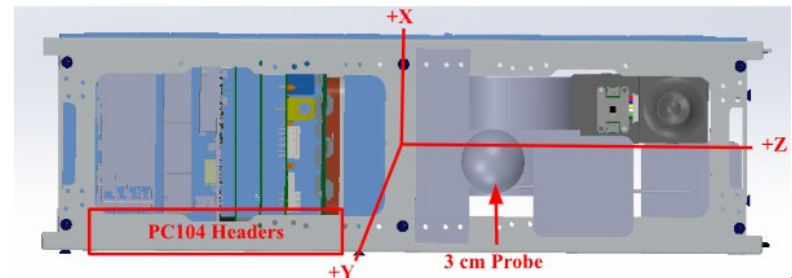


Fig 5: Stowed Configuration

Langmuir Probe

- Pair of Langmuir Probes
 - Main Scientific Instrument
- Probes:
 - Probe Geometry
 - Single and Multiple Probes
- Electron Density and Temperature Sweeps
- Student Built
- Boom Deployment Mechanism

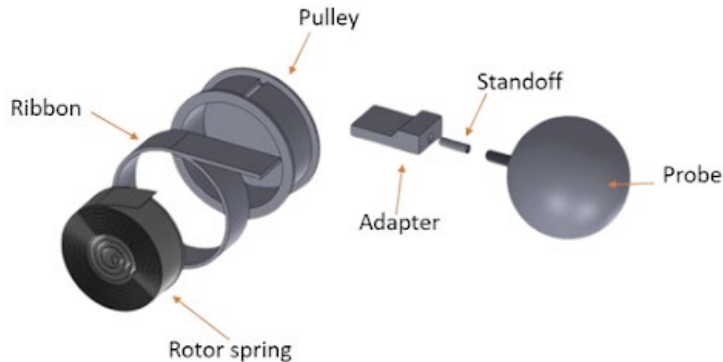


Fig 8: Deployment Mechanism CAD

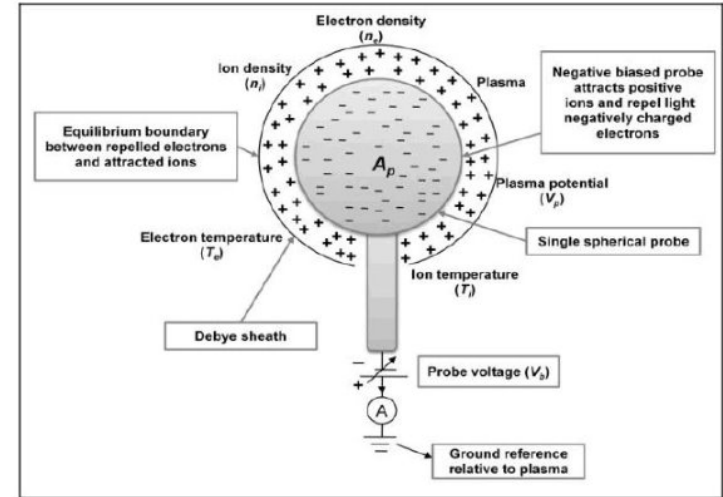


Fig 7: Langmuir Probe Operation

Bhattarai, Shankar, and Lekha Nath Mishra. "Theoretical study of spherical Langmuir probe in Maxwellian plasma." *International Journal of Physics* 5.3 (2017): 73-81.

Flight Computer

- Student Built
- Arduino Portenta H7 Lite
- Tested on a flight mission
- Master's Thesis Project

Fig 9:
DAPPER
Flight
Computer
PCB File in
Altium

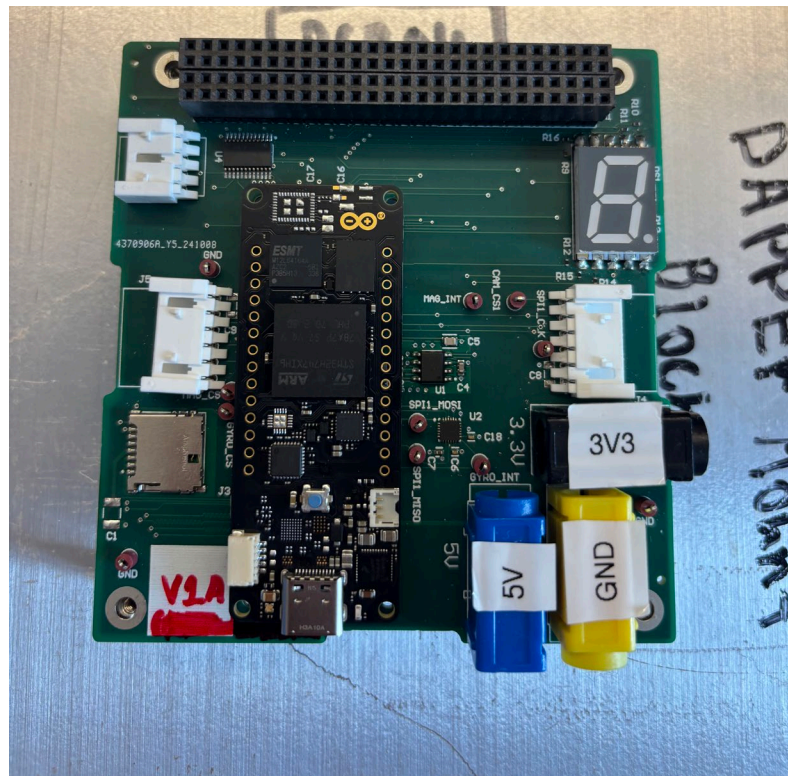
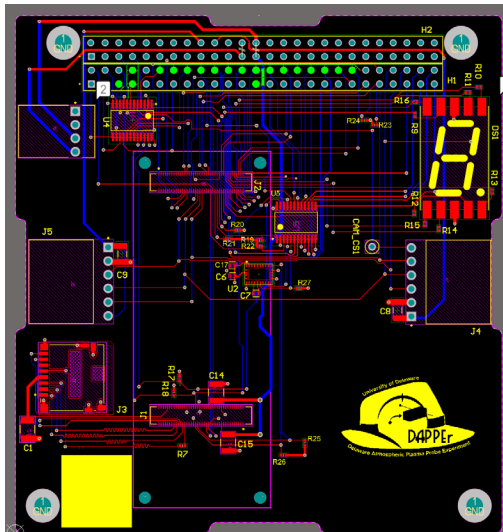
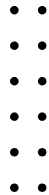


Fig 10:
DAPPER
Flight
Computer



Science Board

- Student Built
- Regulates Langmuir Probe Sweeps
 - Independent and Double-Probe Operation

Fig 11:
DAPPER
Science
Board
PCB File in
Altium

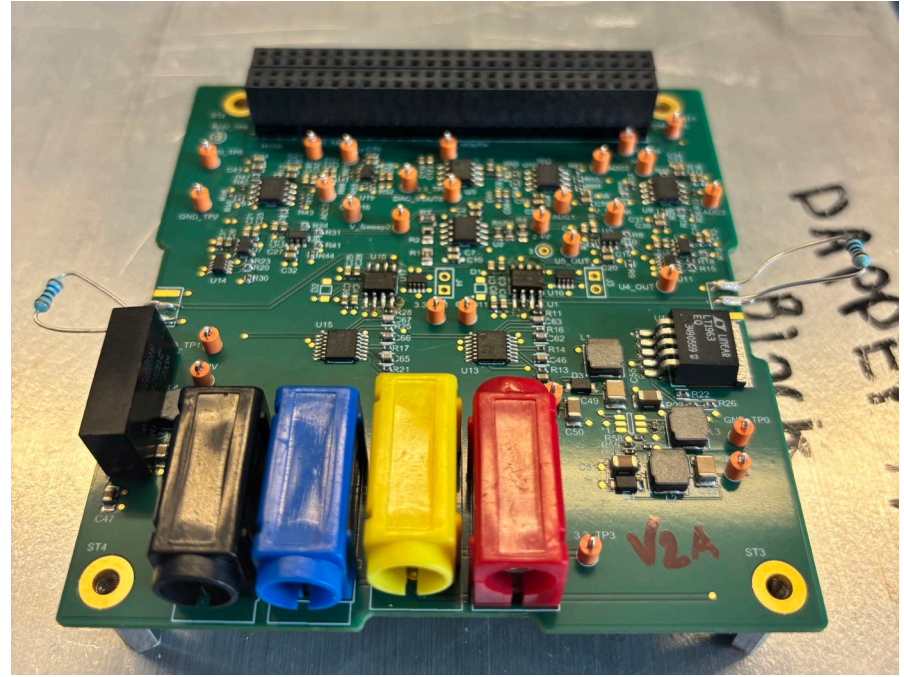
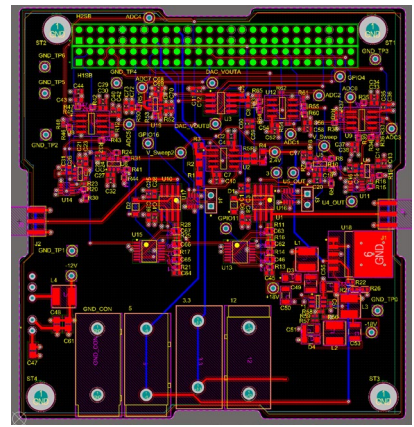


Fig 12:
DAPPER
Science
Board



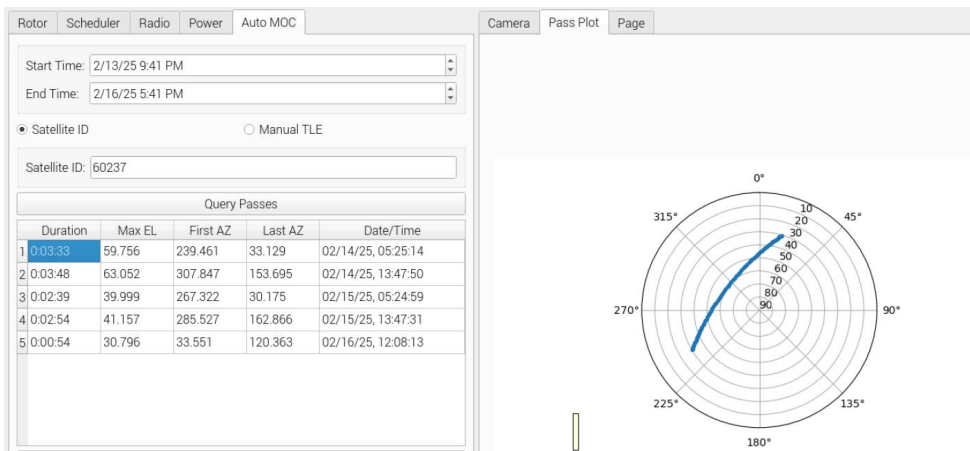
Ground Station

- Student Built, Run, and Programmed
- Hosted at Mount Cuba Astronomical Observatory, Greenville DE
- Operational at 915MHz
 - Supporting Missions
 - Undergoing 430MHz Upgrade



Fig 14:
Delaware
CubeSat
Ground
Station

Fig 13:
Ground
Station
GUI
Scheduled
Pass



Other Components

ADCS

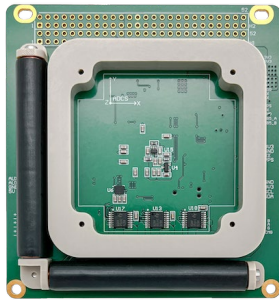


Fig 15: Tensor Tech MTQ*

Solar Pannels

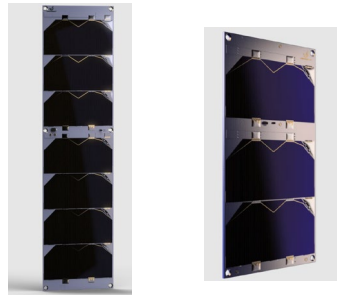


Fig 16: EnduroSat Solar Pannels (3U/1.5U)*

Battery / EPS

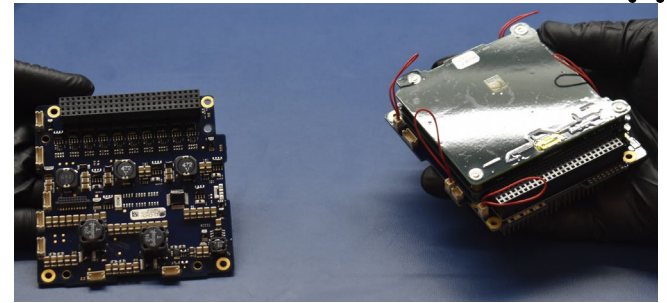


Fig 17: ClydeSpace Starbuck Nano and OPTIUMS Battery

Antennas



Fig 18: EnduroSat UHF Antenna III*

Cameras



Fig 19: ArduCam Mega 5MP with M12 Lens*

Radio Board

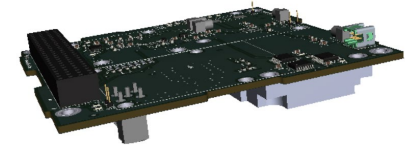


Fig 20: NarrowBay UHF Radio

*Denotes images taken from manufacturer website

Heritage

- Sounding Rocket Missions
- Previous UDIP Missions
 - RockSat-C
 - UDIP-4 2024
 - Lessons Learned

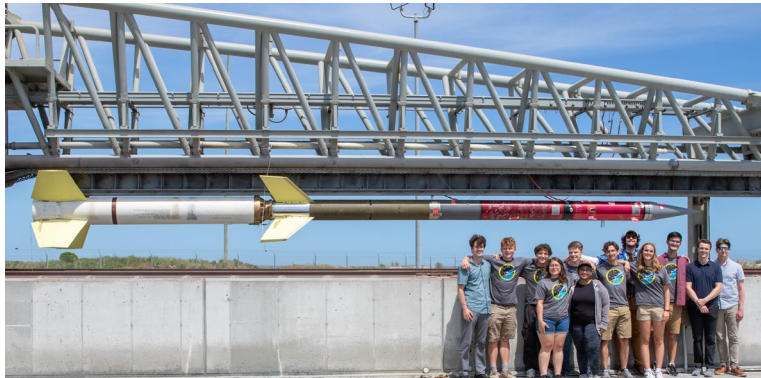
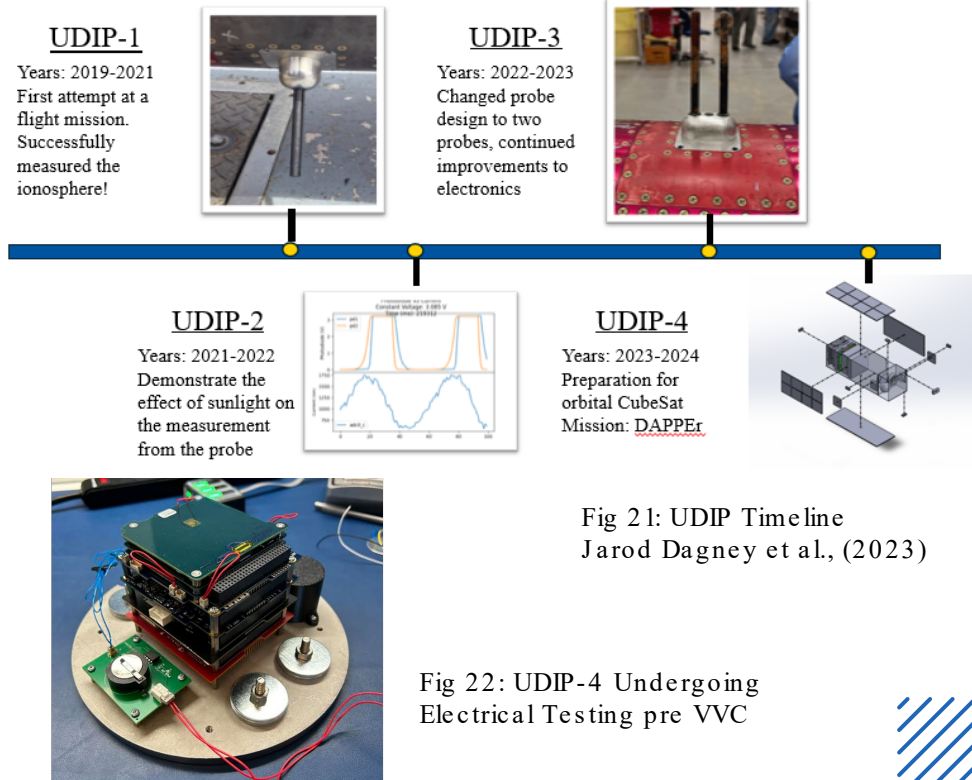


Fig 23: The UDIP-4/DAPPER team at NASA WFF



Going Forward

- UDIP-X
- DAPPER Planned Delivery in Late 2026
 - PDR – Summer 2025
 - CDR – Fall 2025
 - PPRR – Spring 2026



Fig 25:
DAPPER
2024-
2025
Team

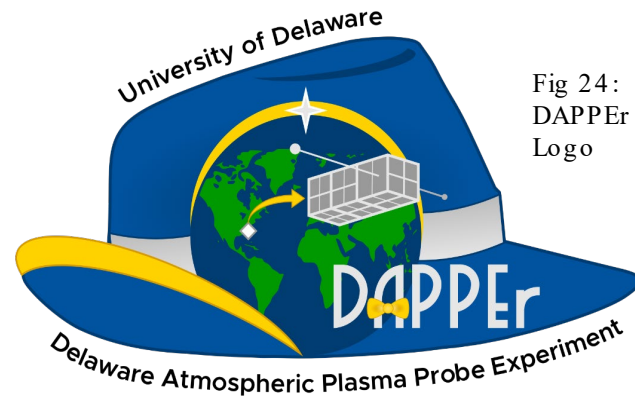


Fig 24:
DAPPER
Logo

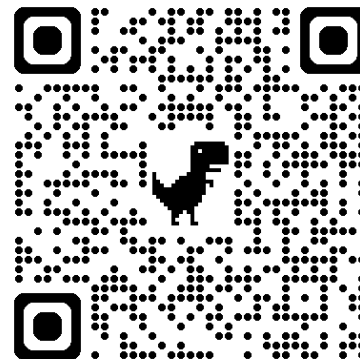


Fig 26:
DAPPER
Instagram