

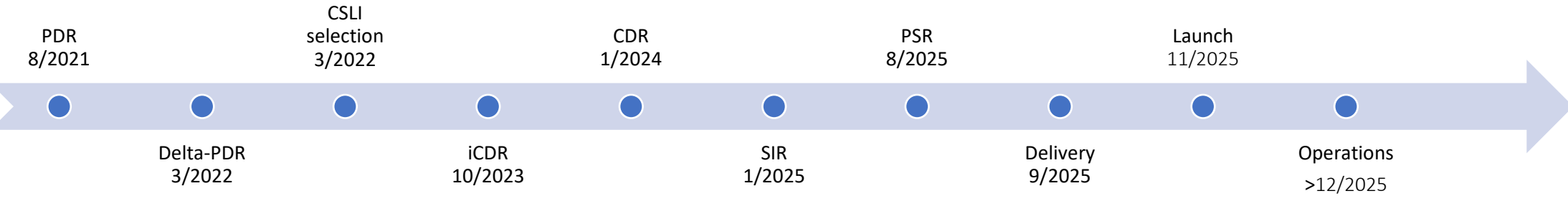


3UCubed: The Science of Upwelling & Uplifting Undergraduates

Eben Quenneville, with support from Noé Lugaz and the 3UCubed Team
eben.quenneville@unh.edu

INTRODUCTION

3UCubed is the student collaboration of IMAP. This is a NASA-funded initiative to give hands-on experience in space hardware and software to undergraduate students from the University of New Hampshire, Sonoma State University, and Howard University. The ~70 undergraduate students composing the 3UCubed team built a 9-lb CubeSat to investigate thermospheric upwelling in the Earth's polar cusp region. Undergraduates from UNH worked on flight hardware, software, ground station operations, and science operations over the past 5 years.



UNH GROUND STATION

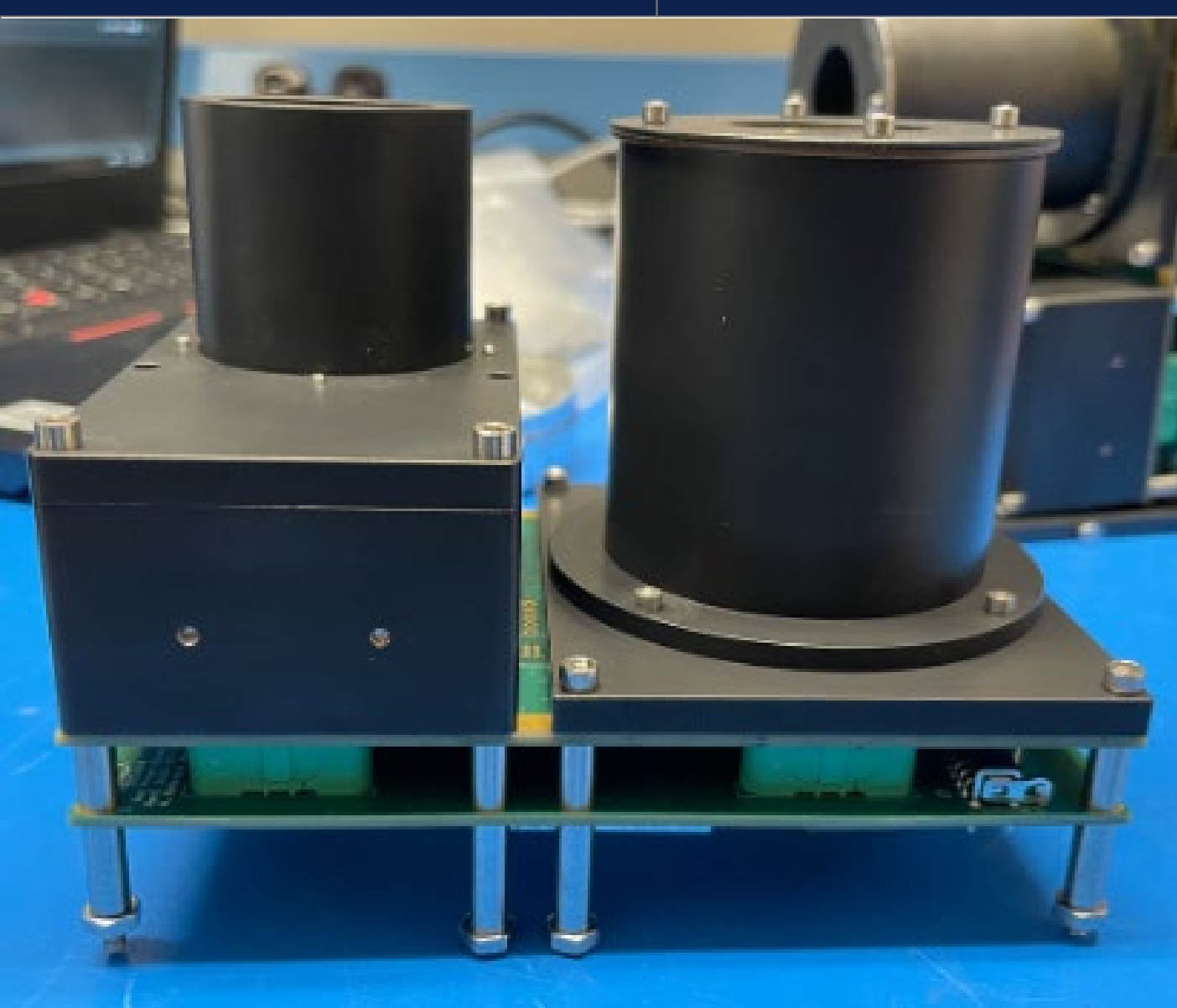
- Ground station mounted on the roof of Morse Hall.
- Operates on Amateur UHF band (ham radio).
- 437 MHz, ~0.7-meter wavelength.
- Dynamic Left/Right Hand Circular Polarization switching.
- Directional 42-element yagi antenna on G5500 motor.
- ~19 dB gain, 21° beamwidth, B200 radio with Tx/Rx.
- Developed Python software for tracking satellite based on telemetry data.
- Automated motor calibration after each pass.
- Automated notification and commanding options.



UV-PMT

Ultraviolet Photomultiplier Tube

- Measures spectral UV emissions of neutral atomic oxygen.
- The current produced is directly related to the photoelectron flux.
- The device is filtered around a 20 nm passband to measure primarily UV emissions of oxygen at 130.4 and 135.6 nm.



3UCubed Flight Model instrument assembly, without housing. On left is the UV-PMT, right is the ERPA.

ERPA

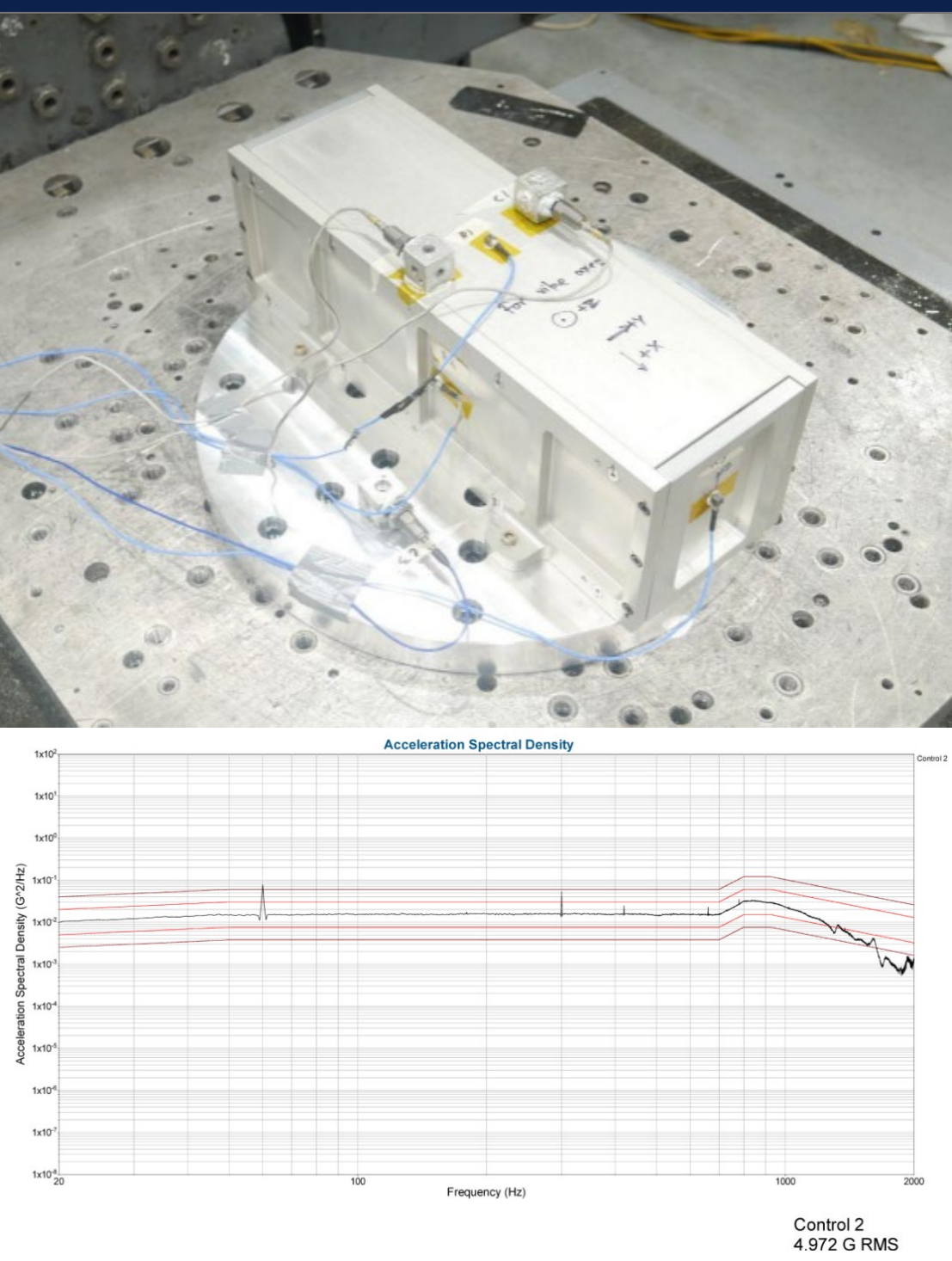
Electron Retarding Potential Analyzer

- Measures electron energy.
- Uses a selection screen with a swept retarding potential and measures the current incident to an anode.
- Measures the flux of suprathermal electrons in eight energy bands of >10 to 150 eV at a cadence of 100 ms (6.25 ms instantaneous measurements).

THERMAL VACUUM AND VIBRATION TESTING

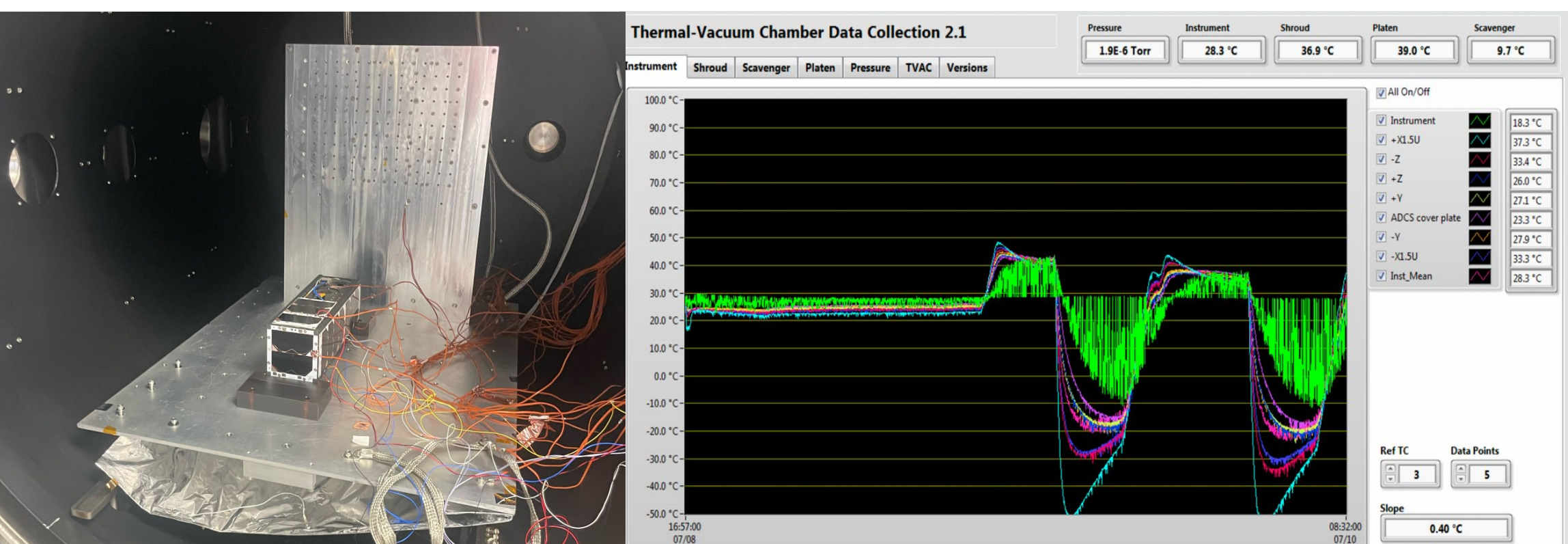
Vibration Test

- Completed to SpaceX profile at Element Materials.
- Random vibration of 5.57 Grms in 20-2000 Hz for 1 min. on each axis.
- Lower intensity 0.5G sine sweep pre and post random vibrate.
- DILT post vibrate.



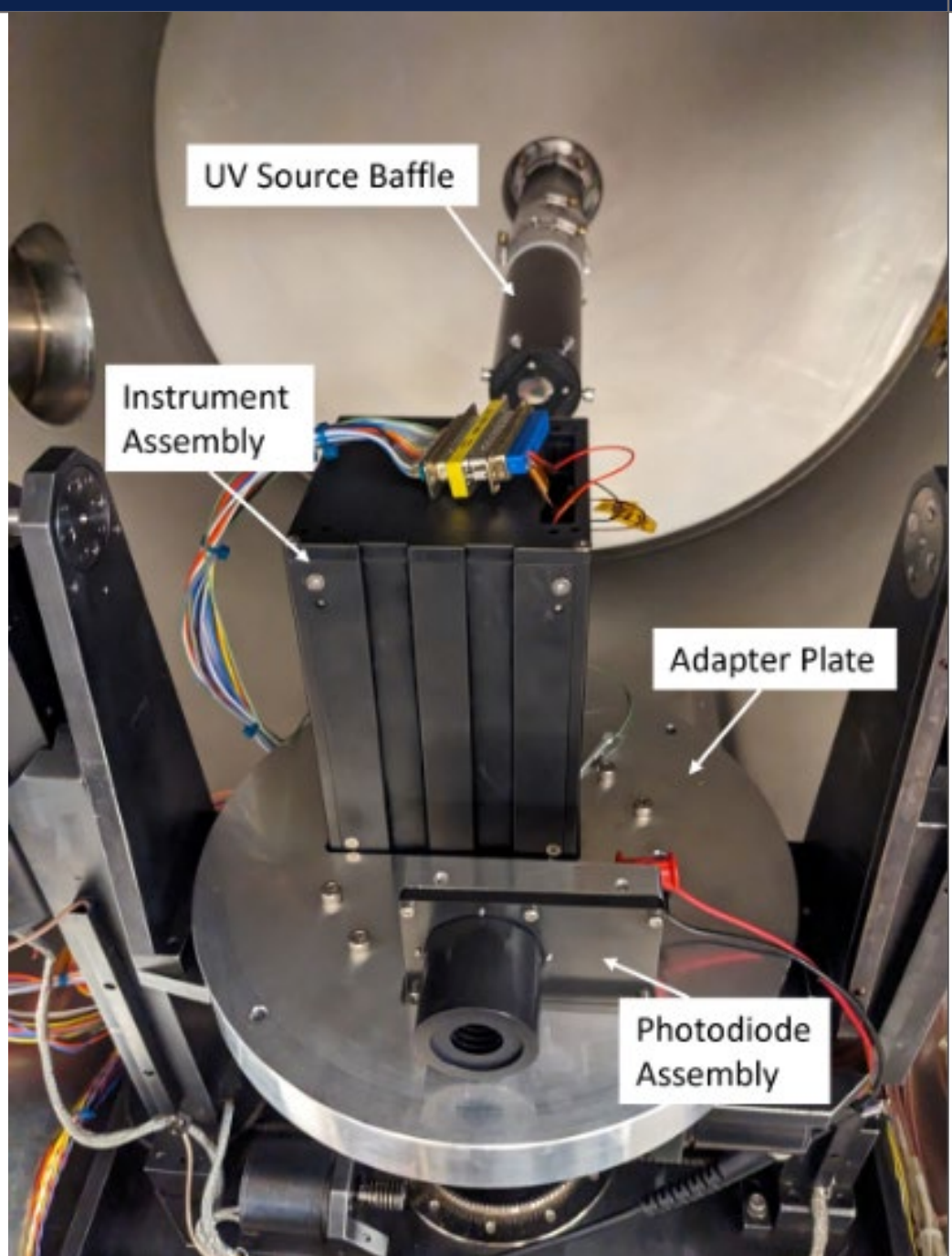
Thermal Balance Test:

- 3 cycles from +40°C to -20°C with 1 hour dwell at extremes, as expected from simulation.
- Temperatures were monitored from thermocouples installed on outside, and subsystem internal reads.



INSTRUMENT TESTING

- UV-PMT** is calibrated at UNH using an ultraviolet source with a known flux spectrum.
- We use a rotating plate to compare voltage between UV-PMT and a NIST-calibrated photodiode.
- Comparison allows us to calibrate the UV light flux.
- ERPA** is calibrated using a filament tube at a set voltage to emit specific energy electrons.



UV-PMT calibration and testing setup. The plate on the bottom rotates to point the photodiode or the instrument at the source. Located in Marc Lessard's Lab in Morse Hall.

UV-PMT CALIBRATION

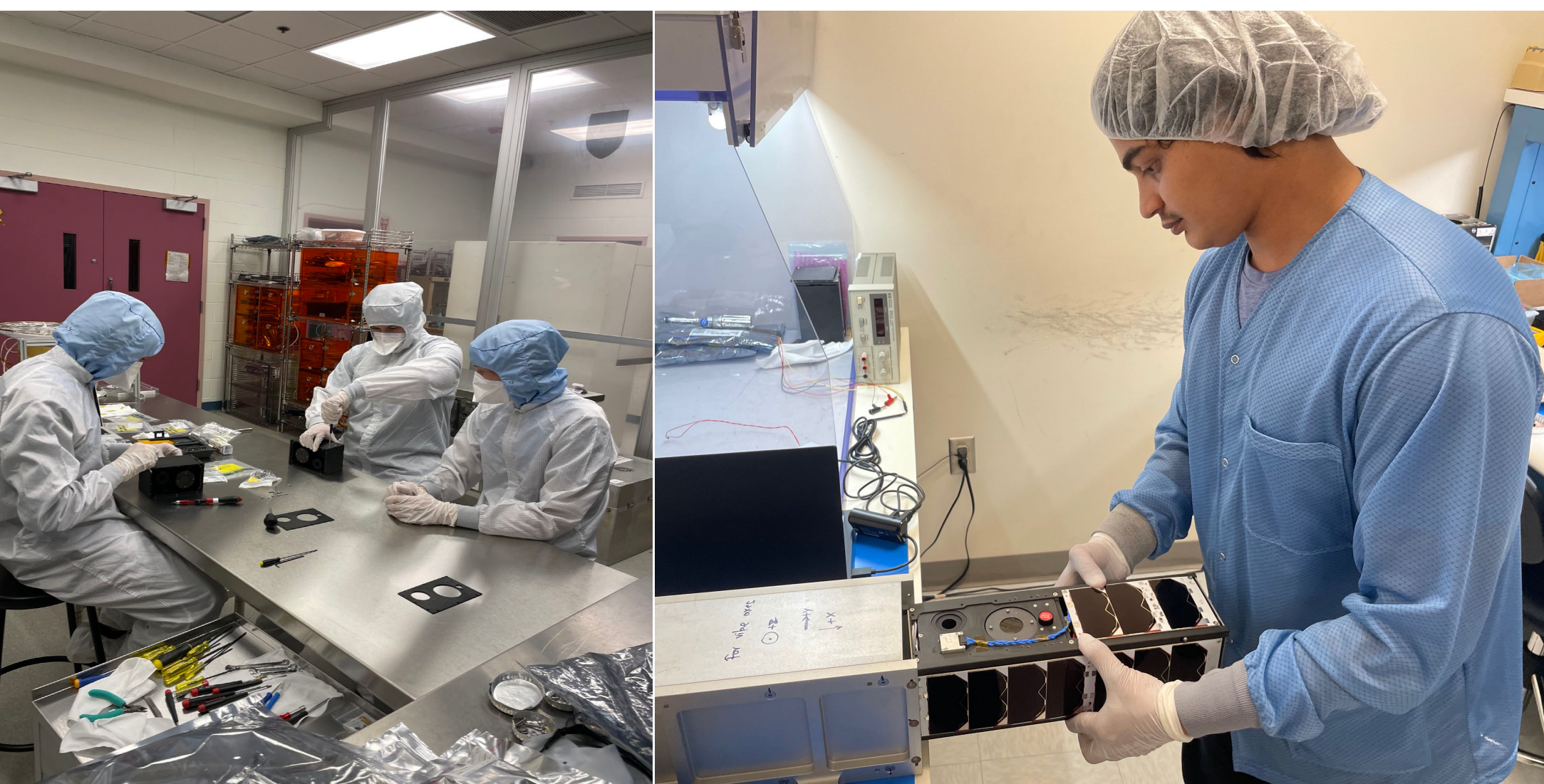
- The angular responses for each neutral density filter test are averaged and centered at 0 degrees.
- Take the maximum ADC reading at the peak of each curve.
- Create a linear fit to predict ADC readings for a given proxy brightness.

Averaged PMT ADC angular responses centered at 0 degrees for each OD filter.

Linear fit from maximum PMT ADC readings for each OD filter.

FLIGHT BUILD

The flight model (FM) instrument build was initially completed at UNH November 21st, 2024. We spent the year before integration preparing for final assembly, which was completed September 16th, 2025.



LAUNCH AND ORBIT

3UCubed launched aboard SpaceX Transporter-15 on November 28, 2025, entering a nominal 515 km sun-synchronous orbit. Although post-deployment operations were not established, the spacecraft passes over UNH an average of eight times per day, enabling repeated communication attempts.



ACKNOWLEDGMENT

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