



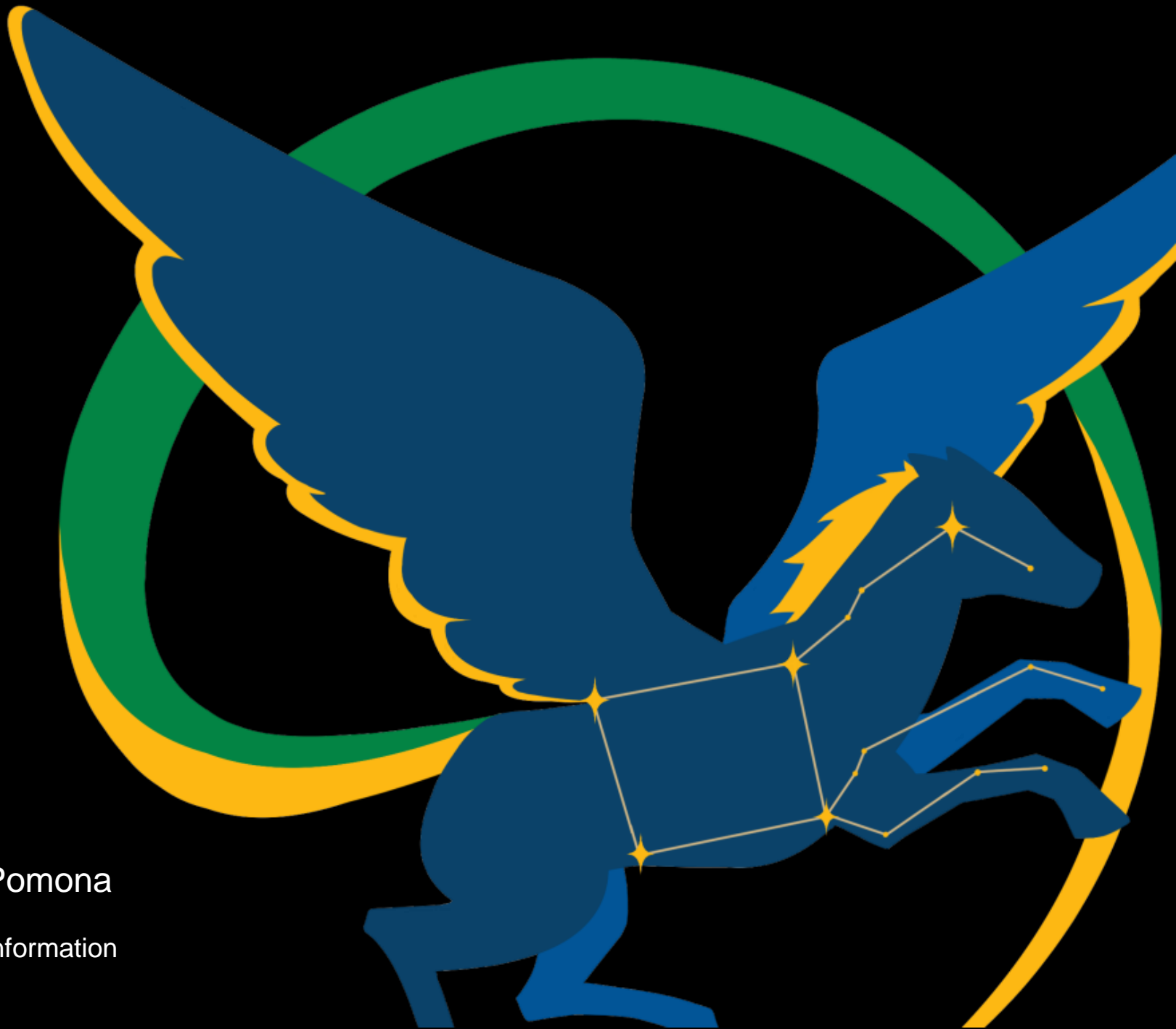
Academic CubeSats are the Stroads of the Space Industry

Bronco Space

California State Polytechnic University, Pomona

For Public Release – Does Not Contain Controlled Information

April 25, 2023

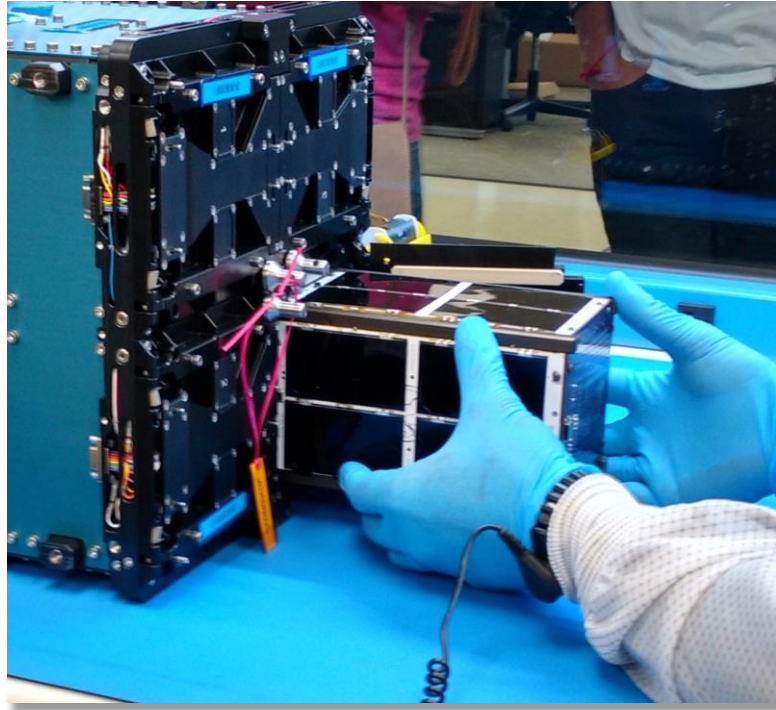


About Bronco Space



- Bronco Space is a mostly undergraduate student organization at Cal Poly Pomona
- Founded in 2019, Bronco Space has run the entire gamut from starting at zero to becoming the leading space technology group at Cal Poly Pomona

Bronco Space's Satellites



- In the last calendar year our organization has delivered three unique CubeSats for launch to LEO, all on commercial launch services
- The satellites have trended to be significantly cheaper and faster with each iteration

What is a Stroad?

A Street



- A street is a place
- Streets are ideally low speed, high density, and provide a venue for people to live, work, and recreate

A Road



- A road is a throughfare for getting from one place to another
- A road is ideally high speed, low density, and few people (if any) linger in a road

The Stroad



- Tries to be a place where people exist and interact, while also trying to provide quick transportation from one place to another
- Results in a development that performs poorly in both regards, is economically disadvantageous, and is significantly more dangerous

The Academic CubeSat

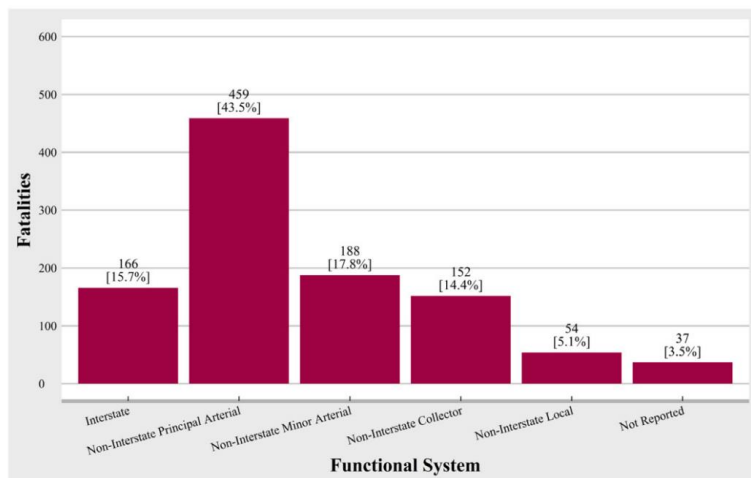


- Tries to be an educational tool that provides unique learning to students while also being a novel and high-risk research instrument
- Often results in a space mission that does a mediocre job of being both or blocks the mission from reaching launch at all

How Academic CubeSats are Like Stroads

The Stroad

Roadway Type for Speeding-Related Fatal Injury, California, 2016



Source: FARS ARF 2016

- Tries to be a place where people exist and interact, while also trying to provide quick transportation from one place to another
- Results in a development that performs poorly in both regards, is economically disadvantageous, and is significantly more dangerous

The Academic CubeSat



- Tries to be an educational tool that provides unique learning to students while also being a novel and high-risk research instrument
- Often results in a space mission that does a mediocre job of being both or blocks the mission from reaching launch at all

Case Study 1: GWSat

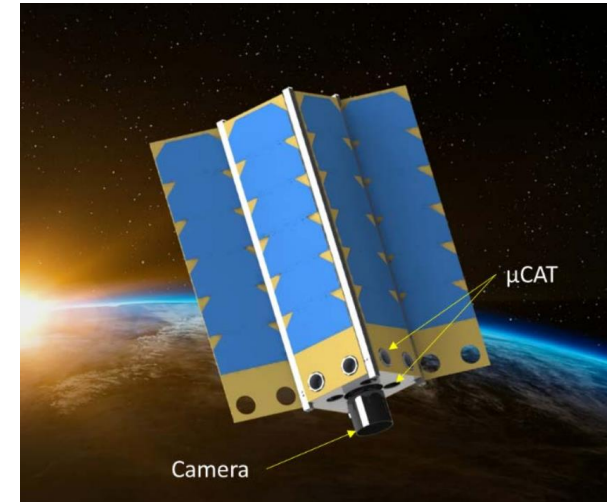
MISSION TIMELINE

Table 2 shows the expected date for various key milestones of the mission. Only major milestones are shown.

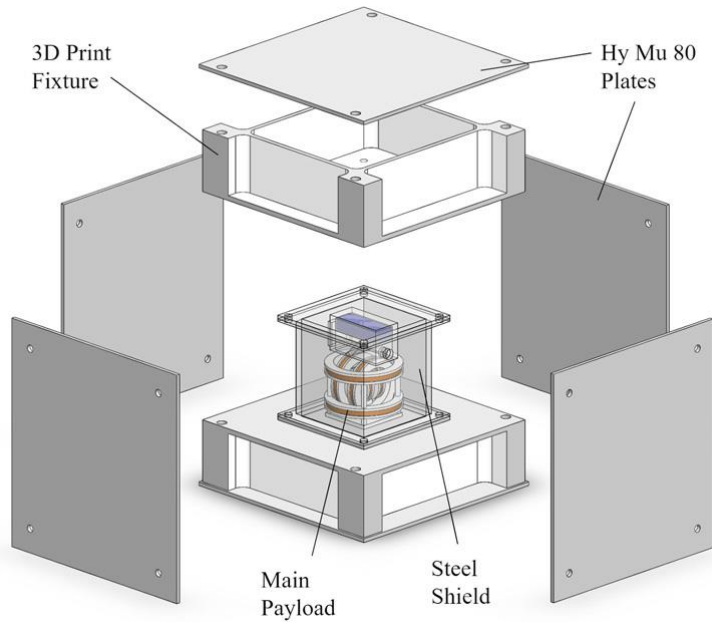
Table 2: Mission Milestones

Milestone	Date
Feasibility Study	Completed Late 2016
Phase 0/A	Completed Early 2017
Phase B (PDR)	Completed Oct. 2017
Phase C (CDR)	Expected Sep. 2018
Phase D (SC Ready)	Expected Dec. 2019
Phase D (Launch)	Expected Q1 2020
Phase E (Mission Op)	Expected Q1-Q4 2020
Phase F (Deorbit)	Expected Q1 2021

- Selected for CSLI in 2018
 - No known manifest as of Spring 2023
- Suffered loss of institutional knowledge and momentum
- Complex propulsion related mission added significant overhead on student team



Case Study 2: The QubeSat



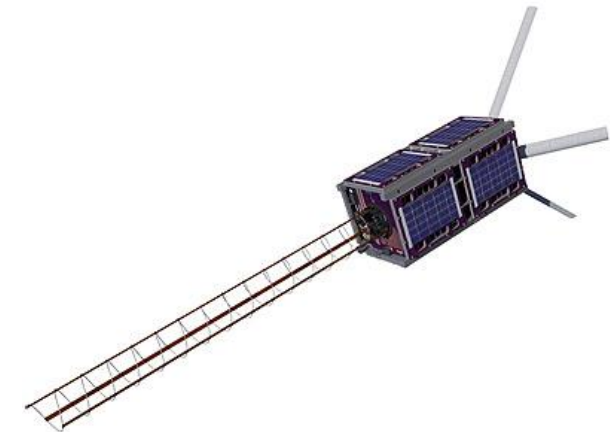
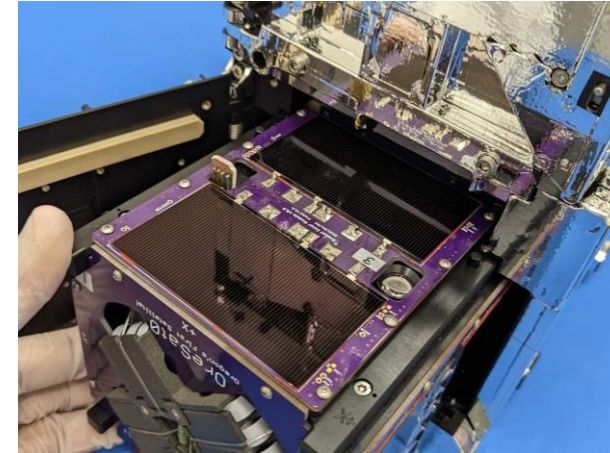
- Selected in the 2020 round of CSLI
 - Launched on the failed Astra LV-0008
- Quantum Gyro payload was dead on delivery
- Team rated only 5% chance of success, but 5% in space is better than 0% from the ground



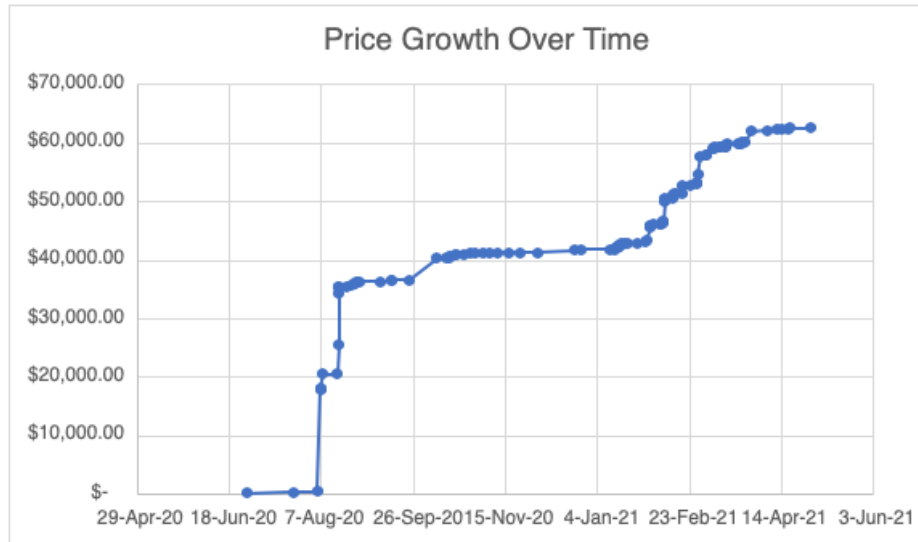
Case Study 3: OreSat-0 and OreSat-1



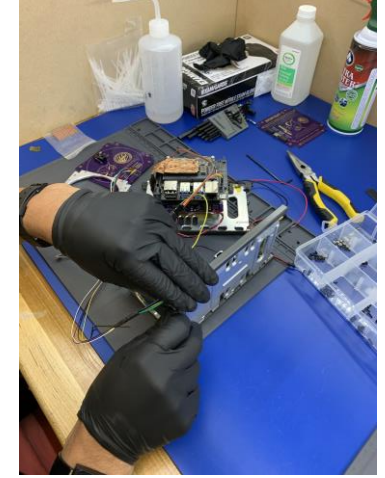
- OreSat-1 selected for CSLI in 2017
 - Still unmanifested as of Spring 2023
 - Repeated delays due to payload complexity
- OreSat-0 Launched in Spring 2022
 - Manifested commercially
 - Successful mission thanks to massive descope
- Example of a resilient team with strong lineage



Case Study 4: BroncoSat-1

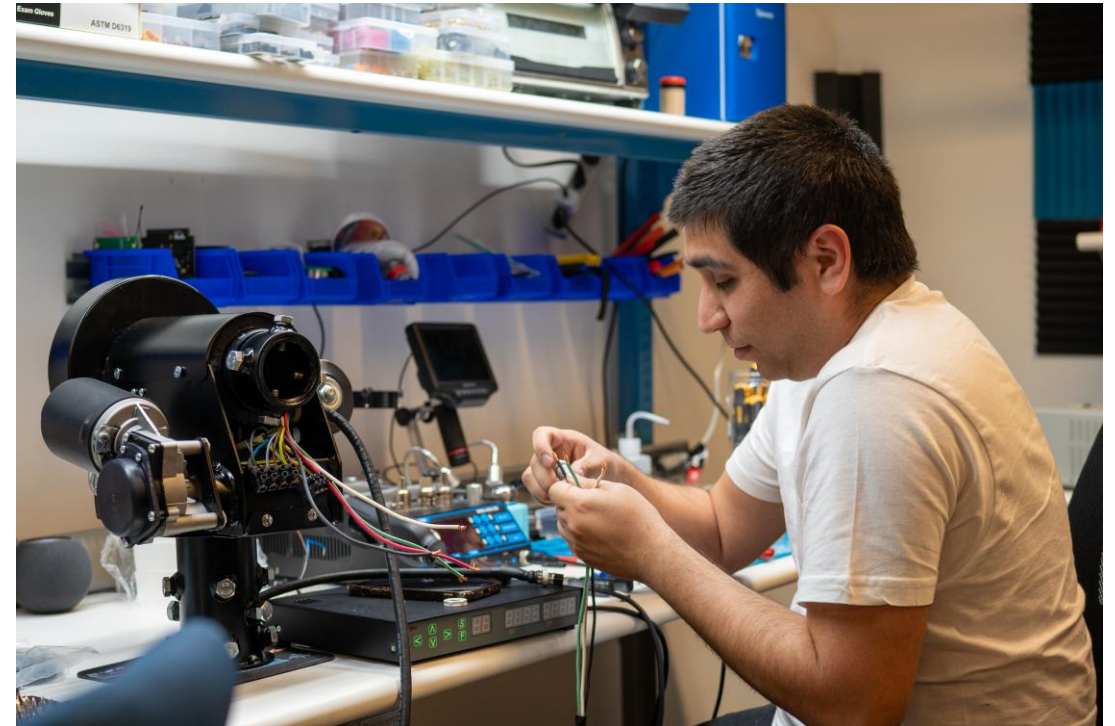


- BroncoSat-1 selected for free launch by Momentus in July 2020
- Initial delivery of the satellite in April 2021
- Program cost of BroncoSat-1 tripled vs original budget during course of program
- Launch in May 2022
 - Satellite was DoA due to failure of COTS comms system



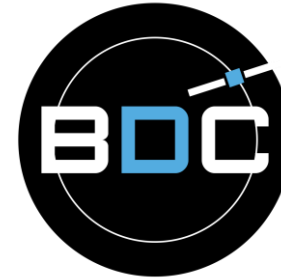
Current Issues

- Perceived need for a high performing mission causes universities to over scope
- Costs are often poorly understood, and way underestimated
- Revolving door turnover in academic projects torpedoes productivity on multigenerational programs
- Siloed development and a lack of community knowledge leads to many mistakes being made multiple times

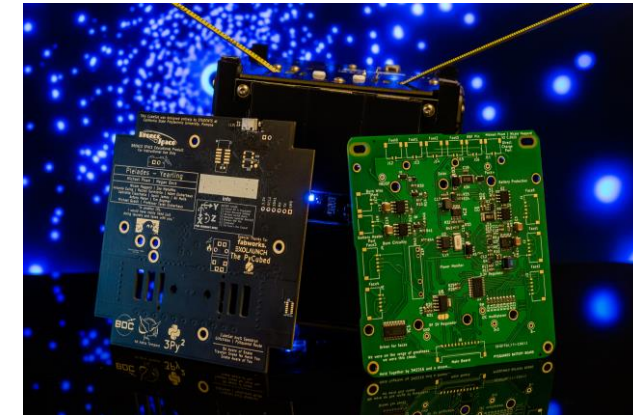
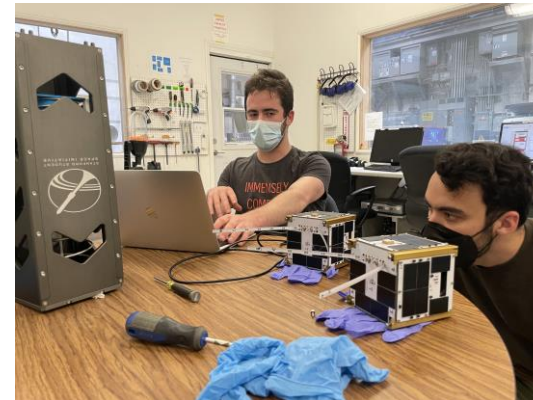


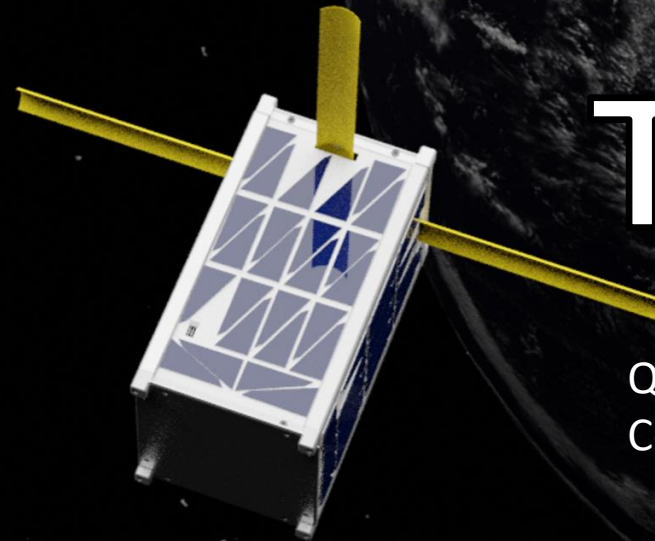
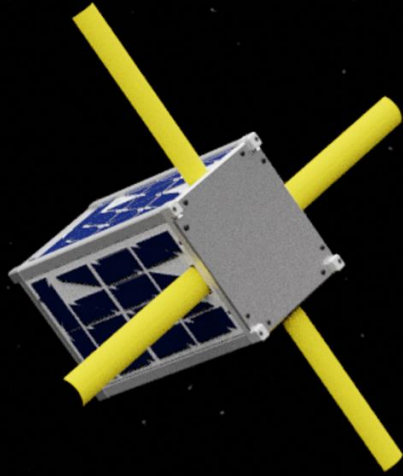
Potential Solutions

- Push an understanding of Academic CubeSats as primarily or purely educational tools
- Discuss cost more openly and drive for CubeSats to become more accessible through significantly lower cost
- Reduce the timeline of academic CubeSats to align them with other successful student programs
- Promote and participate in collaborative channels and share data and designs openly
 - **Support open CubeSat architectures!**
 - Like the 1U PROVES Kit



STANFORD STUDENT
SPACE INITIATIVE





Thank You!

Questions?
Contact: mlpham@cpp.edu | mcbeck@cpp.edu