

# Kumu a`o CubeSat

(Source of learning)

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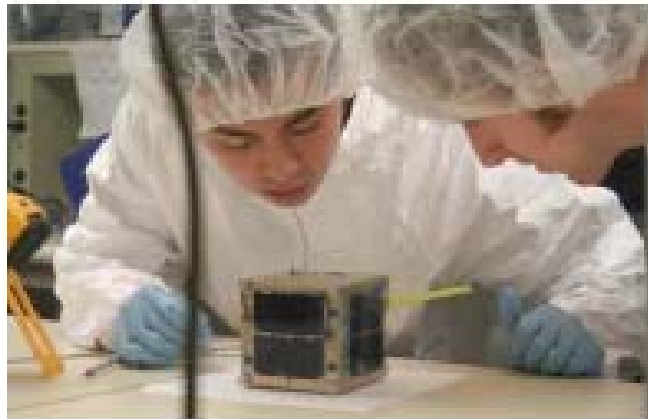
Hawaii Space Flight Laboratory  
University of Hawai`i at Manoa

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# More than meets the eye



**Mea Huaka`i (Voyager)**

**Kumu a`o (Source of learning)**



# Mission Objectives

- Develop heritage CubeSat bus for future UH CubeSats
- Operate CubeSat in orbit
- Provide a multi-disciplinary undergraduate engineering project and opportunity for Native Hawaiian and Pacific Islander students







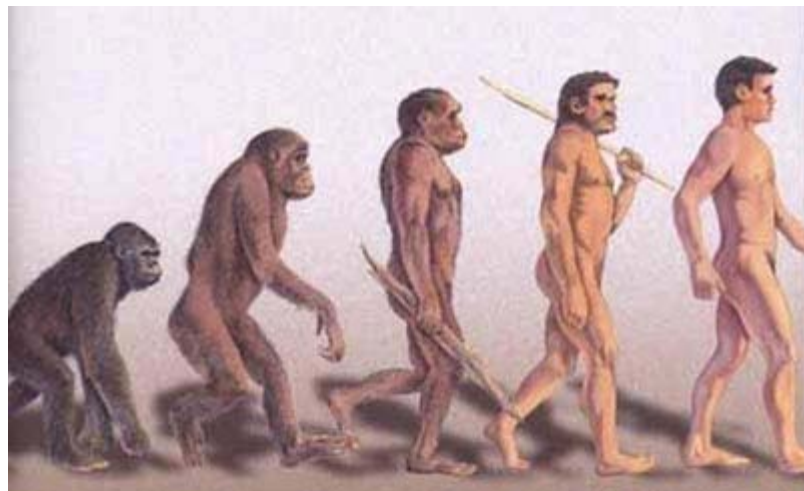
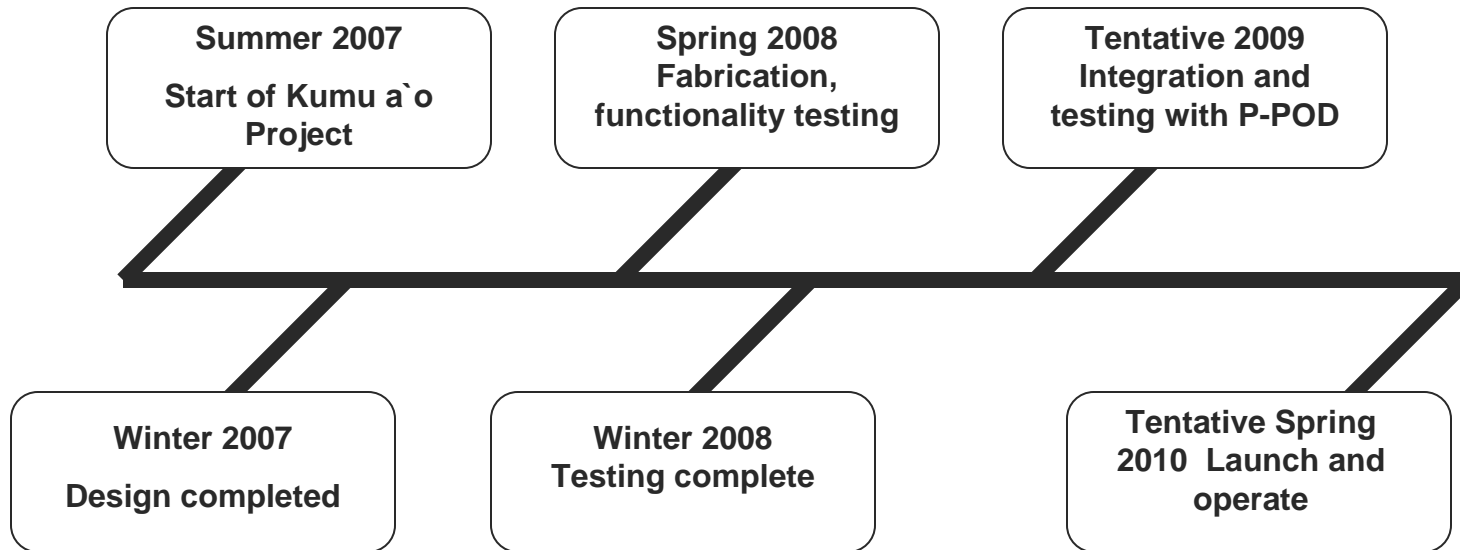
# Kumu a`o Team

- 4 former collegiate baseball and football athletes
- 1 former high school dropout
- 4 community college students
- 7 Native Hawaiian & Pacific Islanders





# Schedule





# C&DH Hardware

## ■ CubeSat Kit FM430 Module

- COTS Product

- Sensor data is gathered via standard I<sup>2</sup>C protocol

- PC104 Form Factor

- Texas Instruments MSP430 Microcontroller

- Data sent to storage via SPI bus

- Low Power: 66mW Active (~8MIPS)

- Transmitted to ground via RS-232

- Mass: 80g

- Operating Temperature: -40 to 85 °C





# Telecom Functions

- 4 minute telecommunication window
- Beacon Mode

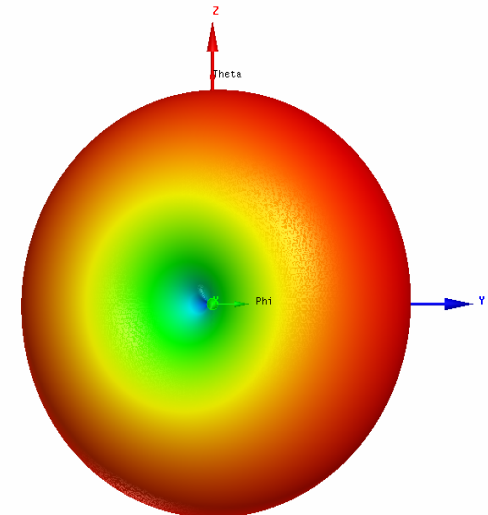
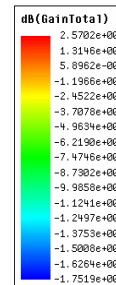
Call Sign (2) Receive (8) Off (70)	Call Sign (2) Receive (8) Off (70)	Beacon Telemetry (8) Call Sign (2) Receive (8) Off (62)
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- Telecom Mode
  - Hand shake & Protocol Checkout
  - Send telemetry ( 120 seconds)
  - End link



# Telecom Components

- Yaesu VX-3R Transceiver
  - Transmit @ 437 MHz (UHF)
  - Small size 4.7x8.1x2.3cm
  - 2W RF output power
- Terminal Node Controller TinyTrak 4
  - KISS packets.1200 bps
  - Modem in software
- Monopole Antenna
  - Measuring tape
  - Length of 17.1 cm







# EPS Functions

- Produce at least 1 Wh per orbit
- No more than 40% depth of discharge on battery
- Gather and relay voltages and currents readings
- Low Earth Orbit (400 km) – 27.27 minutes eclipse, 63.73 minutes sunlight
- Mass < 200g
- Battery: 7 Ah capacity @ 3.7V

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' I CHANGED TO GAS.'



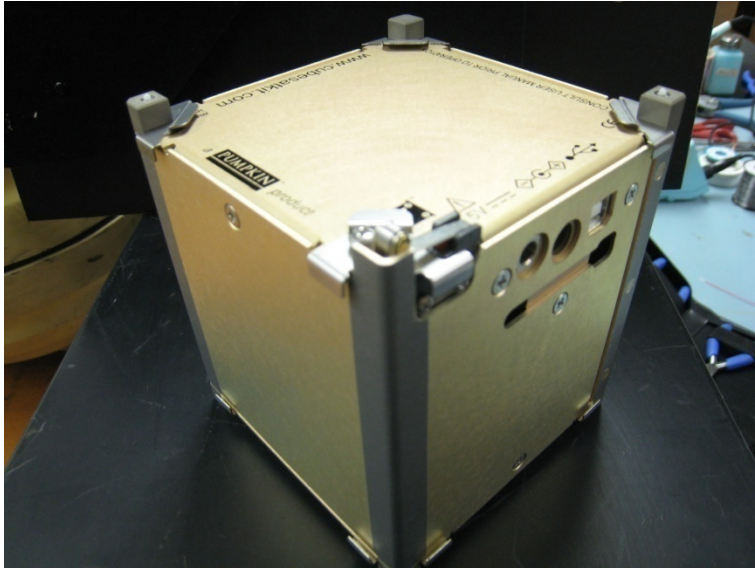
# EPS Components

- Solar Cells
  - ITJ – 26.8% (Spectrolab)
  - 1 Watt of continuous power
  - 4.46 V and 450.8 mA per face
- Batteries - Saft MP 176065
  - Lithium Ion Technology
  - Typical Capacity: 7Ah @ 1.4 A
- DC Converter / Distributor
  - System will support 3.3, 5, and 6 V.
    - Maxim
    - TI





# Structural Subsystem

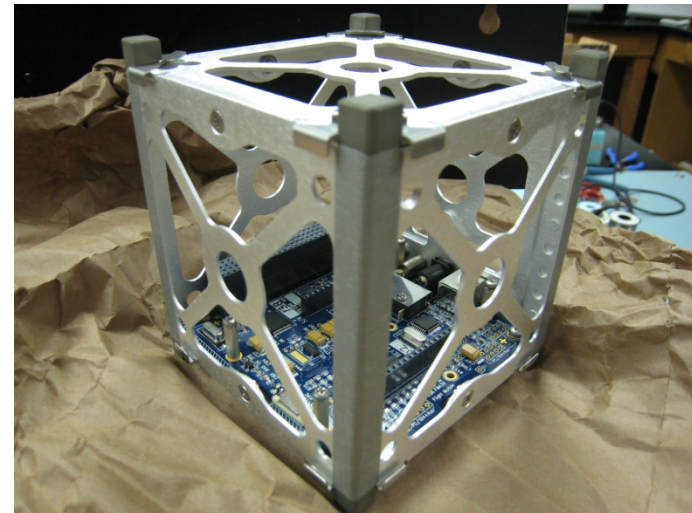


## Engineering Model

- Solid wall chassis
- 1 unit
- Aluminum
- Stainless Steel Fasteners

## Flight Model

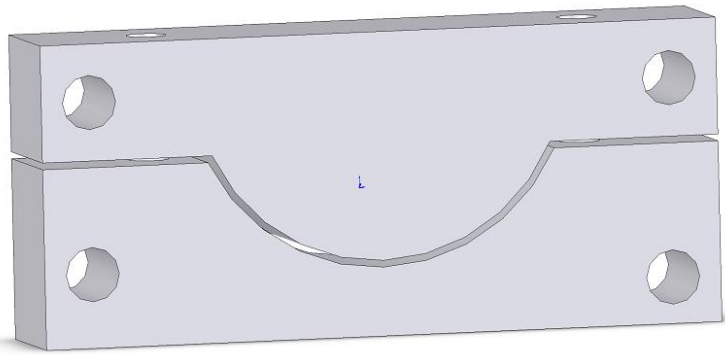
- Skeleton wall chassis
- 1 unit
- Aluminum
- Stainless Steel Fasteners



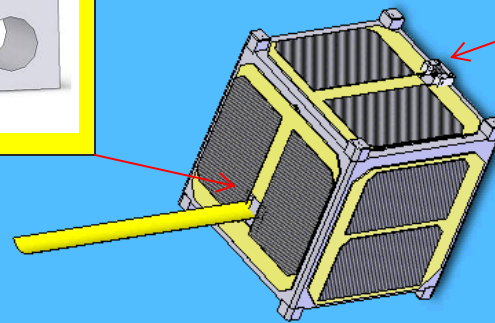


# Mechanisms

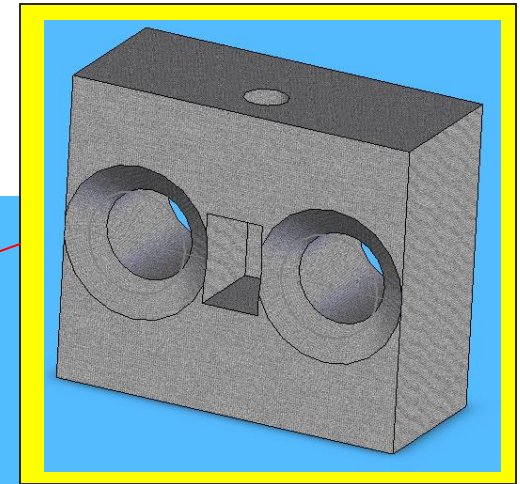
- Controls mechanical features for Antenna Deployment



Non-Metallic  
Antenna Clamp



CubeSat Exterior

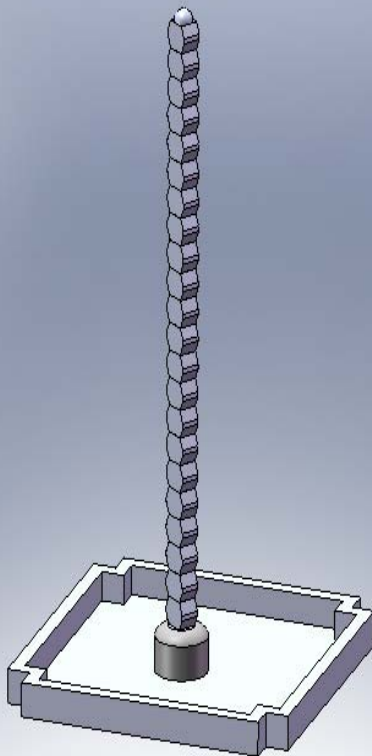


Deployment  
Mechanism



# Gravity Gradient Boom

- Provide nadir orientation within  $\pm 5$  degrees
- Under 80g
- 100 x 100 x 13 mm



- Length  $\leq 456$  mm
- Tip mass  $\leq 50$  g
- PTFE Teflon





# Acknowledgements

## OUR SPONSORS



**NHSEMP**



**Special Thanks**

**OUR ADVISORS AND MENTORS**

**BYRON WOLFE**

**DR. WAYNE SHIROMA**

**LLOYD FRENCH**

