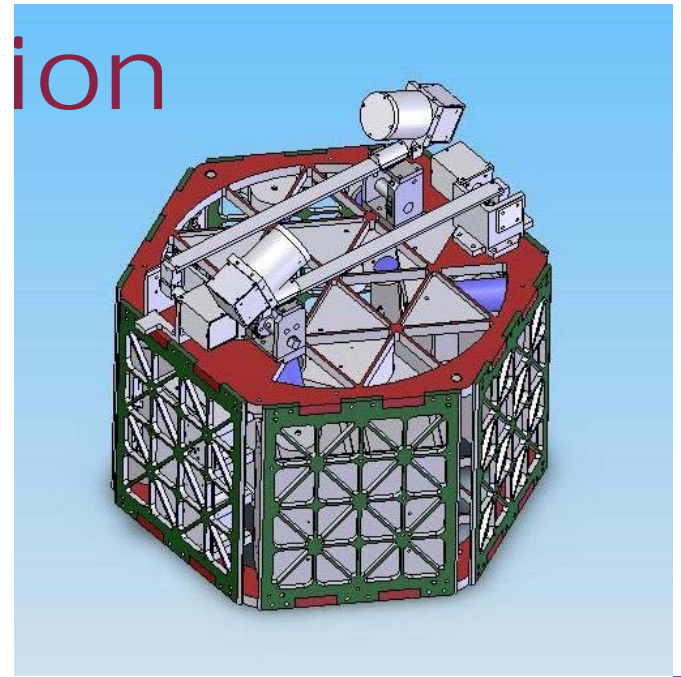


# Nanosat 4 Competition

*NMSUSat2* Team

New Mexico State University  
College of Engineering

Presented by Jeremy Bruggemann



# Topics

- Competition Overview
- Mission Overview
- Design Concept
- Tests and Analyses
- Hardware
- Project Status
- Acknowledgements



# Competition Overview



- 12 Universities across the nation compete to launch student designed and developed nanosatellite into orbit
- Sponsored by:
  - Airforce Research Laboratory (AFRL)
  - NASA
  - Airforce Office of Scientific Research (AFOSR)
  - AIAA
  - SMC Det 12
- Some Competition requirements:
  - Must not exceed 18"x20"x20" envelope
  - Must withstand 20 g load
  - Must exhibit a vibration frequency no less than 100 Hz
  - Etc.
- Design guidelines set to match those of industry
  - Strictly enforced by AFRL

# Mission Overview – Mission Statement & Objectives



- **Project Mission Statement**

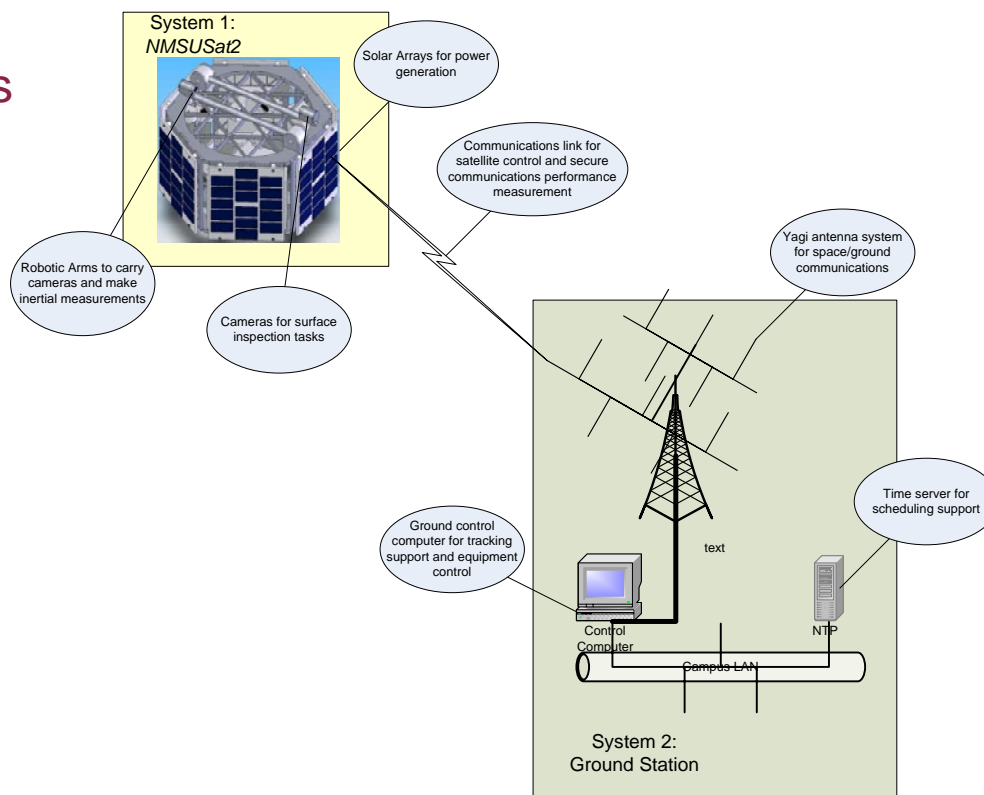
- The mission for the *NMSUSat2* is to perform science and technology experiments, in a time-sharing fashion, from LEO using a university designed and built nanosatellite.

- **Project Technology Demonstration**

- Satellite Inspection
- Measure Inertial Properties
- Secure Communications

- **Project Space Science Measurement**

- Atmospheric UV Albedo Measurement



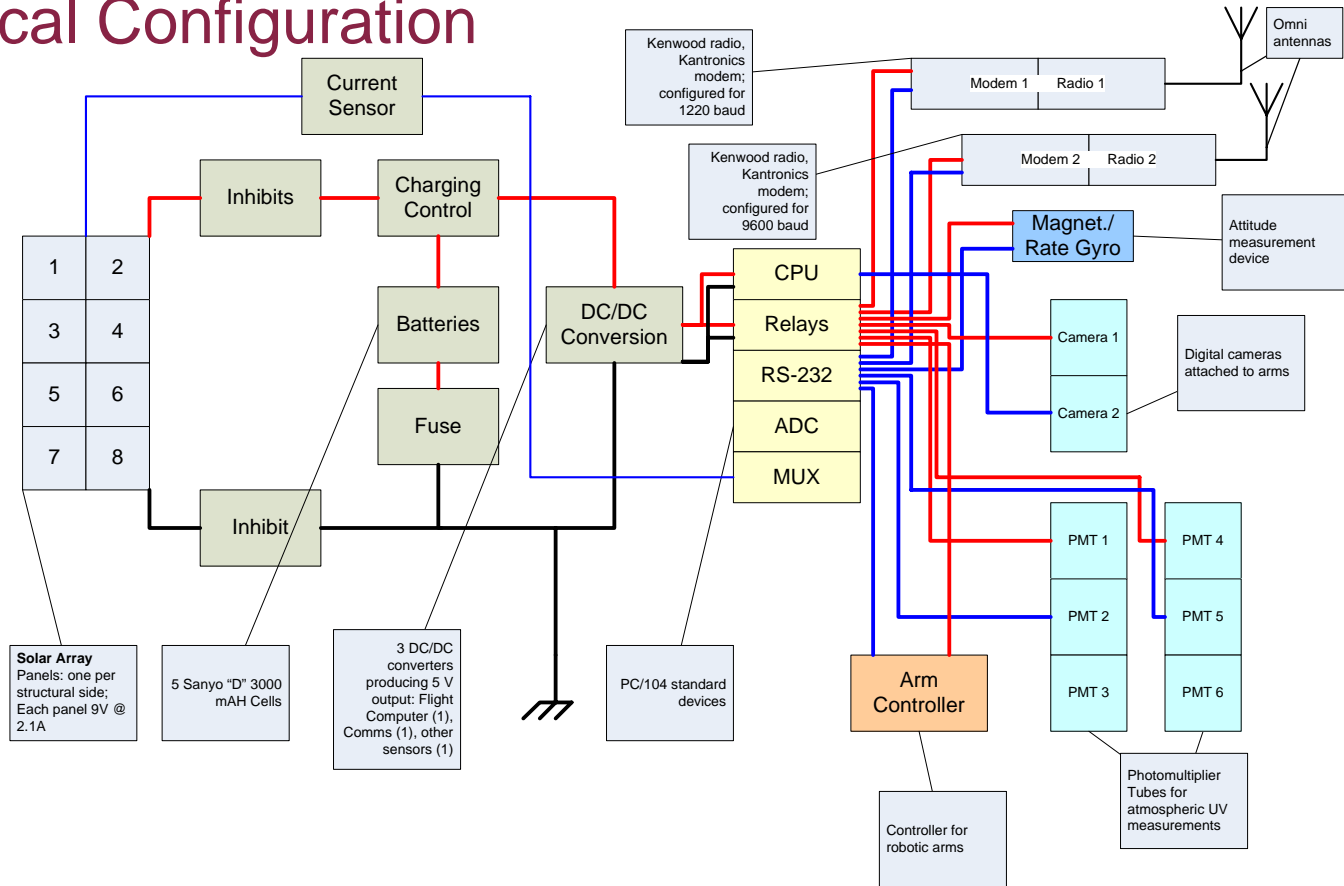
# Mission Overview – Mission Relevance



- **Secure Communications Measurements:** These measurements are useful to mission designers to assess the performance of secure communications for low signal-to-noise-ratio satellite links.
- **Near Ultra Violet Measurements:** This will assist astrophysicists in developing sensor suites for space-based measurements of cosmic ray interactions with the earth's atmosphere; current data set from all investigators at all locations is ~ 100 min.
- **Charging Control Circuit:** Verify optimal solar energy conversion, and supply rated voltage and current to subsystems during eclipse operations.
- **Inertia Property Measurements:** Acquired data will be applied to verify a newly developed algorithm that will be implemented to identify the changing inertia distributions of on-orbit spacecraft.

# Mission Overview – System Diagram

## Electrical Configuration

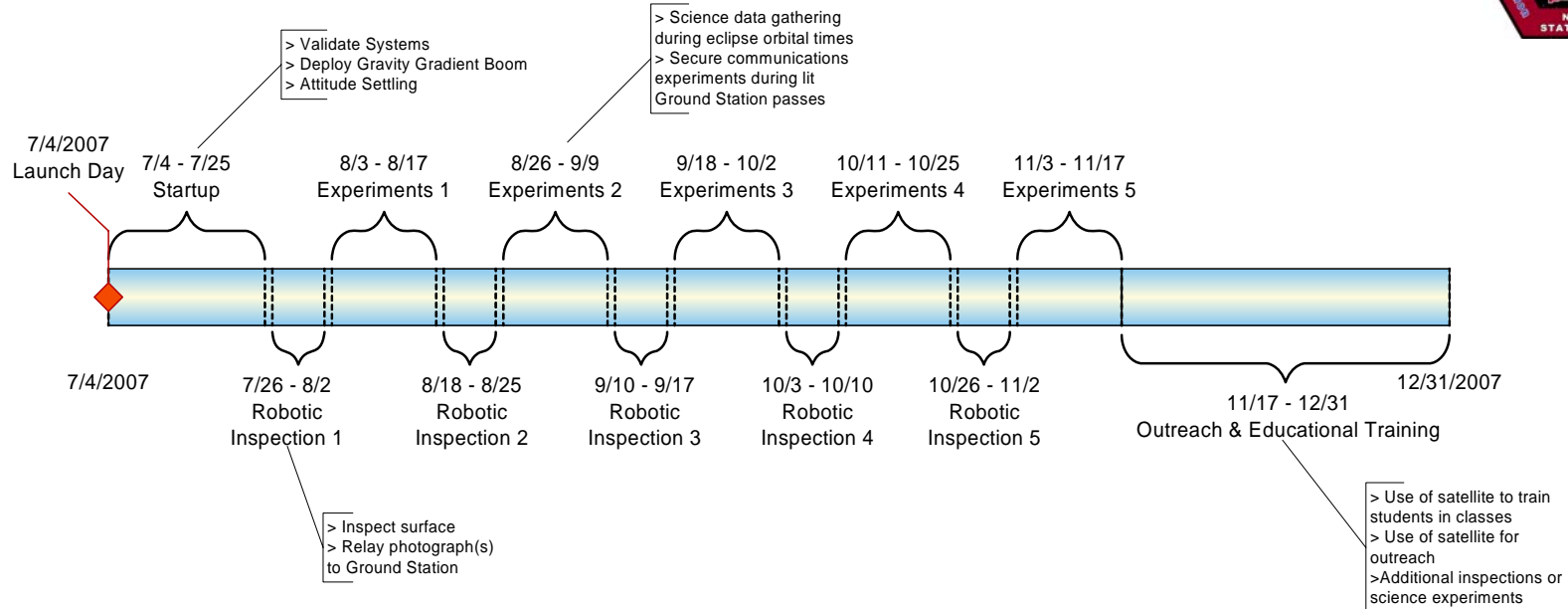


# Mission Overview – System Diagram

## Mechanical Configuration



# Mission Overview – ConOps



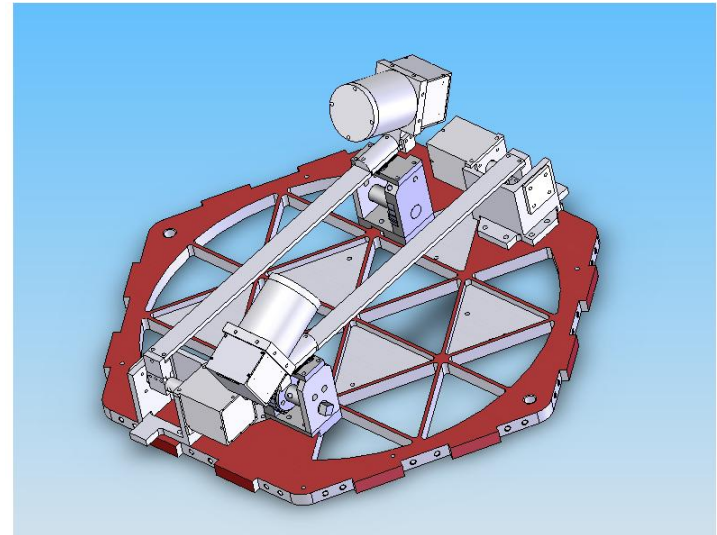
- Use moon phases and orbit parameters to develop a schedule to time-share the robotic arm movements and the science measurements over a six-month period
- Use satellite for public outreach after science and technology main mission accomplished.

# Design Concepts



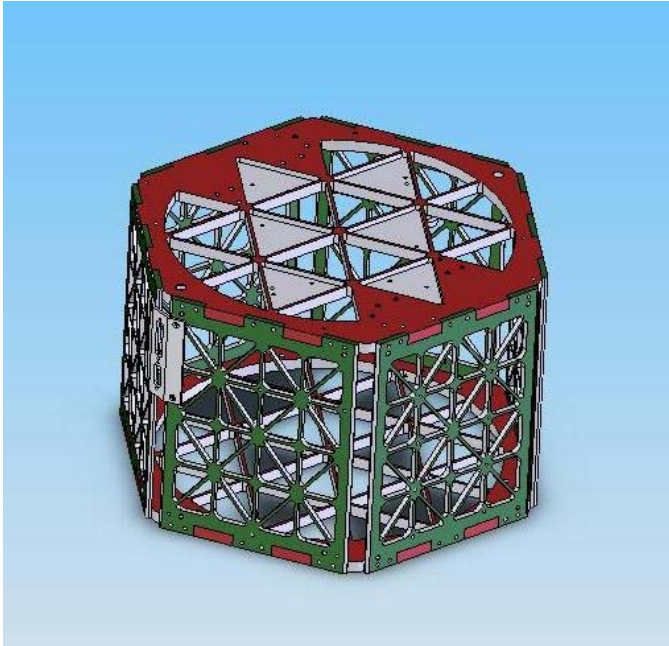
## Robotic arms

- Two single axis robotic arms mounted on satellite's top panel
  - Each with  $\sim 200^\circ$  Range of motion
  - Each arm accommodates one camera for satellite surface inspection subsystem
  - Each arm requires a latch mechanism for secure launch configuration

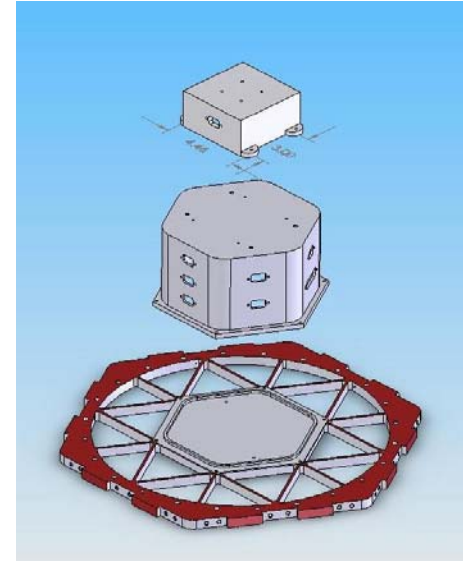


# Design Concepts

## Bus Structure and Containment Boxes



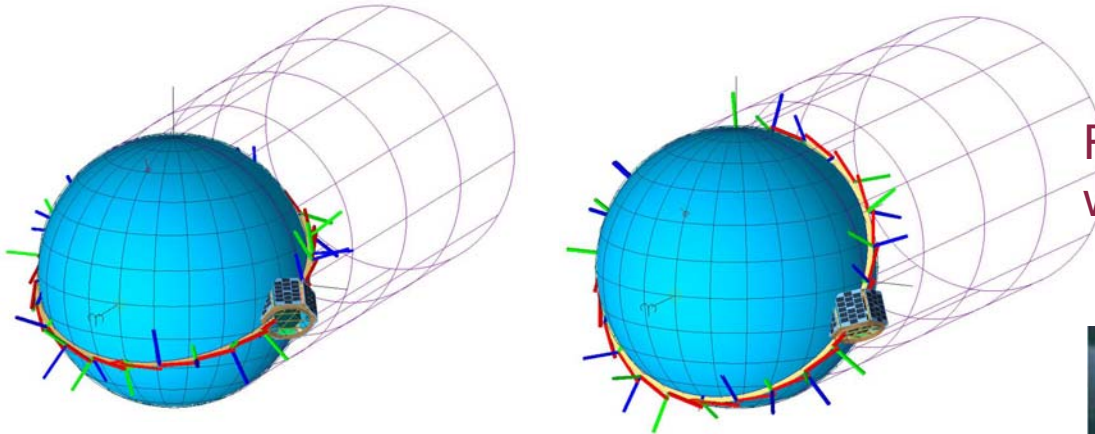
- Isogrid panels as heritage from 3-CornerSat
  - Selected for launch in previous NanoSat competition



- All boxes fitted to specific electrical component and to accommodate connectivity
- Designed to effectively mitigate EMI (Electromagnetic Interference)

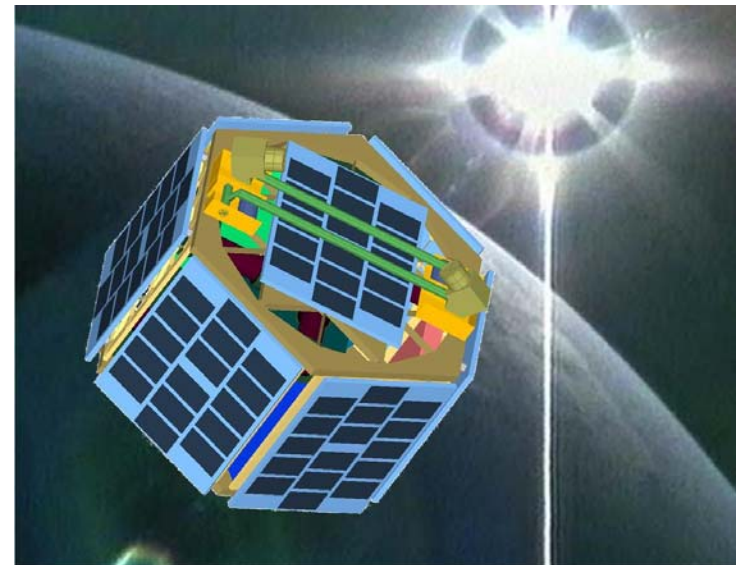
# Mechanical Analysis & Test

## Thermal Analysis



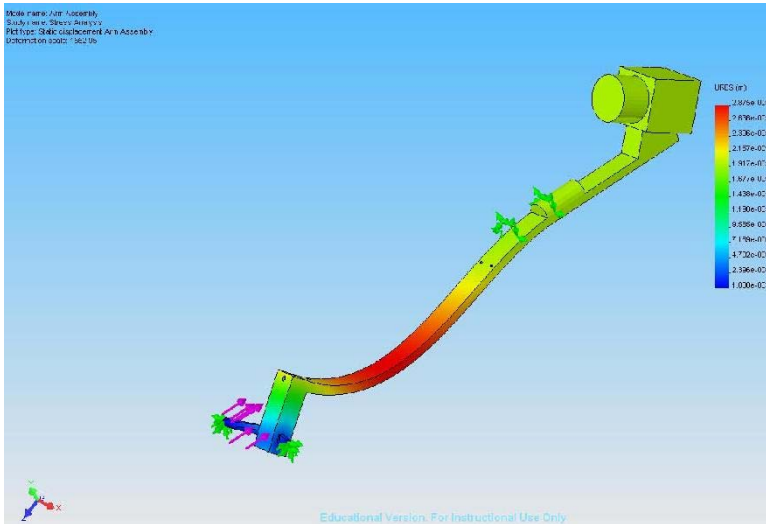
Results: All temperatures were within operational conditions

- Thermal Analysis conducted by Oate High School student and PSL Thermal Engineer Mentor
- Analysis considered two possible orbits
  - 28° and 51° inclination
  - Hot and cold conditions analyzed for both orbits



# Mechanical Analysis and Test

## Structural Analysis

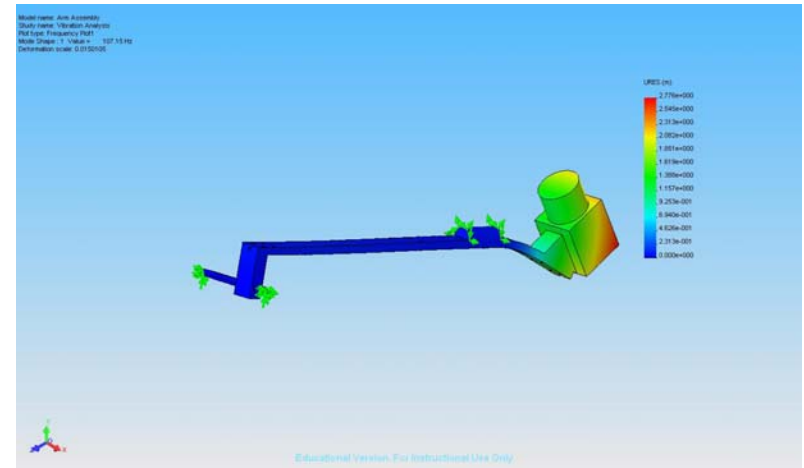


## Vibration Analysis

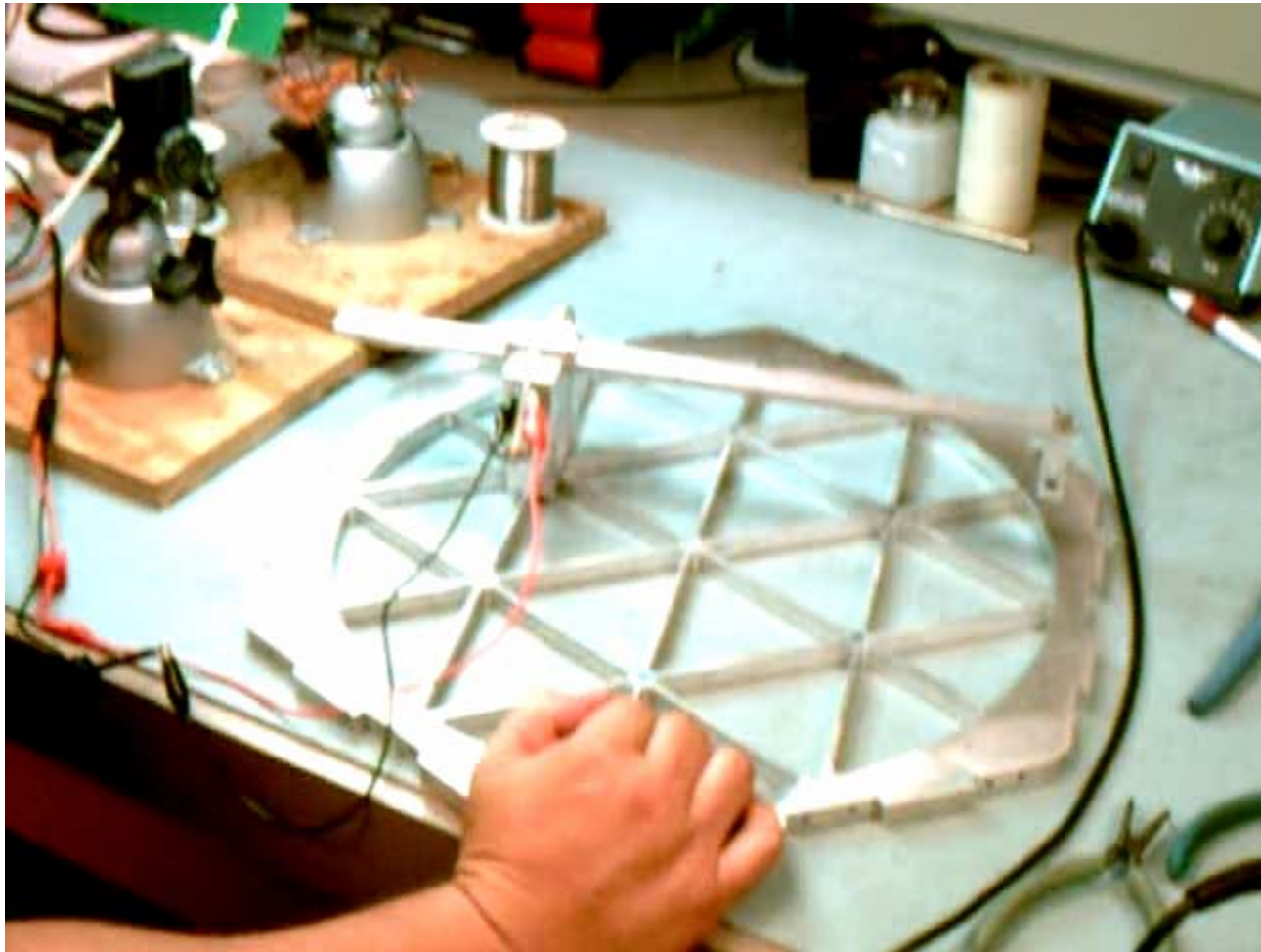
- Design criteria
  - No less than 100 Hz
- FEA software: CosmosWorks
- Proposed to be tested on vibration test bed

## Stress Analysis

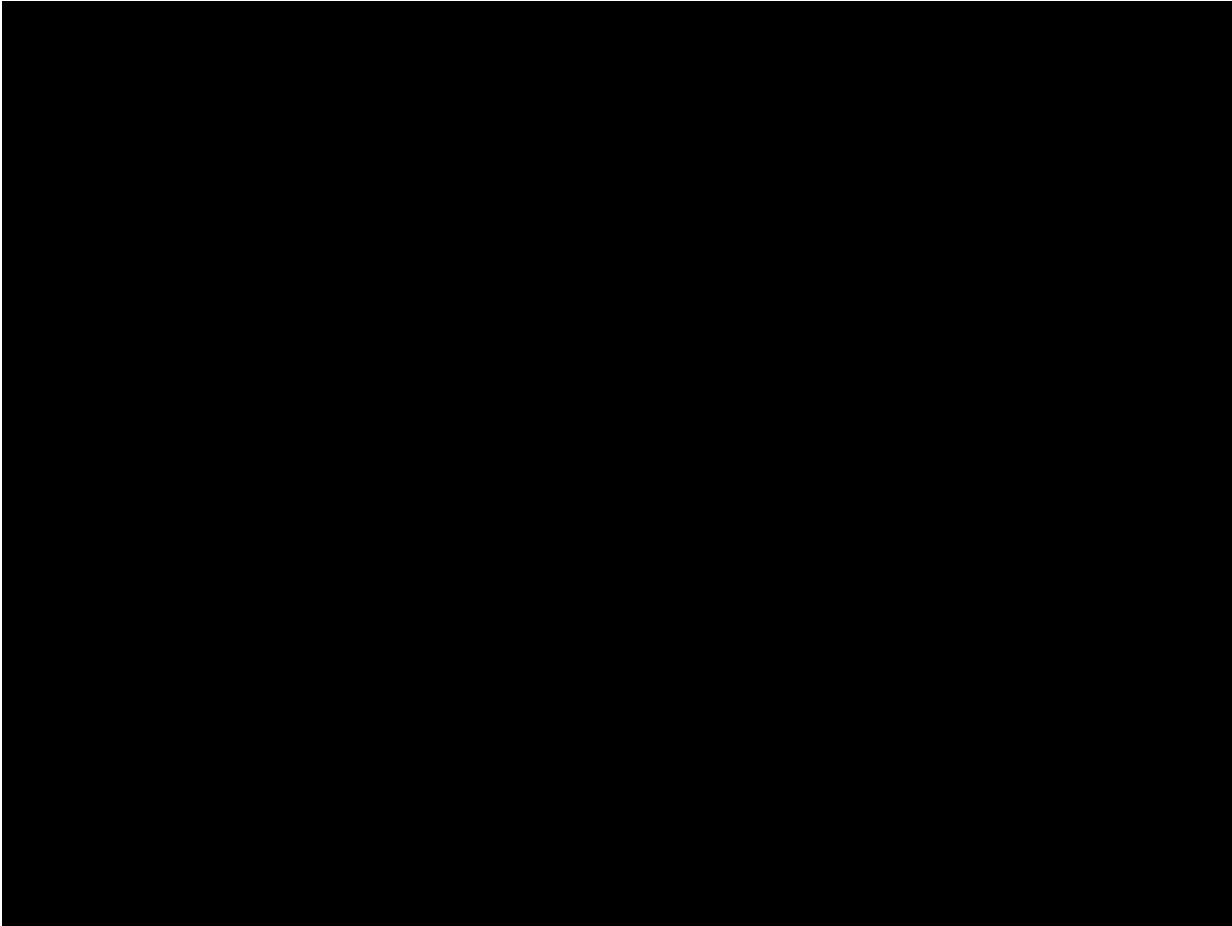
- Design criteria
  - 20 g load
- FEA software: CosmosWorks
- Manual methods also applied to verify FEA results



# Release Mechanism Field Test



# Robotic Arm Dynamic Field Test

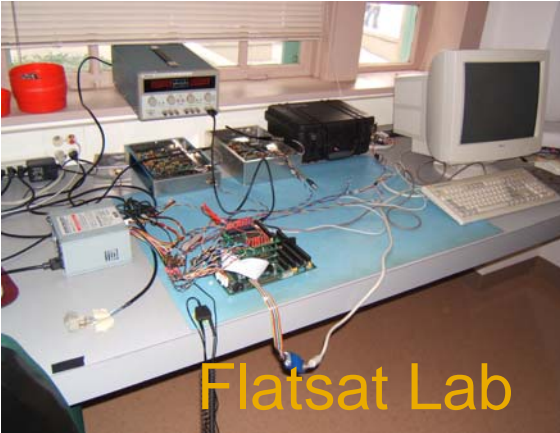


# Electrical Tests and Analysis

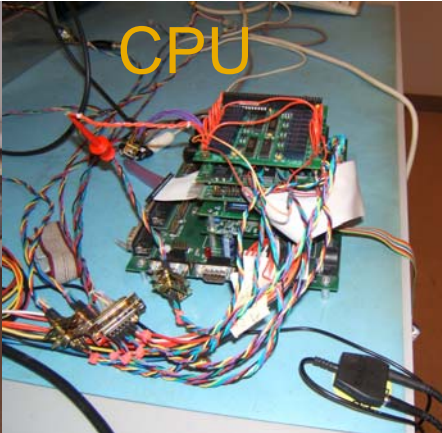


- Com System
  - Verified connectivity between simulated ground station-satellite interface
- Charging System
  - In-lab test proved battery charging capability with current charging circuit
- Solar Panel
  - Solar panels proven to be functional at anticipated power rating
- Sensor System
  - Magnetometer
    - Passed through magnetic field with varying strength to verify sensor functionality

# NMSUSat2 Subsystems



Flatsat Lab



CPU



Charging Controller



Comm String



Camera



Magnetometer



PMT

# Project Status



- NanoSat Competition Completed
  - NMSUSat2 not selected for launch
- Communications and Particle UV emission experiment approved to fly on high altitude scientific balloon
- Inertia property experiment proposed to fly in the NASA Microgravity Program

# Acknowledgement



- NanoSat Teams over 2 years of development
- Dr. Ou Ma – ME Advisor/Mentor
- Dr. Stephen Horan – EE Advisor/Mentor
- Larry Alvarez – EE mentor
- Robert Hull – EE mentor
- Kim Parkee and Machinist Staff
- New Mexico Space Grant Consortium

# Questions??

