TAYLOR UNIVERSITY

Micro Gravity Balloon Drop

TETHER RELEASE

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Presentation Outline

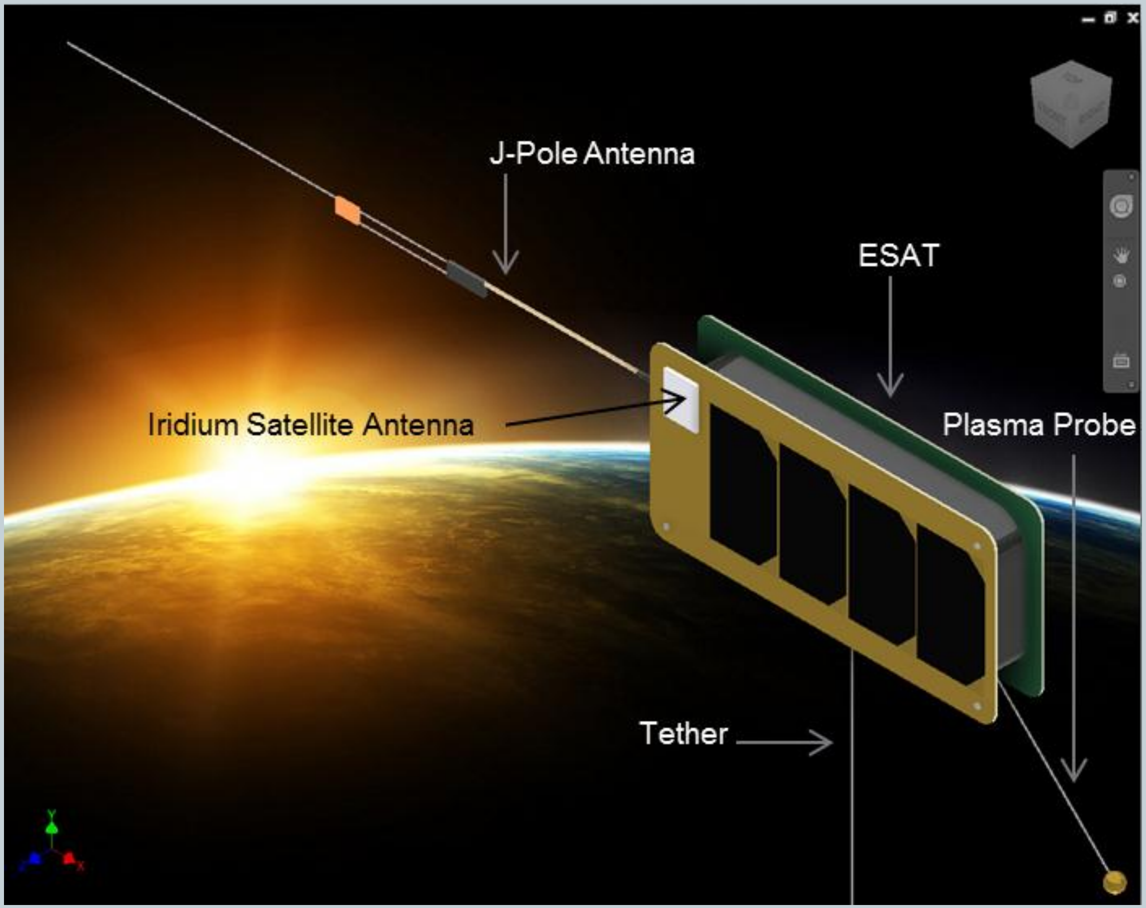
- Objectives
- Introduction
- System Diagram
- General Guidelines
- Rotational Control
- Camera Field of View
- Accelerometer
- Balloon Controlled Descent
- J-Pole Antenna
- Solar Panel Analysis
- Conclusion
- Acknowledgements

Objectives

- Testing of a 10 meter Tether in Micro Gravity
- Testing of a Smaller Balloon in the parachute for a Less Chaotic Descent
- Testing of Thermodynamic Properties of Different Thermal Surfaces on ESAT
- Testing of Gallium Arsenide (GaAs) Solar Array
- Testing of the Communications Link of a Nickel-Titanium (Ni-Ti) J-pole Antenna

Introduction

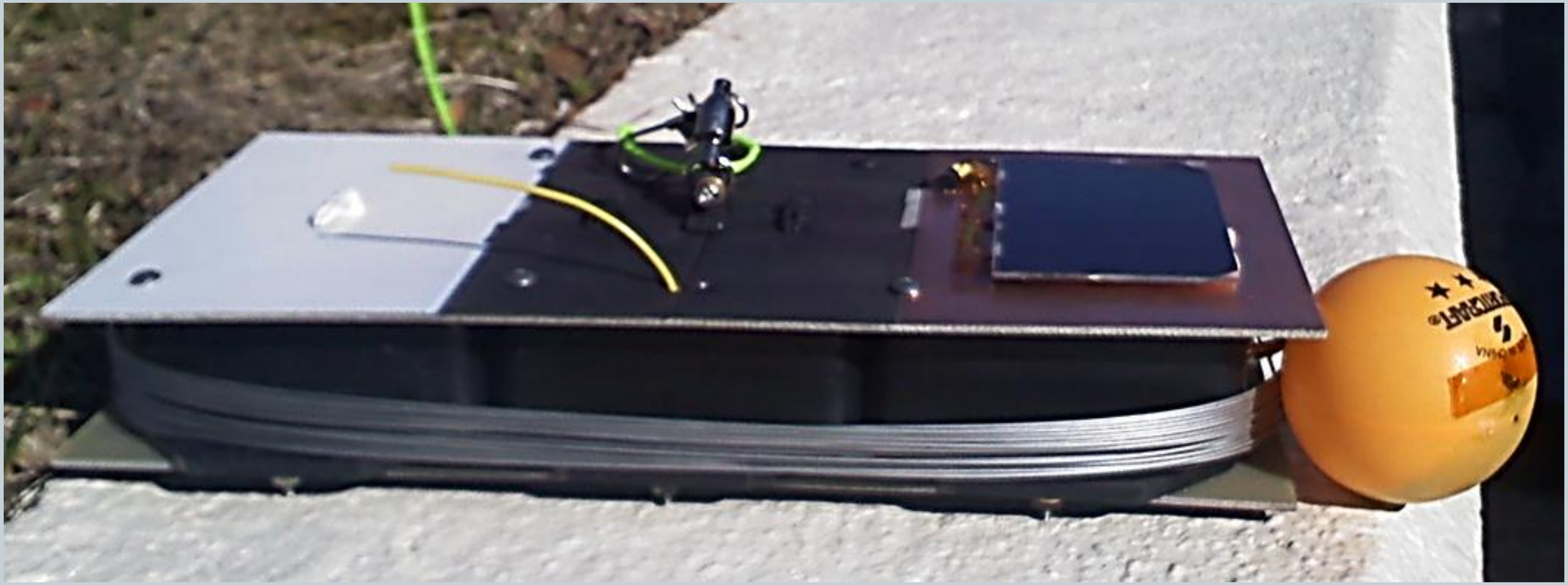
- Theoretical Model of ESAT



Computer model done in Autodesk Inventor Professional 2012.

Introduction

- Real Mass Model of ESAT (Every Student A Trojan)



Introduction

- Command Pod
  - Dimensions
    - $4\ in \times 4\ in \times 8\ in$
  - Contents
    - Accelerometer
    - Temperature Sensor
    - Pressure Sensor
    - Humidity Sensor
    - Data Relay
    - 2 Video Cameras
    - 1 HD Video Camera

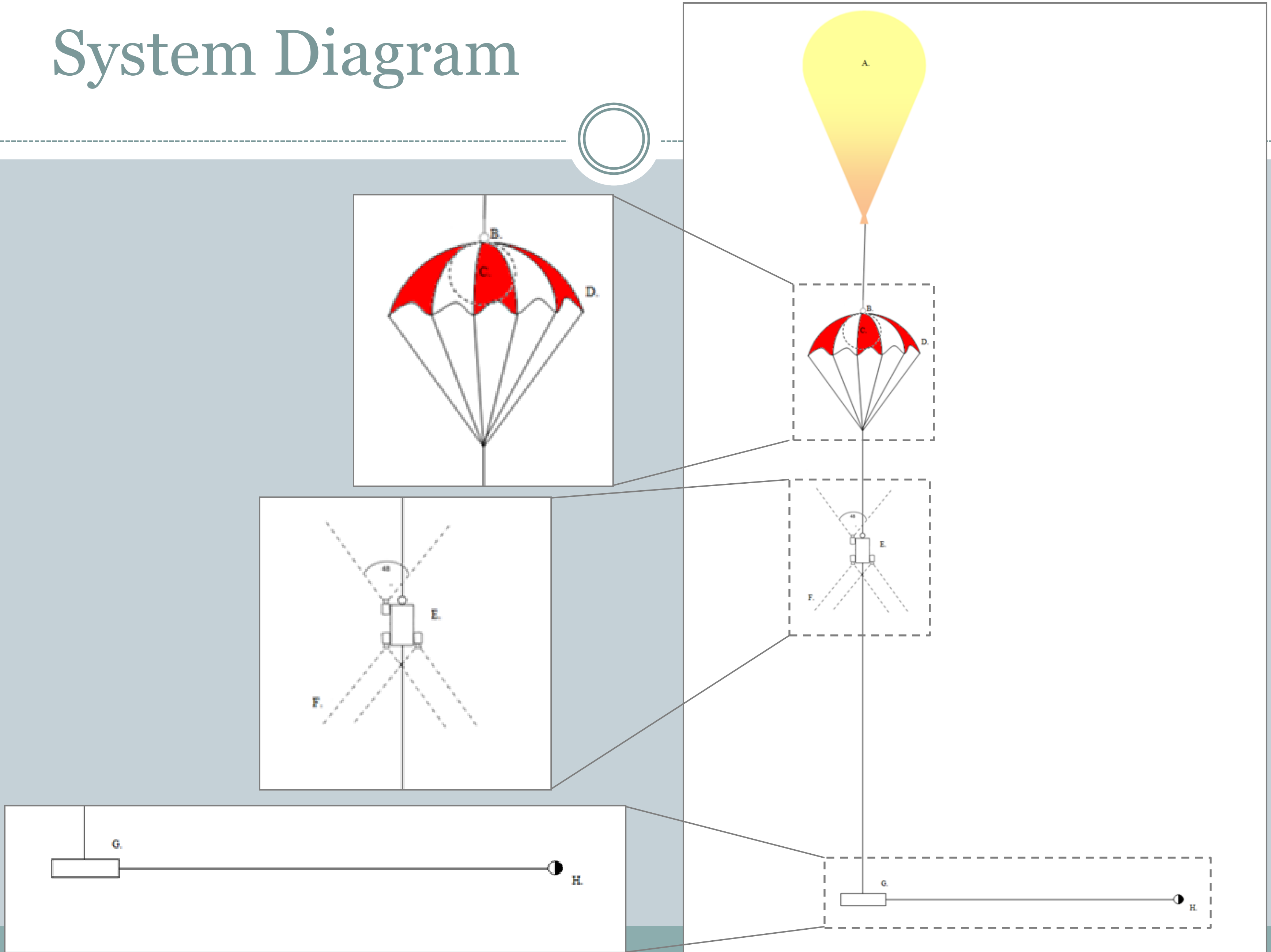
Introduction

- Payload
  - ESAT Dimensions
    - $20.32\ cm \times 10.16\ cm \times 3.38\ cm$
  - Magnetometer
  - GaAs Solar Array
  - Plasma Probe
  - E-Field Detector
  - VLF Receiver
  - Temperature Sensors for Thermal Surface Test Attached on ESAT for This Flight

Introduction

- 1000g – 1500 g Latex Weather Balloon Launch Vehicle

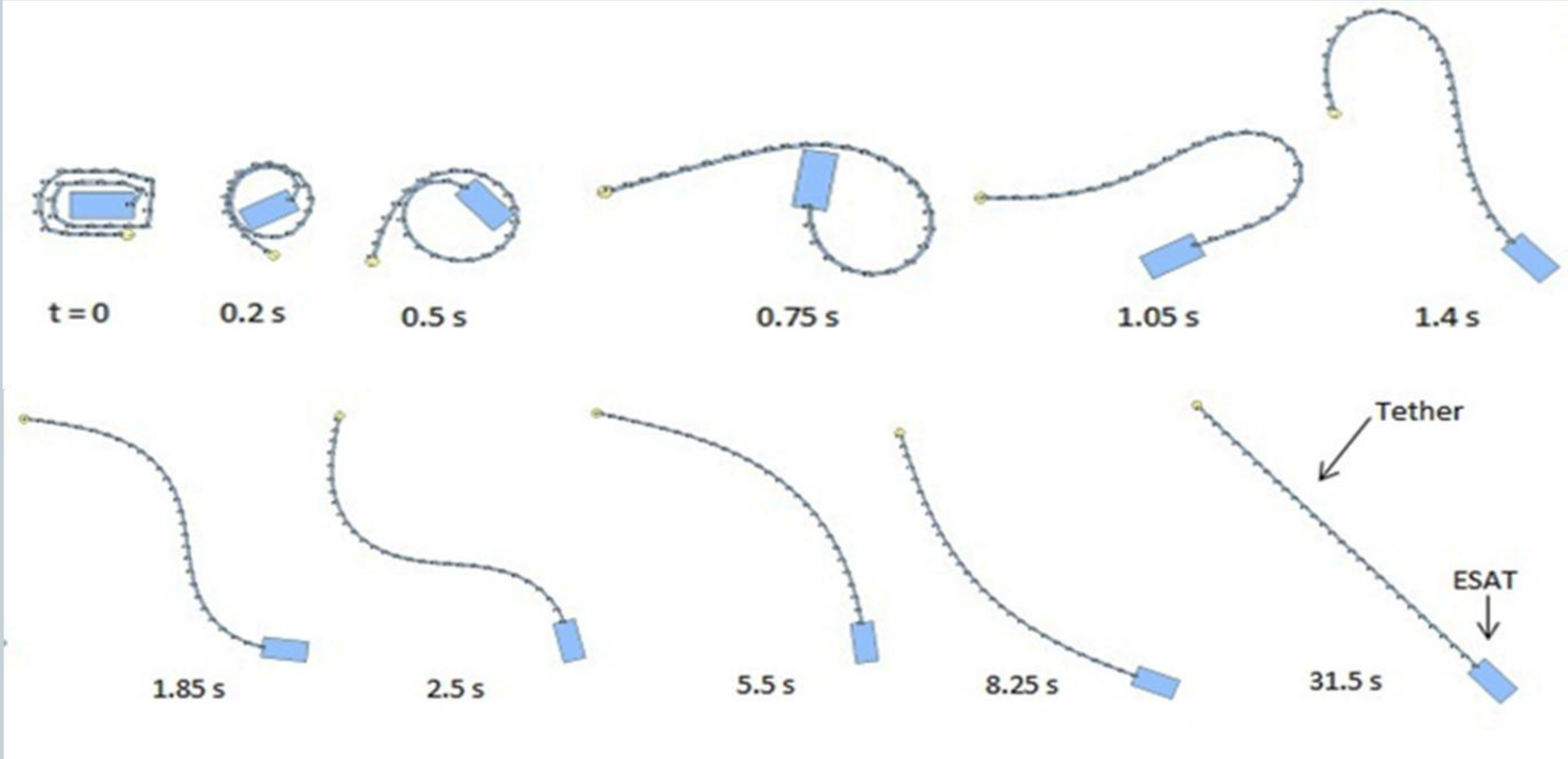
System Diagram



Tether

- 0.75 mm Nickel-Titanium Wire
- Release Mechanism
- Simulation
  - Importance of theoretical modeling

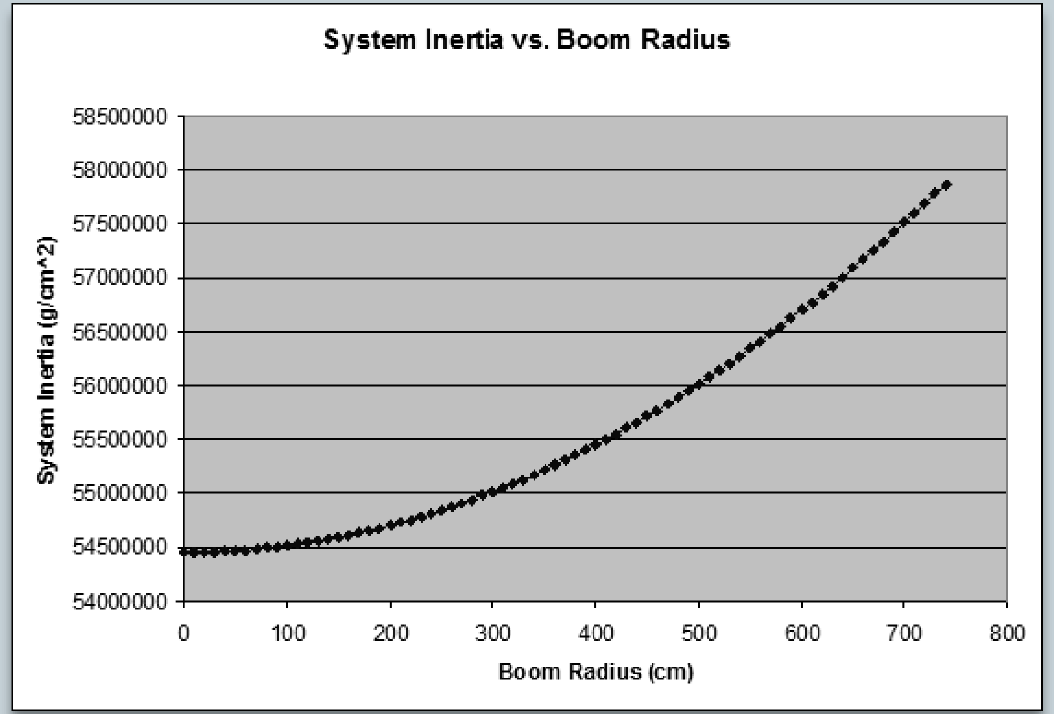
Interactive Physics Tether Simulation



ESAT Mass in simulation: 400 grams, Ping Pong Ball Mass: 40 g

Rotational Control

- Attitude and Stability
- Theoretical Model of ESAT Stability Control
  - Inertia
    - Varying the radius
    - Varying mass



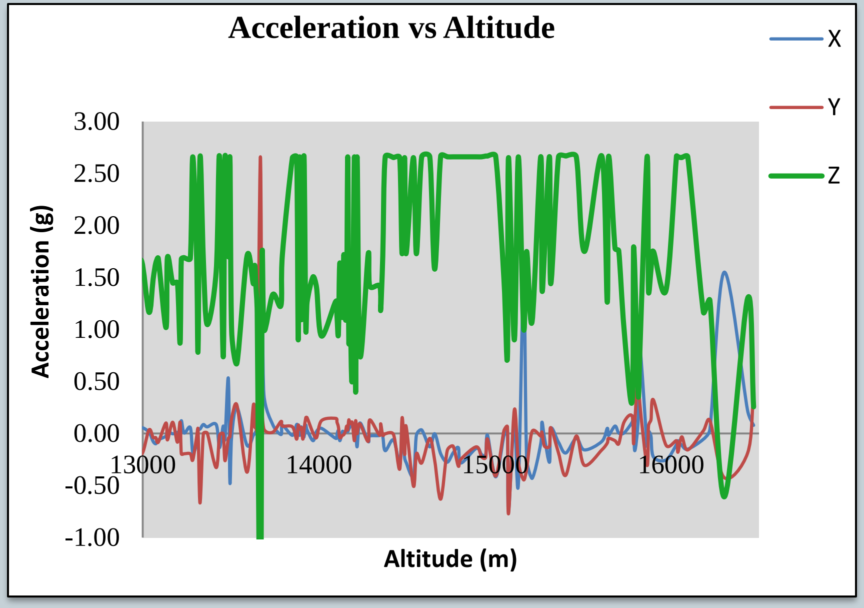
- See paper Appendix Section C for more detailed calculations and information

Camera Field of View

- Camera
  - Contour HD 1080p video camera
  - 135° wide angle lens
- Importance
  - Length of tether
  - Height of Camera above ESAT

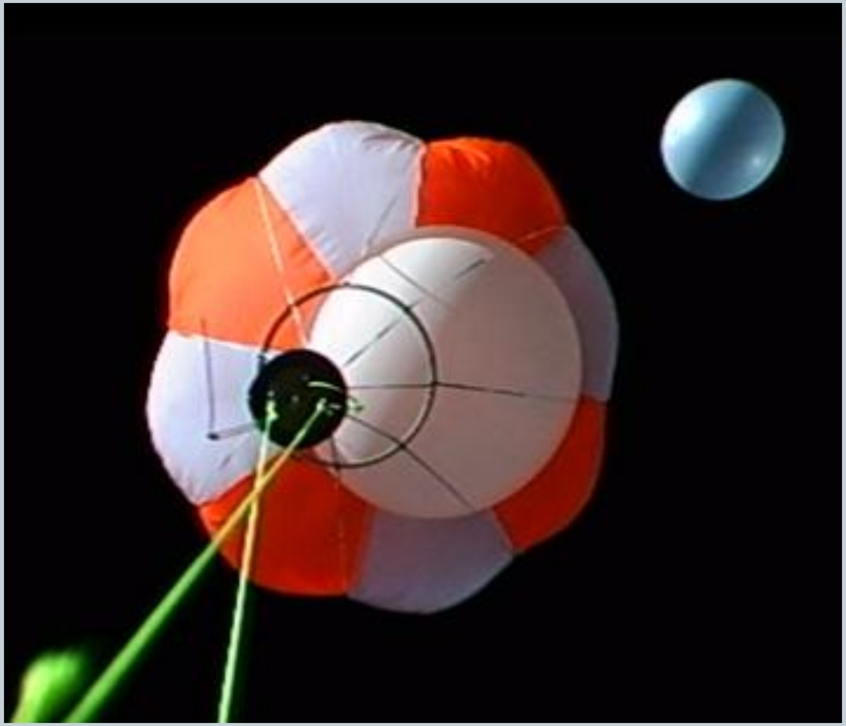
Accelerometer

- Tri-axis (x,y,z) Accelerometer
  - DE-ACCM3D2 Buffered +/- 2 g
  - Zero gravity (0 g) reference point is 1.66 V
- Uses
  - Analyze the motion of the system
    - Validate the use of the small balloon in the parachute
  - Know if and when the system achieved micro gravity during free fall
- Accelerometer Specifications Sheet Validation
  - Verifying reference points at zero gravity and normal gravity



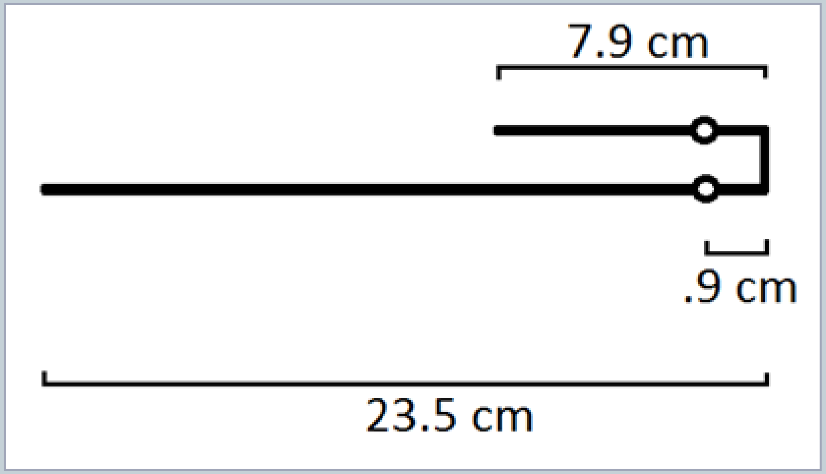
Balloon Controlled Descent

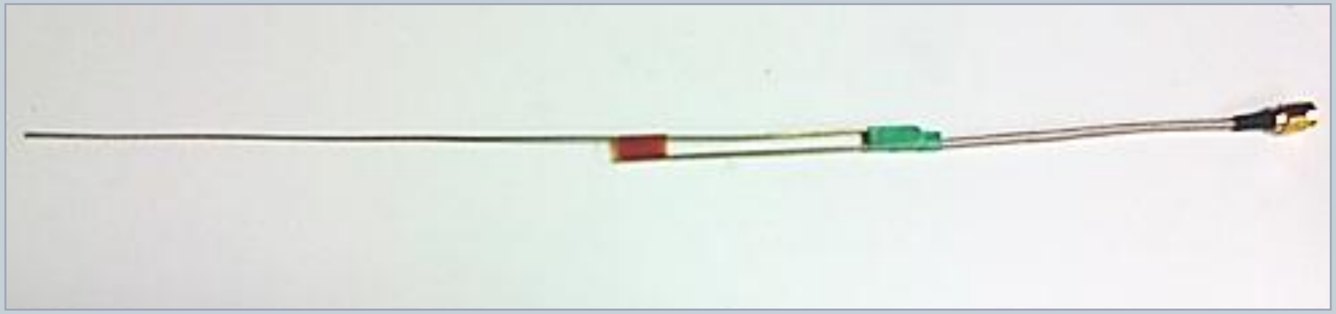
- Small Balloon
  - 100 gram balloon inside parachute
- Fill
  - Not too much
  - Not too little
    - Proper volume calculations for our experiment can be found in the paper Appendix Section B.
- Success
  - The system remained vertical after the larger balloon was released.



J-Pole Antenna

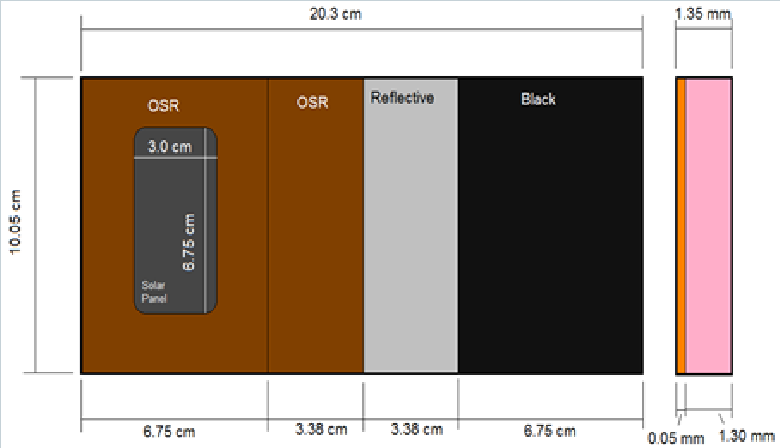
- Properties
  - Unidirectional dipole antenna
  - Easily manufactured at a variety of frequencies
- Online J-Pole Antenna Dimension Calculator
  - Input frequency
    - Frequency for our command pod is 915 MHz
  - Outputs J-pole antenna dimensions

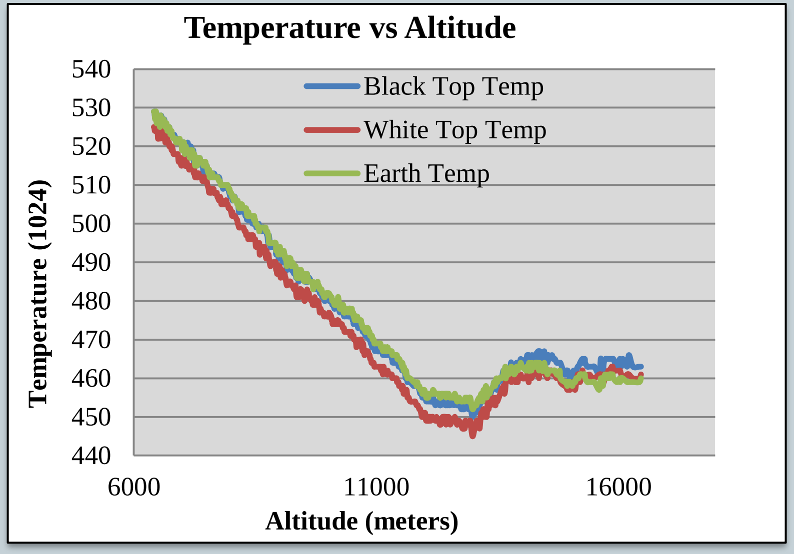




Thermal Model Test

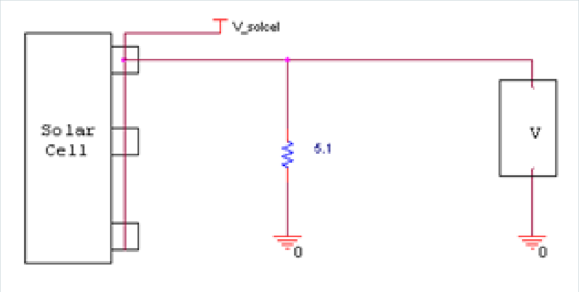
- Testing the Heat Transfer by Radiation of Various Materials.
- Surfaces
  - Solar panel
  - Metal painted black
  - Metal painted white
    - Each surface has a temperature sensor
- Results
  - The metal surface painted white temperature varied the least from the pod surroundings

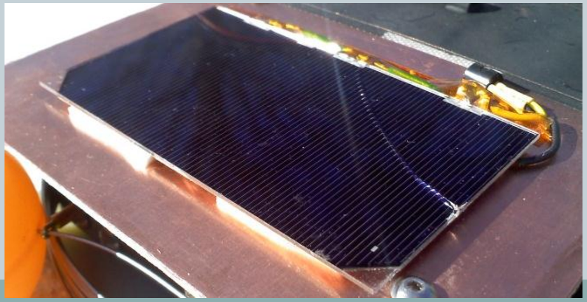


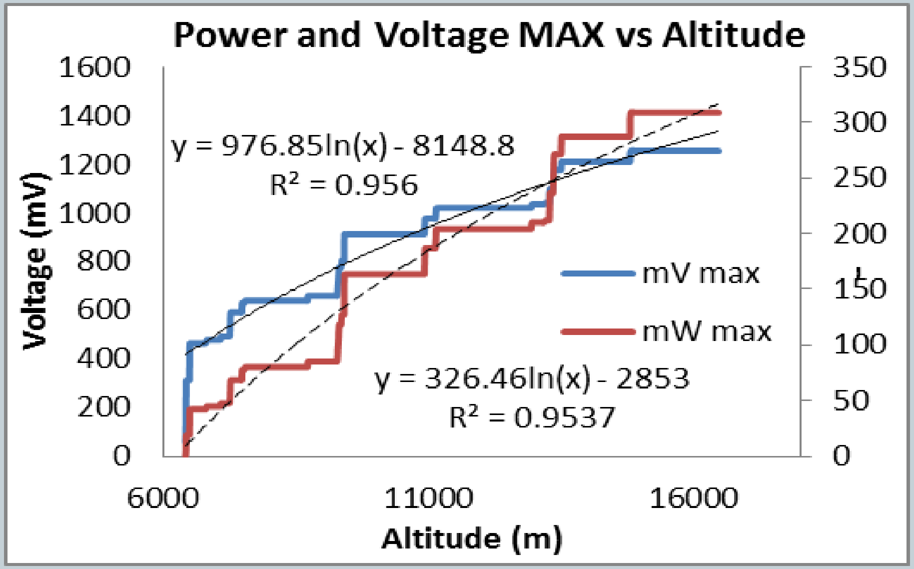


Solar Panel Analysis

- Test the peak voltage and current of a solar panel
  - Attach a resistor of a known resistance and monitor the current and voltage throughout the flight
  - 5.1 Ω resistor was selected
    - Please see paper for proper resistance calculations







Conclusion

- Gathering of Useful Information
- Successes
- Future Work

Acknowledgements

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