Potential Experiments

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for Explorer Post 632: BalloonSat
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Goals for today

- **Discuss potential Experiments**
- **Decide on 7 or 8 experiments/measurements**
  - 4 to 6 'slots' available
  - Down-select in January
- **What additional information is needed?**
  - Assign leaders/advocates to begin designing experiments
  - Present designs in January.

Baseline: Mass Requirements

- **Balloon Requirements**
  - Reach 100Kft
  - With 5lb payload, and 2 lb lift (well under FAA 12 lb limit)
    - Add to this parachute, string, tape, connections (1 lb?)
  - Look at 1200g and 1500g balloons
- **Payloads**
  - Primary Communications, House keeping data
  - Two experiment payloads, including secondary communications
- **Preliminary Mass requirements**
  - Derived from Balloon 5 lb requirement.
  - Primary Communications: 2.5 lb (1134 g)
  - Experiment 1: 1 lb (454 g)
  - Experiment 2 (w/secondary comm): 1.5 lb (680 g)
  - Note: Box weighs 120 g

Baseline: Communications

Communication Requirements

- **Successful Recovery**
- **Two Independent Communications Systems**
  - Transmit GPS Location and Altitude
  - Using Packet Radio.
  - Operating on separate bands
    - 2 m (140 MHz) and 70 cm (440 MHz) bands
  - Independent GPS engines and antenna
  - Position on separate payload packages
    - Top and bottom, incase they become seperated.
  - Lighter system accompanies bottom payload.

Communications Payloads

- **Comm 1: (745 g est +box)**
  - Kenwood TH-D7 w/built in TNC
    - 488 g w/battery & data cable
  - Garmin GPS 15 (15 g)
  - Garmin Antenna (66 g w/cable)
  - 70 cm Antenna (60 g estimate)
  - Beeper (1 oz w/battery, 29 gr)
  - Housekeeping Data (HOBO Data Recorder, 25 g)
    - Internal Temperature
    - Pressure (60 g estimate)
    - Relative Humidity(?)
    - Photosensor (orientation relative to sun)
- **Comm 2: (280 g estimate)**
  - Pocket Tracker transmitter (53 g parts, 31 g cable)
  - Garmin GPS 15 (29 g w/ antenna connector)
  - Microantenna (64 g)
  - 2 m Antenna (100 g estimate)

Typical Measurement

Measurement -> Signal Conditioning -> Data Logger

- **Measurement of interest**
  - Voltage
  - Current
  - Resistance
- **Signal conditioning**
  - Convert measurement to signal for Data Logger
    - Amplify, or reduce signal
    - 2.5 V limit
  - Usually an OpAmp circuit
    - Requires a small amount of power
- **Each HOBO can log up to 4 signals**

Measurement Types

Engineering vs Scientific

- Engineering measurements help to understand the balloon, payload, future missions
  - Internal Temperature
  - Rotation Rate
  - Acceleration Environment
  - Pressure
  - Solar Cell and Power measurements
- Scientific Measurements
  - Atmosphere measurements
    - *External Temperature, Dust, light radiation*
  - Remote Sensing
    - *Ground photograghs, solar imaging, astro imaging.*

Active vs Passive

- Active: need continuous data (powered)
  - Log or transmit data
- Passive: Look only at end result (unpowered)

Experiment Proposal

- **Purpose or Objective**
  - What do you want to learn?
- **Description**
  - What is to be measured?
  - How is it measured?
- **Equipment**
  - Sensor
  - Signal Conditioning
  - Data Acquisition, Data Logging
- **Expected Results**
  - How big an effect do you expect?
  - Preliminary calculations?
- **Requirements**
  - Cleanliness
  - Temperature
  - Altitude?
  - Tests

Potential Experiments

List from EOSS
Exemplary Student Payloads

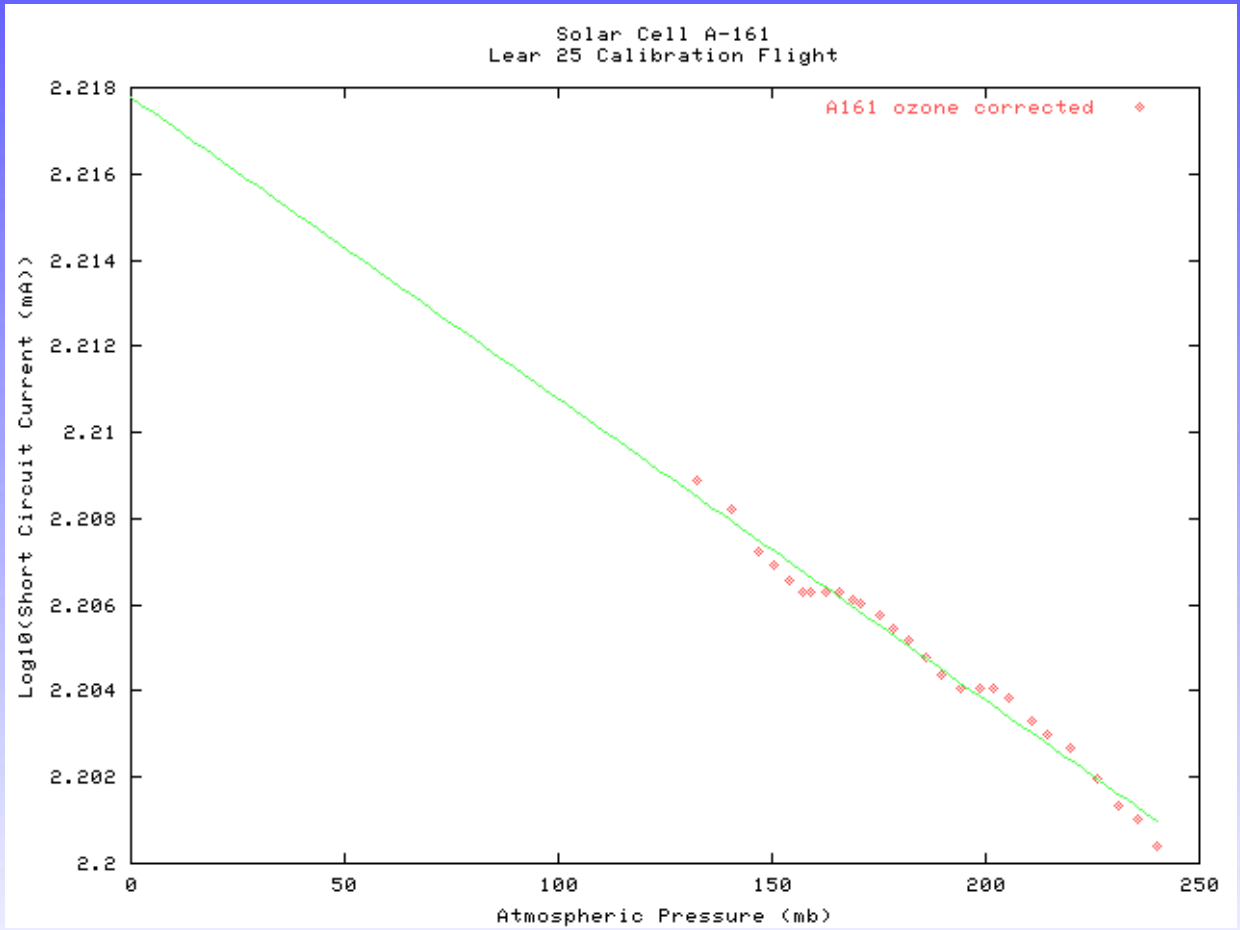
- Solar UV imaging
- Spin Stabilization
- Comparative Barometric pressure sensing
- High altitude photography
- Si solar cell efficiency vs altitude
- Ionizing radiation profiling
- Gravimetry vs altitude
- Ozone profiling
- Pollution profiling
- UV intensity profiling

Potential Experiments II

- **Dust collection**
  - Develop “window” drive mechanism
- **High altitude Photography**
  - Vertical (ground [use remote sensing])
  - Horizontal (Horizon [atmosphere profiling remote sensing])
- **Accelerometer**
  - Document free fall time
- **Solar cell performance**
  - Short Circuit Current Measurement [& temperature]
  - Langley Plot
- **Thin Film Array performance**
  - Near Max Power, Measure Voltage across known load.
- **Payload Rotation (photo diode detection)**
- **Atmospheric Scattering**
  - Rayleigh scattering (blue light) off dust
    - Red & Blue background light levels
  - Spectral Radiometer ([nearly] full spectrum measurements of background.)

Langley Plot

- **Useful for analyzing light adsorption by the Atmosphere.**
  - Plot Log(signal) vs pressure
  - Measure space (vacuum) condition by extrapolating to p=0.



What Are Your Ideas?

How would you Prioritize them?

- **Australian Ballot (optional)**
  (1) List Experiments (up to N) in order of preference
  (2) Weight each and sum
  (3) Delete the lowest
  (4) Repeat with step 2

- **Might be easier to discuss highest priority and vote on lower priorities**

Experiment Leaders

Who will propose and lead each experiment?

- Suggestion: no one should lead more than 2

Schedule

- 8 Dec: Continue Experiments Discussion
- 15 Dec: Party
- 19 Jan 2005:
  - Work (Clean up?) on Proposals
- 26 Jan: (PDR)
  - Decide on Balloon Size, Payload
  - Review Comm 1 Package
  - Select Proposals