Presentation Outline

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  • Mission Statement
  • Success Criteria
  • Concept of Operations
  • Mission Timeline
  • Payload Location
  • Timer Event Matrix
Presentation Outline

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  - System Changes Since STR
  - Design Overview
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  - Mechanical Design
  - Detailed Weight Budget
  - Materials List
  - Hazardous Mechanical Items
  - Electrical Design
  - Electrical Schematics
  - Updated Power Budget

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- Telemetry Pin Assignments
- Hazardous Electrical Items
- Software Design
- Special Requests
Presentation Outline

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  • Power System Testing Results
  • C&DH Testing Results
  • Flight Software Testing Results
  • Spark Gap Spectroscopy Testing Results
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  • Sub bullet
Presentation Outline

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  - Electrical Testing
  - Software Testing
  - System Level Testing
  - Plan for FMSR

- Section 6: Project Schedule
  - Project Schedule
  - August Operations
Presentation Outline

• Section 7: Project Management Update
  • User Guide Compliance Summary
  • Team Picture
  • Team Organization Chart/Contact Matrix
  • Monetary Budget
  • Availability Matrix
  • Worries and Concerns
  • Conclusions

• Section 8: Launch Procedures
  • Sub bullet
Presentation Outline

• Section 8: Launch Procedures
  • Operations Prior to Sequence Testing in Norway
  • Time of Operations
  • Experiment Access
  • Team Attendance to Support Launch
1.0 Mission Overview

Sophia LoSchiavo
Action Items from STR

• Spark Gap Science Summit
• Participated in April 14th, 2018 Balloon Launch
• Assemble Payload systems and integrate together
• Resolve Data Handling Method
• Get parts on time
Mission Statement

• Our mission is to observe the effects of the Aurora Borealis on the atmosphere while testing the performances of a custom modified Aerogel thermal insulation and Iridium’s data rates

  • We intend to compare the effects of the Aurora Borealis on the atmosphere with average atmospheric conditions

  • We expect to explore the benefits of the modified Aerogel insulation compared to the limits of Multi Layer Insulation (MLI)

  • We intend to compare the data relay performance of the Iridium network to the rocket’s RS232 line

• The full mission experience this project provides will directly benefit students of the team and encourage future research opportunities at Capitol Technology University
Success Criteria

**Minimum Success Criteria:**
- Get at least a single data package from Iridium
- Be able to plot the location of the rocket from that data package
- Receive at least one spectrographic measurement from the spark gap experiment
- Receive at least one complete temperature comparison from the insulation demonstration

**Comprehensive Success Criteria:**
- Receive 60% RS232 data through Iridium
- Receive 60% complete spectrographic measurements during electric excitation of particles
- Receive a series of temperature comparisons at various altitudes to identify trends in insulation performance
Concept of Operations

Launch to apogee

Apogee

Descent

Splashdown
ConOps Cont’d

1. Launch
   • Systems power on

2. Launch to Apogee
   • Systems wait on timer for skirt deployment
   • Thermistors begin taking readings until splashdown

3. Apogee
   • Skirt deploys
   • Spark Gap Begins Sparking
   • Spectrograph begins taking readings
   • Iridium antennas begin transmitting telemetry

4. Descent
   • Spark Gap continues sparking
   • Spectrograph continues taking readings
   • Thermistors continue taking readings
   • Iridium antennas continue transmitting telemetry

5. Splashdown
   • Everything hits the water at terminal velocity and is destroyed
## Mission Overview

### Mission Statement

### Mission Timeline

<table>
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<tr>
<th>Event</th>
<th>Time (sec)</th>
<th>2 sigma Low Altitude (km)</th>
<th>Nominal Altitude (km)</th>
<th>2 sigma High Altitude (km)</th>
<th>Nominal Range (km)</th>
<th>Velocity (m/s)</th>
<th>Nominal Q (psf)</th>
<th>Mach NO.</th>
<th>Flight Elevation (deg)</th>
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• We are confirming our mounting location as spot 7
# Timer Event Matrix

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<tr>
<th>Event</th>
<th>Time On</th>
<th>Units</th>
<th>Dwell Time</th>
<th>Units</th>
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<tr>
<td>GSE 1</td>
<td>(T-X)</td>
<td>(sec)</td>
<td>(sec)</td>
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<td></td>
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<td>GSE 2</td>
<td>(T-X) sec)</td>
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<td>(sec)</td>
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<tr>
<td>TE-R</td>
<td>(T+X)</td>
<td>(sec)</td>
<td>(sec)</td>
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<td>TE-1</td>
<td>3</td>
<td>(T+X)</td>
<td>3 (sec)</td>
<td></td>
<td>Launch Indicator (T+3 seconds until T+6 seconds)</td>
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<td>TE-2</td>
<td>74</td>
<td>(T+X)</td>
<td>3 (sec)</td>
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<td>Indicates Skirt Deployment (T+74 seconds until (T+77 seconds)</td>
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<tr>
<td>TE-3</td>
<td></td>
<td>(T+X)</td>
<td>(sec)</td>
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</table>

After 15-20 minutes, our payload will automatically disable.
System Changes since STR

• Addition of filtering or some other AC sinking to prevent noise emitted from transformer
  • Semi-successful
• TTL Serial to RS232 functionality now handled by small breakout board rather than an in house circuit
  • Still uses the RS232 chip
Design Overview - Top
Design Overview - Front
Design Overview - Right
Design Overview - Left
Design Overview - Bottom
Design Overview - Iso Top Front Right
Design Overview - Iso Top Right Back
Design Overview - Iso Top Back Left
Design Overview - Iso Top Left Front
Mission Overview: Mission Statement

Functional Block Diagram

Small text contains voltage levels and data types as it flows through system, full image will be attached, see Aether System block diagram 4_29_18.png
Payload inhibits

Transformer

Spark Gap

Wall Corner Welds (welds not displayed)
Mechanical Design

- Insulation cube 2
- Glass covered antenna
- Charging port
- Status LED
- Insulation cube 1
Mechanical Design

Port used for camera interface

Castled Walls
Mechanical Design

Flame Camera with ‘booster seat’

Power board

Pi 3
Mission Overview:
Mechanical Design

Status LED

Battery Assembly
<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Total Weight (lbs)</th>
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<tbody>
<tr>
<td>Structure</td>
<td>3214.1g = 7.086 lbs</td>
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<tr>
<td>Power</td>
<td>367.117g = 0.809 lbs</td>
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<tr>
<td>C&amp;DH</td>
<td>246.8g = 0.544 lbs</td>
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<tr>
<td>Spark Gap and insulation experiments</td>
<td>347g = .765 lbs</td>
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<td>RockSat Plate</td>
<td>1467g = 3.235 lbs</td>
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<td>Ballast Weight</td>
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<tr>
<td>Total</td>
<td>12.439 lbs</td>
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<tr>
<td>Over/Under</td>
<td>2.561 lbs</td>
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Materials List

• 6061 Aluminum
• Stainless nuts and bolts
• Quartz Crystal
• Glass
• Viton Rubber
• G10/FR4
• Teflon Coated Copper Wire
• PLA Plastic
Hazardous Mechanical Items

• 4 Antennas
  • One for all four sides
• There will be Carbon based aerogel
  • Used in insulation
  • It is sealed within Kapton tape
• About 6 square inches of material ~20 grams
**Mission Overview: Mission Statement**

- A simple DCDC converter used to output 5V and -5V
  - Used to support RS232 Chip in C&DH
- An adafruit daughter board to provide gain and ADC for detecting sparks

**Electrical Design - Not shown**
# Updated Power Budget

## CTU Project Aether - Power Budget

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<th>Subsystem</th>
<th>Date</th>
<th>Voltage (V)</th>
<th>Max Current (A)</th>
<th>Start Time (min)</th>
<th>Time On (min)</th>
<th>Watts</th>
<th>Ah</th>
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<th>Time On (min)</th>
<th>Watts</th>
<th>Ah</th>
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<td>0.84</td>
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# of Flights Margin: 20000.0
# Power Interface

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<th>Power Pin</th>
<th>Function</th>
<th>Intended Use</th>
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<td>1</td>
<td>GSE 1</td>
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<td>2</td>
<td>Timer Event Redundant (TE-RA)</td>
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<td>3</td>
<td>Timer Event Redundant (TE-RB)</td>
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<tr>
<td>4</td>
<td>Timer Event 1 (TE-1)</td>
<td>Launch indicator signal for power on</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Main payload ground</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>9</td>
<td>GSE 2</td>
<td>N/C</td>
</tr>
<tr>
<td>10</td>
<td>Timer Event 2 (TE-2)</td>
<td>Skirt deployment signal for science instruments</td>
</tr>
<tr>
<td>11</td>
<td>Timer Event 3 (TE-3)</td>
<td>N/C</td>
</tr>
<tr>
<td>12</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>N/C</td>
</tr>
<tr>
<td>15</td>
<td>GND</td>
<td>N/C</td>
</tr>
</tbody>
</table>
## Telemetry Interface

<table>
<thead>
<tr>
<th>Telemetry</th>
<th>Function</th>
<th>Intended Use</th>
<th>19</th>
<th>Ground</th>
<th>N/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog 1</td>
<td>N/C</td>
<td>20</td>
<td>Parallel Bit 7</td>
<td>N/C</td>
</tr>
<tr>
<td>2</td>
<td>Analog 2</td>
<td>N/C</td>
<td>21</td>
<td>Parallel Bit 8</td>
<td>N/C</td>
</tr>
<tr>
<td>3</td>
<td>Analog 3</td>
<td>N/C</td>
<td>22</td>
<td>Parallel Bit 9</td>
<td>N/C</td>
</tr>
<tr>
<td>4</td>
<td>Analog 4</td>
<td>N/C</td>
<td>23</td>
<td>Parallel Bit 10</td>
<td>N/C</td>
</tr>
<tr>
<td>5</td>
<td>Analog 5</td>
<td>N/C</td>
<td>24</td>
<td>Parallel Bit 11</td>
<td>N/C</td>
</tr>
<tr>
<td>6</td>
<td>Analog 6</td>
<td>N/C</td>
<td>25</td>
<td>Parallel Bit 12</td>
<td>N/C</td>
</tr>
<tr>
<td>7</td>
<td>Analog 7</td>
<td>N/C</td>
<td>26</td>
<td>Parallel Bit 13</td>
<td>N/C</td>
</tr>
<tr>
<td>8</td>
<td>Analog 8</td>
<td>N/C</td>
<td>27</td>
<td>Parallel Bit 14</td>
<td>N/C</td>
</tr>
<tr>
<td>9</td>
<td>Analog 9</td>
<td>N/C</td>
<td>28</td>
<td>Parallel Bit 15</td>
<td>N/C</td>
</tr>
<tr>
<td>10</td>
<td>Analog 10</td>
<td>N/C</td>
<td>29</td>
<td>Parallel Bit 16 (LSB)</td>
<td>N/C</td>
</tr>
<tr>
<td>11</td>
<td>Parallel Bit 1 (MSB)</td>
<td>N/C</td>
<td>30</td>
<td>Parallel Read Strobe</td>
<td>N/C</td>
</tr>
<tr>
<td>12</td>
<td>Parallel Bit 2</td>
<td>N/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Parallel Bit 3</td>
<td>N/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Parallel Bit 4</td>
<td>N/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Parallel Bit 5</td>
<td>N/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Parallel Bit 6</td>
<td>N/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>N/C</td>
<td>N/C</td>
<td>32</td>
<td>RS-232 Data (TP1)</td>
<td>Telemetry data in</td>
</tr>
<tr>
<td>18</td>
<td>Ground</td>
<td>N/C</td>
<td>33</td>
<td>RS-232 GND (TP2)</td>
<td>Telemetry reference ground</td>
</tr>
<tr>
<td>19</td>
<td>Ground</td>
<td>N/C</td>
<td>34</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>20</td>
<td>Ground</td>
<td>N/C</td>
<td>35</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>21</td>
<td>Ground</td>
<td>N/C</td>
<td>36</td>
<td>Ground</td>
<td>N/C</td>
</tr>
<tr>
<td>22</td>
<td>Ground</td>
<td>N/C</td>
<td>37</td>
<td>Ground</td>
<td>N/C</td>
</tr>
</tbody>
</table>
Hazardous Electrical Items

- Four 18650 batteries - 200 grams of Lithium Ion
- High voltage spark gap - upwards of 80 kilovolts
  - Strong insulators (G10, Quartz Crystal, Viton) will surround the Spark Gap, ensuring that the spark will occur inside the tube
1. Power On (T-1s)
2. Initial State
   a. Software Boot
   b. Iridium Startup
   c. Camera Startup
   d. Temperature Reading
3. Event 1 (T+30s)
4. Main State
   a. AOS with Iridium
   b. Transmit Camera data and HK via RS-232
   c. Transmit Camera data and HK via Iridium (packaged with location data)
FSW Boot Sequence

This flow structure will outline the basic Power on sequence that our Raspberry Pi 3 and other software components will follow in order to assure proper protocol.

SYSTEM POWER ON

RECEIVE POWER FROM EPS

RUN THROUGH RASPBERRY PI BOOT SEQUENCE

TURN ON COMMUNICATIONS?

TURN ON THERMISTOR EXPERIMENT?

COLLECT AND CONVERT DATA

TURN ON SPECTRO EXPERIMENT?

COLLECT AND CONVERT DATA

DETECT SPARK

TRANSMIT

Loops Infinitely Until End of Mission
**C&DH**

This flow structure will outline the basic process of how our data and other payload's data will be processed and handled for transmission.

1. DETECT SPARK
2. RAW DATA
3. RASPBERRY PI 3 via SERIAL (Spectrograph)
4. RASPBERRY PI 3 via GPIO (Thermistors)
5. STACK DATA TO FILE
6. PLACE HEADER AND FOOTER TAGS OF EACH DATA SET
7. MODEM COMMAND IS GENERATED?
   - Yes
   - No
   - COMMAND STORED IN MODEM?
     - Yes
     - No
8. TRANSMIT VIA RS232
9. TRANSMISSION TO IRI DIUM

Loop infinitely until 15-18 minute timer
Packetizing (per transmit)

- Science Data will include the following:
  - Time Stamp
  - Sample Number
  - Data in XY Coordinates

- Temperature Data:
  - Time Stamp
  - Sample Number
  - Data in Celsius
  - Sensor Address

- Modem Data
  - Location data to be paired with all incoming data via email
Software Design

• Spectrograph Data into the RS232 Telemetry Line
  • Ensuring that the data is sent down for primary science
• FSW tasking is done using Python 3.6 with the Raspberry Pi 3
  • Copies the Same data from Spectrometer Camera
    • Data size is comparable to the maximum message size (340 bytes)
• Logs Temperature data
• Logs Sample numbers
• Logs time (in reference to T-0 seconds)
• Compiles all elements for transmission
  • Duplicated to both modems
• Spectrograph and Iridium modem hold built in software
  • Software is then interfaced with Python to scripts for ease of proper command usage.
Special Requests

• There are no special requests at this time.
3.0 Subsystem Testing Results

Sam Lawson
• Weight of metal components: 7.086 lbs
• Design is NOT Final
Mechanical Structure: Summary

- System is 85% Complete
- CADD reflects the most up to date hardware locations
- Vibration Analysis was done to find weak areas
  - Results pointed to locations that needed more support

- Wooden mock up of payload was used to drive interior reorganization
• About 350 hz, Modem Hardware Mount’s oscillation led to more bolts being used to mount it to the payload bottom plate
• Oscillation at various frequencies of other small parts showed what will need viton rubber to dampen or make more stable
Mechanical Structure: Changes

- Walls were Castled - reduces drag on Payload internals
- Wiring now goes through the top of the castle
- Transformer wrapped in viton insulation
• Pipe clamps are adapted and used to fasten spark gap and transformer

• Spark Gap moved from center edge of payload, G10 platform changed to account for curve of deck plate

• Not shown, batteries will be warped in a simple thermal blanket or mylar
Mission Overview: Mission Statement

• A small Board/PLA Plastic piece will be added to the splitter and attached to the nearby battery mount or power circuit board.
  • Increase stability
Mechanical Structure: Yet to be tested

• Most mechanical testing will happen at NASA Wallops Flight Facility

• Simulations will continue to run as time permits
Mechanical Structure: Risk Matrix

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vibrations during launch could loosen screws</td>
<td>Apply loctite to all screws and bolts on final assembly</td>
</tr>
</tbody>
</table>
The power system will draw a brief impulse from rocket power on Launch (TE-1), this will activate the payload which will run off of internal batteries.

- Weight: 0.809lbs

Dashed black is what was built on a proto board. Dashed orange has yet to be tested this project cycle.
Mission Overview: Mission Statement

• Power circuit was built on a proto board
  • Worked as intended
• Power board was then integrated and flown on a balloon payload
  • System ran out of battery early because of the addition of heaters that drew 1A each. We do not plan to use these heaters on the payload.
  • Worked as intended

Power System Testing Results

[Image of a circuit board]
Power System Testing Results - Still to be Tested

• Power Board’s opto coupled circuit has not been tested during this project cycle
  • Has been flown on previous mission (RSX 17)

• Spark Detector circuit has yet to be tested
  • Simple adafruit daughter board, electrical testing should be simple. software interfacing will be more time consuming
# Power System: Risk Matrix

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inability to produce high voltages will prevent spark gap functionality</td>
<td>Conduct testing to verify that the appropriate voltages can be achieved.</td>
</tr>
<tr>
<td>2</td>
<td>Six month containment before launch will cause some battery discharge</td>
<td>Recharge after coming out of containment.</td>
</tr>
<tr>
<td>3</td>
<td>Spark Gap pulsing causes degradation of batteries</td>
<td>Mitigate by including a capacitor bank to deal with high loads. OR Accept as the mission is short compared to battery degradation.</td>
</tr>
</tbody>
</table>
C&DH Testing Results

• Overall, 33% complete with confidence.
  • Temperature data handling and commanding is complete and implemented
  • Iridium modem scripts are ready to be tested with max loads for transmission.
  • RS-232 will be tested for interfacing with the Spectroscopy camera and the thermistors
  • Safety feedback scripts will be implemented once all systems are complete.
C&DH Testing Results

- RS-232 is to be tested for its limits and capabilities.
  - RS-232 ‘mock’ rocket receiver will be built and setup for summer testing and interaction with the rest of the payload.
  - Testing capabilities with MAX3232 chips and MAX232 chips for RS-232 data handling and rates.
  - Components are being received to get started on this test ASAP.
Command & Data Handling:

- Examples of flight data expected for RockSat-XN mission

```
“filename.sbd”
>AT+SBDWRT<
>Time Stamp<
>Sample #<
>Temperature Set<
>Spectrograph (X,Y)<
>Spectrograph (X,Y)<
>Spectrograph (X,Y)<
>Spectrograph (X,Y)<
>Spectrograph (X,Y)<
...
```

Receive an Email

Lat & Lon are provided to Email

Expected Result of Transmission
C&DH Testing Results

- Methods for temperature data handling were a success.
- The same method for temperature data handling will be implemented to the flight model.
### Risk Matrix

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mission profile may not allow enough time to transmit all of our telemetry</td>
<td>Prioritize data to send the most important telemetry first</td>
</tr>
<tr>
<td>2</td>
<td>Rocket rotation may cause data desynchronization during transmission</td>
<td>Send most important data through RS-232 line</td>
</tr>
<tr>
<td>3</td>
<td>Packets get split inconsistently, some packet loss</td>
<td>Cut packet size down to ensure full transmission</td>
</tr>
</tbody>
</table>
Mission Overview: Mission Statement

• Overall, 33% complete with confidence
  • Files are being prepped for multi-threading and processing for the spectroscopy camera and the thermistors.
  • Thermistor commanding has been tested and will be implemented to the flight model.
  • Spectroscopy interface is to be tested with a Raspberry Pi linux system (CML) to test reading and writing to the camera.
The flight software is currently being written.
Upon receiving parts testing will begin to identify ideal data rates for transmission.
Additionally, tests will be conducted to confirm that our software interfaces properly with our systems.

Design NOT Final
## Flight Software: Risk Matrix

### Risk Matrix

<table>
<thead>
<tr>
<th>Possibility</th>
<th>FS.RISK 1</th>
<th>FS.RISK 2</th>
<th>FS.RISK 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequence</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Risk Details

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk Description</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A bug causes incorrect data parsing</td>
<td>Rigorously test code to eliminate all potential bugs</td>
</tr>
<tr>
<td>2</td>
<td>Systems are powered on at the wrong time</td>
<td>Test timer functions of pi to confirm that the time syncs with the timing matrix</td>
</tr>
<tr>
<td>3</td>
<td>Systems fail to boot on</td>
<td>The RPi will be tested to ensure that the boot in various startups</td>
</tr>
</tbody>
</table>
Spark Gap Spectroscopy Review/Changes

• Transformer now mounted in a similar fashion to spark gap

• High voltage mounting style
Spark Gap Spectroscopy Testing Overview

- Testing is continuing, migrating more components into a vacuum environment
- Noise reduction tests are continuing
Mission Overview: Mission Statement

• RF noise due to the transformer was defined on April 9th when Penn State Visited

• Initial Readings from Penn State
  • Base Line of environment
  • With Transformer Active

• It was reported that there were 30dB noise spikes

• There were multiple contributors to noise - this is not all due to the transformer.

Spark Gap Spectroscopy Testing Results - Noise

Penn State’s review of CTU Spark Gap EMI
Spark Gap Spectroscopy Testing Results - Noise

• Current Testing set up
• Most noise is because of the computer power supply when actively supplying power
Spark Gap Spectroscopy Testing Results - Noise

• The Computer power supply has multiple power transformers and switching frequencies

• Removing the Computer power supply and using batteries reduced the noise level substantially. (10 dB spikes)

• Using ferrite chokes has also reduced the noise dramatically (3 dB spikes)

• These results have been measured using equipment from Penn State

• Design is NOT Final
# Spark Gap Spectroscopy: Risk Matrix

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spark gap arcs to a non-ground connection</td>
<td>Use a layered FR-4 plate to mount the spark gap. Isolate the spark within a quartz crystal tube</td>
</tr>
<tr>
<td>2</td>
<td>Spectrographic camera fails because of G-force</td>
<td>Use appropriate mounting and padding within structural box to reduce impulse. Otherwise, accept risk</td>
</tr>
<tr>
<td>3</td>
<td>Draws too much power</td>
<td>On ground testing in and out of vacuum to understand the performance</td>
</tr>
</tbody>
</table>
Insulation Demonstration Overview

- System is 90% complete
- Weight: .122lb
- Design is NOT Final
• Insulation mounting boxes are now wider
  • Done to accommodate larger, more reliable thermistors

• Insulation mounting boxes now re-arranged on plate
  • Done to accommodate larger size
• The thermistors and their data collection system were successfully tested and validated on a high altitude balloon flight.

• Metal mounting boxes are in the process of being constructed.

• Flight insulation still needs to be acquired.
Insulation Demonstration: Risk Matrix

<table>
<thead>
<tr>
<th>RISK #</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One or both thermistors fail during the flight</td>
<td>Accept Failure</td>
</tr>
</tbody>
</table>

ID.RISK 1
4.0 Integrated Subsystem Testing Results

Sophia LoSchiavo
Integrated Subsystem Testing Status

• Structure Current Status (85% Completed)
  • Structure is designed and components are placed in CAD,
  • To be completed
    • Final design of the spark gap
    • Additional support components depending on further vibration testing
    • Placement and mounting of Spark gap ferrite chokes
Integrated Subsystem Testing Status

• Electrical Current Status (60% Completed)
  • Power system has been physically tested
• To be completed
  • Physical Board created with parts soldered on
  • Full integration of DCDC converter and Adafruit ADC Daughter board
Integrated Subsystem Testing Status

• FSW Current Status (33% Completed)
  • Iridium commands and thermistor commanding is made
• To be completed
  • Implement multi-processing and multi-threading to handle multiple tasks.
• Commanding for the camera with CML in Raspberry Pi
• Safety implementations for the Spark Gap and triggering.
Integrated Subsystem Testing Status

• CDH Current Status (33% completed)
  • RS232 parts have been received and testing will now begin.
  • Camera to be plugged into Raspberry Pi
• To be completed
  • RS232 interfaced with Raspberry Pi for camera and thermistor data
• Iridium Subscription needs to be activated
• Antennas are on their way
Integrated Subsystem Testing Status

• Insulation Current Status (90% completed)
  • Code and thermistors work and are ready to be integrated.
• To be completed
  • The insulation needs to be ordered and received
  • Insulation module to be assembled and integrated
Integrated Subsystem Testing Status

• Spark Gap Current Status
  • Sparking in low pressures has been tested
  • Spark gap and Camera are working together, gathering data
  • Initial noise reduction testing has been done

• To be completed
  • Final Design of Spark gap
  • Final Ferrite choke and filter placement
5.0 Plan for FMSR

Dean Zinetti
Mechanical Testing

- Vibration Simulations from 0 to 2000 Hz
Mission Overview: Mission Statement

• Full system (Flat-sat) tests are to be performed to validate functionality of the following:
  • Communications System
  • Spectroscopy Instrument
  • Raspberry Pi and other hardware
• Safety inhibits and components to be implemented
• These items will be tested weekly towards the end of May to ensure our likelihood of surviving during launch.

Electrical Testing
Software Testing

• Weekly testing on build completion every Wednesday through summer until integration/test week
• Testing plans will be written for members to test daily or weekly.
• A test station will be setup for the payload, for ease of testing.
• Observations will be recorded and data will be stored and analyzed to detect bugs and implement fixes.
• Tests will begin towards the end of May.
System Level Testing

• Once fully integrated, we will start conducting payload boot up testing
  • To be done by May 19th
• During this time we will also test and verify our telemetry systems (Iridium & RS-232)
  • To be done by May 26th
• The rest of the time until integration week will be spent conducting full mission simulations and DITL testing
Plan for FMSR

- Conduct daily/weekly tests of our subsystems.
- Continue the testing of the spark gap.

Major Hurdles

- Setting the final design of Spark Gap
- Interfacing with RS232 and multi-threading
- Funding
6.0 Project Schedule

Marissa Jagarnath
Updated Project Schedule

Spring Semester from January 2018 to May 2018

April-May

• Assemble, integrate, and test systems together
• Test data handling method
• Integrated Subsystem Testing Review April 30, 2018 @ 2pm
• Participate in HAB launch April 14, 2018
• Start conducting simulated stress tests
Summer Recess from May 2018 to August 2018

May
- Integrated Subsystem Testing Review April 30, 2018 @ 4pm EST
- Prepare for FMSR

June
- Full Mission Simulation Review FMSR date & time TBD
- Prepare for IRR & Test Week

July
- Integration Readiness Review IRR date & time TBD
- Launch Readiness Review LRR

August
- Test Week @ NASA Wallops August 12-18, 2018
- Final Integration @ NASA Wallops
Project Schedule Cont’d

Fall Semester August 2018 to December 2018
Payload Lock Period

Spring Semester January 2019 to May 2019

January
• Launch @ ACS (Launch Window: January 10-13, 2019)

February
• Debrief and data reports

Weekly team meetings are every Friday at 2pm EST
Summer weekly meetings are every Wednesday at 2pm EST
August Operations

1. Test full system functionality
2. Switch the Payload ON for sequence testing
3. Switch the Spark Gap OFF for integrated testing.
4. Leave Safety inhibits attached to payload
7.0 Project Management
Update
Marissa Jagarnath
### User Guide Compliance Summary

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; plane of plate?</td>
<td>Yes</td>
</tr>
<tr>
<td>Weight 30.0 +/- 1.0 (15.0 +/- 0.5) lbs?</td>
<td>Yes</td>
</tr>
<tr>
<td>Max Height &lt; 10.75&quot; (5.13&quot;)</td>
<td>Yes</td>
</tr>
<tr>
<td>Bottom of deck has flush mount hardware?</td>
<td>Yes</td>
</tr>
<tr>
<td>Within Keep-Out Zone</td>
<td>No</td>
</tr>
<tr>
<td>Using &lt; 10 A/D Lines</td>
<td>Yes</td>
</tr>
<tr>
<td>Using/Understand Parallel Line</td>
<td>Understand, Not using</td>
</tr>
<tr>
<td>Using/Understand Asynchronous Line</td>
<td>Understand, Not using</td>
</tr>
<tr>
<td>Using X GSE Line(s)</td>
<td>No</td>
</tr>
<tr>
<td>Using X Non-Redundant PWR Lines (TE-1, TE-2, TE-3)</td>
<td>Yes; TE-1, TE-2</td>
</tr>
<tr>
<td>Using X Redundant Power Lines (TE-R)</td>
<td>No</td>
</tr>
<tr>
<td>Using &lt; 1 Ah</td>
<td>Yes</td>
</tr>
<tr>
<td>Using &lt;= 28 V</td>
<td>Yes</td>
</tr>
<tr>
<td>Using RF (If yes, list frequency and TX Power)</td>
<td>1616 - 1626.5 MHz, 7-10W</td>
</tr>
<tr>
<td>Using deployable?</td>
<td>No</td>
</tr>
<tr>
<td>Using ITAR and/or Export Controlled hardware</td>
<td>No</td>
</tr>
</tbody>
</table>
### Summer 2018 RS-XN Contact Matrix

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Day Phone</th>
<th>Cell Phone</th>
<th>Text?</th>
<th>Email</th>
<th>Citizenship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Email</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
<td><a href="mailto:ctuprojectaether@gmail.com">ctuprojectaether@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td>Advisor</td>
<td>Angela Walters</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td><a href="mailto:amwalters@captechu.edu">amwalters@captechu.edu</a></td>
<td>U.S.</td>
</tr>
<tr>
<td>Systems Engineer</td>
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</tr>
<tr>
<td>Role</td>
<td>Name</td>
<td>Day Phone</td>
<td>Cell Phone</td>
<td>Texts?</td>
<td>Email</td>
<td>Citizenship</td>
</tr>
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</tr>
<tr>
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<tr>
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</tr>
</tbody>
</table>
Monetary Budget

- The estimates of travel/lodging are covering for 7 students to attend the launch.
- The following amounts are rough estimated based on our current research.
- The first half of the installment has been paid.

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>Payload</td>
<td>$1,200.00</td>
</tr>
<tr>
<td>Wallops Lodging</td>
<td>$2,565.00</td>
</tr>
<tr>
<td>Norway Travel</td>
<td>$5,581.00</td>
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<tr>
<td>Norway Lodging</td>
<td>$3,467.00</td>
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<tr>
<td>Registration</td>
<td>$15,000.00</td>
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<tr>
<td>Fees paid</td>
<td>($7,500)</td>
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<tr>
<td><strong>Total Balance</strong></td>
<td><strong>$20,313.00</strong></td>
</tr>
<tr>
<td>Concerns</td>
<td>Potential Mitigation</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>The mission profile may not allow enough time to transmit all of our telemetry.</td>
<td>Accept and Ignore</td>
</tr>
<tr>
<td>Six month containment before launch will cause some battery discharge.</td>
<td>Top off charge 75% and accept, request to check and charge batteries at Andoya.</td>
</tr>
<tr>
<td>How long do we have before we have to remove inhibits prior to launch?</td>
<td>To remove in Norway for the safety of the other payloads.</td>
</tr>
</tbody>
</table>
Conclusions

For the FMSR:

• Establish a summer 2018 meeting date
• Continue testing of systems
• Develop prototypes
• Establish limitations
8.0 Launch Procedures

Dean Zinetti
Operations Prior to Norway Sequence Testing

- What will need to be done with your experiment hardware prior to sequence testing in Norway in January 2019?
  - Testing Raspberry Pi data handling and commanding throughout all of the systems.
  - Communications with RS232 and Iridium with the Raspberry Pi
- How much time will these operations take?
  - These will take the duration of the summer until August for full integration testing
- What type of access will you need to your experiment?
  - “Walk up access” - Need to be able to plug in an 18650 battery cell charger to ensure full charge before sequence testing and launch.
From the CTU team, we plan to send 4 students on the Norway trip.
Appendix
Update on Partnerships

• The CTU team is collaborating with UMBC for the spark gap.
• Diamond Fabrication
• Gilbert Gamra, Graphics Designer of Pittsburgh, PA
• Steve Schroen & Toyota
Questions?