SEDs UWM
Conceptual Design Review

UW-Milwaukee
Megan Kocher, Carly Rowe, Wesley Roth, Perry Spott
10/8/19
CoDR Presentation Contents

- Section 1: Mission Overview
- Section 2: Conceptual Design Overview
- Section 3: Management
- Section 4: Conclusions
Mission Overview
Our first experiment’s goal will be to measure Cosmic rays and their energies at corresponding altitudes.

We are doing this to compare our experiments known quantities and energies of high energy particles at apogee. Our goal is to create a inexpensive accurate cosmic ray detector.
– Our second experiment’s goal will be to measure the amount of greenhouse gases in the different layers of the atmosphere.

– We would like to measure the current amount of greenhouse gases in the atmosphere to understand the severity of its existence in the earth's atmosphere.
Mission Overview: Mission Objectives

• Minimum success criteria
  – Our scintillator experiment will need to be able to tell the
difference between low energy particles at lower altitudes and
high energy at higher altitudes.
  – Depending on the accuracy of the spectrometer for our
greenhouse gas detector, we will calculate the minimum
amount of carbon atoms needed in the air to create a
noticeable absorption or emission line in our atmosphere.
Mission Objective - System Requirements

– A Scintillator that is fine tuned to detect particles that will reach it that started with around 100 GeV.
  • A detector (UV spectrometer) that will receive photons of the energies emitted.
– A spectrometer that can take measurements of the photons in our upper atmosphere.
– RaspberryPi, Arduinos, Micro-controllers, IMU, Geiger Counter.
– We will use a multi structured platform. Each platform will be made out of a treated wood and connected via bolts. We will use washers to adjust our weights.
Mission Overview: Expected Results

- Scintillator Experiment
  - At lower altitudes a higher particle concentration is expected.
  - These particles are expected to be of lower energy.
  - At apogee, our results should correlate to the plot on the right.
  - Creation of a cheap scintillator capable of analyzing cosmic rays
Mission Overview: Expected Results

- Greenhouse Gas Experiment
  - We expect to have results higher than the results received in 2008 in the graph above due to current research showing trends of increasing CO2 in the atmosphere.

From Figure 6, Foucher, et al., 2011, "Carbon dioxide atmospheric vertical profiles retrieved from space observation using ACE-FTS solar occultation instrument", doi:10.5194/acp-11-2455-2011
Mission Overview: Theory and Concepts

- Scintillator Experiment:
  - High energy particles lose energy via momentum when traveling through material.
  - Scintillators release energy via photons of comparable energy that was gained via momentum.
  - A spectrometer will capture and measure the energies of photons.
Mission Overview: Concept of Operations

• Data collection
  – The equipment will all be active during the whole flight, however, at apogee, the greenhouse gas experiment data may be void.

• Altitudes of interest
  – Stratosphere/Ozone (10-50 km) for greenhouse gases
  – All altitudes for the scintillator experiment

• Data turn off
  – 30 minutes after T-3 is triggered (subject to change)
Flight Path

- **t ≈ 0 min**
  - G switch triggered
  - All systems on
  - Begin data collection

- **t ≈ 1.3 min**
  - High Concentration of N2
  - Altitude: 75 km

- **t ≈ 2.8 min**
  - Apogee
  - Altitude: ≈115 km

- **t ≈ 4.0 min**
  - High Tumble Rate
  - Altitude: 95 km

- **t ≈ 5.5 min**
  - End of Orion Burn – Spin Rate Largest
  - Altitude: 52 km

- **t ≈ 5.5 min**
  - Low N2, Low spin
  - Chute Deploys

- **t ≈ 15 min**
  - Splash Down
Design Overview
Design Overview

- **Major components:**
  - **Structure:**
    - 2 stacked disks
  - **Major technology dependencies:**
    - Scintillator - measure the energies of particles in the GeV range
    - Spectrometer 1 - measure photons emitted by the Scintillator in the UV band and record count and energy.
    - Spectrometer 2 - measure the count and energy of photons in optical band.
    - Geiger Counter - measure a basic count of mid-to high energy particles
Design Overview Continued

- **Major Components (cont’d)**
  - RaspberryPi (optional)
    - Memory backup
  - Arduinos
  - Micro-controllers
  - IMU
  - Battery
    - Power
- **Heritage elements (we will be using some things from last year):**
  - Geiger tube
  - Electrical Components
  - Battery
Electrical FBD

- Scintillator
- Spectrometer
- IMU + Geiger
- Arduino
- Arduino
- Arduino
- 5V Battery
- RP:

Orange lines represent power, and green lines represent data.
Mechanical FBD

- Plate 1
  - Geiger Tube
  - Scintillator
  - Arduino 1
  - Optical Port
  - Spectrometer

- Plate 2
  - Raspberry Pi
  - Arduino 2/3
  - Battery
  - IMU
• Initial idea of what your payload will look like
  – 2 wood plates
  – 1st plate:
    • Scintillator
    • UV spectrometer
    • Arduino
  – 2nd plate:
    • Arduino for optical port
    • IMU
    • Arduino for IMU
    • Raspberry Pi
    • Battery (5V)
  – Optical Port
    • Visible light spectrometer (Carbon emission spectrum)
Design Overview: Ports

• Indicate what kind of port you are requesting
  – Optical

• State what you are using the port for
  – Atmospheric spectroscopy

• No predicted parameters due to currently undefined materials and equipment
• Understanding of weight and volume limit
• Activation type:
  – T-3 wire
Design Overview: Shared Can Logistics

- Collaborating with: Currently N/A
- Plan for Collaboration
  - Email
  - Creo
  - Fit check: March 2020
- Mounting:
  - No preference
- Specialized Ports
  - Optical port
Project Management
Management

• Team organization chart
  - Carly Rowe & Megan Kocher → Co-Presidents
  - Westley Roth → Rocksat-C lead
  - Perry Spot → VP
  - Connor Nethen → Electronics Lead
  - Isaac Ngui → Programming Lead
  - Kate Scholtman → Treasurer
  - Daniel Gomez → Materials Lead

Don’t let the schedule sneak up on you!
Preliminary schedule for the semester

10/11/2019
Earnest Payment of $1,000 Due

10/16/2019
SAC grants due

10/28-11/1/2019
Preliminary Design Review (PDR) Teleconference

12/2-6/2019
Critical Design Review (CDR) Teleconference
Monetary Budget & Mentors

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<th>WSGC</th>
<th>UWM SAC Grant</th>
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Mentors: Dr. David Kaplan & Dr. Salowitz
## Team Contact Matrix

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Role/Position</th>
<th>Email Address</th>
<th>Phone Number</th>
<th>US Person? (Y/N)</th>
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<tbody>
<tr>
<td>Megan Kocher</td>
<td>President</td>
<td><a href="mailto:mnkocher@uwm.edu">mnkocher@uwm.edu</a></td>
<td>414-350-1545</td>
<td>Y</td>
</tr>
<tr>
<td>Carly Rowe</td>
<td>President</td>
<td><a href="mailto:rowece@uwm.edu">rowece@uwm.edu</a></td>
<td>715-393-9185</td>
<td>Y</td>
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<tr>
<td>Perry Spott</td>
<td>Vice President</td>
<td><a href="mailto:paspott@uwm.edu">paspott@uwm.edu</a></td>
<td>414-702-5036</td>
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<tr>
<td>Wesley Roth</td>
<td>COC Representative</td>
<td><a href="mailto:wbroth@uwm.edu">wbroth@uwm.edu</a></td>
<td>920-350-2670</td>
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<tr>
<td>Kathryn Hinderks-Schlotman</td>
<td>Treasurer</td>
<td><a href="mailto:hinderk2@uwm.edu">hinderk2@uwm.edu</a></td>
<td>414-737-0766</td>
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<tr>
<td>Connor Nethen</td>
<td>Electronics Lead</td>
<td><a href="mailto:clnethen@uwm.edu">clnethen@uwm.edu</a></td>
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<tr>
<td>Daniel Gomez</td>
<td>Project Lead</td>
<td><a href="mailto:gomezca3@uwm.edu">gomezca3@uwm.edu</a></td>
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<tr>
<td>Isaac Ngui</td>
<td>Software Lead</td>
<td><a href="mailto:imngui@uwm.edu">imngui@uwm.edu</a></td>
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## Team Availability Matrix

### Fall 2019 RS-C Team Availability Matrix

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Risks and Worries

• What are your biggest worries or potential failure points with your conceptual design?
  – Not entirely confident that we can acquire the correct materials for our experiments for maximum efficiency and component communication
Conclusion

• Mission
  – Accurately detect cosmic rays through an inexpensive means; measure the amount of greenhouse gases in the atmosphere

• Moving Forward
  – Solidifying experiments; fully understanding experiments; finalizing budget
  – Test if spectroscopy will be able to detect ranges accurately using optical port given