Les Rayons Cosmiques
Conceptual Design Review for Rocksat-C 2020

Delgado Community College
M. Amos, S. Golembiewski, E. Marks, J. Daniels, B. Kirk
October 10, 2019
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  • Mission Requirements (top level)
  • Expected Results
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  • Functional Block Diagrams
  • Payload Layout
  • Ports (if applicable)
  • RockSat-C 2018 User’s Guide Compliance
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CoDR Presentation Contents

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  – Schedule
  – Budget
  – Mentors (Faculty, industry)
  – Team Contact Matrix
  – Team Availability Matrix

• **Section 4: Conclusions**
  – Risks and Worries
  – Conclusion
Mission Overview

Je’men Daniels
Ben Kirk
Mission Overview

The goal of Les Rayons Cosmique is to build upon the lessons learned from last year’s project to design and build a cosmic ray detector that is robust enough to withstand multiple applications including but not limited to balloon and rocket flight.
Mission Requirements

Rocksat-C Requirements
• Must be electrically self contained
• Ensure that payload is isolated from the canister
• Provide onset of two Teflon insulated wires for activation
• Must be contained within 9.3in x 9.5in cylindrical canister
• Weigh between 20 $\pm$ 0.02 lbs
• Center of gravity (CG) that lies within a 1 x 1 x 1 inch of canister
Les Rayons Cosmiques Requirements/Minimum Success Criteria

• Battery runs full duration of the flight
• Detect Cosmic rays through plastic scintillator and Geiger tube
• Cosmic Ray detection active throughout flight
• Strong enough to withstand turbulent flights
• Record data successfully throughout flight
Theory and Concepts

Cosmic Rays are High Energy Particles, mostly protons, electrons, and atomic nuclei

- hydrogen and helium nuclei make up the majority of the particles found (around 89% and 10% respectively)
- All the remaining elements comprise of only 1% of radiation.

When this radiation collides with the atoms found in the upper atmosphere, more subatomic particles are created, mainly pions.

*Image source: [https://home.cern/science/physics/cosmic-rays-particles-outer-space](https://home.cern/science/physics/cosmic-rays-particles-outer-space)*
Theory and Concepts

• Cosmic Rays are believed to come from supernovae.

• Because of the interference of various magnetic fields (of the Earth, the Sun, the Galaxy, etc.) that disrupt the path of cosmic rays, it’s impossible to precisely trace their origins traditionally.
  • But scientists have begun to look at the composition of a particle (mainly at the 1% composed of any element other that hydrogen and helium) to attempt to determine an origin.
  • This can be done by either looking at the Spectroscopic signature given off by each nucleus, or by weighing the isotopes of elements that hit cosmic ray detectors.

Theory and Concepts

• Extragalactic Cosmic Rays
  • come from outside of the Milky Way Galaxy
  • 1 ECR particle per square meter reaches the Earth’s Surface per year.

• Strange Anomalous Cosmic Rays (ACRs)
  • Ions that are flung into the inner heliosphere after gaining energy in the terminal shock
  • Large quantity of Oxygen, Helium, and Neon

• Solar Cosmic Rays
  • Ejected from solar flares and coronal mass ejections
  • Cause a decrease in GCRs, called the Forbush Decrease.

• Galactic Cosmic Rays
  • From outside the Solar System but within the Milky Way Galaxy.
  • They travel at very near the speed of light, interacting with one another and emitting Gamma Rays.
Theory and Concepts

**Greisen–Zatsepin–Kuzmin Limit**
- The Greisen–Zatsepin–Kuzmin limit is the theoretical limit of the amount of energy in eV a cosmic ray proton can have while traveling through intergalactic space.
- At energies greater than this, the particles would begin to interact with the Cosmic Background Radiation.

**Regener–Pfotzer Maximum**
- The Regener–Pfotzer maximum is the point in the atmosphere with peak radiation.
- Occurs at around 20 km about the surface of the earth.

Mission Overview: Expected Results

• Les Rayons Cosmiques will function as outlined previously

• Expect 75 coincidences per minute from Geiger counter (based on research last year’s research)

• Expect highest amount of coincidences per minute approaching and passing through the Pfotzer Maximum (approx. 20km above Earth’s surface)
Concept of Operations

• Data collection – At the beginning and end of flight
• Altitudes of interest – Minimum altitude at 0km, maximum ~20km+
• When does your payload stop collecting data? At the end of the flight
• When does it turn off? Upon retrieval
Concept of Operations

- Thermosphere - 87-120km: Detection continues, influx of primary cosmic ray expected.
- Mesosphere - 50-87km: Detection continues, decrease in abundance expected.
- Stratosphere - 10-50km: Detection continues, increase in abundance expected.
- Troposphere - 0-10 km: Detection begins.
Design Overview

Sean Golembiewski
Eli Marks
Major Components of Les Rayons Cosmiques

• 2 Arduino Microcontrollers or 1 Arduino and 1 Basic Stamp (Depending on availability)
• Cosmic Watch (upgraded design using better components and layout)
• 2 Analog-to-Digital Converters
• DC-DC Booster
• Geiger Counter
• Pressure/Temperature/Humidity/Gyro Sensors
• Power Source ([2] 9V batteries wired in Parallel; stepped up to 29.5V for Cosmic Watch)
• 2 SD Card Readers
Payload Mounting and Mechanical Design
Major System Components of Rayons Cosmiques
Mechanical Construction and Design

Major Components:
- Cylindrical support structure for instrumentation
- Circuitry and sensors deployed on Makrolon plates-support system mounted internally.

Major technology dependencies:
- Plastic Scintillator
- Temperature, Pressure, and Humidity sensors
- Storage media for data gathered
- Arduino Controllers
- Geiger Counter
Design Overview and Payload Layout
Design Overview

• Predicted mass without ballast – 14 lbs
• Les Rayons Cosmiques will only fill have a canister
• 1 RBF Switch for activation
• High voltage for Geiger tube
• No special requests seen at this moment
• We do not have a shared can assignment yet.
• Atmospheric port for external temperature data collection tentative
Project Management

Meggan Amos
Organization Chart

Meggan Amos
Project Manager

Science Team
Je’Men Daniels
Ben Kirk

Mechanical Design
Eli Marks

Electrical Design
Sean Golembiewski

Joanna Rivers
Advisor
Schedule

- Oct 10 – CoDR
- Oct 2–Nov. 1 – PDR
- Dec 2–8 – CDR
- Dec 12 – Jan 18 – Winter Break
- Jan 2 – Final Down Select
- Nov 12 – Final deadline to have requisitions submitted
- Jan 19 – Begin Building
- Jan 20–27 – Progress Update
- Feb 3 – Begin Subsystem testing
- Feb 10 – Subsystem Test Review
- Feb 22 – 26 Mardi Gras Break
- March 2 – Progress Update 2
- March 23 – Integrated Subsystem Test Review
- April 13 – Progress Update 3
- April 27 – Full Mission Simulation Test Report
- May 14 – Last Day of Classes
- May 18 – Progress Update 4
- May 19 – Graduation Commencement
- June 1 – LRR Due
- June 10–20 – WALLOPS!!!
- July 10 – PLR due
- July 24 – Final Report
Payload Budget

We have applied for a grant from Louisiana Space Grant and are awaiting their reply.

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<tr>
<th>Component</th>
<th>Supplier</th>
<th>Budget</th>
<th>With Margin</th>
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<tr>
<td>Complete RockON Payload</td>
<td>Wallops Flight Facility and Colorado Space Grant Consortium</td>
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<td>$0.00Thank You CSGC!</td>
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<td>Electronic Components</td>
<td>Digikey</td>
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<td>Geiger Tube</td>
<td>Electronic goldmine</td>
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<td>$163</td>
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<td>Plastic Scintillator</td>
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<td>SiPm</td>
<td>SensL</td>
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<td>$149</td>
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<td>Arduino Nano and Uno</td>
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<td>Testing Batteries</td>
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<td>Scintillator Cut and Polish</td>
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## Travel Budget

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## 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>Meggan Amos</td>
<td>Project Manager</td>
<td><a href="mailto:amos.meggan@gmail.com">amos.meggan@gmail.com</a></td>
<td>(512) 461-9694</td>
<td>Yes</td>
</tr>
<tr>
<td>Sean Golembiewski</td>
<td>Electrical Engineer Lead</td>
<td><a href="mailto:sgolembiewski1@gmail.com">sgolembiewski1@gmail.com</a></td>
<td>(215) 668-7744</td>
<td>Yes</td>
</tr>
<tr>
<td>Eli Marks</td>
<td>Mechanical Engineer Lead</td>
<td><a href="mailto:emarks15@gmail.com">emarks15@gmail.com</a></td>
<td>(504) 427-5948</td>
<td>Yes</td>
</tr>
<tr>
<td>Ben Kirk</td>
<td>Science Officer</td>
<td><a href="mailto:benjaminak@outlook.com">benjaminak@outlook.com</a></td>
<td>(504) 236-9333</td>
<td>Yes</td>
</tr>
<tr>
<td>Je'Men Daniels</td>
<td>Science Officer</td>
<td><a href="mailto:jemendaniels@yahoo.com">jemendaniels@yahoo.com</a></td>
<td>(504) 654-9215</td>
<td>Yes</td>
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<tr>
<td>Joanna Rivers</td>
<td>Advisor</td>
<td><a href="mailto:jriver@dcc.edu">jriver@dcc.edu</a></td>
<td>(504) 300-4179</td>
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### Availability Matrix

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Risks and Worries

• Funding is currently our only worry, but our grant proposal is currently being processed by Louisiana Space Grant.
• Currently no technical worries or foreseen risks.
Conclusion

• Our number one mission with Les Rayons Cosmiques is to use lessons learned from last year to build a more robust and durable cosmic ray detector.

• Funding is a concern, at the moment, while we wait for our grant approval.

• We currently have no technical risks or worries

• From here we plan to continue fine tuning our electrical and mechanical designs