OIT Portland-Metro
Conceptual Design Review

Oregon Institute of Technology

Jean-Luce Nabors
Mark Johnston
Steven Reeves
Francis Bartholomew
Austin Hinman
Krystal Cruz
Thomas Pearce

10/09/2017
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  – Theory and Concepts
  – Mission Requirements (top level)
  – Expected Results
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CoDR Presentation Contents

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  – Team Contact Matrix
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Mission Overview

Jean-Luce Nabors
Austin Hinman
Francis Bartholomew
Mission Overview – Mission Statement

• The primary goal of this project is to use systems as sensors to detect radiation and test materials for shielding.

• The secondary goal of this project is to create a universal mounting system for student capstone projects that would benefit from hostile environment testing.
Mission Overview: Mission Objectives

• Objectives:
  – Measure radiation by analyzing its effect on the performance on a system.
  – Test materials for shielding.
  – Use a universal mounting system for modular experiments.

• Minimum Success:
  – All modular experiments mechanically withstand all the forces acting on the payload during launch.
  – Current and voltage draw is recorded for each experiment.
  – All data is stored.
Mission Overview: Mission Objectives

• System Requirements:
  – Systems must act as radiation sensors by analyzing degradations in their performance.
  – Need a structure to support 5 modular bays.
  – Current, voltage, and functionality must be recorded (possibly transmitted) for each experiment.
  – Modular bays and main experiment must have onboard activation tell tails, linear power regulators, onboard data storage, and data link output.
Mission Overview: Theory and Concepts

• Many projects focus on trying to quantify the amount of radiation present at varying distances from the surface of the Earth.
  – Exposure to alpha, beta, and gamma radiation is deleterious to organic life.
  – Radiation of different kinds can also cause failures in modern electronic equipment (SEU single event upsets).
    • Loss of system functionality.
    • Corruption of communication or data held in storage.
Mission Overview: Theory and Concepts

• Trying to evaluate radiation effects through the use of geiger counters is like trying to dodge a bullet after you’ve already been shot.

• Using systems as sensors, the effects of radiation on complex, modern computing equipment can be analyzed through observing degradations in performance over time due to exposure.
Mission Overview: Expected Results

- Placing a collection of small counting systems into production, all communicating with one ‘well shielded’ central system, an ‘over time’ analysis of SEU can give greater insight about exposure and performance.

- Coupling this with using small enclosures of different shielding materials, measuring performance differences over time as a means to try and find the ‘sweet spot’ between payload lifting costs, manufacturing costs, and mass.
  - Transiting system communication into the main, central system via a shared bus
  - Watchdog system to allow the main unit to survive recoverable failures.
Mission Overview: Expected Results

• At different levels of altitude, the ‘sensor’ systems should experience varying levels of failure - with all data to be captured by the central system via a shared bus.

• With the main system watchdogging the ‘sensor’ units, and then managing a full reset of all of them in the event of any of them locking up. This is meant to give the network data cohesiveness.
  – Different candidate materials will shield more or less effectively based upon exposure, and the time and position data should allow inspection of these environments as the different ‘sensors’ come under changing levels of exposure.
Mission Overview: Concept of Operations

• The main project will begin collecting data at launch. Subsystems will begin collection based on design.

  – Special altitudes of interest include 50 km and above, as these are where radiation will change the most. Subsystems areas of interest will differ.

  – Main project will run until power loss or data capacity is reached.
Concept of Operations Overview:

**Launch**
- G switch triggered
- Main project on
- Begin data collection/data management

**Apogee**
- $t \approx 2.8$ min
- Main project collects radiation data
  - Altitude: $\approx 115$ km

**End of Orion Burn**
- Radiation levels change
  - $t \approx 0.6$ min
  - Altitude: 52 km

**High Tumble Rate**
- Main project collects radiation data
  - $t \approx 4.0$ min
  - Altitude: 95 km

**Low N2, Low spin**
- $t \approx 5.5$ min
- Chute Deploys

**Splash Down**
- $t \approx 15$ min
- Main project stays on

- Subsystems will collect data based on design
Design Overview

Jean-Luce Nabors
Steven Reeves
Francis Bartholomew
Austin Hinman
Krystal Cruz
Thomas Pearce
Design Overview

- **Major Design Components**
  - **Structure:**
    - Stacking Plate System
      - Full can, optical port
      - Small senior project bays for modular senior projects.
  - **Sensor Requirements.**
    - For the main payload, 8 counters will be used to detect faults due to radiation to measure the effectiveness of each counter’s shielding.
    - Various individual senior project experiments will be added throughout the year, the only currently defined senior project is a fiber optic gyroscope, which will use a laser diode and photodiode along with fiber optics to make the main sensor, along with an a traditional mems gyroscope to check against.
Design Overview Continued

• Main Electrical System
  – The main electrical system will be providing power to the entire can, including individual senior projects, and will also store data from all projects, as a backup to the individual project storage. It will also include the fault counter network.

• Heritage Elements:
  – A heritage g-switch will be used for activation.
  – A heritage Arduino mega may be reused with a different shield assembly.
Electrical FBD
Mechanical FBD

Electronics - storing data (mounted to plate) → Sensor(s) → Electronics - controlling sensor (mounted to plate)

Makroлон plate

Connected to each other with cylindrical mounting system

Mounts to lid of canister

Mounts to base of canister

Cylinder for mounting modular bays
Design Overview: Ports

• We have requested access to one optical port for our main project.
  – This port will be used to measure radiation, light level, and provide visual access to the outside of the rocket.

• All components utilizing the optical port will be mounted on a plate inside the diameter of the canister within the field of view of the port.

- Predicted mass approx. 20 pounds
  - Our canister will include one main project and a number of subsystems.
  - The predicted volume for all experiments will fit in one whole canister.
  - A G-switch will provide activation for the main experiment.
  - Subsystems will have different activation based on design.
  - Laser requests will be explained in technology dependencies.
Project Management

Mark Johnston
Management

- Team organization chart
- Preliminary schedule for the semester
- Monetary budget
- Team mentors
Management

Team Organization

ROCKSAT-C

Mark Johnston
Project Manager

Jean-Luce Nabors
Project Engineer/
Mechanical Engineer

Steven Reeves
Software Lead

Francis Bartholomew
Embedded Systems
Lead

Krystal Cruz
Electrical Engineer Lead

Austin Hinman
Systems Integration

Thomas Pearce
Assistant Integrations / Optics Engineer

RockSat-C 2018
CoDR
Management

Fall Term Schedule

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<tr>
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<th>Duration</th>
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### Budget

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- The flight is budgeted at $500 for 7 persons
- Hotel is budgeted at $120 per 2 individuals for 9 days.
- Food is budgeted at the per diem of $55 dollars a day for 9 days.
- Car Rental if for two economy vehicles for the 9 days.
- For travel expenses food and gas will be paid by the individuals attending RockSat-C.
Management

• Mentors

  - Mentors for the RockSat-C team will include Oregon Institute of Technology School of Engineering and Management faculty project advisors.
  - Industry mentors will be accepted and sought after as necessary.
**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>
</tr>
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<tbody>
<tr>
<td>Mark Johnston</td>
<td>Project Manager</td>
<td><a href="mailto:mark.johnston@oit.edu">mark.johnston@oit.edu</a></td>
<td>(760) 401-7723</td>
<td>Yes</td>
</tr>
<tr>
<td>Steven Reeves</td>
<td>Software Lead</td>
<td><a href="mailto:Stevenreeves15@gmail.com">Stevenreeves15@gmail.com</a></td>
<td>(503) 490-9655</td>
<td>Yes</td>
</tr>
<tr>
<td>Jean-Luce Nabors</td>
<td>Engineer Lead</td>
<td><a href="mailto:Jeanluce.nabors@oit.edu">Jeanluce.nabors@oit.edu</a></td>
<td>(503) 890-7752</td>
<td>Yes</td>
</tr>
<tr>
<td>Francis Bartholomew</td>
<td>Embedded Systems Lead</td>
<td><a href="mailto:Francis.bartholomew@oit.edu">Francis.bartholomew@oit.edu</a></td>
<td>(907) 602-1052</td>
<td>Yes</td>
</tr>
<tr>
<td>Krystal Cruz</td>
<td>Electrical Lead</td>
<td><a href="mailto:Krystal.Cruz@oit.edu">Krystal.Cruz@oit.edu</a></td>
<td>(623) 888-2947</td>
<td>Yes</td>
</tr>
<tr>
<td>Austin Hinman</td>
<td>Troubleshooting specialist</td>
<td><a href="mailto:Hinman.aus@gmail.com">Hinman.aus@gmail.com</a></td>
<td>(503) 507-4332</td>
<td>Yes</td>
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<tr>
<td>Thomas Pearce</td>
<td>EE/PCB/Optical Design</td>
<td><a href="mailto:Pearce.thomas42@gmail.com">Pearce.thomas42@gmail.com</a></td>
<td>(503) 519-3834</td>
<td>Yes</td>
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- Mark Johnston and Jean-Luce Nabors will need access to the dropbox folder.
- This contact matrix will remain as is, if a potential need arises a substitution will be made from one of the other members in a timely manner.
### Team Name/School Here: Oregon Institute of Technology

#### Fall 2017 RS-C Team Availability Matrix

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Risks and Worries

• Potential points of failure:
  - Power failure.
  - Cascade failure.
  - Debris damage.

• Mitigation:
  - Will have 2 power supplies, individual relay, armored common power rail.
  - Each system individual.
  - Each modular experiment will be contained within a housing unit.
Conclusion

• Our goals for this project are to use systems as sensors to detect radiation and test materials for shielding, and to create a universal mounting system for student capstone projects that would benefit from hostile environment testing.
• Issues and concerns are mentioned under “risks and worries”
• Next steps
  - Fabricate housing units for capstone projects.
  - Looking into activation timing systems
  - Calculating the weight of our payload thoroughly