CDR Presentation Contents

• Overall Mission
• Fluid Flow Team Presentation
  – Sub-Mission Overview
  – Subsystem Design
  – Prototyping/Analysis
  – Manufacturing Plan
  – Testing Plan
• Radiation Team Presentation
  – Sub-Mission Overview
  – Subsystem Design
  – Prototyping/Analysis
  – Manufacturing Plan
  – Testing Plan
• Biology Team Presentation
  - Sub-Mission Overview
  - Manufacturing
  - Testing
• User Guide Compliance
  – Compliance Table
  – Sharing Logistics

• Project Management Plan
  – Schedule
  – Budget
    • Mass
    • Monetary
  – Work Breakdown Structure
Mission Overview

Community Colleges of Colorado

(CC of CO)

Handicapreader
Overall Mission for the CC of CO Team

Successfully launch an inter-school payload.

• Measure dual phase fluid flow
• Test viability of Carbon Fiber Shielding and RICH radiation detector
• Test durability of DNA under ascent and reentry conditions.
Sub-Mission Overview

Fluid Flow Team

CC of CO
Fluid Flow Mission and Requirements

- Container holding fluid must be shaped to create a flow using the rotation of the rocket.
- The shape of the container will allow the water to flow on the edges and through a tube while trapping the air in the center.
- The behavior of the fluid will be recorded with a video camera.
- The fluid container will be surrounded by a secondary container.
- Both containers must have a clear section so the fluid is visible from the camera.
Fluid Flow: Discoveries and Purpose

- Prove that known fluid mechanics may be used to predict the motion of fluids in microgravity, under centripetal acceleration.
- Dual phase - prove consistent liquid flow from gas/liquid system using only rotation.

Fluid flow: Benefits of Research

- Research on fluids in microgravity is helpful for cooling systems, nuclear power, and even bathrooms.
- Fluid flow in microgravity acts very counterintuitively, so visual data on a moving fluid is useful.
- Pumping fluid that contains both liquid and gas wears pumps quickly, so separating phases and pumping at the same time could be economical.
Fluid Flow: Theory and Concepts

The centrifugal force on the liquid caused by the rotation of the rocket is expected to push the liquid to the edge of the container.

- The centrifugal force on the liquid and geometry (slope) of the interior walls of the container will direct the liquid in order to cause hydrostatic pressure within the container.
- The liquid will be pushed to the edge of the container with the gas in the center due to the centrifugal force induced by the spin of the rocket.

Fluid Flow: Previous Research

Bernoulli’s Equation allows for the hydrostatic pressure to build and turn into velocity to overcome the centrifugal force in our container.

\[ p + \frac{1}{2} \rho V^2 + \rho gh = \text{constant} \]

where \( p \) is the pressure, \( \rho \) is the density, \( V \) is the velocity, \( h \) is elevation, and \( g \) is the gravitational acceleration.

The Rotary Fluid Management Device (RFMD) is “a rotating drum, intended to concentrate liquid at the outer surface.”


Fluid Flow: Expected Results

- Acceleration at pipe : 3.16 G’s
- Velocity of liquid in pipe : 61 cm/s
- Flow Rate : 4.3 g/s

Consistent flow of liquid (No Gas bubbles) through duration of flight
Fluid Flow: Conceptual Ops

Altitude

- **t ≈ 1.7 min**
  - Altitude: 95 km
  - *Spin rate at maximum*
  - *Start of Apparent Weightlessness*

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

- **t ≈ 4.0 min**
  - Altitude: 95 km
  - *End of Apparent Weightlessness*

- **t ≈ 0.6 min**
  - Altitude: 52 km
  - *End of Orion Burn*

Data collection begins at launch until battery dies

- **t ≈ 15 min**
  - Splash Down

**Points of interest:**
- When spin rate is at a maximum
- Between start and end of apparent weightlessness

**t = 0 min**
- G switch triggered
- All systems on
- Begin data collection
Fluid Flow Payload Success Criteria

Minimum:
• Fluid is contained.
• Fluid behavior is observed.

Ideal:
• Consistent flow of fluid from centrifugal force is observed.
## Fluid Flow: Functional & Design Requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary containment can withstand vibration and stresses of launch</td>
<td><strong>Test</strong></td>
<td>Primary container will be put through similar vibration and stress testing when filled with water and tested again in June during testing week</td>
</tr>
<tr>
<td>Secondary containment can withstand vibration and stresses of launch</td>
<td><strong>Test</strong></td>
<td>Secondary container will be put through similar vibration and stress testing when filled with water and tested again in June during testing week</td>
</tr>
<tr>
<td>Camera shall be able to record the container and piping clearly without obstruction</td>
<td>** Inspection**</td>
<td>Visual inspection of camera recordings with verify this.</td>
</tr>
<tr>
<td>Container and secondary container will fit comfortable as designed with other experiments</td>
<td>** Inspection**</td>
<td>Container spacing checked with CAD model and physical verification will be achieved multiple times through build/integration process.</td>
</tr>
</tbody>
</table>
System Overview

Fluid Flow

CC of CO
Fluid Flow Changes Since PDR

• The container sizes were downsized due to space concerns with other projects on payload:
• This lowered the expected acceleration, and flow rate, and Volume of water

- \textbf{Was} $V=160\,\text{mL}$
- \textbf{Now} $V=21\,\text{mL}$
Fluid Flow De-Scopes and Off-Ramps

- Due to space constraints we will not be using a flow meter to measure the flow rate of the water.
- Alternatively we will extract the flow rate from the speed of the water in the video.
- If Hack HD Camera can not be acquired, we will hack a GoPro Hero.
- Further de-scoping would result in failure to meet minimum mission requirements, thus no further descoping is possible.
Subsystem Design

Fluid Flow

CC of CO
Fluid Flow – Physical Models
Fluid Flow – Physical Models

Secondary Container

Primary Container
Fluid Flow Block Diagrams
Fluid Flow Hardware/Weight

- Fluid/Secondary container
  - To be made of polyurethane
  - Mass may vary slightly with production process: 185 grams
- Hack HD Camera: 34 grams
- Water (21 mL): 21 grams
- LED: Mass will vary slightly, 1 LED ~ 1-2 grams

Total Mass: 242 grams
### Risk Matrix – Fluid Flow

- Lack of containment of the Primary and Secondary Container
- Loss of data/footage

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSK.1</td>
<td>Green</td>
</tr>
<tr>
<td>RSK.2</td>
<td>Yellow</td>
</tr>
<tr>
<td>RSK.3</td>
<td>Red</td>
</tr>
</tbody>
</table>

Fluid.RSK.1: Camera placement shifts during launch leading to lack of footage.
Fluid.RSK.2: Primary container cannot survive launch conditions
Fluid.RSK.3: Secondary Container cannot survive launch conditions
Prototyping/Analysis
Analysis Results

- Physics further analyzed with new dimensions
- Acceleration at pipe : 3.16 G’s
- Velocity of liquid in pipe : 61 cm/s
- Flow Rate : 4.3 g/s
- These results indicate stable flow will be achieved at a measurable rate
Prototyping Results

• Various prototypes have been made leading to the final design
• Testing on prototypes indicates successful proof of concept

https://youtu.be/HEfxuLl0uWQ
Manufacturing Plan

CC of CO
Fluid Flow: Manufacturing Plan

- Primary and Secondary Container need to be molded and sent to the Plastic company
  - Mold Making
    Manufacturing
    Dec 14-Jan 13
    Jan 13-27
- Hack HD Camera order
  Jan 13 (Order) - Jan 28 (Received)
- Staging and final integration of parts.
  Jan 28 (Estimated Day when all parts are in)
## Fluid Flow Part list / Price

<table>
<thead>
<tr>
<th>Name</th>
<th>Price</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufactured/Molded Clear polyurethane plastic</td>
<td>$150-$300 (Dependent on Manufacturer)</td>
<td>182g (Both Containers)</td>
</tr>
<tr>
<td>Water</td>
<td>Acquired</td>
<td>21g</td>
</tr>
<tr>
<td>Hack HD Camera</td>
<td>$165</td>
<td>34g</td>
</tr>
<tr>
<td>Hack HD Lens</td>
<td>$10</td>
<td>^</td>
</tr>
<tr>
<td>LEDs</td>
<td>$5</td>
<td>~1g</td>
</tr>
</tbody>
</table>
Testing Plan

CC of CO
Fluid Flow: Testing

- **Container Structural/Leakage Test**
  - Fill both containers with water and test initial leakage
  - Put both containers (with water) through high vibration and impacts simulating near 50 g’s
  - Rerun tests with Primary container nested inside secondary container

- **Data Storage Test**
  - Record Video footage to ensure successful video recording and data storage
Sub-Mission Overview

Radiation Team

CC of CO
Radiation Mission and requirements

Shielding Experiment

- Two identical Geiger counters will be flown
- One will be coated in 3 cm. of Carbon fiber epoxy shielding
- Radiation counts per unit time will be recorded from each Geiger counter and compared post-flight
Radiation Mission and requirements

RICH Detector

- Refracting medium must be held flush against CMOS image sensor
- Refraction index must be high enough to create Cherenkov radiation but low enough to allow light to reach the CMOS
- Detector must be isolated from all other light sources inside payload and facing “outward”
- Images of Cherenkov radiation will be recorded during flight
Radiation: Discoveries and Purpose

• Measure the effectiveness of carbon fiber epoxy coating as radiation shielding
• Determine the viability of a small, inexpensive RICH detector for use in particle astrophysics research
• Observe Cherenkov radiation caused by encounters with ionizing particles from cosmic rays
Radiation: Benefits of Research

- Carbon fiber and epoxy are light and inexpensive compared to materials typically used as radiation shielding.
- The durability of carbon fiber makes it a potential substitute for aluminum as a structural component.
- Compact, light and inexpensive RICH detectors could improve access to particle astrophysics for researchers working with strict mass, volume or budget constraints.
Radiation: Theory and Concepts

- Cosmic rays strike Earth at relativistic velocities and decay into lower energy particles as they move through the atmosphere.
- Radiation is “blocked” by dense materials by slowing down ionized particles that pass through them.
- Carbon nanotubes have been demonstrated to block radiation from cosmic rays.
- Carbon fiber composite material is atomically equivalent to carbon nanotubing, but less expensive and more readily available.

Radiation: Theory and Concepts

- Cherenkov radiation is the “sonic boom” of light.
- When a particle passes through a medium at a speed greater than the speed of light through that medium, light is emitted.
- The velocity of the particle can be determined from the radius of the cone at a given point.

Radiation: Previous Research

Materials rich in hydrogen and carbon are known to be effective shielding materials against GCR.


A DemoSat experiment flown flown in May of 2015 by the Community College of Aurora showed that E Coli bacteria contained within a carbon fiber shield did not become mutated after the DemoSat experiment.
Radiation: Expected Results

Shielding:
• Shielded sensors should record fewer radiation events than unshielded sensors (~3-5%)
• Expect frequency to increase with altitude up to approximately 15 km (the Pfotzer Maximum), and then decrease beyond that altitude. See: http://physics.okstate.edu/rpl/muons.htm for more details.
Radiation: Expected Results

**RICH:**

- Radius of rings will increase with altitude due to increased velocity of particles
- Frequency of radiation events will increase with altitude up to ~15 km, then decrease
Radiation: Conceptual Ops

**Altitude**

- **Pfotzer Maximum (15 km)**
  - $t \approx 1.7$ min
  - Altitude: 95 km
  - Spin rate at maximum
  - Start of Apparent Weightlessness

- **Apogee**
  - $t \approx 2.8$ min
  - Altitude: $\approx 115$ km

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

- **Pfotzer Maximum (15 km)**
  - $t \approx 4.0$ min
  - Altitude: 95 km
  - End of Apparent Weightlessness

- **Splash Down**
  - $t \approx 15$ min

Data collection begins at launch until battery dies
Points of interest: Pfotzer maxima
Radiation Payload Success Criteria

Minimum:
• Geiger counters detect radiation and data is recorded throughout flight
• RICH detector records images throughout flight

Ideal:
• Shielded and unshielded geiger counters record measurably different data
• RICH detector records at least one instance of Cherenkov radiation
## Radiation: Functional & Design Requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RICH enclosure must block all other sources of light in the payload from reaching CMOS image sensor</td>
<td>Test</td>
<td>Record data inside enclosure and check data for any false readings caused by light leakage</td>
</tr>
<tr>
<td>CMOS image sensor must detect light through refractive medium.</td>
<td>Test</td>
<td>Controlled light tests to check camera's ability to detect light emissions</td>
</tr>
<tr>
<td>RICH must withstand vibrations during flight</td>
<td>Inspection</td>
<td>Visual inspection of camera recordings with verify this.</td>
</tr>
<tr>
<td>Geiger counters and RICH detector fit comfortably with other payload components, and detector is oriented outward</td>
<td>Inspection</td>
<td>Container spacing checked with CAD model and physical verification will be achieved multiple times through build/integration process.</td>
</tr>
</tbody>
</table>
System Overview

CC of CO
System Definitions

- **RICH Detector**: Ring-imaging Cherenkov Detector
- **CMOS**: Complementary metal–oxide–semiconductor used for image sensors
- **Cherenkov Radiation**: electromagnetic radiation emitted when a charged particle passes through a dielectric medium at a speed greater than the phase velocity of light in that medium
- **Refraction Medium**: The substance through which particles will move to produce Cherenkov Radiation
Radiation: Changes Since PDR

- Shielding design has changed to achieve greater shielding and fit volume constraints
- De-scoped the shielded RICH detector (only flying one)
- Descoped Dosimeters
- Only shielding Geiger Tube, instead of the entire board.
- RICH detector design has improved in detail and theory and concepts are better understood
Radiation De-Scopes and Off-Ramps

• If time table cannot be met, descope the RICH Detector
Subsystem Design

CC of CO
Radiation – Physical Models
Radiation – Physical Models

Carbon Fiber Shielding
Geiger Tube
Radiation – Physical Models

COSGC Geiger Counter
Radiation Block Diagrams

- Geiger counter shielded
  - Power
  - Data Collection
  - G-switch on

- Geiger counter unshielded

- Neutrino
  - G-switch on
  - Stand Alone Data Logging and Power

- RICH detector unshielded

RockSat-C 2015
CDR
Radiation Hardware/Weight

- **COSGC Geiger Counters:** 52g (Each)
  - Flight Tested
  - Acquired
- **Carbon Fiber (~3 Yards)**
  - Shield + epoxy mass: 772g
- **RICH Detector:** 120g
  - Sony Camera components (CMOS)
  - Sodium Fluoride Medium

**Total Mass:** 1002 g (1.002 kg)
Risk Matrix – Radiation

- RICH Detector may be subject to damage from launch conditions
- Carbon Fiber Shielding shifts during launch and detaches wiring to Geiger Counter from Geiger Tube

Radiation.RSK.1: RICH Detector cannot survive launch conditions
Radiation.RSK.2: Loss of Geiger Counter Data (Data corruption)
Radiation.RSK.3: Carbon Fiber Shielding shifts during launch, causing damage to electronics
Prototyping/Analysis

CC of CO
Radiation: Analysis Results

- In order to see at least a 3-5% reduction of counts, Shielding must be at least 3 cm thick in all directions.
- The refractive indices and other optical properties of several materials have been considered, and Sodium Fluoride has been chosen as the RICH medium.
Radiation: Prototyping

- Scale model of shielding has been made for accurate volume checks and spacing.
- Geiger Counters have been flown and tested on RockOn 2015 flight
- Scale model of RICH detector enclosure has been made for accurate volume checks and spacing
Manufacturing Plan

CC of CO
Radiation: Manufacturing Plan

Carbon Shielding

- Create mold of Geiger Tube
- Epoxy layers of Carbon Fiber cloth together
- Vacuum mold the curing sheets of carbon fiber to the shape of half of the “pill” (shield design) with the Geiger Tube mold in the center
- Repeat step 2 and 3 until both halves of shielding are 3 cm in thickness
- Insert Geiger Tube and epoxy both halves of shield together
- Epoxy ~2 more sheets of Carbon Fiber around shield
- Sand to accurate dimensions
Radiation: Manufacturing Plan

RICH Detector

- Take apart Sony A3000 Camera for critical components (CMOS, Video processor)
- Modify electrical components to connect to master power flow for g-switch activation and image capture triggering
- Attach Sodium Fluoride lens flush with CMOS
- Build an enclosure to block external light
## Radiation Part list / Price

<table>
<thead>
<tr>
<th>Name</th>
<th>Price</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSGC Geiger Counter (2)</td>
<td>Acquired</td>
<td>110g (Both Counters)</td>
</tr>
<tr>
<td>Carbon Fiber (~ 3 yards)</td>
<td>$75 ($25 per yard)</td>
<td>772g</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Acquired</td>
<td>^ (included)</td>
</tr>
<tr>
<td>Sony A3000</td>
<td>$350</td>
<td>120g</td>
</tr>
<tr>
<td>Sodium Fluoride Lens</td>
<td>-</td>
<td>21.0g</td>
</tr>
</tbody>
</table>
Testing Plan

CC of CO
Radiation: Testing

Geiger Counter

• Data log test
  • Run each Geiger counter separately to test data storage abilities
  • Run RICH detector to test data recording ability

• Calibration and data logging full test
  • Run both Geiger counters and log data into the same storage device for a period of multiple days (4) in order to calibrate the counters

• Shielding test
  • Run Geiger counter with Geiger tube in Carbon Fiber shielding and data log for 4 days
Radiation: Testing

RICH Detector

• Firmware test
  • Run firmware for g-switch activation and data logging ability

• Vibration test
  • Standalone vibration and spin test using the shake and spin tables used for full integration test

• Detection Test
  • Shine blue light into medium to simulate Cherenkov radiation and capture image
Sub-Mission Overview

Biology Team

CC of CO
Our study is a contribution to two other scientific proposals:

1. NASA 100-Year-Starship
   • A study that focuses on the next era of space exploration, by examining sending humans on long voyages into space

2. ESA Noah’s Cosmic Ark
   • An idea to store various species’ DNA on the moon in case of a global catastrophe
Biology Payload Mission Overview

• Test the building blocks of life
• Determine the durability of chromosomal DNA versus plasmid DNA
• Survivability of DNA will be tested to see if long term storage in upper atmospheric levels and beyond is a viable option.
• In the occurrence of a cataclysmic event, storage of earth’s beauty should be stored in an off planet vault.
Biology Payload - Benefits for Humanity

- In order to truly understand what separates prokaryotic and eukaryotic DNA from one another we must understand their similarities and differences
- Understanding the structure of DNA, enables us to address the possibility of life beyond Earth.
  - Organic compounds are very powerful biomarkers, especially those whose structures show long-term preservation
- Discuss sending DNA outside of the atmosphere for safekeeping
Bio Team Expected Results

- We don’t expect DNA to be cooked by extreme radiation exposure
- We don’t expect DNA gel to freeze, but will prepare 4 capsules incase we are wrong
- Some sloshing of the gel is expected
- Given the conditions of the environment we expect to see more than 50% survivability of DNA (10 out of 16 survive)
What other research has been performed in the past?
– Researchers from Germany placed plasmid DNA on the outside of a rocket where some DNA came back intact and functional.
Biology Payload Concept of Operations

- Data collection: Liftoff to landing
- Altitudes of interest: Launch and parachute deployment
- End of data collection: When payload is recovered
Biology Payload Success Criteria

Minimum success criteria:

- Measure the survivability of DNA
  - Even a full mortality count is considered successful data
Biology Payload Risks

- DNA cradle must withstand against physical forces taking place within the rocket, otherwise DNA may not survive flight.

- Such forces include:
  - Lift-off impulses
  - Turbulence
  - Parachute deployment
  - Landing
  - Manufacturing mistakes
  - Bad DNA
Biology Payload - Changes Since the PDR

- We have decided to purchase mouse or rat DNA online
- We are going to specifically compare the differences between plasmid and chromosomal DNA
- We will be testing the differences between ‘wet’ (DNA contained in fluid) versus ‘dry’ (DNA without a medium)
- We will test DNA that belongs to a plant
- We have changed the arrangement of the centrifuge tubes within the payload
- DNA concepts are better understood
- Gel electrophoresis dry run has occurred to practice
Bio-System Design

• Our experiment consists of a total of 16 DNA tubes
• In order to fit all 16 tubes and secondary containment with the other experiments, special arrangement was in order
• Red tubes (two capsules per tube) on next page
• Yellow (one capsule per tube) on next page
• In order of outer diameter to inner diameter: First (8 capsules) and Second (4 capsules) rows will be contained in secondary Containment. Third row (4 capsules) will be inside a separate secondary containment.
• The separate containment will provide thermal Shielding.
Bio-System Design
### Biology: Functional & Design Requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA must be completely contained within the centrifuge tubes.</td>
<td><strong>Test</strong></td>
<td>Testing of structural components/materials will be conducted using a vibration and drop test.</td>
</tr>
<tr>
<td>BNO055 sensor must be able to detect vibration and g-forces</td>
<td><strong>Test</strong></td>
<td>Vibration and simulated g-forces will be applied to sensor to check functionality.</td>
</tr>
<tr>
<td>Primary and secondary containment must be able to withstand vibration and g-forces.</td>
<td><strong>Inspection</strong></td>
<td>Drop test, vibration testing, and materials testing will be conducted to determine durability.</td>
</tr>
<tr>
<td>Centrifuge tubes and DNA samples must be integrated properly into the payload with consideration of other schools.</td>
<td><strong>Inspection</strong></td>
<td>Container spacing checked with CAD model and physical verification will be achieved multiple times through build/integration process.</td>
</tr>
</tbody>
</table>
Risk Matrix – Biology

- Fluid loss may occur if containment is disturbed, fluid exists in such small amounts (10 microLiters), it can be considered negligible
- 3D printed structures may break, resulting in more extreme vibration for DNA samples

BIO.RSK.1: Fluid loss from ‘wet’ DNA samples involving primary containment
BIO.RSK.2: Cradle/3D holder breaking
BIO.RSK.3: Fluid loss from ‘wet’ DNA samples involving secondary containment
Manufacturing Plan

*Biology Team*

*RRCC 0f CO*
Bio Manufacturing Plan

- Sketch structural components that are to be used in AutoCad
- Extract a sample of DNA and place in appropriate centrifuge tubes
- Secure lid on tubes
- Place hot glue adhesive as a form of secondary containment
- Place inside 3D printed ‘cradle’ and secure with lid.
- Hot glue cradle and tube into place
Prototype Testing

*Biology Team*

*RRCC of CO*
Bio Testing

- Vibrations testing: Simulate vibration and g-forces to test durability of 3D printed materials.
- Sonication: Applies hydrodynamic shearing forces to DNA, then fragmentation is observed.
- Needlepoint Shearing: Simulates shearing forces by pushing DNA through a small gauge needle.
- Gel electrophoresis: Mechanism used to analyze DNA molecules by their fragments (size and charge).
## Fluid Flow Experiment

<table>
<thead>
<tr>
<th>Part #</th>
<th>Part Name</th>
<th>Description Link (Shrunk)</th>
<th>Weight (g)</th>
<th>Quantity Required</th>
<th>Quantity Aquired</th>
<th>Power Consumed (mAh)</th>
<th>Unit Price</th>
<th>Total Weight (g)</th>
<th>Total Current (mAh)</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3D Plastics (ABS, PLS, orPLA)</td>
<td></td>
<td>123.91</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>unknown</td>
<td>123.91</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Plexiglass container</td>
<td></td>
<td>unknown</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$50.00</td>
<td>N/A</td>
<td>$50.00</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>PMMA/Plastic</td>
<td></td>
<td>unknown</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$50.00</td>
<td>N/A</td>
<td>$50.00</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Pipe</td>
<td></td>
<td>unknown</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$50.00</td>
<td>N/A</td>
<td>$50.00</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>HackHD</td>
<td></td>
<td>100.00</td>
<td>1</td>
<td>0</td>
<td>650.00</td>
<td>$165.00</td>
<td>100.00</td>
<td>650.00</td>
<td>$165.00</td>
</tr>
<tr>
<td></td>
<td>HackHD Lens</td>
<td></td>
<td>unknown</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$10.00</td>
<td>N/A</td>
<td>$10.00</td>
<td>#VALUE!</td>
</tr>
</tbody>
</table>

Legend: N/A - Not applicable, #VALUE! - Invalid value.
## Biology Experiment

<table>
<thead>
<tr>
<th>Part #</th>
<th>Part Name</th>
<th>Description Link (Shrinked)</th>
<th>Weight (g)</th>
<th>Quantity Required</th>
<th>Quantity Aquired</th>
<th>Power Consumed (mAh)</th>
<th>Unit Price</th>
<th>Total Weight (g)</th>
<th>Total Current (mAh)</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3D Plastic (ABS or PLA)</td>
<td></td>
<td>750.00</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>unknown</td>
<td>750.00</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>1.5 mL centrifuge tubes</td>
<td></td>
<td>0.30</td>
<td>25</td>
<td>25</td>
<td>N/A</td>
<td>unknown</td>
<td>7.50</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Mouse DNA</td>
<td></td>
<td>0.10</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>unknown</td>
<td>0.10</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Rat DNA</td>
<td></td>
<td>0.10</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>unknown</td>
<td>0.10</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Human DNA</td>
<td></td>
<td>0.10</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>unknown</td>
<td>0.10</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Dog DNA</td>
<td></td>
<td>0.10</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>unknown</td>
<td>0.10</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
<tr>
<td></td>
<td>Cat DNA</td>
<td></td>
<td>0.10</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>unknown</td>
<td>0.10</td>
<td>N/A</td>
<td>#VALUE!</td>
</tr>
</tbody>
</table>
# Parts List Electronics

## Electronics/Sensor Package

<table>
<thead>
<tr>
<th>Part #</th>
<th>Part Name</th>
<th>Description Link (Shrunked)</th>
<th>Weight (g)</th>
<th>Quantity Required</th>
<th>Quantity Acquired</th>
<th>Power Consumed (mAh)</th>
<th>Unit Price</th>
<th>Total Weight (g)</th>
<th>Total Current (mAh)</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2472</td>
<td>Adafruit 9-DOF Absolute Orientation IMU</td>
<td><a href="https://www.adafruit.com/products/2472">Website</a></td>
<td>3.00</td>
<td>2</td>
<td>0</td>
<td>12.300</td>
<td>$34.95</td>
<td>6.00</td>
<td>-2,500.00</td>
<td>$69.90</td>
</tr>
<tr>
<td>328</td>
<td>Lithium Polymer Battery - 3.7v 2500mAh</td>
<td><a href="https://www.adafruit.com/products/328">Website</a></td>
<td>52.00</td>
<td>1</td>
<td>0</td>
<td>-2,500.00</td>
<td>$14.95</td>
<td>52.00</td>
<td>-2,500.00</td>
<td>$14.95</td>
</tr>
<tr>
<td>2455</td>
<td>Rechargeable 5V Lipo USB Boost</td>
<td><a href="https://www.adafruit.com/products/2455">Website</a></td>
<td>6.00</td>
<td>1</td>
<td>0</td>
<td>5.000</td>
<td>$19.95</td>
<td>6.00</td>
<td>0.00</td>
<td>$19.95</td>
</tr>
<tr>
<td>1995</td>
<td>5V 2A Power Supply w/ MicroUSB Cable</td>
<td><a href="https://www.adafruit.com/products/1995">Website</a></td>
<td>N/A</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$7.95</td>
<td>N/A</td>
<td>N/A</td>
<td>$7.95</td>
</tr>
<tr>
<td>NEUTRINO</td>
<td>NEUTRINO</td>
<td><a href="http://www.jaxxon.com/neutrinol">Website</a></td>
<td>n/a</td>
<td>2</td>
<td>0</td>
<td>200.000</td>
<td>$20.00</td>
<td>N/A</td>
<td>400.00</td>
<td>$40.00</td>
</tr>
<tr>
<td>DEV-09510</td>
<td>SparkFun OpenLog</td>
<td><a href="https://www.sparkfun.com/products/85318">Website</a></td>
<td>10.00</td>
<td>2</td>
<td>0</td>
<td>6.000</td>
<td>$24.95</td>
<td>20.00</td>
<td>12.00</td>
<td>$49.90</td>
</tr>
<tr>
<td>Various</td>
<td>Geiger Counter</td>
<td><a href="https://www.geiger">Website</a></td>
<td>55.00</td>
<td>2</td>
<td>0</td>
<td>N/A</td>
<td>$93.09</td>
<td>110.00</td>
<td>N/A</td>
<td>$186.18</td>
</tr>
</tbody>
</table>

---

RockSat-C 2015

CDR
# Parts List Radiation

## Radiation Experiment

<table>
<thead>
<tr>
<th>Part #</th>
<th>Part Name</th>
<th>Description Link (Shrunked)</th>
<th>Weight (g)</th>
<th>Quantity Required</th>
<th>Quantity Aquired</th>
<th>Power Consumed (mAh)</th>
<th>Unit Price</th>
<th>Total Weight (g)</th>
<th>Total Current (mAh)</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carbon Fiber (per yard)</td>
<td></td>
<td>257.00</td>
<td>3</td>
<td>0</td>
<td>N/A</td>
<td>$25.00</td>
<td>771.00</td>
<td>N/A</td>
<td>$75.00</td>
</tr>
<tr>
<td></td>
<td>Epoxy (per qt)</td>
<td></td>
<td>N/A</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$49.99</td>
<td>N/A</td>
<td>N/A</td>
<td>$49.99</td>
</tr>
<tr>
<td></td>
<td>Vacuum Bag Seelent</td>
<td></td>
<td>N/A</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>$9.99</td>
<td>N/A</td>
<td>N/A</td>
<td>$9.99</td>
</tr>
<tr>
<td></td>
<td>Breather Fabric (per yard)</td>
<td></td>
<td>N/A</td>
<td>2</td>
<td>0</td>
<td>N/A</td>
<td>$3.49</td>
<td>N/A</td>
<td>N/A</td>
<td>$6.98</td>
</tr>
<tr>
<td></td>
<td>Release Fabric (per yard)</td>
<td></td>
<td>N/A</td>
<td>2</td>
<td>0</td>
<td>N/A</td>
<td>$6.99</td>
<td>N/A</td>
<td>N/A</td>
<td>$13.98</td>
</tr>
</tbody>
</table>
System Overview

Community Colleges of Colorado (CC of CO)
Mechanical Design Elements
Mechanical Drawings - Bird’s eye view
Makrolon Plate mounts to aluminum as per user guide.
Fluid Flow
Max Height
Radiation

Bio
Bio Shielded

Geiger Counters not shown on this view
Mechanical Drawings - Aluminum Base Plate

- Max Height
- Makrolon Plate
Mechanical Drawings - Specimen Tray
Attachment points printed as part of the structure.
5V Powerboost

Electronics pkg will be contained in a 3D print cradle. Attachments will be 3003 Al \( \frac{1}{16}'' \) Angle.
Fluid attachment base.
Shielding Top

Shielding Side

Geiger Counter Top

Geiger Counter Side

Radiation
Printed Geiger Cradle.
Systems Block Diagram
RockSat C
2016
Geiger Counter Schematic
REV 1.0
Date: 12/5/2015
Drawn by David A. Ferguson & Lawrence Perkins
Page 1 of 1
Subsystem Design – Weight Budget

Biology Payload weight: 457.5g (0.4575kg)
  • each test tube weighs ~.3g X 25 tubes = ~7.5 g
  • we are choosing between plastics (PLS and ABS) to 3D print the cradle 450g

Radiation Shielding weight: 1002g (1.002kg)
  • Geiger Counters (2): 110g
  • Carbon Fiber Shielding: 772g
  • RICH Detector: 120g
Subsystem Design – Weight Budget Cont.

Fluid Flow weight: 242g (0.242 kg)
  • Container+Containment: 185g
  • Liquid (water): 21g
  • Components(LED + Camera): 36g

Electrical Weight: 124g (0.124kg)
  • Flight controllers & loggers: 60g
  • Battery & Boost Converter: 58g
  • Sensors: 6g

Ballast/Mounting weight: 1.2 kg

Total weight from parts list: 1.825 kg
Total weight estimate: 3.025 kg
Testing Plan

Community Colleges of Colorado

(CC of CO)
Mechanical Testing

- Spin test
  - Build a spin table and rotate payload using acrylic prototype plate at a rotation rate of 10 Hz

- Vibration test
  - Test full payload on a shake table (currently owned) and use an inverted sander with test plate bolted to it to simulate flight/launch vibration
Electrical Testing

• Electrical integration
  • Connect and confirm power and code requirements of all electrical systems integrated together.

• Full electronics data logging test
  • Record data from integrated electronics system for a 24 hour period
Electrical Testing

• The payload with camera and lights will be turned on at full operational capacity until the battery is fully discharged
  • est. 1 hour 20 minutes
User Guide Compliance
Community Colleges of Colorado
(CC of CO)
Center of Gravity Compliance

- All components will be distributed such that the center of gravity compliance will be met.
- Fluid container will be located in the center to minimize its effect on the center of mass during rotation.
Liquid Containment Compliance

Fluid Flow: Container of distilled water + Secondary containment container

Bio Package: DNA will be contained inside 1.5mL centrifuge tubes with a lid, each tube will be placed inside a structural tube with a secondary containment “shell” with a lid extending to the top of a structural tube.
Activation Compliance

- Electronics Activation via G-Switch (1.SYS.2) (Acquired and flight tested on RockOn 2015)
Canister Sharing

- We will communicate with them via e-mail and Google Drive.
- We will plan on not using a mid-mounting plate.
- Note that mounting to the bottom is preferable.
- Half of the mass will be shared as per the User Guide.
Project Management Plan

Community Colleges of Colorado
(CC of CO)

/u/Bibasa
Student Organizational Chart

**Scheduler**
Joseph Hamvas

**Project Management Lead**
David Colclazier

**Project Management Co-lead**
Wesley Perkins

---

**Electronics Team**
Wesley Perkins - Lead
George Pandya
David Colclazier
Chris Littlefield
Juan Garcia-Coque?
*Faculty: Jennifer Jones*

**Biological Payload**
Lev Seyfman - Lead
Sara Vigil
Blake Levien
Duncan Smith?
Peer Seyfman
*Faculty: Barb Sobhani and Brandon English*

**Radiation Shielding**
Phil Baranowski - Lead
Jamie Principato
Thomas Horning
Juan Garcia-Coque?
Gregoria Olivas?
*Faculty: Victor Andersen*

**Fluid Flow**
Thomas Horning - Co Leader
Joseph Hamvas - Co Leader
Wes Perkins
George Pandya
Chris Littlefield
*Faculty: Hank Weigel*

**Software Design**
David Colclazier - Lead
Wesley Perkins
Juan Garcia-Coque?
Peer Seyfman?
*Faculty: Jeromie Rand*

**Structural Team**
Chris Littlefield - Lead
Blake Levien
Phil and Jamie
Sara Vigil
*Faculty: Jennifer Jones*
Faculty Advisors

Bio - Barbra Sobhani and Brandon English
Fluid - Hank Weigel
Radiation - Victor Andersen
Electronics - Jennifer Jones
Software - Jeromie Rand
Schedule During Break

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Days to Complete</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Integrated Geiger</td>
<td>12-Dec</td>
<td>32</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Build Preliminary Electronics and Software</td>
<td>12-Dec</td>
<td>14</td>
<td>26-Dec</td>
</tr>
<tr>
<td>Test Data Storage</td>
<td>26-Dec</td>
<td>18</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Accelerometer Vibration Test</td>
<td>26-Dec</td>
<td>18</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Electronics Limits Test</td>
<td>26-Dec</td>
<td>18</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Make Fluid Flow Mold</td>
<td>12-Dec</td>
<td>32</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Test Lighting and Focus for Camera</td>
<td>12-Dec</td>
<td>32</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Build Biology Cradle</td>
<td>12-Dec</td>
<td>32</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Test Mounting Points of Subsystems</td>
<td>12-Dec</td>
<td>16</td>
<td>28-Dec</td>
</tr>
<tr>
<td>Documented Process for Mounting</td>
<td>28-Dec</td>
<td>16</td>
<td>13-Jan</td>
</tr>
<tr>
<td>Preliminary Vibration Test</td>
<td>12-Dec</td>
<td>32</td>
<td>13-Jan</td>
</tr>
</tbody>
</table>
1st Testing Review - Integrated Review

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Days to Complete</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sybsystem Testing Review Teleconference</td>
<td>15-Feb</td>
<td>4</td>
<td>19-Feb</td>
</tr>
<tr>
<td>Integration Building</td>
<td>19-Feb</td>
<td>16</td>
<td>6-Mar</td>
</tr>
<tr>
<td>Electrical Integration</td>
<td>19-Feb</td>
<td>16</td>
<td>6-Mar</td>
</tr>
<tr>
<td>Final Integration Process Documentation</td>
<td>19-Feb</td>
<td>16</td>
<td>6-Mar</td>
</tr>
<tr>
<td>Integrated Testing</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Spin Test</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Vibration Test</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Test Electronics Data Log</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Vacuum Test</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Cold Test</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>G-Switch Activation Test</td>
<td>6-Mar</td>
<td>22</td>
<td>28-Mar</td>
</tr>
<tr>
<td>Integrated Subsystem Testing Review Telecon</td>
<td>28-Mar</td>
<td>4</td>
<td>1-Apr</td>
</tr>
<tr>
<td>Integration Process Documentation</td>
<td>11-Feb</td>
<td>47</td>
<td>29-Mar</td>
</tr>
</tbody>
</table>
Integrated Review - Full Mission Test Report

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Days to Complete</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Subsystem Testing Review Telecon</td>
<td>28-Mar</td>
<td>4</td>
<td>1-Apr</td>
</tr>
<tr>
<td>Detailed Process for Canister Integration</td>
<td>1-Apr-16</td>
<td>10</td>
<td>11-Apr</td>
</tr>
<tr>
<td>Canister Building</td>
<td>11-Apr-16</td>
<td>7</td>
<td>18-Apr</td>
</tr>
<tr>
<td>Spin Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Vibration Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Total Mass Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Center of Mass Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>G-Switch Activation Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Full Mission Simulation Test</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Bug Squashing!</td>
<td>6-Apr-16</td>
<td>23</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Full Mission Test Report Telecon</td>
<td>18-Apr-16</td>
<td>11</td>
<td>29-Apr</td>
</tr>
<tr>
<td>Canister Integration Documentation</td>
<td>28-Mar</td>
<td>34</td>
<td>1-May</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5/2/2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6-May</td>
</tr>
</tbody>
</table>
CC of CO Budgets

Red Rocks Community College: $500
Arapahoe Community College: $500
Community College of Aurora: $500

Total estimated price from parts list: $805
Total estimated mass from parts list: 3.025kg
### Team Contact Matrix

<table>
<thead>
<tr>
<th>Arapahoe Contact list</th>
<th>Email Address</th>
<th>Phone Number</th>
<th>US Person? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jennifer Jones (faculty)</td>
<td><a href="mailto:jennifer.jones@arapahoe.edu">jennifer.jones@arapahoe.edu</a></td>
<td>(303) 797-5839</td>
<td>Yes</td>
</tr>
<tr>
<td>Jeromie Rand (faculty)</td>
<td><a href="mailto:jeromie.rand@arapahoe.edu">jeromie.rand@arapahoe.edu</a></td>
<td>(303) 797-5230</td>
<td>Yes</td>
</tr>
<tr>
<td>Hank Weigel (faculty)</td>
<td><a href="mailto:henry.weigel@arapahoe.edu">henry.weigel@arapahoe.edu</a></td>
<td>(303) 797-5831</td>
<td>Yes</td>
</tr>
<tr>
<td>David Colclazier (student)</td>
<td><a href="mailto:david@jdc.tech">david@jdc.tech</a></td>
<td>(720) 496-9118</td>
<td>Yes</td>
</tr>
<tr>
<td>Joe Hamvas (student)</td>
<td><a href="mailto:jhamvas@student.cccs.edu">jhamvas@student.cccs.edu</a></td>
<td>(720) 878-7050</td>
<td>Yes</td>
</tr>
<tr>
<td>Chris Littlefield (student)</td>
<td><a href="mailto:chr1ltt@comcast.net">chr1ltt@comcast.net</a></td>
<td>(303) 981-6064</td>
<td>Yes</td>
</tr>
<tr>
<td>George Pandya (student)</td>
<td><a href="mailto:gpandya@student.cccs.edu">gpandya@student.cccs.edu</a></td>
<td>(303) 522-6868</td>
<td>Yes</td>
</tr>
<tr>
<td>Wesley Perkins (student)</td>
<td><a href="mailto:lwpmoon@me.com">lwpmoon@me.com</a></td>
<td>(720) 935-0931</td>
<td>Yes</td>
</tr>
<tr>
<td>Jaime Principato (student)</td>
<td><a href="mailto:jprincipato@student.cccs.edu">jprincipato@student.cccs.edu</a></td>
<td>(239) 810-4951</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### RSC 2016 Contact List for: Community College of Aurora

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Email Address</th>
<th>Phone Number</th>
<th>US Person? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victor Andersen (faculty)</td>
<td><a href="mailto:victor.andersen@ccaurora.edu">victor.andersen@ccaurora.edu</a></td>
<td>(303) 340-7085</td>
<td>Yes</td>
</tr>
<tr>
<td>Philip Baranowski (student)</td>
<td><a href="mailto:filpamtbkk@yahoo.com">filpamtbkk@yahoo.com</a></td>
<td>(313) 729-1462</td>
<td>Yes</td>
</tr>
<tr>
<td>Thomas Horning (student)</td>
<td><a href="mailto:horning.thomas@yahoo.com">horning.thomas@yahoo.com</a></td>
<td>(303) 319-5712</td>
<td>Yes</td>
</tr>
<tr>
<td>Juan Garcia-Coque (student)</td>
<td><a href="mailto:garco.ja@gmail.com">garco.ja@gmail.com</a></td>
<td>(303) 253-5765</td>
<td>Yes</td>
</tr>
<tr>
<td>Gregoria Olivas (student)</td>
<td><a href="mailto:golivas88@hotmail.com">golivas88@hotmail.com</a></td>
<td>(719) 329-4627</td>
<td>Yes</td>
</tr>
</tbody>
</table>
# RSC 2016 Contact List for: Red Rocks Community College

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Email Address</th>
<th>Phone Number</th>
<th>US Person? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barb Sobhani (faculty)</td>
<td><a href="mailto:barbra.sobhani@rrcc.edu">barbra.sobhani@rrcc.edu</a></td>
<td>(303) 914-6366</td>
<td>Yes</td>
</tr>
<tr>
<td>Brandon English (faculty)</td>
<td><a href="mailto:brandon.english@rrcc.edu">brandon.english@rrcc.edu</a></td>
<td>(303) 914-6483</td>
<td>Yes</td>
</tr>
<tr>
<td>Blake Levien (student)</td>
<td><a href="mailto:blakezlevien@gmail.com">blakezlevien@gmail.com</a></td>
<td>(773) 387-6278</td>
<td>Yes</td>
</tr>
<tr>
<td>Lev Seyferman (student)</td>
<td><a href="mailto:lseyferman@hotmail.com">lseyferman@hotmail.com</a></td>
<td>(720) 987-1218</td>
<td>Yes</td>
</tr>
<tr>
<td>Peer Seyferman (student)</td>
<td><a href="mailto:pseyferman@gmail.com">pseyferman@gmail.com</a></td>
<td>(303) 718-6499</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Duncan Smith (student)</strong></td>
<td><strong><a href="mailto:duncan-smith@live.com">duncan-smith@live.com</a></strong></td>
<td><strong>(720) 810-0249</strong></td>
<td><strong>Yes</strong></td>
</tr>
<tr>
<td>Sara Vigil (student)</td>
<td><a href="mailto:smvigil70@gmail.com">smvigil70@gmail.com</a></td>
<td>(303) 842-2964</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Community Colleges of Colorado (CC of CO)

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCHEDULE IS MOUNTAIN TIME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:00 PM</td>
<td></td>
<td></td>
<td></td>
<td><strong>Yes</strong></td>
<td><strong>Yes</strong></td>
</tr>
<tr>
<td>2:00 PM</td>
<td><strong>Yes</strong></td>
<td></td>
<td><strong>Yes</strong></td>
<td><strong>Yes</strong></td>
<td></td>
</tr>
<tr>
<td>3:00 PM</td>
<td><strong>Yes</strong></td>
<td></td>
<td><strong>Yes</strong></td>
<td><strong>Yes</strong></td>
<td></td>
</tr>
<tr>
<td>4:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Project Summary

• Areas of concern
  – Build time/process for RICH detector (experimental detector)
Conclusion

By Jan 13th

• Electronics
  • data storage tests
  • accelerometer vibration tests
  • test integrated Geiger Code
  • Test and debug integrated code

• Structure
  – spin/vibration test mounts

• Radiation
  – Run Geiger counter data log and calibration tests
Conclusion

By Jan 13th

• Bio
  – All control testing complete
  – First Physical prototype built via 3D printed
  – Structural testing begins

• Fluid
  – Make mold of Primary and Secondary Container
  – Continue Prototype spin testing.
  – Fluid vibration testing
  – Begin Lighting and Camera tests