PRESENTATION OUTLINE

- **Section 1**: Mission Overview
- **Section 2**: Design Overview
- **Section 3**: Subsystem Status
- **Section 4**: Integrated Subsystem Testing Status
- **Section 5**: Full System Integrated Plan
- **Section 6**: Project Management Subsystem
1.0 MISSION OVERVIEW

Quiana McKnight
MISSION OVERVIEW: MISSION OBJECTIVES

Mission statement

- The purpose of participating in RockSat-C is to answer our question of suborbital micro gravity effects on immune cell regulation.
- This project is in conjunction with our existing NASA project investigating natural countermeasures to Astronaut’s immune system dysregulation that is of current interest to NASA.
- The mission is to provide natural supplements (plants and probiotics metabolites extraction) testing in suborbital space to show the effects at a molecular level of gene expression change in activated immune cells.

Project requirements

Building a sounding payload-electronic system Integrate the biological experiment- human immune cells subject to microgravity in space and on the ground and spin in a clinostat for 6 minutes
SUCCESS CRITERIA

Minimum Success Criteria:
- What is the least amount of data you can collect that will still constitute a success?
  - Physical components of the sample: Able to collect RNA Seq Data and LC/MS data from cells.

Comprehensive Success Criteria
- What is the ideal amount of data to have a full or comprehensive mission success?
  - Able to collect RNA Seq Data and LC/MS data from cells.
CONCEPT OF OPERATIONS

AT T-3 prior to launch of the rocket, the payload will turn on, causing the servo to trigger the syringe to introduce the PHA into the PBMC’s.
Using a servo motor and syringe system instead of a pumping system
2.0 DESIGN OVERVIEW

Charles Thomas
DESIGN OVERVIEW:

View of the Makrolon plates and subsystems
DESIGN OVERVIEW

- **SW ISO VIEW OF THE MECHANICAL AND ELECTRICAL STRUCTURE INSIDE THE ROTOR.**

Cryovials

Syringe system

Servo motors
DESIGN OVERVIEW

- **Top View of the Rotor, Mechanical and Electrical View of the Payload.**
DESIGN OVERVIEW

- SW ISO VIEW OF PAYLOAD
DESIGN OVERVIEW

- SIDE VIEW OF PAYLOAD INSIDE OF CANISTER

LID WILL BE SECURED USING SCREWS AND BOLTS
Start

T-3 will start payload, samples are injected w/ PHA-L

All cells of data are being stored and recorded onto the SD card

Gyroscope will monitor

Is the rocket spinning faster?

- yes
  - Microcontroller will take in information the gyro
  - Centrifuge will run at speeds determined by the microcontroller.
  - Centrifuge will continue the same speed

- no
  - We will deactivate the payload.

Stop
HAZARDOUS MECHANICAL ITEMS

• **If the rotor is not stable, this can be hazardous as it can spin off the bolts and possibly cause injury to the operator or offset the center of gravity within the canister.**

• **Leakage of liquid can cause electrical problems**
HAZARDOUS ELECTRICAL ITEMS:

If Leakage of liquid was to occur this can possibly interfere with the electrical items within canister subsystems.

If this was to occur it will cause a shortage in the system, or fire.
SPECIAL REQUEST:

- Makiron plate (Disk)
- T -3 switch
- Use of 10 ml of methanol
- to put experiment on rocket last
3.0 SUBSYSTEM STATUS
Servo Motor and injection system (new)
Gear motor (new)
Shield
Temperature sensor
Pressure sensor
Humidity sensor
Geiger counter
1 and 2 Axis Accelerometers
3 Axis Gyroscope
Completed code to control three servos at once

Plan to inject 3 cryovials with PHA-L
Its not easy to see the mechanical layout of the rotor

Below is a mock model of the inside of the rotor

There will be 3 Pha injectors set up within this rotor

Servos are below the syringe and turn on to inject liquid into cryovial
SERVO MOTOR/SYRINGE TESTING

- **General idea of how things will look in rotor (first trial set up)**
- **Tested water/powerade to see if liquid was pumping into tube and it does.**
- **Leakage is occurring right now but that is because we have not sealed the pathways. Once we seal the tubing, we are sure that the system will work properly.**
#include <Servo.h>

Servo servo1;
Servo servo2;
Servo servo3;

int i = 140;

void setup() {
  servo1.attach(5);
  servo2.attach(7);
  servo3.attach(9);
}

void loop() {
  for (i = 140; i < 180; i++) {
    servo1.write(i);
    servo2.write(i);
    servo3.write(i);
    delay(15);
  }
  for (i = 180; i > 140; i--) {
    servo1.write(i);
    servo2.write(i);
    servo3.write(i);
    delay(10);
  }
}
SUBSYSTEM TESTING

- These subsystems are to be tested once we are able 3-D print rotor and integrate with the Rock-on Heritage system.
- Gear motor
- We know that these subsystems function properly, but need to test with our integrated system.
- Geiger counter
- Pressure sensor
- Humidity sensor
- 1 and 2 Axis Accelerometers
- 3-Axis Gyroscope
4.0 INTEGRATED SUBSYSTEM TESTING STATUS

CHARLES THOMAS
INTEGRATED SUBSYSTEM TESTING STATUS

- Currently our testing consist of injecting liquid into the cryovials in a mock model. (Shown in previous section)

- Because we have not been able to procure our 3D printed rotor this has delayed our process in integrating the system.
INTEGRATED SUBSYSTEM TESTING STATUS

• **We hope to have our rotor 3-D printed the week of April 1-5, 2019 to be able to integrate and test all subsystems as a whole.**

• **Proposed plan of integration is as followed**
  
  • After additional Makrolon plate has been attached
  • Motor box that holds rotor will be attached
  • Servo attached to bottom of rotor
  • Place liquids into syringe
  • Integrate the syringe and attach to syringe holders
  • Place cryovials into slots in rotor
  • Attach cryovials to tubing/syringe system
  • Attach rotor to motor box
  • Test the mechanics inside the rotor, to view what’s happening inside
  • We will then test the components with the lid attached as a secondary containment
  • Run full integrated subsystem testing
5.0 PLAN FOR FULL SYSTEM INTEGRATION
CANISTER INTEGRATION

• We plan to test our integrated system multiple times before integration in the canister.
• Once this has been completed we will integrate the payload into the canister.
• Once integrated into the canister, we plan to do the vibrations test.
VIBE TEST

- We plan to do vibration test several times prior to arrival.
- We will be bringing a spare set of components.
- We will be bringing a spare set of samples.
- During the vibe test, water will be used instead of specimens.
ELECTRICAL TESTING

- We will power on payload to determine if we get a signal.
- We will do a run down test to check the battery life.
SOFTWARE TESTING

- Code is mostly completed just have to integrate our individual codes for each subsystem and pool them together.
- If the software is not programmed correctly, the electrical components will not work accurately.
- Most important tests have been done separately, the integration of the subsystems still needs to be done.
SYSTEM LEVEL TESTING

- Everything needs to be completely integrated in order to see the system work properly.
- Full system testing will be completed once we can procure our 3D rotor and other components to secure the syringe and the rotor.
PLAN FOR FMSR

- Once we are approved to 3-D print our rotor and integrate our full system completely, it will allow us to start constant testing.
6.0 PROJECT MANAGEMENT UPDATE
**SCHEDULE UPDATE**

- **We have doubled our meeting times. We currently meet everyday at 4pm.**

<table>
<thead>
<tr>
<th>Date</th>
<th>Testing</th>
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<tbody>
<tr>
<td>April 1-5, 2019</td>
<td>3-d print component necessary for the completion of integration</td>
</tr>
<tr>
<td>April 8-12, 2019</td>
<td>Integrate all subsystems for testing and final payment due</td>
</tr>
<tr>
<td>April 15-19, 2019</td>
<td>Testing simulation similar to the environment of the rocket and Progress update telecon</td>
</tr>
<tr>
<td>April 22-26, 2019</td>
<td>Hopefully by this time we have the canister and are able to integrate our payload.</td>
</tr>
<tr>
<td>April 29 – May 3, 2019</td>
<td>Continuing to test, completing final details and Full simulation testing review</td>
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</table>
SUMMARY OF PROGRESS

- We are currently behind without being able to print our rotor for successful testing of the integrated system.
- We will continue to work in order to get these components printed and integrated.
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
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<tbody>
<tr>
<td>Center of gravity in 1&quot; mid-can?</td>
<td>In progress of checking center of gravity</td>
</tr>
<tr>
<td>Contained in can</td>
<td>In progress of checking center of gravity</td>
</tr>
<tr>
<td>Connected to can by 4/5 bulkheads on top and bottom only</td>
<td>N/A until rotor is printed</td>
</tr>
<tr>
<td>Mass at $20 \pm 0.2$ lbs</td>
<td>N/A until rotor is printed</td>
</tr>
<tr>
<td>Shared canister clearance</td>
<td>Using full canister</td>
</tr>
<tr>
<td>No voltage on the can</td>
<td>In progress of checking plates</td>
</tr>
<tr>
<td>Activation wires at least 4 ft</td>
<td>24 gauge</td>
</tr>
<tr>
<td>Activation wire at least 24 gauge and Teflon coated</td>
<td>In progress of checking plates</td>
</tr>
<tr>
<td>Early Activation: current &lt; 1 A</td>
<td>In progress of checking plates</td>
</tr>
<tr>
<td>T-0 Activation: current &lt; .1 A</td>
<td>Using T-3 Activation</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Lithium Polymer (will not charge at Wallops)</td>
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</tbody>
</table>
• Using Full Canister
### BUDGET

- **FUNDING IS IN-HOUSE**
- **NASA-MIRO FUNDING PROJECT**
- **BELOW IS AMOUNT SPENT ON ADDITIONAL ITEMS SO FAR…**

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier</th>
<th>Estimated, Specific Cost</th>
<th>Number Required</th>
<th>Total Cost</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Motor Controller</td>
<td>Pololu</td>
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<td>Microchip</td>
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</table>

**Total (no margin):** $62.68

**Total (w/ margin):**

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**Last Update:** 2/21/2019
LUNARBC is interested in RockSat-C to answer our question of suborbital micro gravity effects on immune cell regulation. This project is in conjunction with our existing NASA project investigating natural countermeasures to astronaut’s immune system dysregulation that is of current interest to NASA. The mission is to provide natural supplements (plants and probiotics metabolites extraction) testing in suborbital space to show the effects at a molecular level of gene expression change in activated immune cells.
PLAN B

• If our servo idea does not work, this is Plan B.

• Freeze cells prior to shipment

• Add PHA-L into tubes prior to integration into the rocket as an alternative to using pumping system.

• Add coolant system into payload that would cool cells at $T=5.5$ min (idea from past year) as an alternative to the methanol.