COUNTERMEASURES FOR DYSREGULATION OF THE IMMUNE SYSTEM OF ASTRONAUTS DURING PROLONGED SPACE FLIGHTS

LANGSTON UNIVRSITY S.T.E.M
CONCEPTUAL OVERVIEW
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COAUTHORS: KAMERON GIBSON, CELICIA KINLOW, ROSALBA WHITE, MICAIAH TRIPPLETT

INTRODUCTION

Abstract

ROCKON 2017 Langston University (Fig 1-3.)

NASA and Oklahoma Space Grant Consortium Team, form Langston University and Oklahoma State University built a Real sounding rocket payload then integrated and LAUNCHED it on a two stage Terrier-Orion rocket into outer space. It will be used as a heritage system and continuous building plate for the ROCKSTAT-C program.

Fig.1

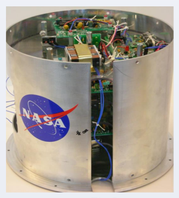


Fig.2

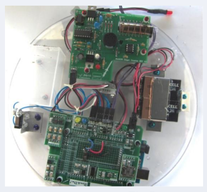


Fig.3

Langston University RockSat-C 2018

Langston University STEM team technicians are building a real sounding rocket/biology experiment payload; we will integrate and launch it on a two-stage Terrier-Orion rocket into outer space, will design and manufacture a clinostat (rotating microgravity machine) and use it as a ground biology comparison experiment.

Payload Biology Experiment Integration (RockSat-C) Design, manufacture and integrate a structure and centrifuge as part of a sounding payload that holds vials of human immune cells that will start spinning upon entering outer space and stop on reentry to space, for six minutes in microgravity. The payload control system will control the centrifuge on the rocket. Ground Biology Comparison Experiment (Clinostat) Researchers will simulate microgravity by using a clinostat (rotating microgravity machine) that will keep a constant speed. The clinostat will hold a biological experiment inside a vial, placed at the center of the rings which are suspended in the middle of a media growth liquid and will be spinning on 3-axis points at a particular RPM to negate the effects of gravitational pull.

Centrifuge – a machine with a rapidly rotating container that applies centrifugal force to its contents.

Cryogens - the study of the production and behavior of materials at very low temperatures

PROBLEM

Expose a biology experiment to six minute of microgravity on the ground and in space.

REVIEW OF LITERATURE

(background research, specify requirements)

Langston University / NASA Oklahoma Space Grant Consortium RockOn 2017

The workshop is intended to provide University level educators and students with an introductory level space flight opportunity. This RockOn workshop provides a hands-on, rocket flight training experience NASA Wallops Flight Facility will be the launch range and will provide all the range support services, including tracking and data acquisition, safety, recovery, and range logistics functions.

NASA Mission Operations Directive (MOD)

Student outreach project, 41.121 Rockon2017, Goddard Space Flight Facility, Wallops Flight Facility, Wallops Island, Virginia

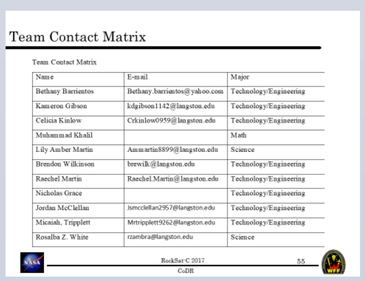
NASA RockSat-C Payload Canister User's Guide, The Next Step In Low Cost Student Access To Space, Colorado Space Grant Consortium, Discovery Learning Center Room 270, 520 UCB, Boulder, Colorado 80309-0520, Wallops Flight Facility , Wallops Island, Virginia.

RockSat Program

RockSat-C is a follow-up program to the RockOn workshop where customers design their own sounding rocket payload and compete for a spot on the launch vehicle. The RockOn Workshop teaches participants how to build a sounding rocket payload in three days. The goal is that participants will take what they learn during the workshop and return the next year with an original payload to fly with RockSat-C or RockSat-X program.

METHODS

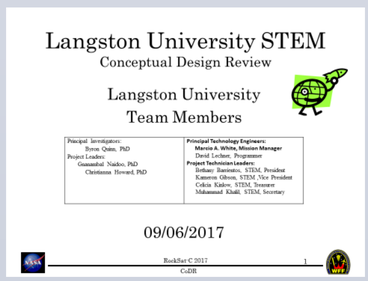
Conceptual Design Review - Bethany Barrientos


Team Contact Matrix

Team Contact Matrix

Name	E-mail	Major
Bethany Barrientos	Bethany.barrientos@yahoo.com	Technology/Engineering
Kameron Gibson	kdgibson1142@langston.edu	Technology/Engineering
Celicia Kinlow	Crkinlow0959@langston.edu	Technology/Engineering
Muhammad Khalil		Math
Lily Amber Martin	Ammartin8899@langston.edu	Science
Brendon Wilkinson	brewilk@langston.edu	Technology/Engineering
Raechel Martin	Raechel.Martin@langston.edu	Technology/Engineering
Nicholas Grace		Technology/Engineering
Jordan McClellan	Jsmcclellan2957@langston.edu	Technology/Engineering
Micaiah, Tripplett	Mtrippplett9262@langston.edu	Technology/Engineering
Rosalba Z. White	rzambra@langston.edu	Science

RockSat-C 2017 CoDR 5:5


Langston University STEM
Conceptual Design Review
Langston University
Team Members

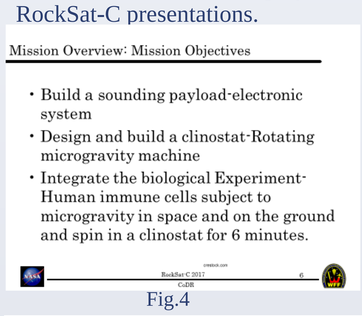
Principal Investigators:	Principal Technology Engineers:
Byron Quinn, PhD	Marcio A. White, Mission Manager
Project Leaders:	David Lechner, Programmer
Gnanambal Naidoo, PhD	Project Technician Leaders:
Christanna Howard, PhD	Bethany Barrientos, STEM, President
	Kameron Gibson, STEM, Vice President
	Celicia Kinlow, STEM, Treasurer
	Muhammad Khalil, STEM, Secretary

09/06/2017

RockSat-C 2017 CoDR 1

Mission Overview, Theory and concepts, Mission requirements (top level), Expected Results, Concept of Operations.

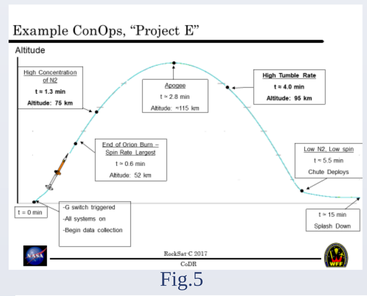
Astronauts are leaving earth healthy and then after being in a micro gravity environment they are experiencing sicknesses and the relapse of illnesses. Being in that environment causes for the immune system to weaken and if we can find a way to simulate micro gravity on cells while on earth then scientists will be able to see the possible effects that environment will have on astronauts and then we can find a way to prevent those effects. With that being said finding a way to simulate microgravity on earth was our first puzzle to solve we found that a clinostat was an effective choice. Our clinostat will simulate microgravity by spinning on a 3-axis multiring rotational device and build an electronic sounding system, along with the centrifuge, and the biological experiment to create a payload and integrate it onto a two-stage Terrior-Orion rocket. This rocket would be launched into outer space and after splash down it will be retrieved and then disintegrated so that we can collect our project and data. Figures 4-7 are slides from the RockSat-C presentations.


Mission Overview: Mission Objectives

- Build a sounding payload-electronic system
- Design and build a clinostat-Rotating microgravity machine
- Integrate the biological Experiment-Human immune cells subject to microgravity in space and on the ground and spin in a clinostat for 6 minutes.

RockSat-C 2017 CoDR 6

Fig.4


Example ConOps, "Project E"

Altitude

High Concentration of N2 t = 1.3 min Altitude: 76 km

Apogee t = 2.8 min Altitude: ~115 km

High Tumble Rate t = 4.0 min Altitude: 95 km

End of Orion Burn – Spin Rate: Largest t = 0.6 min Altitude: 52 km

Low N2, Low spin t = 5.5 min Chute Deploys

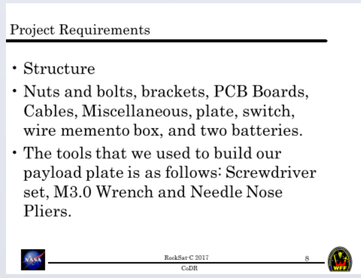
t = 0 min

-G switch triggered
-All systems on
-Begin data collection

t = 15 min Splash Down

RockSat-C 2017 CoDR

Fig.5


Project Requirements

- Structure
- Nuts and bolts, brackets, PCB Boards, Cables, Miscellaneous, plate, switch, wire memento box, and two batteries.
- The tools that we used to build our payload plate is as follows: Screwdriver set, M3.0 Wrench and Needle Nose Pliers.

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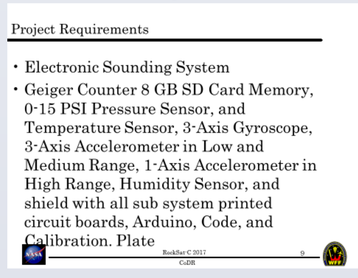
Fig. 6


Project Requirements

- Electronic Sounding System
- Geiger Counter 8 GB SD Card Memory, 0-15 PSI Pressure Sensor, and Temperature Sensor, 3-Axis Gyroscope, 3-Axis Accelerometer in Low and Medium Range, 1-Axis Accelerometer in High Range, Humidity Sensor, and shield with all sub system printed circuit boards, Arduino, Code, and Calibration. Plate

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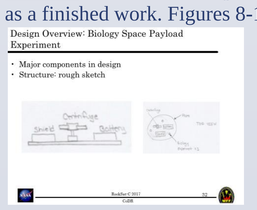
Fig.7

Conceptual design overview, Design Overview, Functional Block Diagrams, Payload Layout, RockSat-C 2016 User's guide Compliance, Shared can Logistics.

Sketches - A sketch is a rapidly executed freehand drawing that is not usually intended as a finished work. Figures 8-13 are photos of sketches used for RockSat- C


Design Overview: Biology Space Payload Experiment

- Major components in design
- Structure: rough sketch

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Fig.8

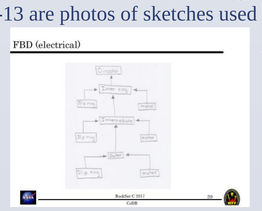
FBD (electrical)

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Fig.9

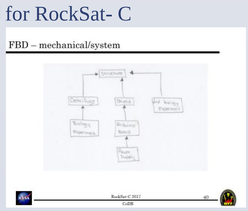
FBD – mechanical/system

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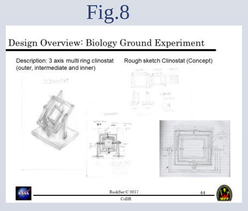
Fig.10


Design Overview: Biology Ground Experiment

Description: 3 axis multi ring clinostat (outer, intermediate and inner)

Rough sketch Clinostat (Concept)

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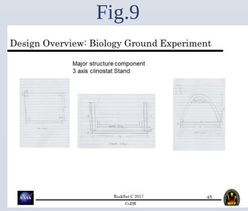
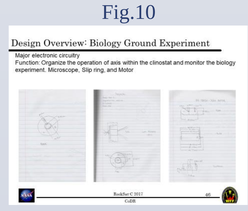
Fig.11


Design Overview: Biology Ground Experiment

Major structure component
3 axis clinostat Stand

RockSat-C 2017 CoDR 45

Fig.12


Design Overview: Biology Ground Experiment

Major electronic circuitry
Function: Organize the operation of axis within the clinostat and monitor the biology experiment. Microscope, Slip ring, and Motor

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Fig.13

Mockup Model - Early approximation of a final product is built, tested, and then reworked as necessary until accepted. Figures 14-16 are photos of the payload.

Figures 17-20 are photos of the ground experiment.

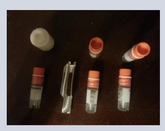


Fig. 14

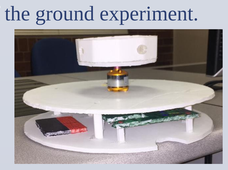


Fig. 15

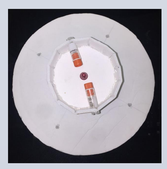


Fig.16

Fig.17

Fig.18

Fig.19

Fig.20

Management Schedule and Major Document List

Figures 21-23 are photos of the RockSat-C schedule and the major document list.


RockSat-C 2018 Schedule

This schedule is subject to change, and this online version supercedes the schedule in the User's Guide. Presentation dates may vary from team to team. Questions can be directed to rocksatprogram@gmail.com

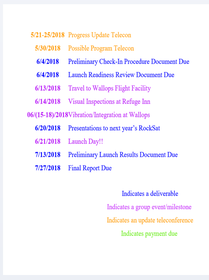
Fall 2017 Schedule

- TBD Informational Teleconference for RockSat-C and RockSat-X
- 8/15/2017 RockSat Payload User's Guide Released
- 9/18/2017 Deadline to submit Intent to Fly Form (ITF)
- 9/20/2017 Initial Down-Selections Made, Welcome Package Sent Out
- 10/9-13/2017 Conceptual Design Review (CoDR) Teleconference
- 10/13/2017 Earnest Payment of $1,000 Due
- 10/30-11/3/2017 Preliminary Design Review (PDR) Teleconference
- 12/4-8/2017 Critical Design Review (CDR) Teleconference

Spring 2018 Schedule

- 1/10/2018 Final Down Select – Flights Awarded
- 1/22-26/2018 Progress Update Telecon
- 2/12-16/2018 Subsystem Testing Review Teleconference
- 2/12/2018 First payment due
- 3/5-9/2018 Progress Update Telecon
- 3/26-30/2018 Integrated Subsystem Testing Review Teleconference
- 4/2/2018 Final payment due
- 4/9/2018 RockSat Payload Canisters sent to customers *pending receipt of final payment*
- 4/9-13/2018 Progress Update Telecon
- 4/30-5/4/2018 Full Mission Simulation Test Report Presentation Telecon

Fig.21


5/21-25/2018 Progress Update Telecon
5/30/2018 Possible Program Telecon
6/4/2018 Preliminary Check-In Procedure Document Due
6/4/2018 Launch Readiness Review Document Due
6/13/2018 Travel to Wallops Flight Facility
6/14/2018 Virtual Inspections at Refuge Inn
06/(15-18)/2018 Vibration/Integration at Wallops
6/20/2018 Presentations to next year's RockSat
6/21/2018 Launch Day!!
7/13/2018 Preliminary Launch Results Document Due
7/27/2018 Final Report Due

Indicates a deliverable
Indicates a group event/milestone
Indicates an update teleconference
Indicates payment due

Fig.22

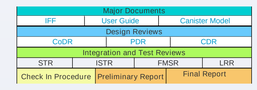

Major Documents
IFF | User Guide | Canister Model
Design Reviews
CoDR | PDR | CDR
Integration and Test Reviews
STR | ISTR | FMSR | LRR
Check In Procedure | Preliminary Report | Final Report

Fig. 23

ROCKON 2017 Langston University –Micaiah Tripplett

NASA and Oklahoma Space Grant Consortium Team, form Langston University and Oklahoma State University built a Real sounding rocket payload then integrated and LAUNCHED it on a two stage Terrier-Orion rocket into outer space.. Its will be used as a heritage system and continuous building plate for the RockSat-C program.

Biological Experiment – Rosalba White

The current grant involves the effects of microgravity on the immune system. Research experiments involve the exposure of human immune cells to natural supplemental extracts including medicinal plants, probiotic, and vitamins/minerals. Researchers want to simulate the best comparison for human astronauts' immune system by human immune cells. The project is to use the above mentioned natural product for a countermeasure to the dysregulation of the astronauts' immune cells after having been exposed to microgravity in space. Researchers will simulate microgravity by using a clinostat (rotating machine) that keeps a constant speed to suspend the cells in the middle of the media growth liquid. The cells will be subjected to a simulated microgravity environments (Clinostat) for 6 min. with exposure to the different natural supplemental extracts. The resulting cell environments will be analyzed by current standard methods in science.

Preliminary Design Review - Celicia Kinlow

System Overview, requirement /design changes since CDR, Mechanical Design Elements, Port Design Elements (if applicable), Electrical design element, Software Design Element, De-scopes/off Ramp, Detailed Drawing – A part with dimensions

Critical Design Review – Kameron Gibson

Sub-System, Payload, Heritage system, Centrifuge

Creating schematics, 2D CAD drawing, 3D CAD drawing, procurement, printing/assemble

CONCLUSIONS

We have completed all of our sketches, manual drawings, 2D CAD drawings, and 3D CAD drawings. We also have built a conceptual design of the payload along with the clinostat. We have already presented our conceptual design review, the critical design review, the sub-system testing review and the integrated design review to the Colorado space grant consortium.

ACKNOWLEDGEMENTS

Dr. Byron Quinn – Langston University professor, mentor, Donor
Mr. Marcio White - Langston University professor, mentor
Dr. Randy Hunt – Langston University professor, mentor, Donor
Dr. Franklin Fondjo – Langston University professor, mentor
David Lechner- Mentor,
NASA Colorado Space Grant Consortium

REFERENCES

RockSat-C, Colorado Space Grant Consortium, spacegrant.colorado.edu/national-programs/rs-c-home.

White, Marcio. *RockOn 2017 Langston University*. *RockOn 2017 Langston University*.

Arrasmith, Trevor. *RockSat-C Payload Canister User's Guide*. Colorado Space Grant Consortium, *RockSat-C Payload Canister User's Guide*, spacegrant.colorado.edu/national-programs/rs-c-home.

White, Marcio. RockOn 2017 General Information. RockOn 2017 General Information.

Arrasmith, Trevor. Introduction: *RockSat-C Program*. Colorado Space Grant Consortium, Introduction: *RockSat-C Program*, spacegrant.colorado.edu/national-programs/rs-c-home.