Project Imua Mission 10

Integrated Subsystem Test Review

University of Hawai‘i Community Colleges

HonCC: D’Elle Martin, Caleb Yuen, Frank Bolanos, Deysha Childs

WinCC: Nikki Arakawa, Quinn Patrick O‘Malley

Jared Estrada

Assets School: Mason Pimentel and Chris Noon

April 1, 2022

Presentation Outline

- Section 1: Mission Concept and Interfaces
- Section 2: Design Overview
- Section 3: Subsystem Testing Status
- Section 4: Integrated Subsystem Testing Status
- Section 5: Plan for FMSR
- Section 6: Project Schedule
- Section 7: Project Management
- Section 8: Conclusion

1.0 Mission Concept and Interfaces

Mission Statement (Summary)

1. Project Imua
   a. Collaboration of Honolulu Community College (HonCC) & Windward Community College (WinCC) with Assets High School
   b. Promote STEM education & careers
2. Research
   a. Launch a small scale sublimation rocket
   b. Determine specific impulse I_{sp} of sublimate (camphor)
   c. Electronic Payload
      i. Student Development & Understanding
      ii. Proof of Concept test of the 1U Artemis CubeSat

Mission Statement

Project Imua Mission 10's goals are:

- To encourage UHCC students to explore and enter STEM-based careers by engaging in team-oriented, problem-solving activities that emphasize the integration process involved in the design, fabrication, testing and documentation of launch-ready, space-bound payloads supporting scientific and/or engineering experiments.
- To conduct research on the feasibility of using a sublimation–fueled motor for providing low-power venier thrust. The specific impulse of the sublimate camphor will be determined by a static ground test and by deploying the rocket from a sounding rocket at apogee. On board cameras will record the sublimation rocket's flight parameters. This data will be supplemented by an IMU and a multi-axis accelerometer that will provide a baseline for the payload's flight trajectory. In addition, a proof of concept test will be performed on a 1U Artemis CubeSat.

Mission Objectives

Mission: Our mission is to design a payload that supports two primary and two secondary experiments while fostering intercampus collaboration.

1. **Objective 1: Student Engagement (STEM)**
   a. Facilitate cross campus collaboration (HonCC +WinCC)
   b. Foster interest in aerospace education of high school students (Assets)
   c. Project-based internship in aerospace engineering
2. **Objective 2: Primary Experimental Payload**
   a. Deploy sublimation rocket (**ScubeR**) and determine specific impulse of camphor
   b. Record flight parameters of sublimation rocket
3. **Objective 3: Secondary Experimental Payload**
   a. Measure flight parameters of flight deck with multi-axis IMU and Accelerometer
   b. Proof of Concept of a 1U Artemis CubeSat

Minimum Success Criteria: Primary Objectives

Primary Objectives	Minimum Success Criteria
Engage students in design, fabrication and aerospace engineering.	5 students awarded scholarship per semester; 5 students & 2 faculty mentors attend RockSat-X 2022 test & launch at WFF with fully integrated, flight certified payload.
Deploy sublimation rocket from payload bay near apogee.	Achieve sublimation thrust sufficient for rocket to fully clear CarRoLL.
Capture imagery by Mobius ActionCam.	Record deployment of sublimation rocket with visual cues determining acceleration. Record a minimum of three images at three different times.

Minimum Success Criteria: Secondary Objectives

Secondary Objectives	Minimum Success Criteria
Demonstrate operation of 9-axis motion tracking device.	Save data to SD card on deck plate.
Demonstrate operation of 3-axis accelerometer.	Save data to SD card on deck plate.
Proof of Concept flight for modified Artemis CubeSat Kit.	Demonstrate Artemis CubeSat onboard utilities

Desirable Success Criteria: Primary Objectives

Primary Objectives	Minimum Success Criteria
Engage students in design, fabrication and aerospace engineering.	10 scholarships awarded per semester; 8 students and 3 faculty mentors to attend RockSat-X 2022's test and launch events at WFF with a fully integrated, flight certified payload.
Deploy sublimation rocket from payload bay near apogee.	Achieve sublimation thrust sufficient for rocket to fully clear the CarRoLL and with a greater than initial release velocity.
Capture imagery by Mobius ActionCam.	Record deployment of sublimation rocket with visual cues determining acceleration. Obtain a video recording of ScubeR's flight for approximately 2 minutes.

Desirable Success Criteria: Secondary Objectives

Secondary Objectives	Minimum Success Criteria
Demonstrate operation of 9-axis motion tracking device.	Save data to SD card on deck plate.
Demonstrate operation of 3-axis accelerometer.	Save data to SD card on deck plate.
Proof of Concept flight for modified Artemis CubeSat Kit.	Demonstrate Artemis CubeSat onboard utilities (same as minimum success criteria)

ScubeR Expectations

$$F = \dot{m} v_{ex} + A_{th} P_{vap}$$

Thermodynamic Considerations: The payload compartment radiates heat (on ascent) lowering the temperature by less then 2K at the time of ScubeR deployment. The exhaust speed, v_{ex}, is essentially the thermal velocity of the reaction mass particles. The vapor pressure, P_{vap}, can be related (to first order) to the rate of sublimation of the reaction mass, $\dot{R}$.

$$P = \frac{N k_B T_K}{V} = \left(\dot{R} \frac{N_A}{\mathfrak{M}} \Delta t \right) \left(\frac{k_B T_K}{V} \right)$$

Where $\mathfrak{M}$ is the molar mass of the sublimating material, N_A is Avogadro's number, R_u is the universal gas constant, and Δt is the elapsed time from the on-set of sublimation. The rate of mass loss is the ratio of the throat area A_{th}, to the total surface area that sublimation can occur over $\dot{m} = \left(\frac{A_{th}}{A} \right) \dot{R}$.

$$F = \dot{R} A_{th} \left\{ \frac{1}{A} \sqrt{\frac{3 R_u T_K}{\mathfrak{M}}} + \left(\frac{N_A k_B T_k}{\mathfrak{M} V} \right) \Delta t \right\}$$

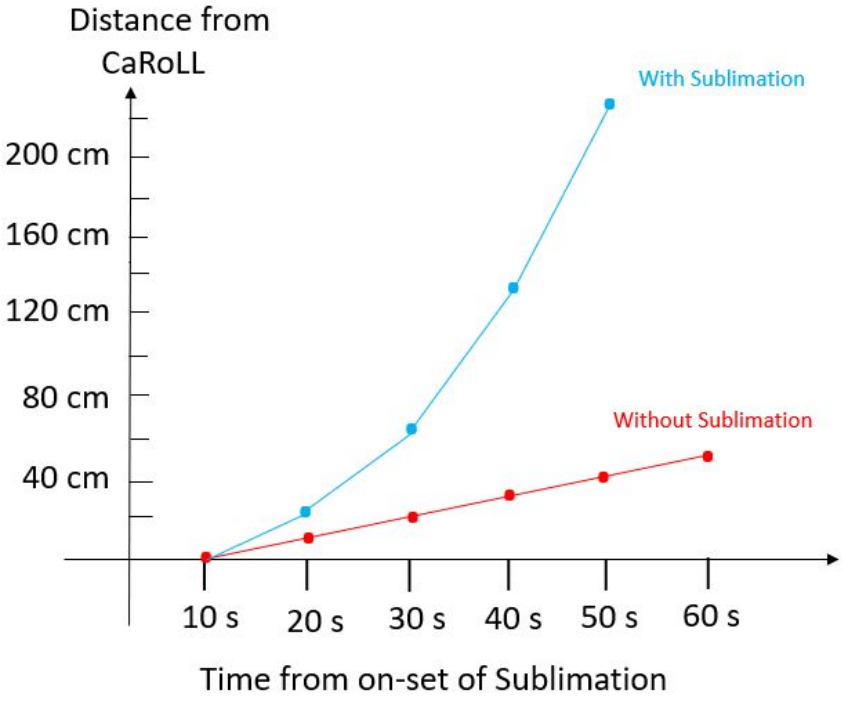
Since not all the volume holding the reaction mass is available for the sublimating material to expand to, we need to include a volume coefficient ϵ indicating the percentage of the volume that is available for the sublimating material to expand into.

ScubeR Thrust Equation

$$F = A_{th}\dot{R}\left\{\frac{1}{A}\sqrt{\frac{3R_uT_K}{\mathfrak{M}}} + \left(\frac{N_Ak_BT_K}{\mathfrak{M}\epsilon V}\right)\Delta t\right\}$$

F is the thrust of ScubeR measured in Newtons
$\dot{R}$ is the sublimation rate of Camphor measured in grams per second
A_{th} is the area of the throat measured in square meters
A is the cross-sectional area of the sublimation chamber measured in meters
R_u is the Universal Gas Constant 8.31 J/mol K
N_a is Avogadro's number 6.02 X 10^{23}
k_B is Boltzmann's constant 1.38 X 10^{-23} J/K
T_K is the temperature of ScubeR, taken to be 299 K
$\mathfrak{M}$ is the molar mass of Camphor, 0.152 kg/mol
Δt is the time interval from the onset of sublimation measured in seconds
ϵ is the percentage of the ScubeR volume that the sublimating material can expand into
V is the volume of the ScubeR sublimation chamber in cubic meters

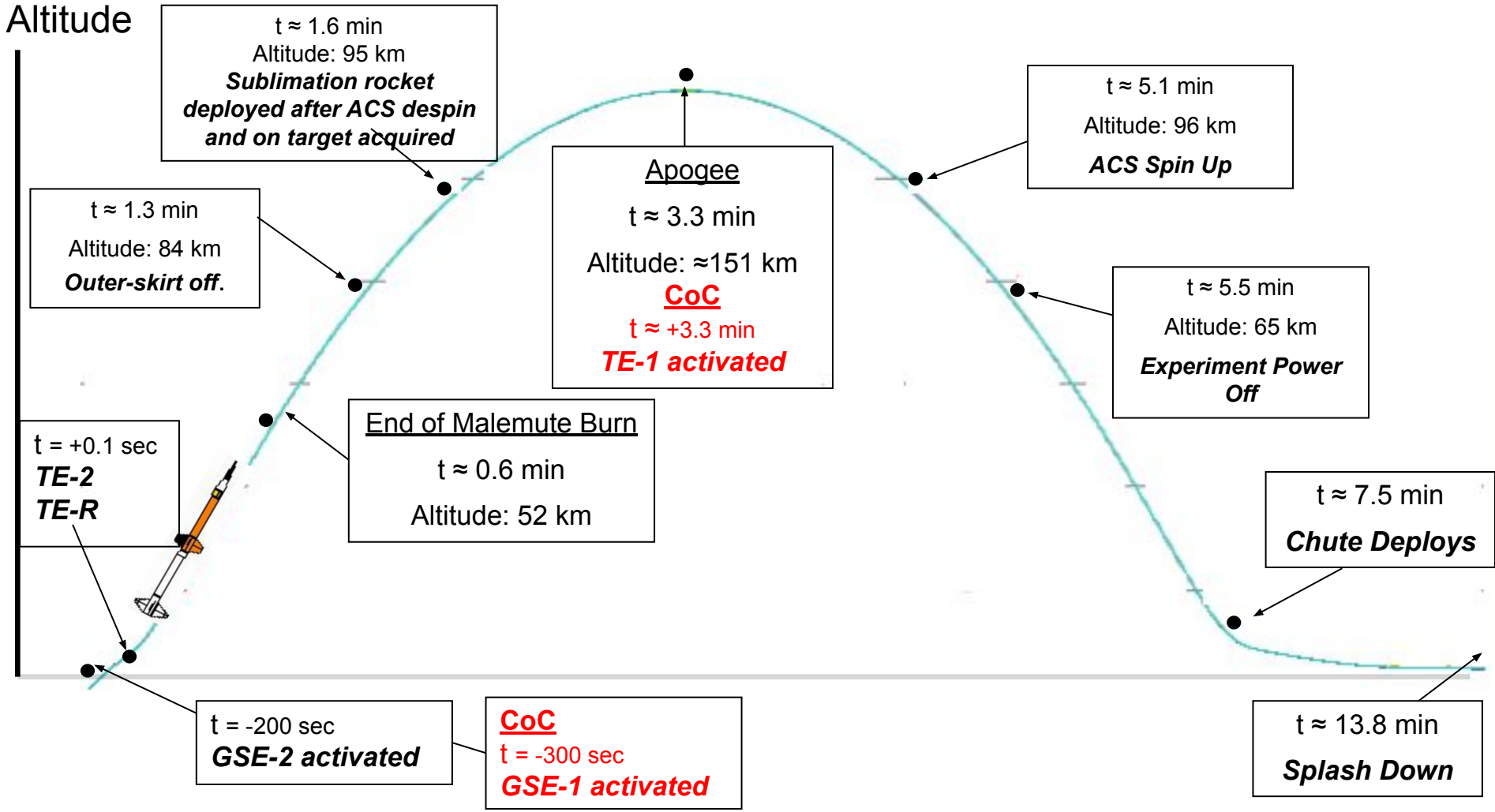
ScubeR Expectations



The maximum thrust, given the current dimensions of ScubeR, is estimated to be 0.69 mN. ScubeR reaches this maximum thrust 2 s after on-set of sublimation, while still on the stepper motor thread. With an estimated ScubeR mass of 0.30 kg, ScubeR will have a constant acceleration of 2.3 mm/s^2, along with an initial speed of 10 mm/s, at the time of deployment.

Concept of Operations

Jared



Concept of Operations [Cont.]

Event	Time On	Dwell	Event Description
GSE 1	N/A	N/A	N/A
GSE 2	T-200 sec	Flight	Powers on Artemis Raspberry Pi.
TE-1	N/A	N/A	N/A
TE-2	T+0.1 sec	Flight	Supply Power to Power Distribution Board.
TE-3	N/A	N/A	N/A
TE-R	T+0.1 sec	Flight	Ensures that power is supplied to the Power Distribution Board.

Concept of Operations: ScubeR

Jared

ScubeR Deployment Timeline	Event
T = -200s	Artemis powered on via GSE
T = +0.1s	ScubeR Controller to give H bridge command to power motor, level shifter turned on via TE-2 and TE-R through PDB.
T = +96s	ScubeR Controller to start full backwards turn step command towards puncturing sublimate chamber for experiment start
T = +99s	ScubeR Controller to start full forwards rotation command (after ACS)
T = +110s	ScubeR is released from the shaft
T = +115s	ScubeR Controller to complete command cycle and cease all commands

Concept of Operations: Data Controller

Data Controller Deployment Timeline	Event
T = +0.1s	Power Distribution Board (PDB) supplies power to data controller and turns on. One accelerometer at ±2g & the other at ±16g. The gyroscope will be set to ±245 dps Magnetometer set to ±4 gauss (0.4mT) Saving Data to MicroSD card
T = +336s	Power off.

Concept of Operations: On-board Video Camera

Caleb

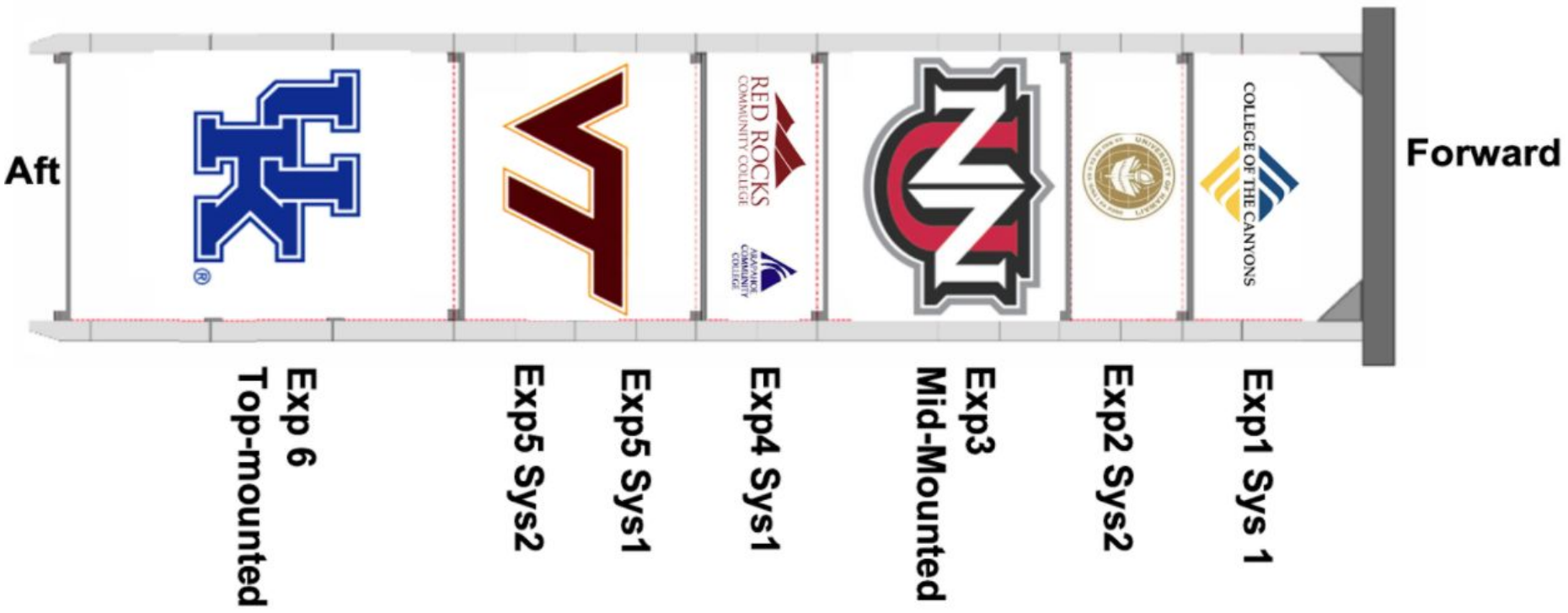
On-board Cameras Deployment Timeline	Event
T = +0.1s	Power Distribution Board (PDB) supplies power to Mobius Action Cameras and turn on. Video Camera starts recording video of the ScubeR deployment. Recorded video will be stored onto MicroSD card.
T = +300s	Video recording has ended the 1st video clip and data is stored on MicroSD. 2nd video clip now recording (Internal event to the camera. Nothing is needed)
T = +336s	Power off and video will end.

Concept of Operations: On-board Photo Camera

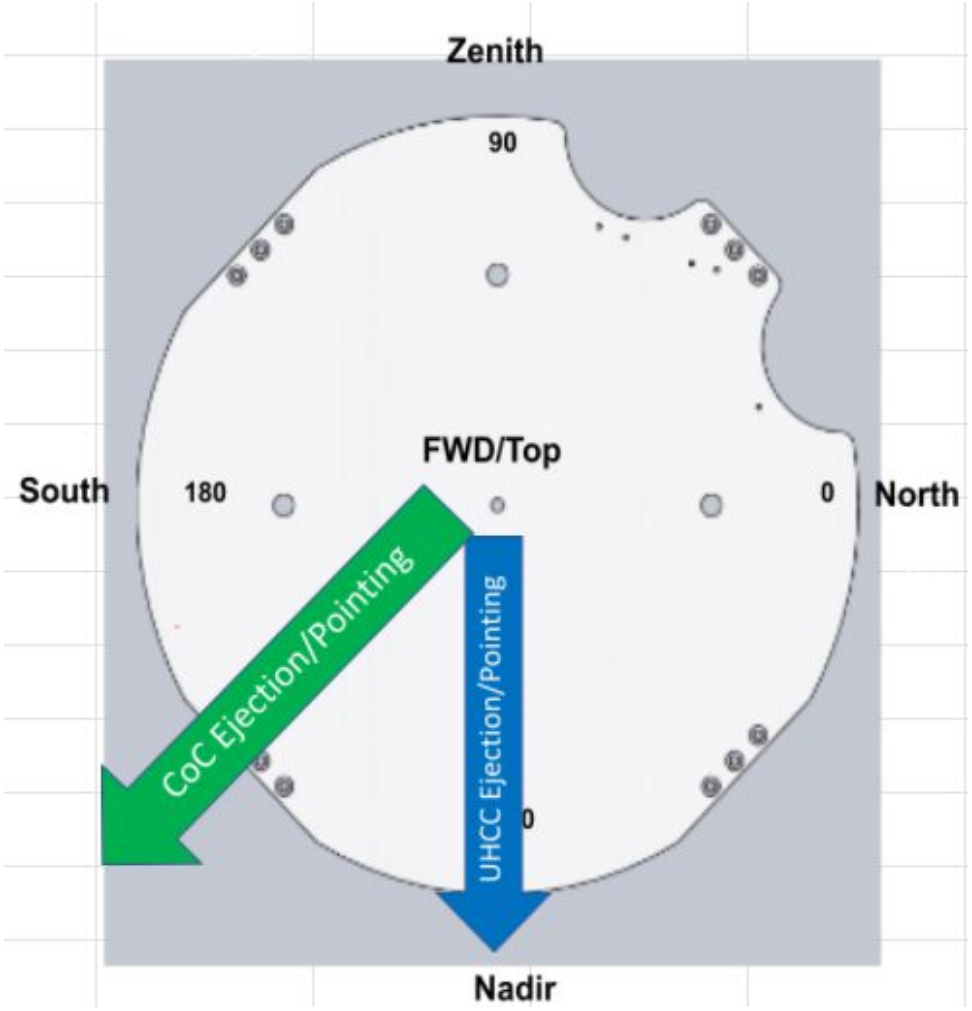
Caleb

On-board Cameras Deployment Timeline	Event
T = +0.1s	Power Distribution Board (PDB) supplies power to Mobius Action Cameras and turn on. Photo Camera constantly takes a photo every 2 seconds throughout the deployment and stores data onto a MicroSD card.
T = +336s	Power off and picture taking will stop.

Payload Location



Pointing


Zenith
90
FWD/Top
South
180
0
North
CoC Ejection/Pointing
UHCC Ejection/Pointing
0
Nadir

Timer Event Matrix

Team Name: UHCC
Date: 3/27/22

Event	Time On	Units	Dwell Time	Units	Event Description
GSE 1		(T-X) (sec)	Flight	(sec)	
GSE 2	T = -200 sec	(T-X) sec)		(sec)	Powers on Artemis Raspberry Pi.
TE-R	T = +0.1 sec	(T+X) (sec)	Flight	(sec)	Supply power to Power Distribution Board.
TE-1		(T+X) (sec)		(sec)	
TE-2	T = +0.1 sec	(T+X) (sec)	Flight	(sec)	Supply power to Power Distribution Board.
TE-3		(T+X) (sec)		(sec)	

Activation Sequence: COC and UHCC

	School	Start (sec only)	Start (min, sec)	Dwell (sec)	End (sec only)	End (min, sec)	Comments
GSE 1	CoC	T-300s	T-5min	Flight	Flight	Flight	Main power for experiment computers
GSE 2	UHCC	T-200s	T-3min, 20 sec	Flight	Flight	Flight	Power on Artemis raspberry pi.
TE-R	UHCC	T+0.1s	T+0.1sec	Flight	Flight	Flight	Supply power to power distribution board.
TE-1	CoC	T+200s	T+3min, 20sec	5s	T+205sec	T+3min, 25s	Launch Suborbital Reentry Payload at apogee, WVU antenna deploy
TE-2	UHCC	T+0.1s	T+0.1sec	Flight	Flight	Flight	Flight

- - - - - - -

Power Pin Assignment

Power Pin	Function	Intended Use
1	GSE 1	N/C
2	Timer Event Redundant (TE-RA)	Failsafe for turning on Power Distribution Board
3	Timer Event Redundant (TE-RB)	N/C
4	Timer Event 1 (TE-1)	N/C
5	GND	GSE 2
6	GND	TE-2
7	GND	TE-RA
8	GND	N/C
9	GSE 2	Turn on Artemis Raspberry Pi at T = -200 sec
10	Timer Event 2 (TE-2)	Turn on Power Distribution Board at T = 0.1 sec
11	Timer Event 3 (TE-3)	N/C
12	GND	N/C
13	GND	N/C
14	GND	N/C
15	GND	N/C

Telemetry Pin Assignment

Telemetry	Function	Intended Use
1	Analog 1	N/C
2	Analog 2	N/C
3	Analog 3	N/C
4	Analog 4	N/C
5	Analog 5	N/C
6	Analog 6	N/C
7	Analog 7	N/C
8	Analog 8	N/C
9	Analog 9	N/C
10	Analog 10	N/C
11	Parallel Bit 1 (MSB)	N/C
12	Parallel Bit 2	N/C
13	Parallel Bit 3	N/C
14	Parallel Bit 4	N/C
15	Parallel Bit 5	N/C
16	Parallel Bit 6	N/C
17	N/C	N/C
18	Ground	N/C
19	Ground	N/C
20	Parallel Bit 7	N/C
21	Parallel Bit 8	N/C
22	Parallel Bit 9	N/C
23	Parallel Bit 10	N/C
24	Parallel Bit 11	N/C
25	Parallel Bit 12	N/C
26	Parallel Bit 13	N/C
27	Parallel Bit 14	N/C
28	Parallel Bit 15	N/C
29	Parallel Bit 16 (LSB)	N/C
30	Parallel Read Strobe	N/C
31	N/C	N/C
32	RS-232 Data (TP1)	Status Update for controllers
33	RS-232 GND (TP2)	Status Update for controllers
34	N/C	N/C
35	N/C	N/C
36	Ground	N/C
37	Ground	N/C

Power Budget Deliverable

UHCC - Power Budget							
Date: 12/1/21							
Wallops Power Line	Subsystem	Voltage (V)	Max Current (A)	Start Time (min)	Time On (min)	Watts	Ah
GSE1/2	PDB (Artemis)	5.0	1.00	t = -3.3 min	8.9	5.00	0.15
						0.00	0.00
TE1/2/3/R	PDB (Cameras - 2)	5.0	1.60	t = +0.01 min	5.6	8.00	0.15
	PDB (Data and ScubeR Controllers)	9.0	0.16	t = +0.01 min	5.6	1.43	0.01
	PDB (Stepper)	3.3	0.29	t = +0.01 min	5.6	0.96	0.03
						0.00	0.00
		GSE 1/2 Total	1				
		TE1/2/3/R Total	2.05				
		Total	3.05			15.39	0.34
		Total Power Capacity					0.50
		Over/Under					0.16
					# of Flights Margin		2.9

Mechanical Design Weight Budget

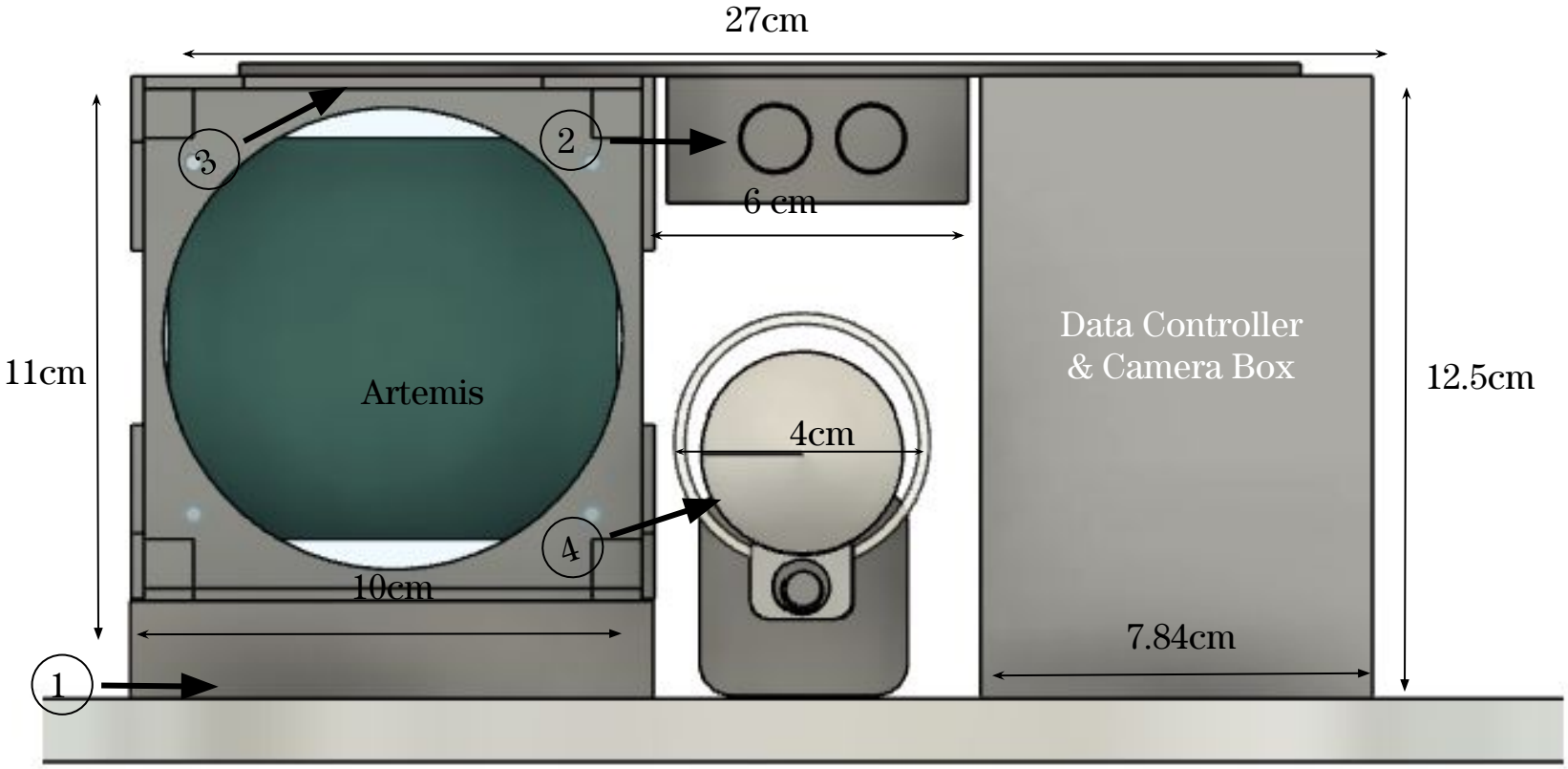
UHCC - Weight Budget	
Date: 12/2/21	
Subsystem	Total Weight (lbs)
ScubeR	0.768
Artemis	1.31
Data Controller	0.03125
Mobius Cameras (2)	0.13
Hammond Box	0.99
Payload Deck	3.425
Total	6.65425
Over/Under (15 lbs)	Under by ~ 8.35 lbs

2.0 Design Overview

Updates Since STR

- There were no primary action items assigned during STR, so no updates.
- We have completed individual subsystem testing.
- We have made progress on integrated testing with major subsystems tests planned over the next few weeks.

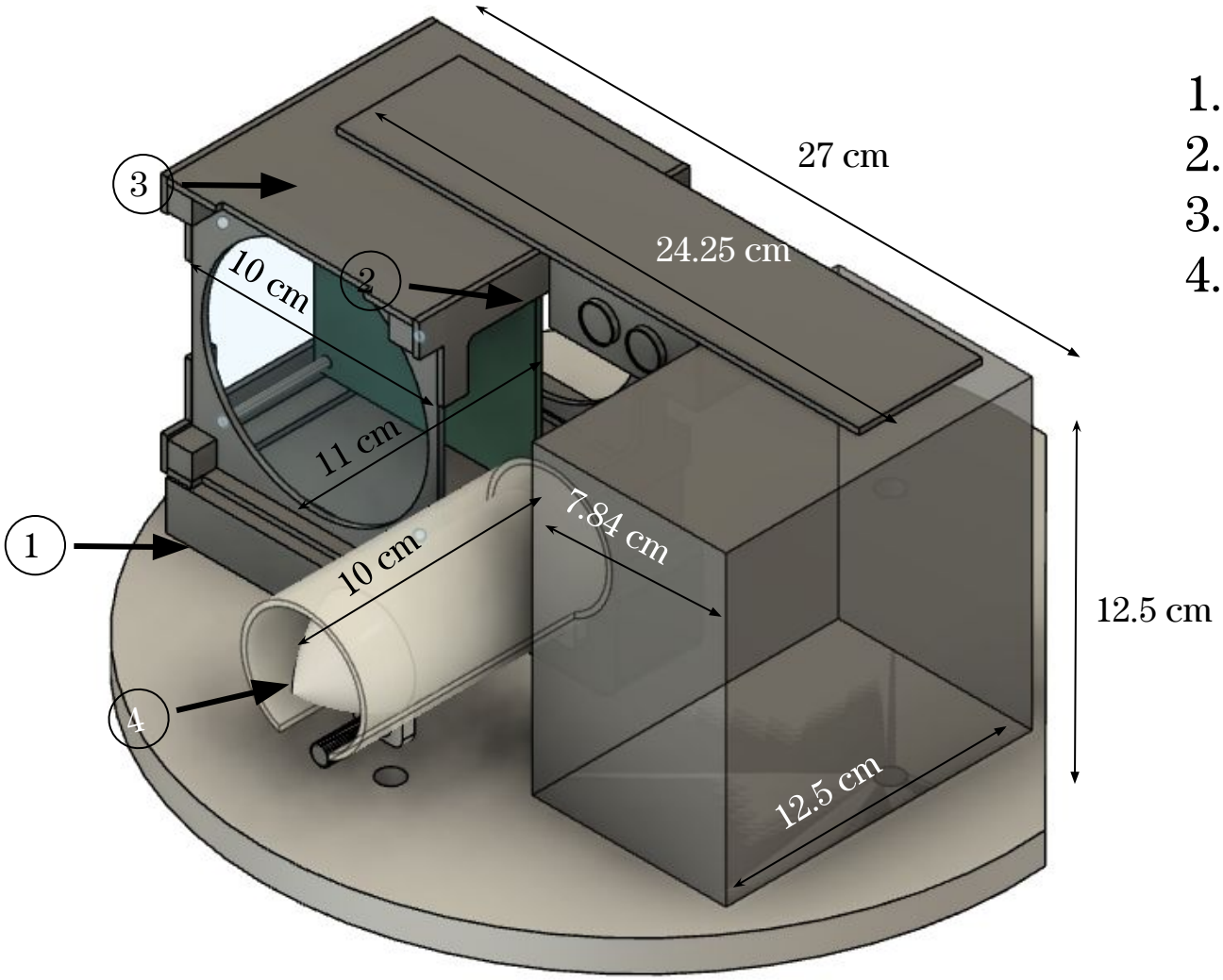
Design Overview Front View



1. Dead Mass Base Plate
2. Camera Lensed
3. Lens Bridge
4. ScubeR Assembly

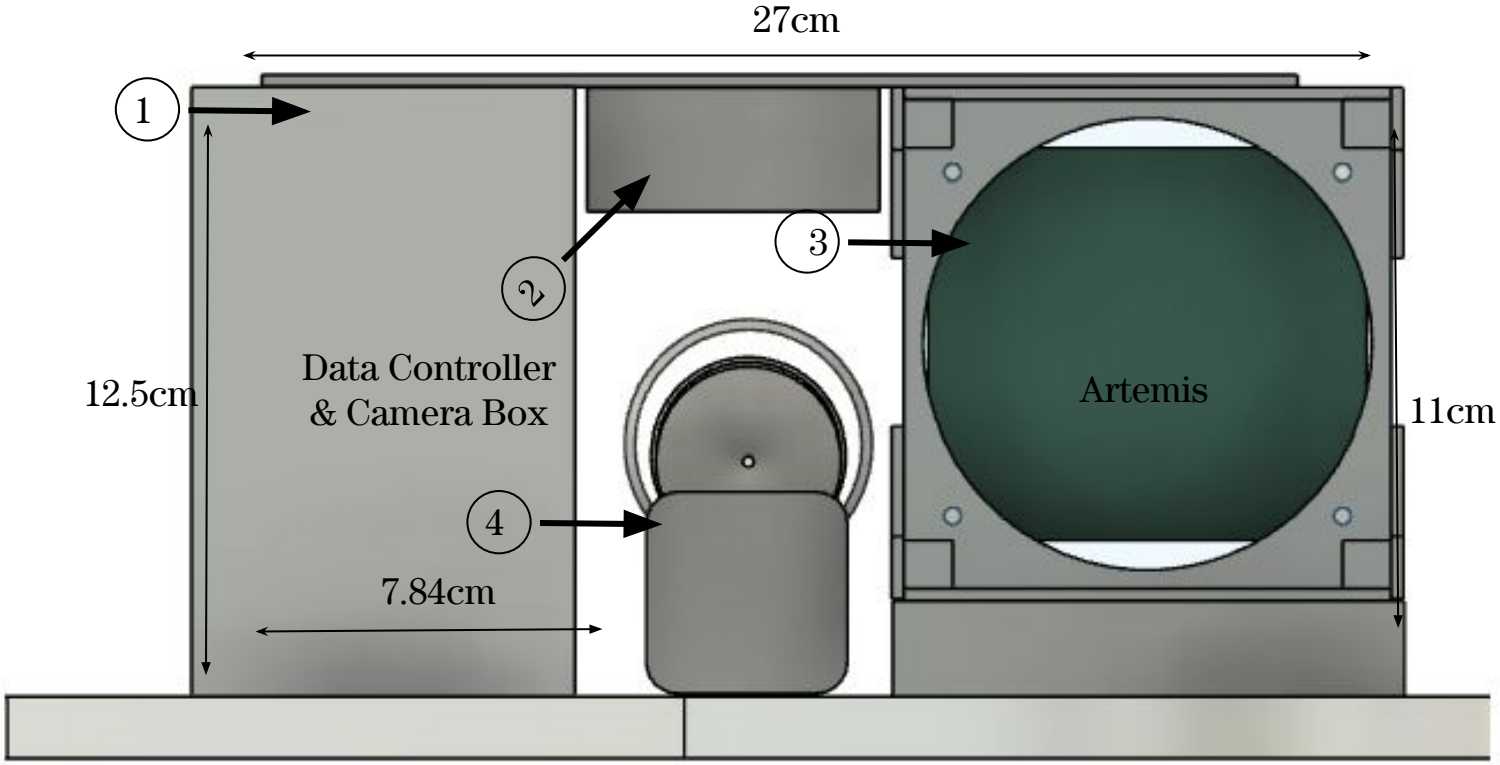
Note: ScubeR is a deployable sublimation rocket. Total deployment time is an estimated 14 seconds.

Design Overview Angled View



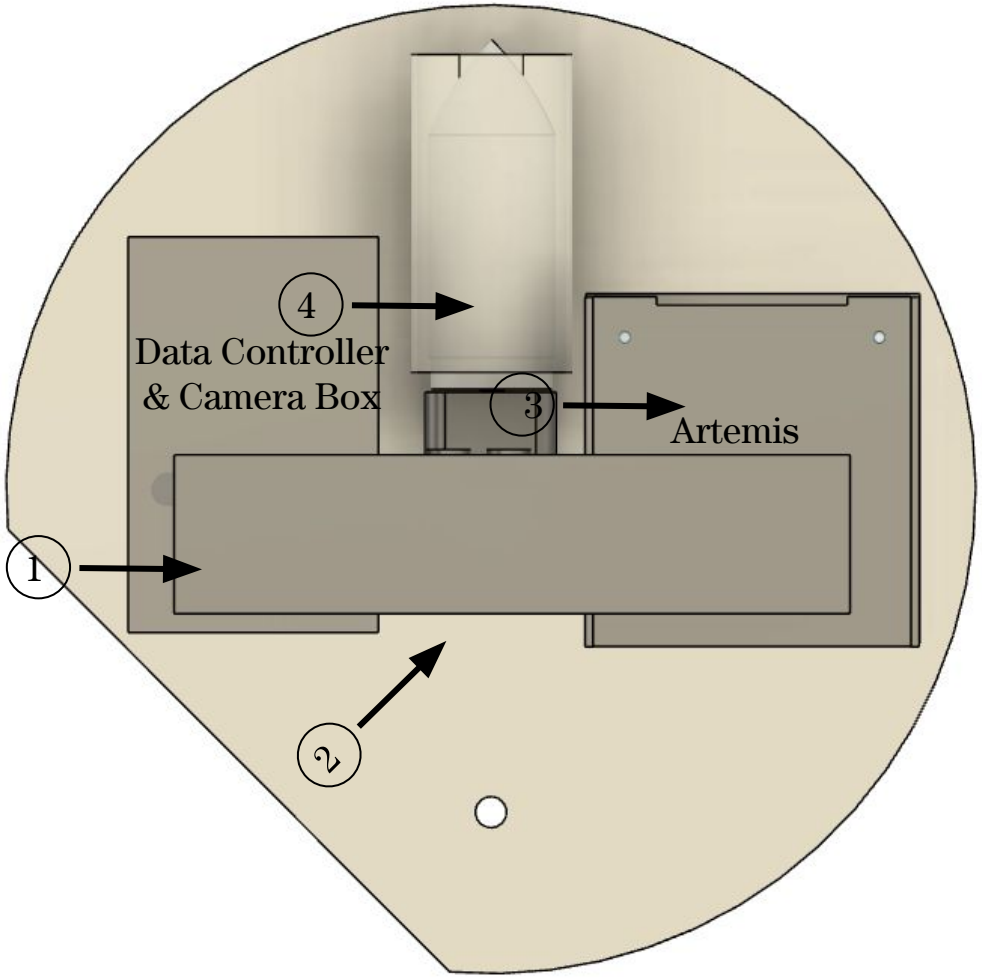
1. Dead Mass Base Plate
2. Camera Lenses
3. Lens Bridge
4. ScubeR Assembly

Design Overview Back View



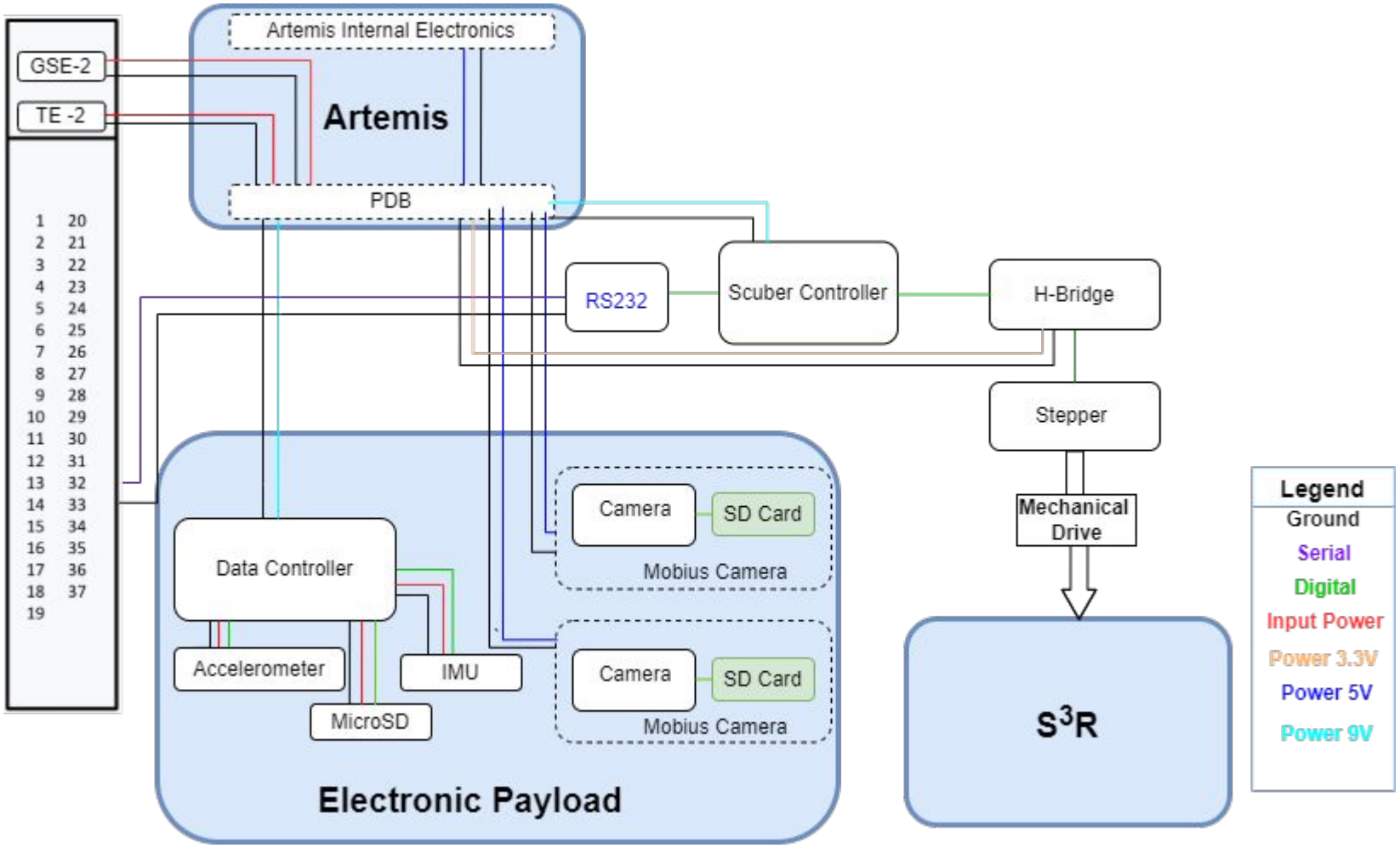
1. Lens Bridge
2. Camera Lenses
3. Artemis
4. ScubeR Assembly

Design Overview Top View



1. Lens Bridge
2. Camera Lenses
3. Artemis
4. ScubeR Assembly

Functional Block Diagram



Hazardous Mechanical and Electrical Materials

We are not utilizing any hazardous components or substances in either our mechanical or electrical designs.

Notes:

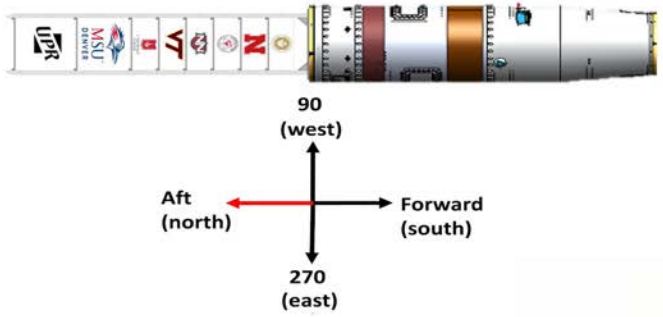
- we are not using a H.V. source
- ScubeR will travel an approximate 10 cm in 11 seconds.

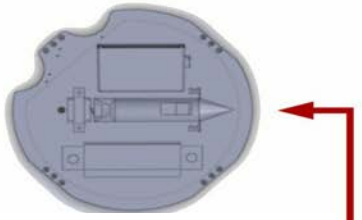
System Overview: Special Requests

Our only special request for WFF is to have an orientation of the release of ScubeR in direct sunlight—the preferred direction is along the eastern edge of the horizon.

46.014 Pointing Request

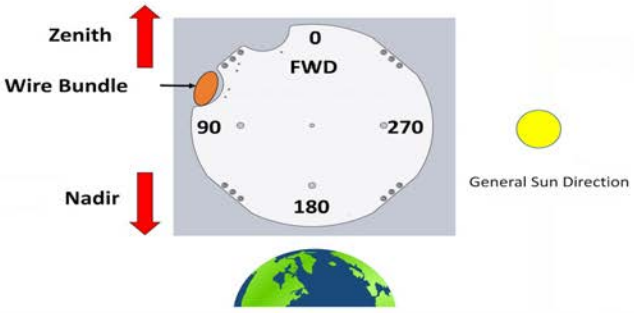
- View downwards from zenith to nadir (earth behind payload)

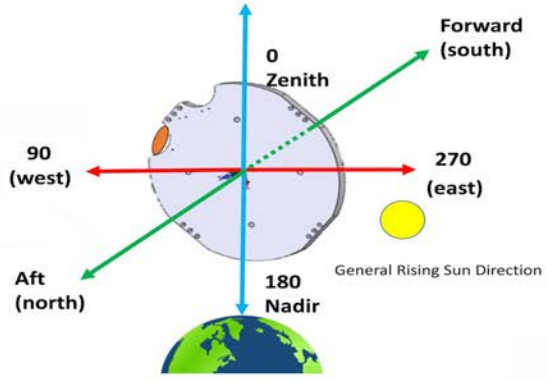




Orientation of ScubeR on Deckplate

- Desire to have active ACS throughout flight. Hold on target.





Description of Partnerships

Build Teams:

Project Imua Mission 10 currently consists of three student teams from Windward Community College, Honolulu Community College, and Assets High School.

Sponsors:

Hawaii Space Grant Consortium (HSGC) for the funding of Project Imua.

NASA for deck space within their 2-stage suborbital sounding rocket.

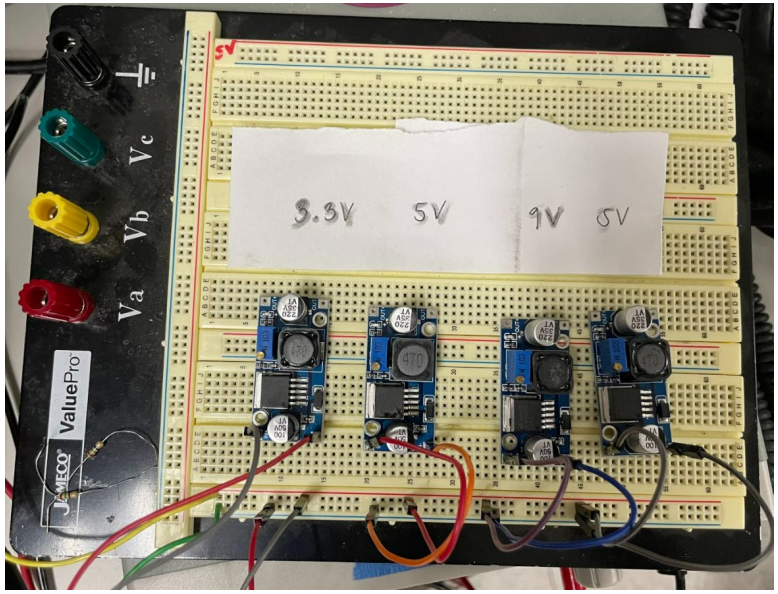
3.0 Subsystem Testing Status

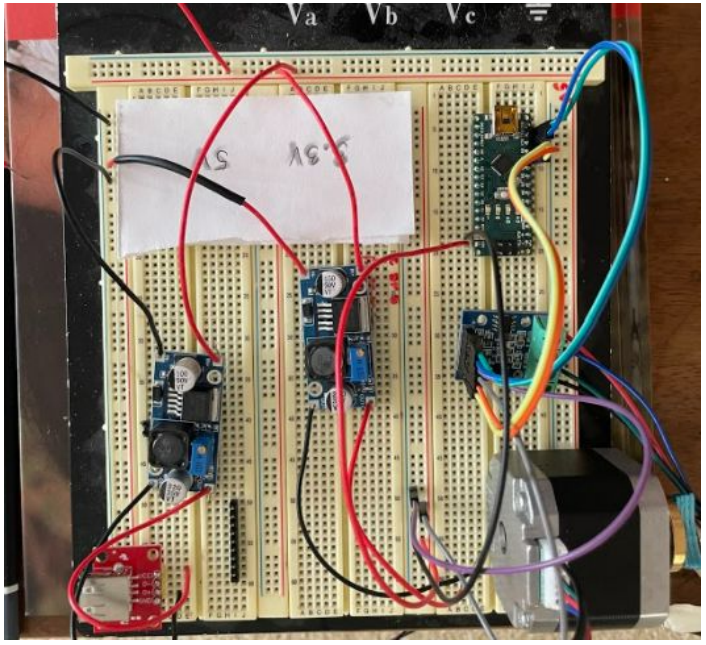
Subsystem Testing Status PDB

Power Distribution Board

All 4 LM2596 able to adjust to desired output voltages for the experiment.
No software needed.

Integrated power test will be conducted by April 2, 2022





Subsystem Testing Status ScubeR Controller

ScubeR controller

Verified ScubeR controller can receive power from PDB. Code is able to move motor according to the timing table.
Power and heat test has been performed and completed with success.

```
void setup()
{
  int j;
  Serial.begin(9600);
  Serial.println("Begin!");
  stepper.setSpeed(70); //speed 70 rpm
  delay(1000); //might edit this pause with more testing

  for (j=0;j<43;j++)
  {
  stepper.step(-1);
  Serial.print("Step Count: ");
  Serial.println(j);
  Serial.write(j);
  delay(2000); //pause between backsteps
  }

  stepper.step(-200*14); //13 revolutions to deploy scuber, +1 to make

  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,LOW);
  Serial.write("done"); //last transmission verify program complete
}
```

setup and start running at startup

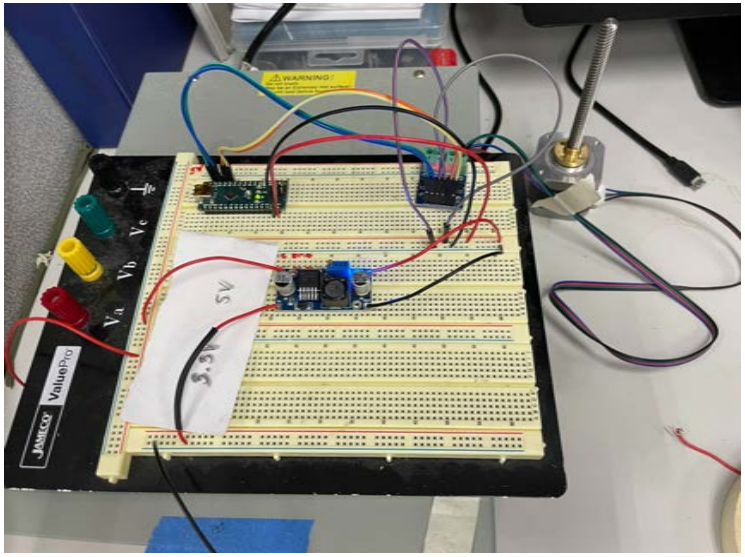
Move the motor to deploy scuber and send updates via serial communication

Deployment complete. Motor off

Subsystem Testing Status H-Bridge and Stepper Motor

H-Bridge

The H-bridge is able to receive movement instructions from the ScubeR controller and threaded rod moves the threaded nut off of the rod according to the experiment timing table.
Status updates via serial communications sendable.
Power and heat test has been performed and completed with success.



Subsystem Testing Status ScubeR

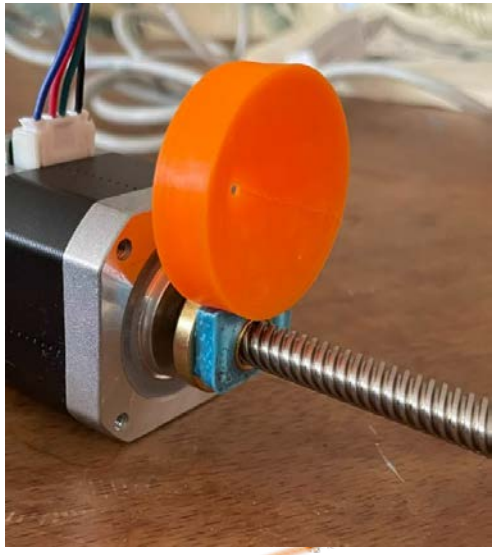
ScubeR

100%

First iteration print was not smooth with many open unprinted areas

Second iteration showed more continuity and smoothness in the design. connector for the nose cone did not fit

Third iteration print consisted of changes to nose cone and nozzle diameters for better fit. No major changes to overall design.

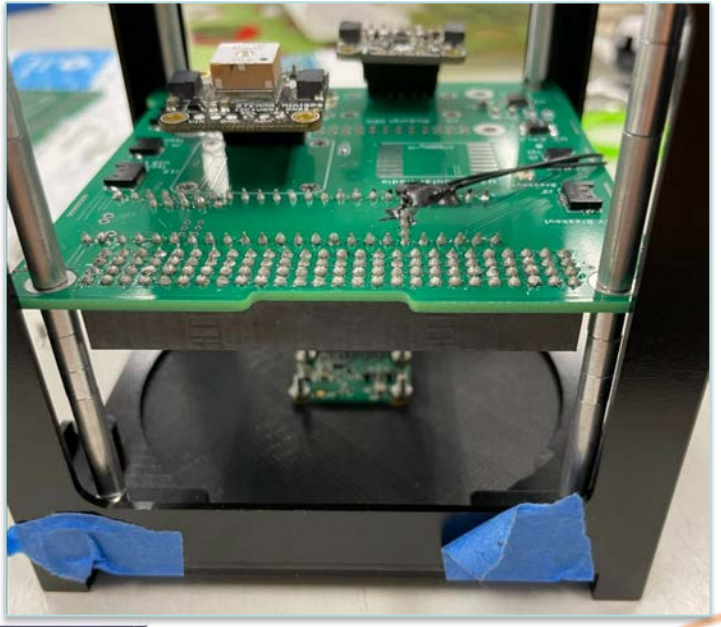


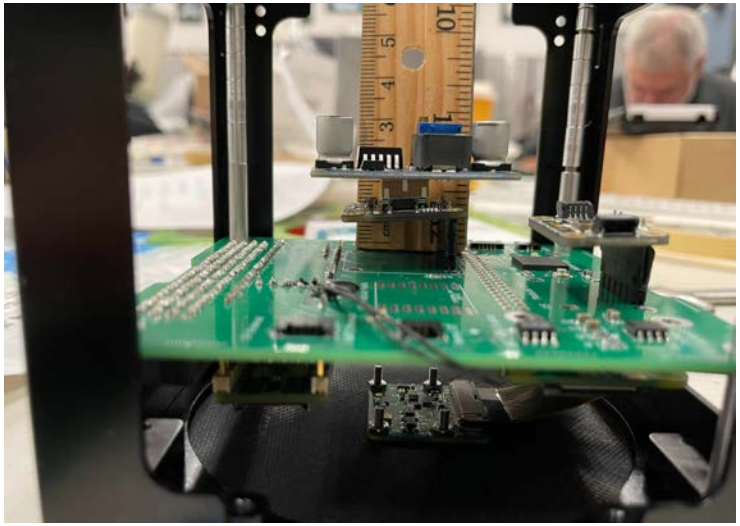
Subsystem Testing Status Artemis

Artemis

Built and ready for integrated testing with PDB

Power test scheduled for April 2, 2022





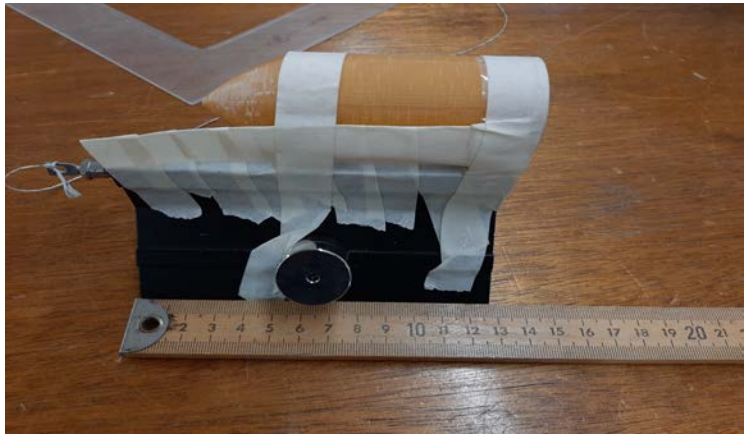
Subsystem Testing Status: Video Camera

Video Camera

The video quality and resolution of imagery sufficient for acceleration calculations (success).

No failure in imagery test, but testing revealed inaccuracies in our procedures which we improved upon.

Power test w/ PDB not been tested but will be by April 2, 2022

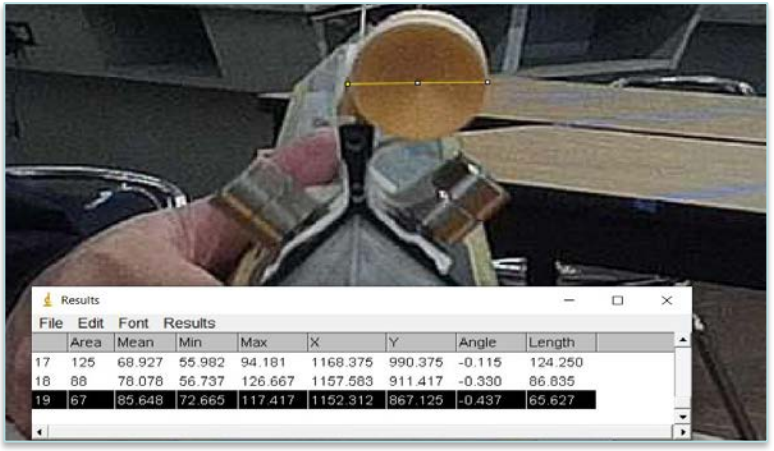


Subsystem Testing Status: Photo Camera

Photo Camera

The photo quality and resolution of imagery sufficient for acceleration calculations (success).

No failure in imagery test, but testing revealed inaccuracies in our procedures which we improved upon.

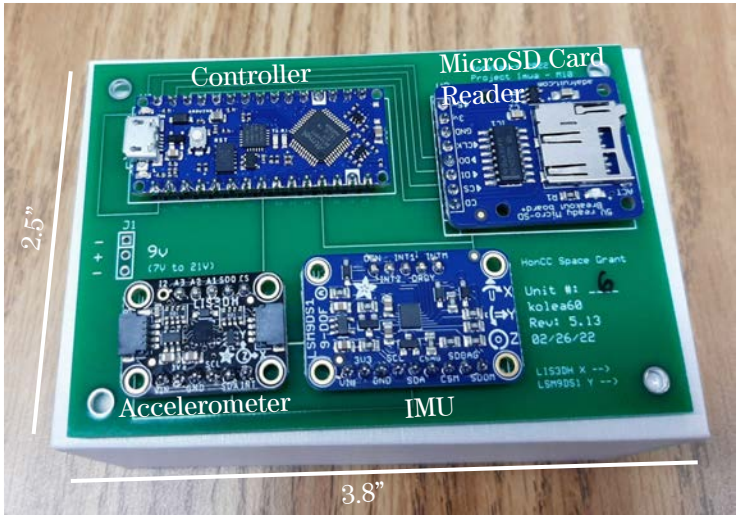


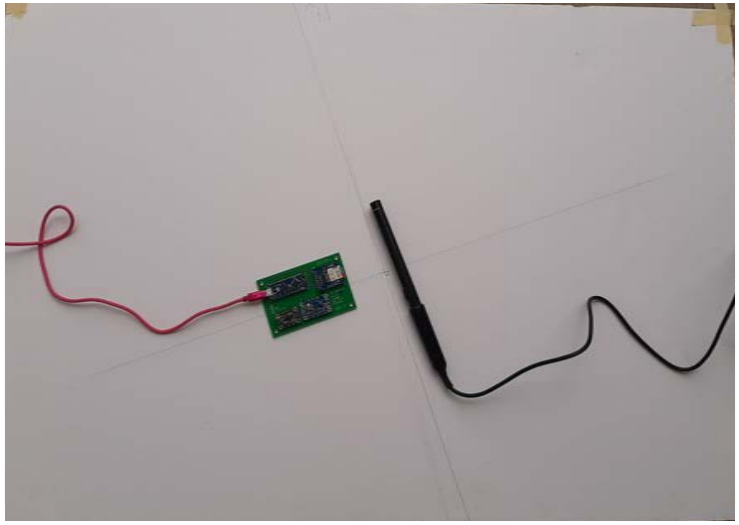
Subsystem Testing Status: Data Controller

Data Controller

Accelerometers (+/-2g & +/-16g), Gyroscope (245dps), and Magnetometer (4gauss = 0.4mT) have been tested.

Fully functioning Printed Circuit Board ready for integrated testing.
Accelerometers and Gyroscope have been tested with great success.
Magnetometer tested but data output is still being interpreted with Magnetic Field Sensor.



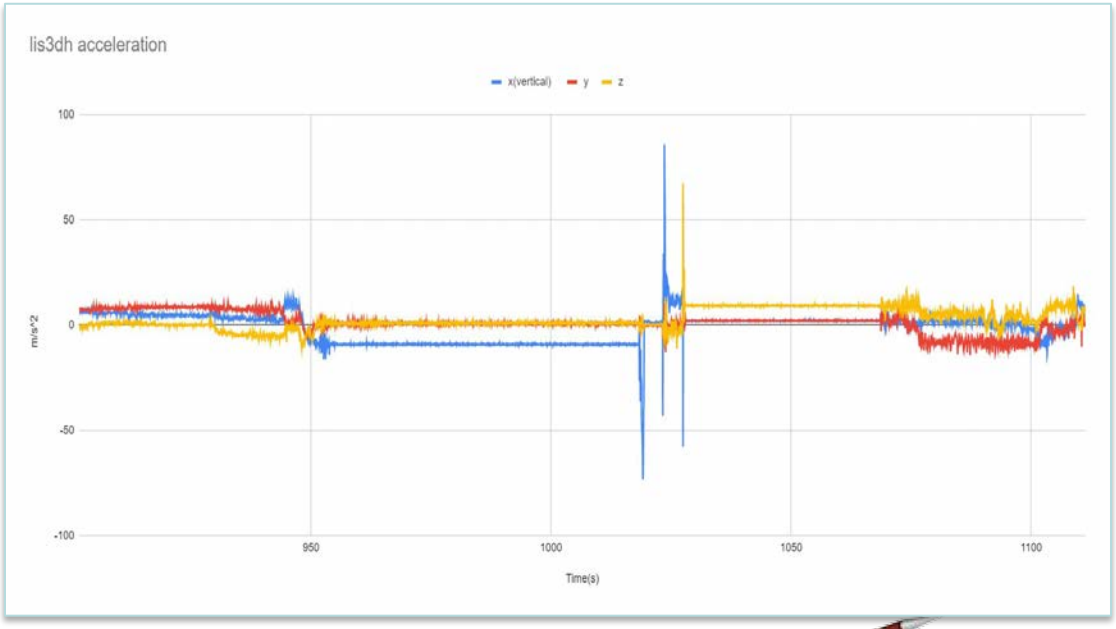


Subsystem Testing Status: Data Controller

Data Controller

Accelerometers (+/-2g & +/-16g), Gyroscope (245dps), [Magnetometer (4gauss = 0.4mT) have been tested.

Model Rocket flight tests have been tested with great success.



4.0 Integrated Subsystem Testing Status

Subsystem Integration Outline [Intra-Campus]

Windward Community College inner-campus integrated tests

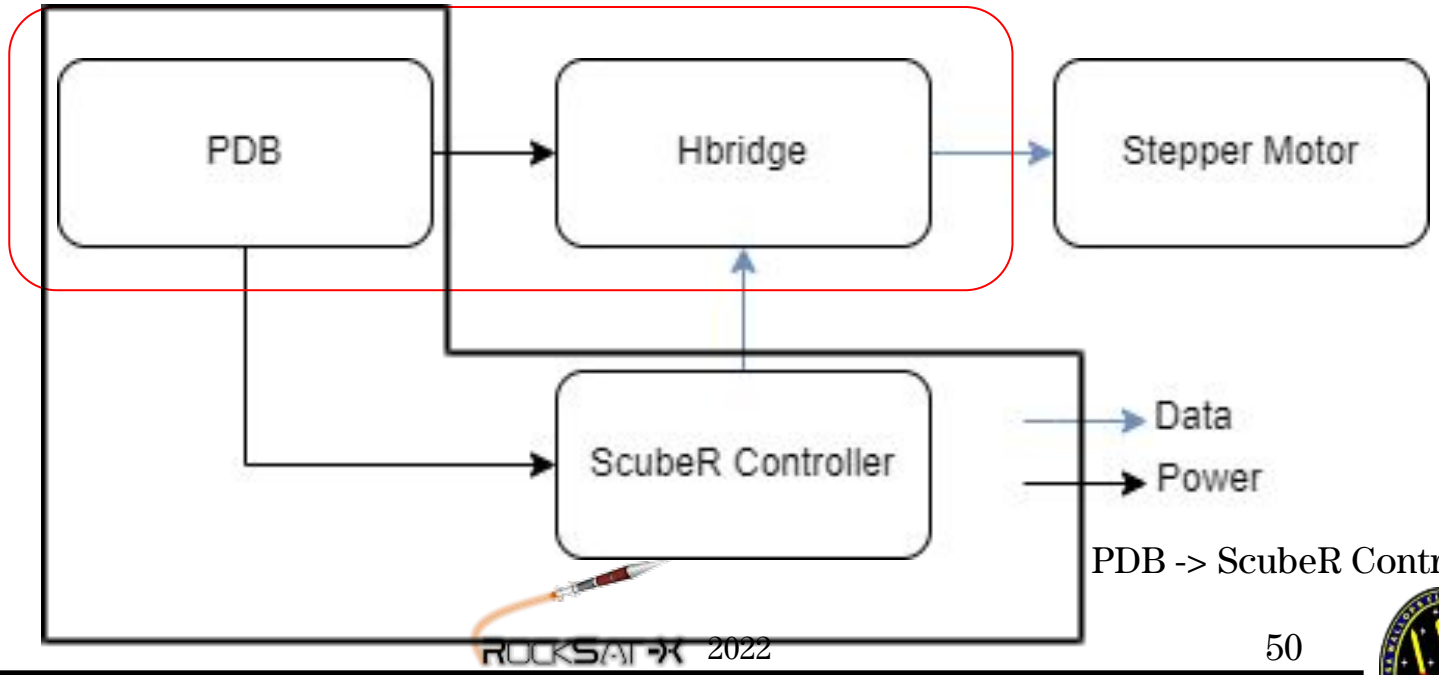
1. LM2958 buck converter integrated test for PDB 1/22/22
2. PDB -> H-bridge power 1/29/22
3. PDB -> ScubeR controller power 2/5/22
4. PDB -> ScubeR controller -> H-bridge powered 2/26/22
5. PDB -> ScubeR controller -> H-bridge -> stepper movement 3/5/22
6. PDB -> ScubeR controller -> H-bridge -> stepper programming validation, power and temp test 3/26/22
7. PDB -> ScubeR controller -> H-bridge -> ScubeR physical deployment 4/2/22
8. PDB-> Artemis 4/2/22

Integrated Subsystem Testing Status: PDB and H-Bridge

PDB, H-Bridge and ScubeR controller

1. Tested PDB ability to supply power to H-Bridge and ScubeR controller.
   a. completed on 1/29/22
2. Programming motion test involving ScubeR controller, H-Bridge and stepper motor testing
   a. Validated 3/26/22

PDB -> H-Bridge



PDB -> ScubeR Controller test

Integrated Subsystem Testing Status: PDB and Artemis

Artemis & PDB

This test will verify the ability for the Power Distribution Board to supply power to Artemis.

Test is planned for 4/2/22

5.0 Plan for Full Mission Simulation Review (FMSR)

Caleb

Subsystem Integration Outline [Inter-Campus]

1. Power Test: Mobius Cameras [4/2/22]
2. Power Test: Data Controller [4/2/22]
3. Integrated Power Test [4/9/22]
4. Image Capture Test [4/9/22]
5. Full integration and Deck Plate mounting [4/15/22]

Integrated Subsystem Testing Plan: Image Capture

Caleb

[Mechanical + Software]

Mobius Cameras, ScubeR & ScubeR Controller

Primary Objective(s): Ensure data capture of ScubeR's deployment through pictures and videos collected from the Mobius Cameras.

Secondary Objective(s): To calculate/measure a simulated acceleration and ensure accuracy in data acquisition by comparison to a known theoretical acceleration.

Details:

- Test will be completed on April 9, 2022.
- We plan on conducting a minimum of 3 simulated deployments of ScubeR.
- ScubeR will be deployed via the bridge onto an airtrack. The Mobius Cameras will be set up to record the simulated deployment.
- Theoretical acceleration will be measured through the implementation/combination of a set angle of deployment (tilting the air track) and the implementation of photogates.

Integrated Subsystem Testing Plan: Power Test for Mobius Cameras [Electrical]

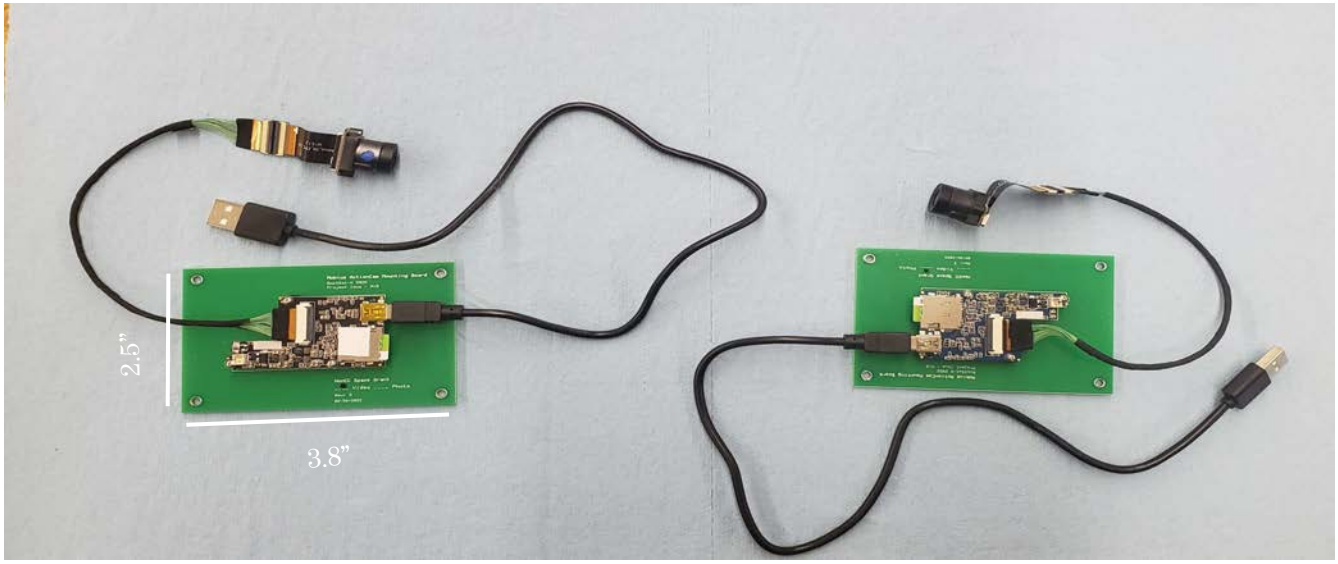
Caleb

Photo and Video Camera

50%

This test will verify that both Photo and Video Camera power on successfully w/PDB and image capture is significant for calculations

This test is Scheduled for April 2, 2022



Integrated Subsystem Testing Plan: Power Test for Data Controller [Electrical]

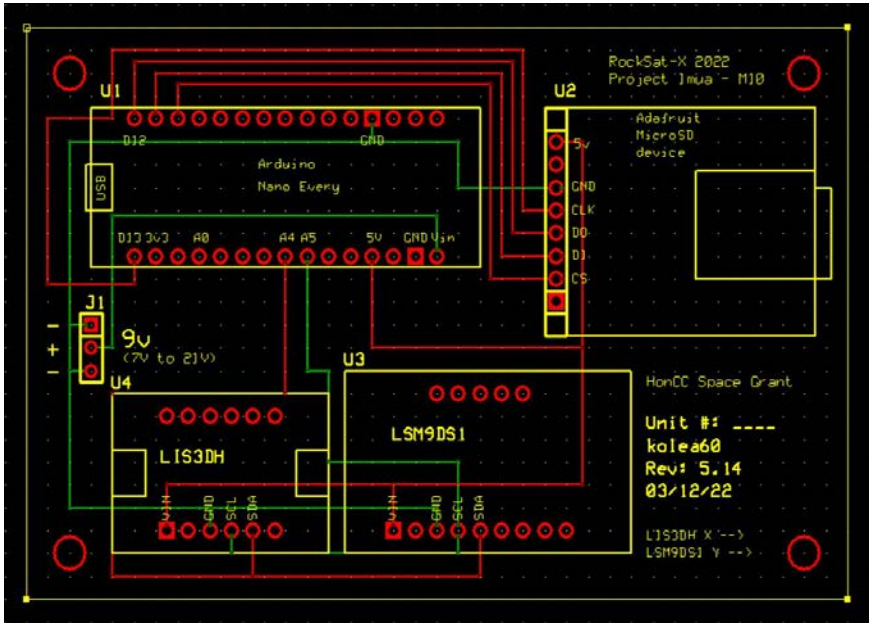
D'Elle

Data Controller

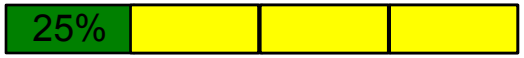
50%

Primary Objective: This will demonstrate the ability for the PDB to turn on the Data Controller and it will also test the Data Controller's functionality.

Test will be completed on April 2nd, 2022



Integrated Subsystem Testing Plan: Fully Integrated Power Test [Electrical]



Power Distribution Board

Primary Objective: To ensure that the Power Distribution Board can power on all electrical components of the design payload in addition to testing the functionality of all electrical components.

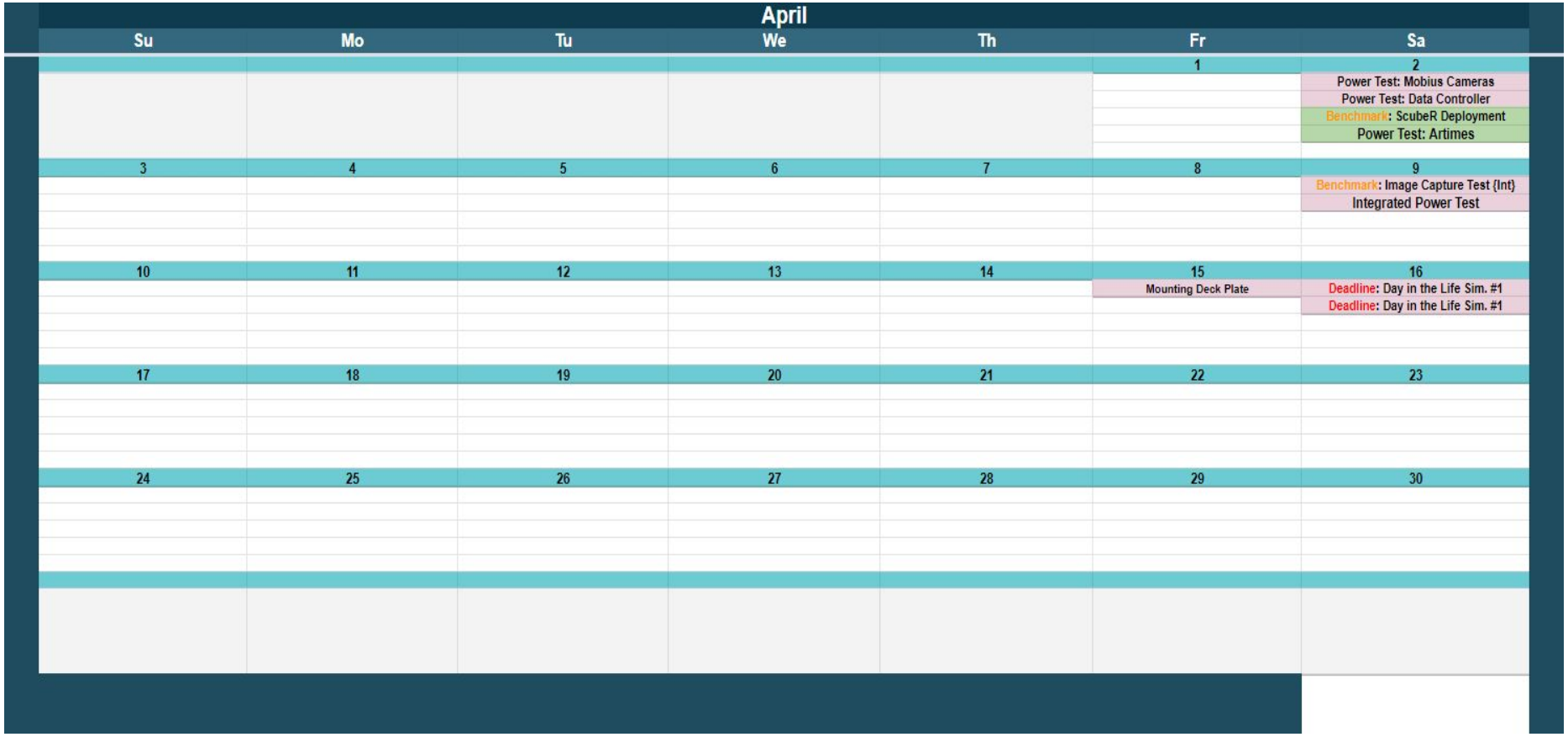
This test will be conducted on 4/9/22

Overall Integration/Testing Status

- Our payload will be completed after the completion of our cross-campus integrated tests, in addition to deck plate mounting.
- Our largest hurdles will be the Image Capture test, in addition to ensuring an adequate amount of time for mounting components to the deck plate.
- From our current schedule, we have about 1-2 weeks of flexibility.

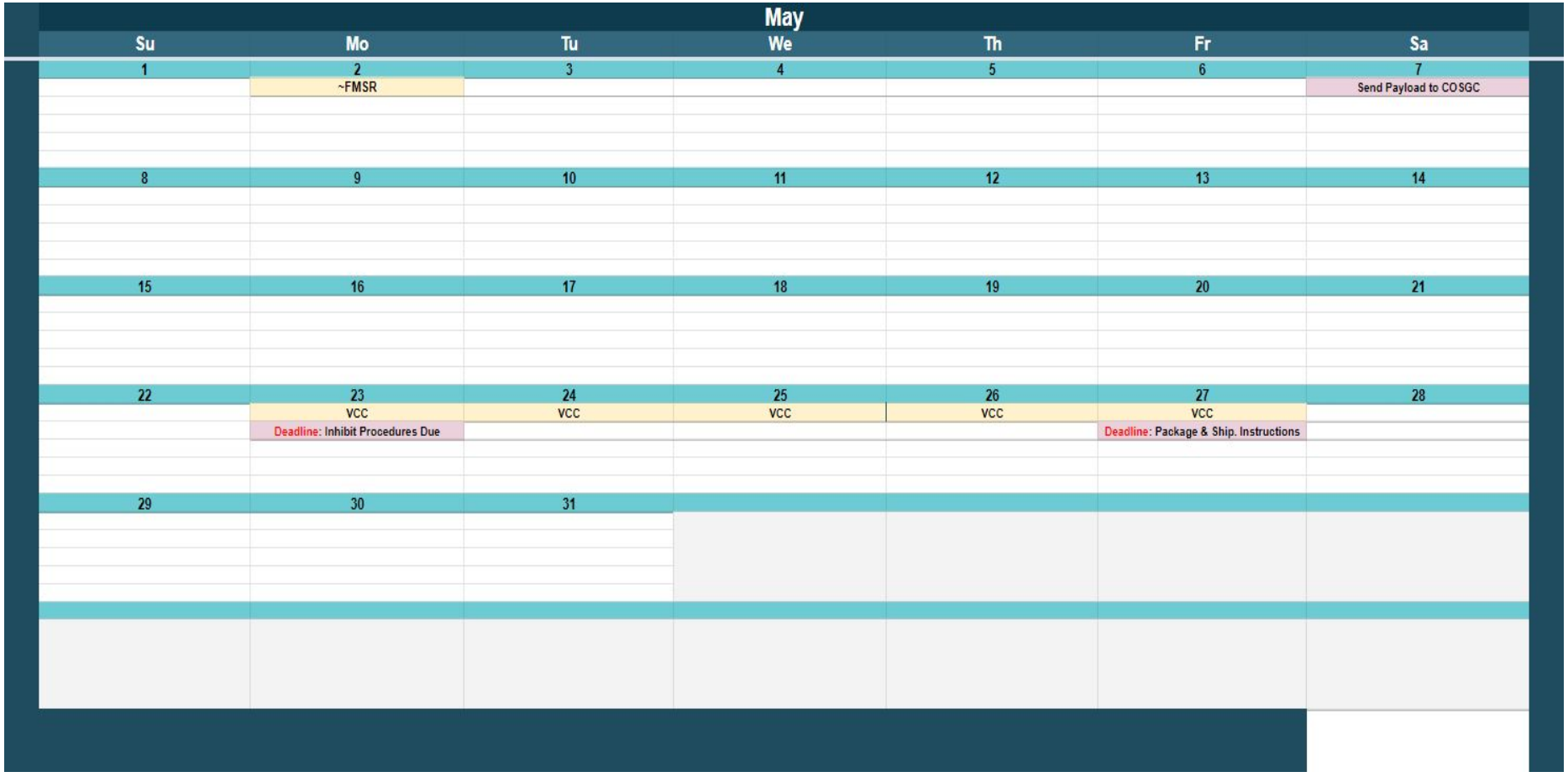
6.0 Project Schedule

Schedule: April



April						
Su	Mo	Tu	We	Th	Fr	Sa
					1	2
						Power Test: Mobius Cameras
						Power Test: Data Controller
						Benchmark: ScubeR Deployment
						Power Test: Artimes
3	4	5	6	7	8	9
						Benchmark: Image Capture Test (Int)
						Integrated Power Test
10	11	12	13	14	15	16
					Mounting Deck Plate	Deadline: Day in the Life Sim. #1
						Deadline: Day in the Life Sim. #1
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Schedule: May



May						
Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
	~FMSR					Send Payload to COSGC
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
	VCC	VCC	VCC	VCC	VCC	
	Deadline: Inhibit Procedures Due				Deadline: Package & Ship. Instructions	
29	30	31				

Schedule: June

June						
Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
			Deadline: Payload to COSGC			
5	6	7	8	9	10GSE Checkout	11
	GSE Checkout	GSE Checkout	GSE Checkout	GSE Checkout		
12	13	14	15	16	17	18
19	20	21	22	23	24	25
	Travel for Seq. Test	Travel for Seq. Test	Travel for Seq. Test	Travel for Seq. Test	Travel for Seq. Test	Travel for Seq. Test
26	27	28	29	30		

June Operations

- Camphor as a sublimate will not be available for June testing. The minimum conditions for sublimation will not be met during testing (low pressure).
- A dummy mass representing the Camphor will be utilized for testing to create an accurate simulation of launch conditions.

June Operations Cont.

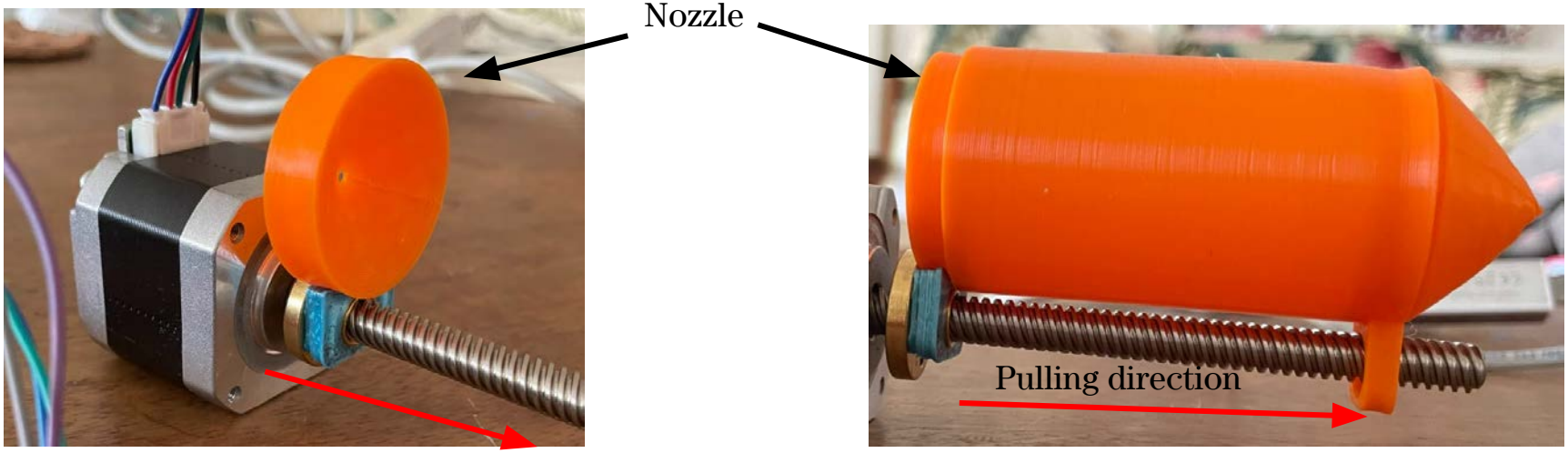
- All components of UHCC's payload will be available for sequence testing.
- The only feature that could be conditionally tested would be deployment due to an inhibit placed for testing.

7.0 Project Management

Payload Special Operations/Inhibits

Preliminary Inhibit Plan

1. Identify removable flange nut on ScubeR. The flange nut is detached by removing it from the footing.



Payload Special Operations/Inhibits second page

2. Remove ScubeR fuselage from drive screw completely
3. At nozzle, using precision, phillips screwdriver, remove the flange nut from the footing.
4. Complete
   - ScubeR can remain on the threaded rod
   - ScubeR will not move with the absence of the flange nut

User Guide Compliance: Summary

	Assets	Honolulu	Windward	Total
Weight?	**~1.31 lbs**	~ 1.14 lbs	~ 0.77 lbs.	**~6.64 lbs excluding mounting hardware and including the payload deck**
Dimensions?	**Height = 110 mm Area 100 x 100 mm**	4.92" x 4.49" X 3.11"	Height = 40mm Base = 250 x 40mm	**Within space**
Within 1 inch keep out zone?	**yes**	yes	yes	**yes**
Deployments?	**No**	No	Yes	**Yes, speed is under 1 inch/sec**
ADC Lines?	**No**	No	No	**0**
Async/Parallel?	**No/No**	No/No	Yes/No	**Yes/No**
GSE Lines?	**No**	No	Yes	**1**
Power/Timer Events?	**Yes, GSE-2 @ T= -200**	TE-2 @ T= 0.1+	TE-2 @ T= 0.1+ TE-R @ T=0.1 +	**TE-2 @ T= 0.1+ TE-R @ T=0.1+ GSE-2 @ T = -200**
Understand CG Requirement?	**Yes**	Yes	Yes	**Yes**
High Voltage?	**No**	No	No	**No**
Using < 0.5 Ah	**Yes**	Yes	Yes	**Yes**
Hazardous Procedures?	**No**	No	No	**No**
RF?	**No**	No	No	**None**
Bottom of Deck Plate Flush?	**Yes**	Yes	Yes	**Yes**
US Persons for whole team?	**Yes**	Yes	Yes	**Yes**
ITAR? Export Control Hardware?	**Compliant,none**	Compliant, none	Compliant, none	**Compliant, none**

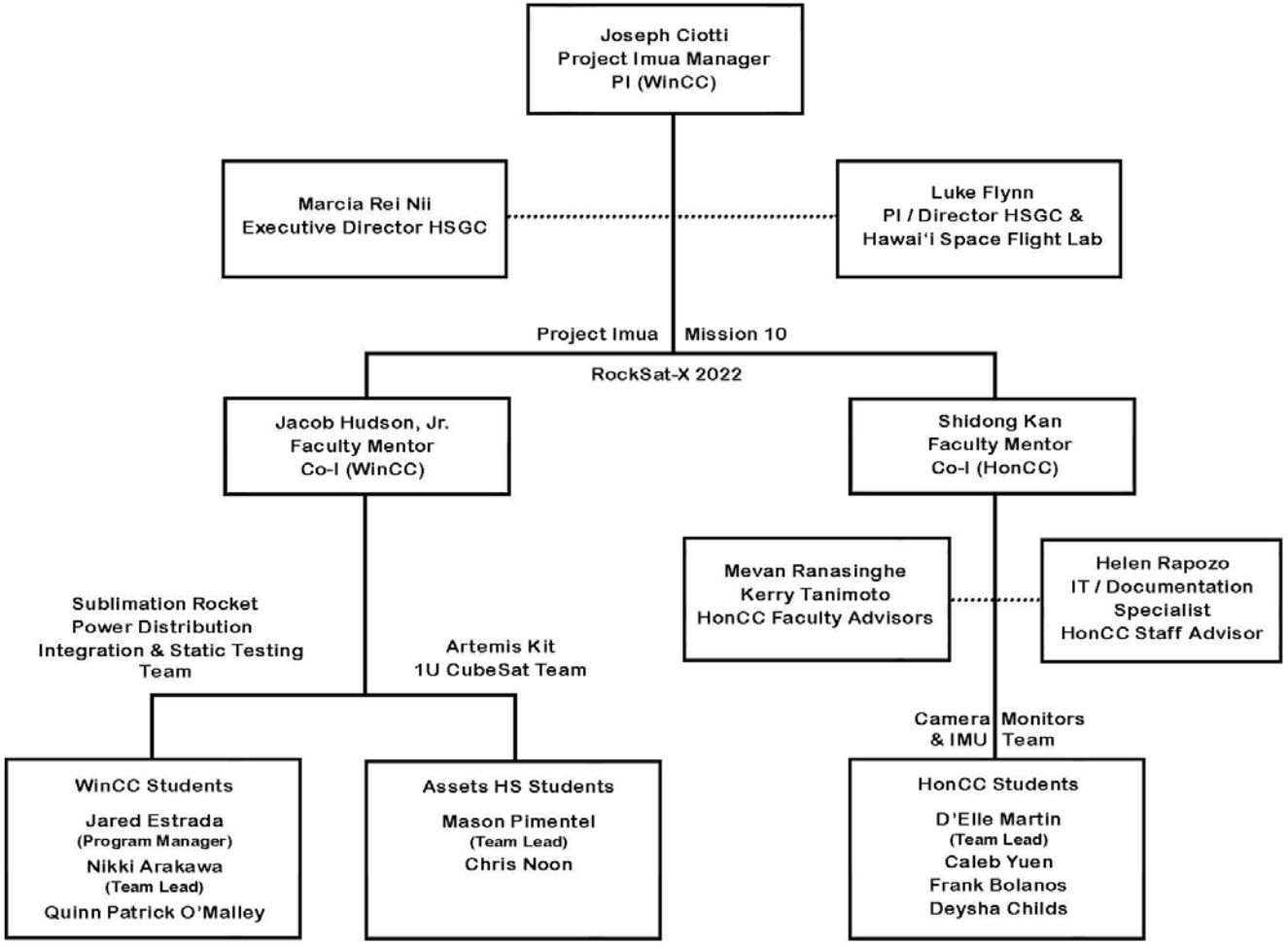
Team Mentors

Jared

revised 10-30-21

University of Hawai'i Community College (UHCC) Project Imua Mission 10		
RS-X 2022 Team Mentors & Advisors		
Institution	**Mentor/Advisor**	**Cell Phone**
Windward CC		
Project Manager (PI)	Joseph Ciotti	808-225-5637
Faculty Mentor (Co-I)	Jacob Hudson	808-347-8246
Honolulu CC		
Faculty Mentor (Co-I)	Shidong Kan	808-724-1533
Faculty Advisor	Mevan Ranasinghe	862-803-0760
Faculty Advisor	Kerry Tanimoto	808-295-3475
Staff Advisor	Helen Rapozo	808-367-3684
Assets High School		
Faculty Mentor	Jacob Hudson	808-347-8246
UH Manoa		
Advisor—HSGC/HSFL Director	Luke Flynn	808-277-7218
Advisor—HSGC/ Program Coordinator/ Executive Director	Marcia Rei Nii	808-384-4684

Team Organization



Schedule

Tasks	October	November	December	January	February	March	April	May	June	July	August
PDB											
ScubeR											
Mobius Camera development											
Mobius Camera fabrication											
Data Controller development											
Data Controller fabrication											
Artemis Cubesat development											
Artimes Cubesat fabrication											
Scuber Controller											
Sub-System test											
Integration											
Full Mission Simulation											
Integration Readiness Review											
Environmental Testing Simulation											
Review/Telecon	CoDR	PDR	CDR	Manifested?	STR	ISTR	FMSR	IRR	ETS	LRR	Launch

Wincc
HonCC
Assets
Everyone

Team Avalibility

	Team Name/School: UHCC Project Imua 10					
	Spring RS-X Team Availability Matrix. STR Week of TBD					
	PLEASE USE MOUNTAIN TIME ZONE TIMES					
HST	MST	Monday	Tuesday	Wednesday	Thursday	Friday
4:00 AM	7:00 AM	4	4	4	4	4
5:00 AM	8:00 AM	4	4	4	4	4
6:00 AM	9:00 AM	4	4	4	4	4
7:00 AM	10:00 AM	1	4	4	4	3
8:00 AM	11:00 AM	1	1	1	4	3
9:00 AM	12:00 PM	1	1	1	4	3
10:00 AM	1:00 PM	4	4	4	4	4
11:00 AM	2:00 PM	4	4	4	4	4
12 noon	3:00 PM	4	4	4	4	4
1:00 PM	4:00 PM	2	4	4	4	4
2:00 PM	5:00 PM	2	4	4	4	4
	Please Place priority levels for times you are availible. This is done by simply typing a 1,2,3, or 4 in each clear box.					
	Example	1	2	3	4	
		Highest Priority			Lowest Priority	

Team Contact Matrix

revised 3/26/22

Team Name/School: UHCC Project Imua Mission 10							
Fall 2021 RS-X Contact Matrix							
Role	**Name**	**Day Phone**	**Cell Phone**	**Receive Texts?**	**Email**	**Citizenship**	**Add to mailing list?**
Project Manager (PI)	Joseph Ciotti	808-236-9111	808-225-5637	yes	ciotti@hawaii.edu	U.S.	yes
Windward CC							
Faculty Mentor (Co-I)	Jacob Hudson	808-347-8246	808-347-8246	yes	jacobh@hawaii.edu	U.S.	yes
Student (Program Manager)	Jared Estrada	719-440-0941	719-440-0941	yes	jestrada7125@gmail.com	U.S.	yes
Student (Team Lead)	Nikki Arakawa	808-450-4294	808-450-4294	yes	nikkia@hawaii.edu	U.S.	yes
Student	Quinn Patrick O'Malley	808-738-2618	808-738-2618	yes	qomalley@hawaii.edu	U.S.	yes
Honolulu CC							
Faculty Mentor (Co-I)	Shidong Kan	808-845-9499	808-724-1533	yes	shidong@hawaii.edu	U.S.	yes
Faculty Advisor	Mevan Ranasinghe	862-803-0760	862-803-0760	yes	mevanr@hawaii.edu	U.S.	yes
Faculty Advisor	Kerry Tanimoto	808-845-9154	808-295-3475	yes	kerryt@hawaii.edu	U.S.	yes
Staff Advisor	Helen Rapozo	808-845-9202	808-367-3684	yes	rapozo@hawaii.edu	U.S.	yes
Student (Team Lead)	D'Elle Martin	808-358-5743	808-358-5743	yes	dellej@hawaii.edu	U.S.	yes
Student	Caleb Yuen	808-476-8018	808-476-8018	yes	yuenc734@hawaii.edu	U.S.	yes
Student	Frank Bolanos	808-271-3405	808-271-3405	yes	fbolanos@hawaii.edu	U.S.	yes
Student	Deysha Childs	808-375-3331	808-375-3331	yes	dchilds7@hawaii.edu	U.S.	yes
Assets High School (Mentor: Jacob Hudson)							
Student (Team Lead)	Mason Pimentel	808-726-1616	808-726-1616	no	mason_pimentel@assets-school.org	U.S.	yes
Student	Christopher Noon	808-423-1356		no	christopher_noon@assets-school.org	U.S.	yes

Budget

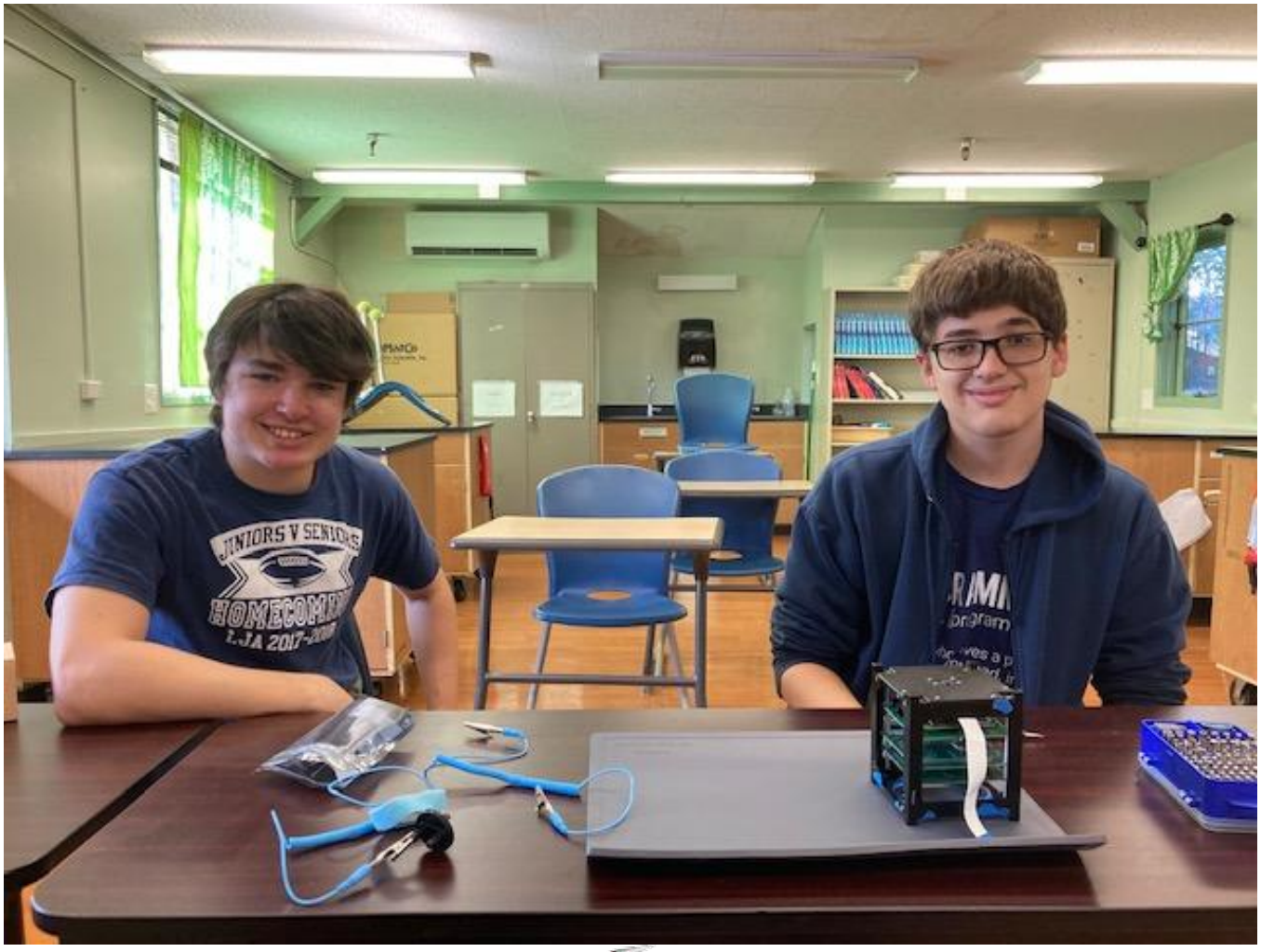
rev 3-26-22

UHCC Project Imua Mission 10: RS-X 2022

Item	Budgeted	Expended/ Encumbered	Balance
Student Fellowships (Fall/Spring/Summer)	37,500	22,500	15,000
Student Summer Travel Stipend	12,330	0	12,330
Mentor Summer Travel	10,357	0	10,357
Supplies	7,000	1,000	6,000
RockSat-X 2022 launch fee deposit	2,000	2,000	0
RockSat-X 2022 launch fee 1st Install	6,000	6,000	0
RockSat-X 2022 launch fee 2nd Install	6,000	6,000	0
Total	81,187	37,500	43,687

Team Photo [HonCC & WinCC]

Team Photo Cont. [Assets]



8.0 Conclusions

Risks/Concerns

- **Concern 1:** Sublimation Rocket may not clear CarRoLL before re-entry.
  - ❖ **Mitigation:** Use of worm gear will guarantee clearing of CarRoLL section.
  - ❖ Additional vacuum pressure test planned.
- **Concern 2:** The Specific Impulse of the sublimation propellant is unknown, resulting in an uncertainty of rocket's maximum reaction mass.
  - ❖ **Mitigation:** Once a prototype ScubeR is constructed, it will be loaded with varying concentrations of different sublimation propellant and tested inside a vacuum chamber at the Center for Aerospace Education.
- **Concern 3:** Mobius camera data retrieval damage (Still Pictures & Video)
  - ❖ **Mitigation:** Hammond box for heat & water proofing.

Conclusion

- <u>Mission deserves to fly because:</u>
  - Provides proof-of-concept and baseline measurements for innovative low-thrust venier rockets.
  - Provides early college students with high-tech NASA-focused design and production experience
  - Proof of Concept Flight for Artemis CubeSat Kit

- <u>Next steps for your team to get to FMSR:</u>
  - Compete all integrated subsystem testing
  - Compete payload integration and mounting

Discussion of Questions & Concerns

Questions:

When does ACS stop?

- UHCC is concerned with ACS taking the Mobius cameras out of sight, so by knowing when ACS stops we can plan our deployment accordingly.

Appendix

Acronyms

Jared

HonCC – Honolulu Community College

WinCC – Windward Community College

UHCC – University of Hawai‘i Community Colleges

HSGC – Hawai‘i Space Grant Consortium

HSFL – Hawai‘i Space Flight Lab

ScubeR – Super Simple Sublimation Rocket (S^3R)

PDB - Power Distribution Board

Special Names

Jared

Mobius ActionCam – On-board cameras

ScubeR Controller - Arduino Nano Every controlling the Stepper Motor

Data Controller - Contains Motion Sensors and Data Storage

Kolea projects - HonCC controller based projects, testing of technology & components, documenting using Google Core Apps