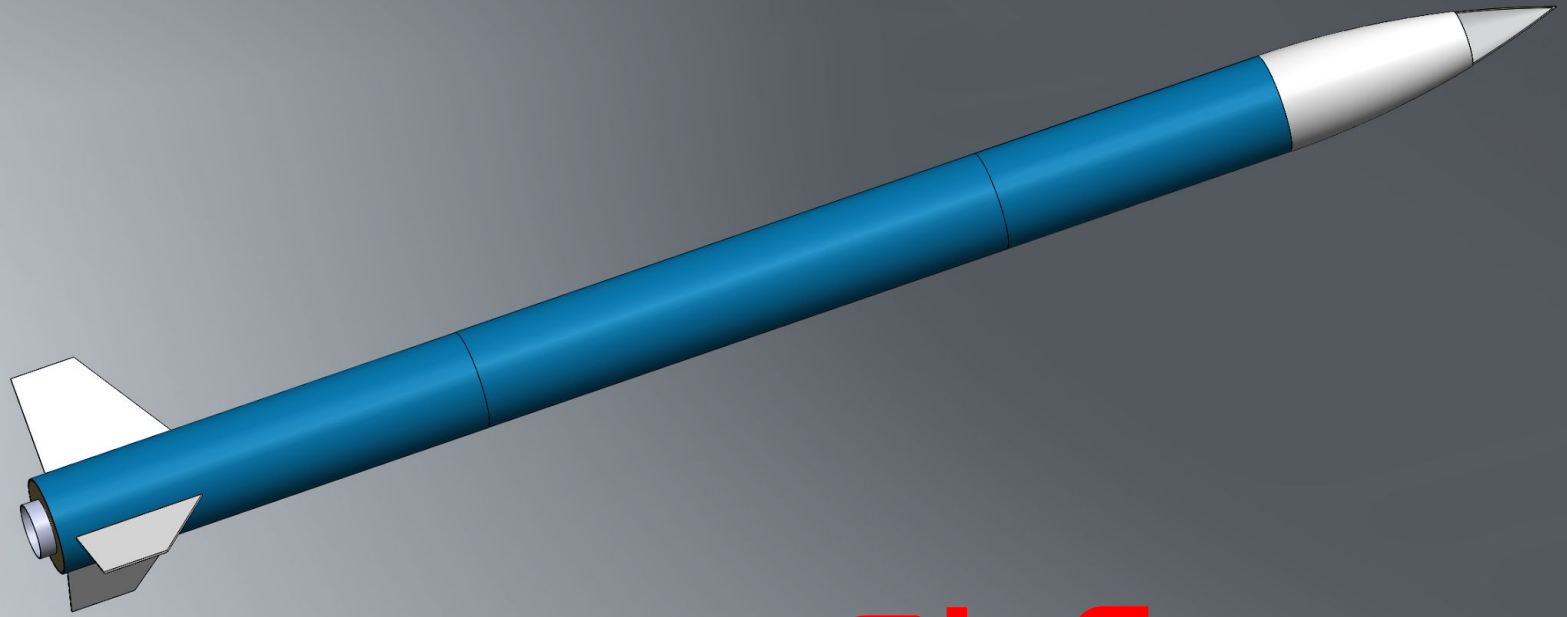

STAR

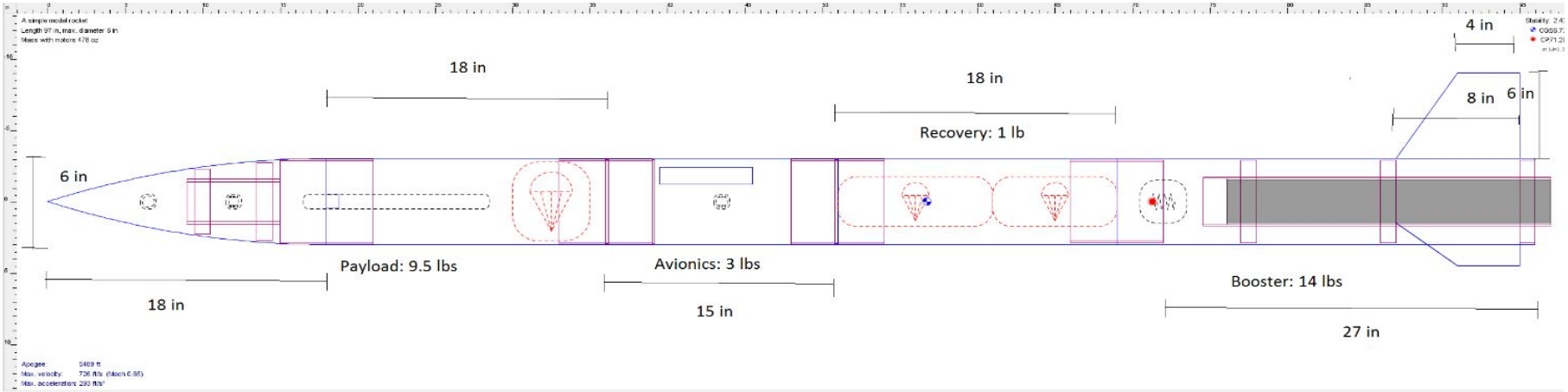


Airframe

Summary/ OpenRocket Diagram

- Overall length: 8’ 1”
- Nose cone base diameter: 6”
- Nose cone length (ogive): 18”
- Payload section diameter: 6”
- Payload section length: 18”
- Booster section diameter: 6”
- Booster section length: 2’3”

- Motor type: Aerotech L1150 motor
- CG: 39.7” from rear
- CP: 25.7” from rear
- Stability margin: 2.34 calibers
- Thrust to weight ratio: 8.839
- Rail exit velocity: 67.4 ft/s

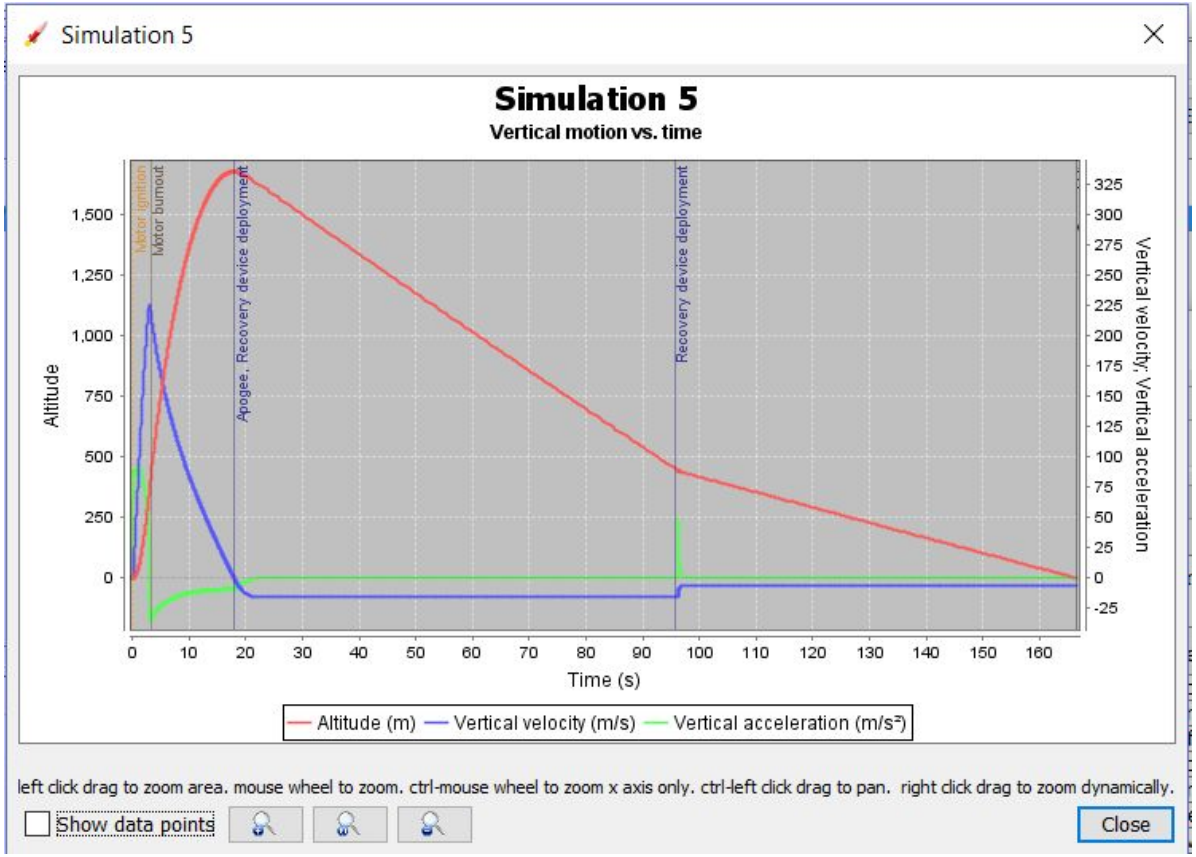


Materials

Airframe

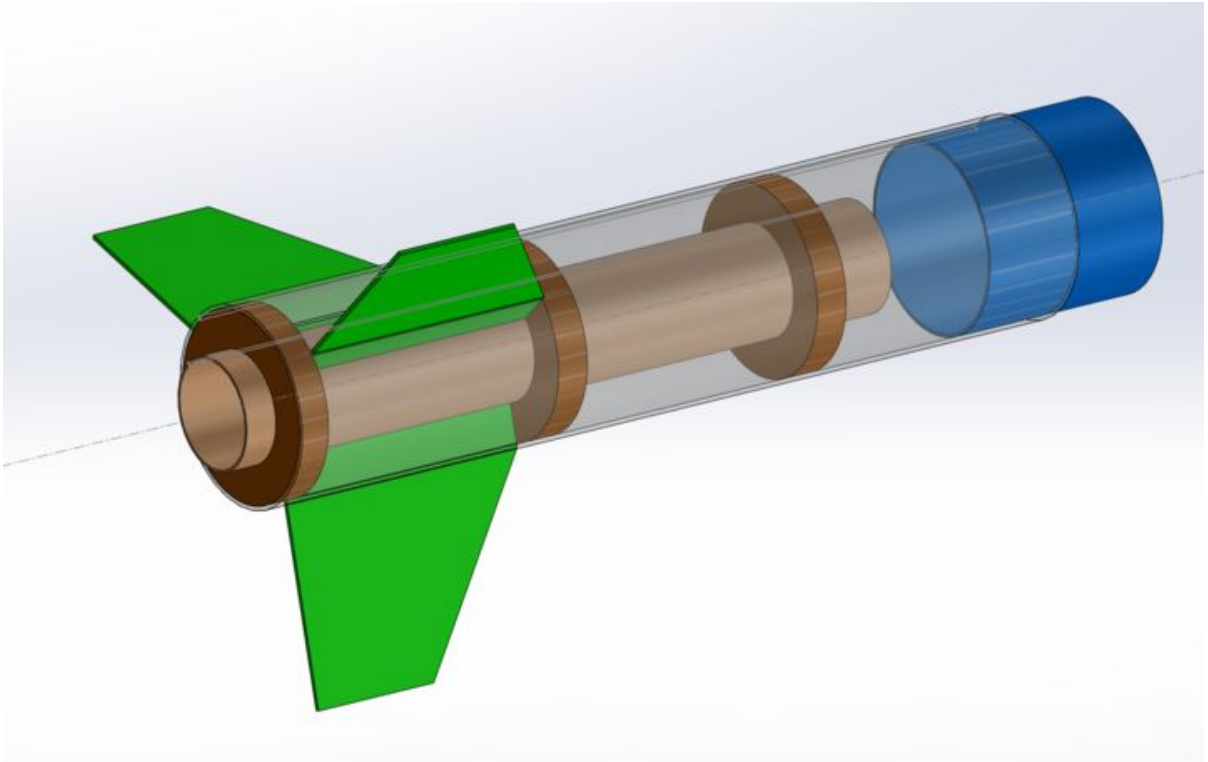
- Main body
  - BlueTube
- Nose cone
  - Upper-half polycarbonate
    - To facilitate camera viewing through the nose cone, as required by our payload experiment.
  - Lower-half fiberglass
- Fins
  - Fiberglass with carbon fiber/glue reinforcement
- Motor Mount Tube
  - Phenolic
  - Wood centering rings
- Glue
  - Epoxy/ JB Weld

Airframe Simulation

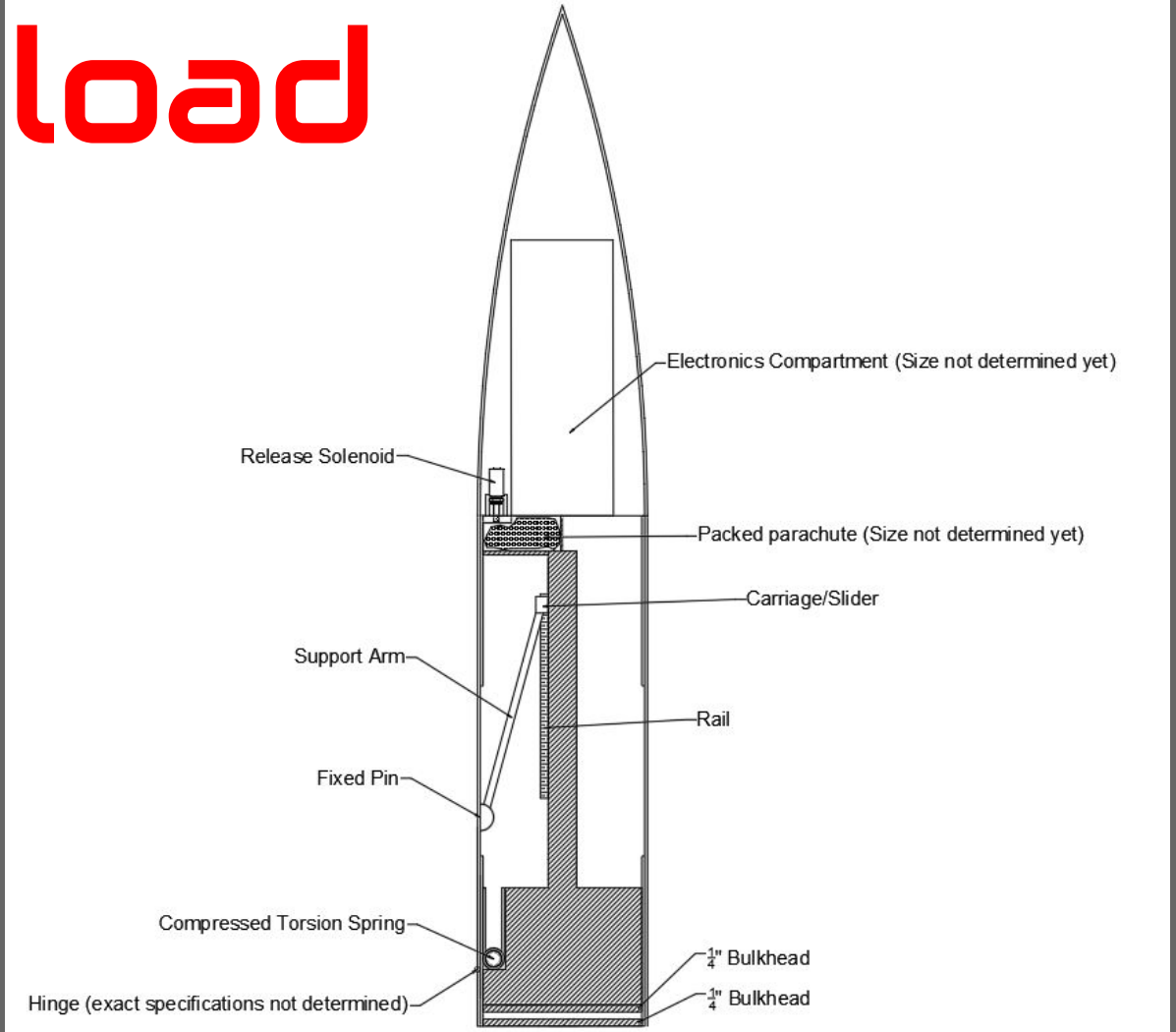


Booster Section

AirFrame



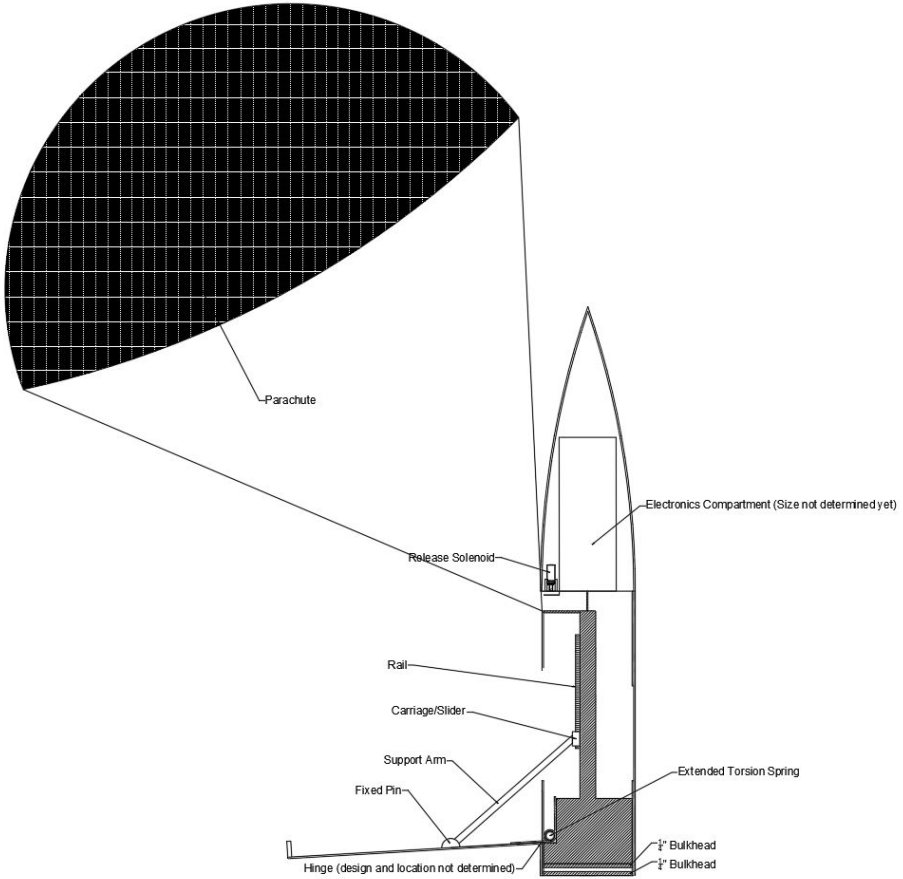
Payload


Electronics Compartment (Size not determined yet)
Release Solenoid
Packed parachute (Size not determined yet)
Carriage/Slider
Support Arm
Rail
Fixed Pin
Compressed Torsion Spring
Hinge (exact specifications not determined)
¼" Bulkhead
¼" Bulkhead

Payload

Target Detection and Upright Landing

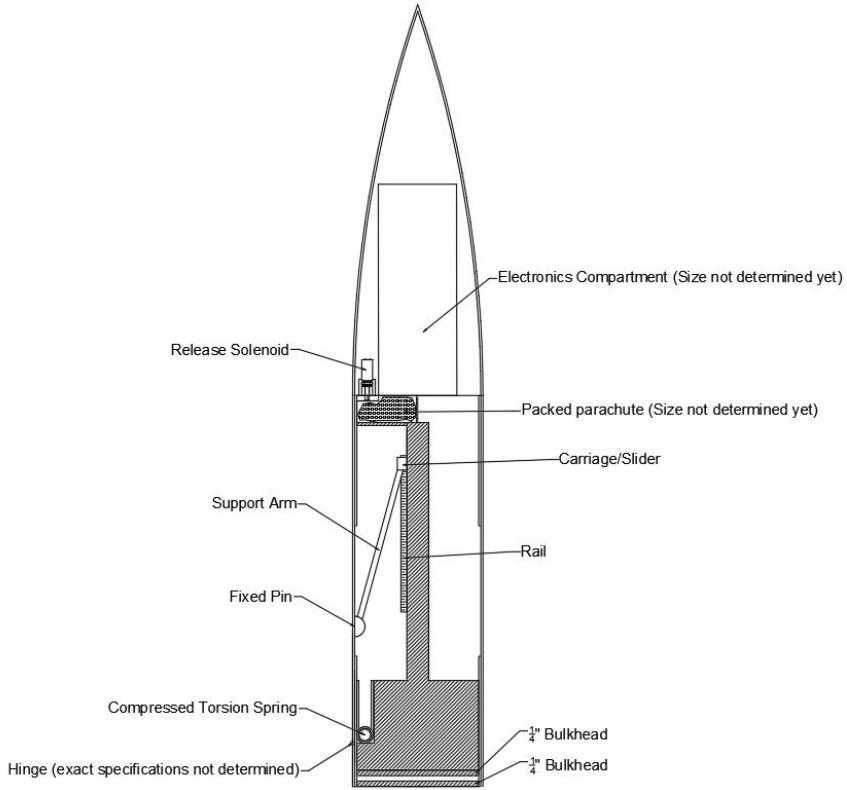
- Detect and differentiate ground targets with camera mounted in nose cone
- Deploy landing legs
  - Simultaneously deploy three parachutes

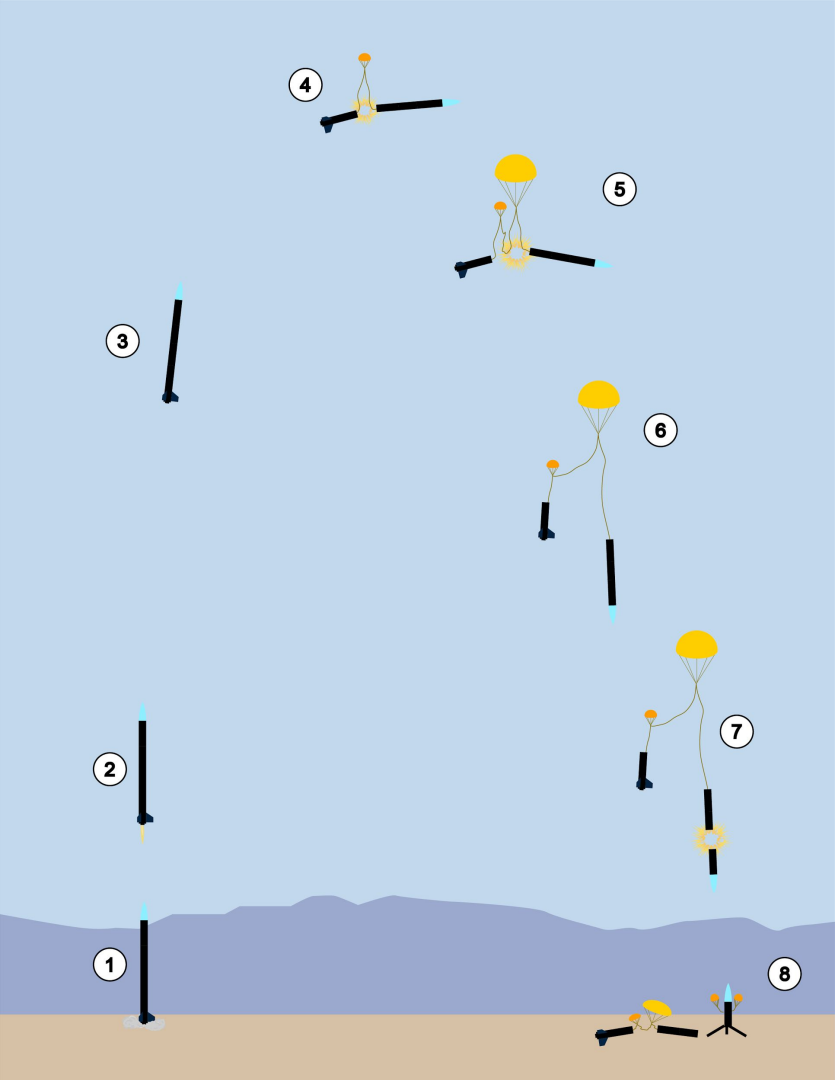


Payload

Target Detection and Upright Landing

- Legs mounted within airframe wall, pin-closure
  - Spring-loaded hinge
  - Alternative: gas-spring deployment

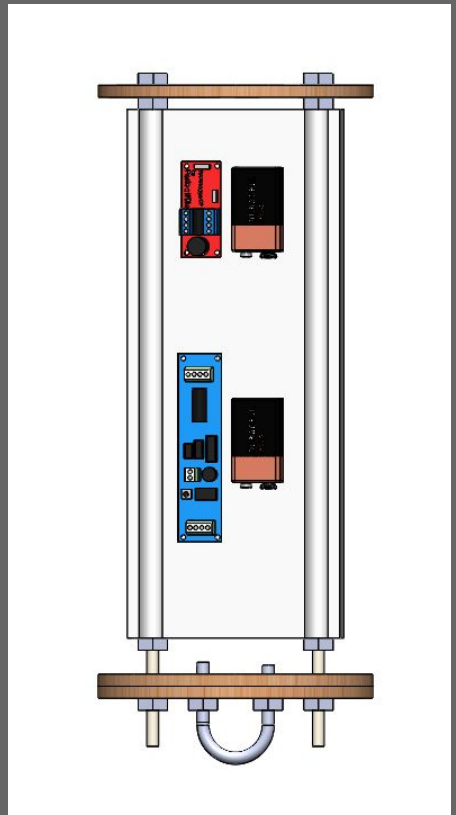


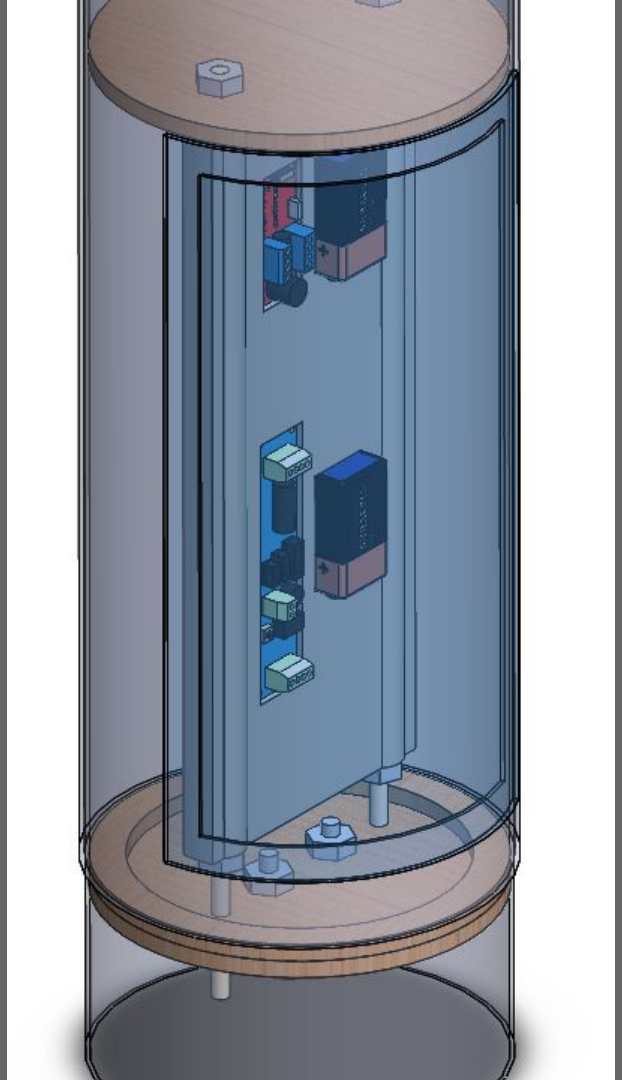


Payload/Recovery

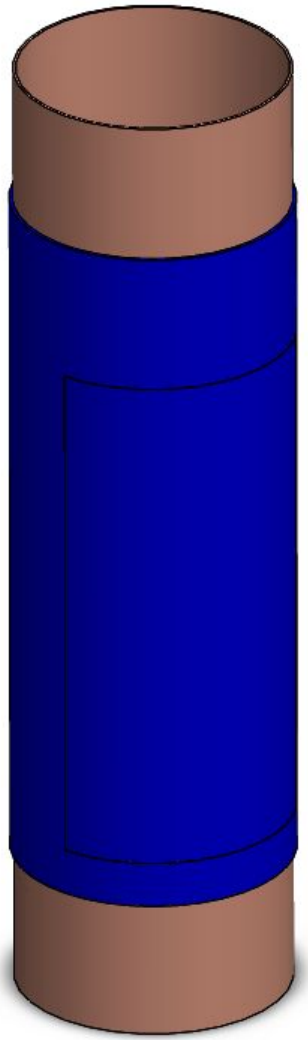
PHASE	EVENT
1	Ignition.
2	Powered flight.
3	Coasting.
4	Drogue parachute deployed at apogee (projected at 5,567 ft. AGL)
5	Main parachute deployed at an altitude of 1,000 ft. AGL.
6	Camera in the nosecone of the rocket begins target spotting.
7	Payload section deploys itself from rocket and deploys its legs and three parachutes.
8	All sections of the rocket land with a KE under 75 ft-lbf.

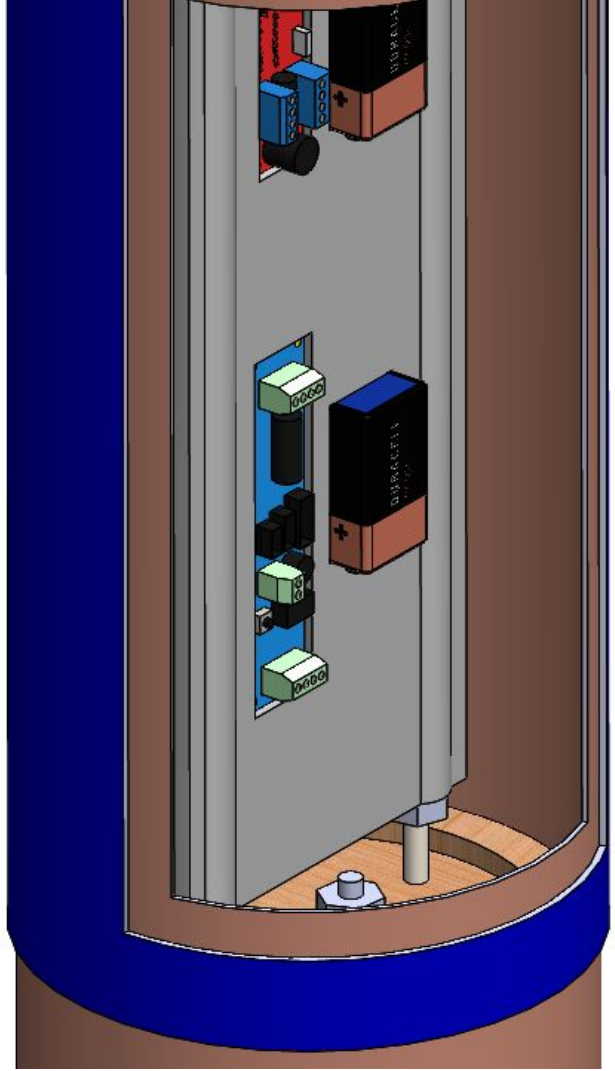
Recovery





Recovery





Avionics Bay

External Design

-removable door

-covered by an O-ring

Internal Design

-3D printed

Calculating Parachute Sizes

- *Drogue Parachute*
  - Optimally velocity 50 mph (or 73 ft/s)
  - **1x 24'' diameter elliptical parachute with C_d = 1.5**
- *Main Parachute*
  - Payload will detach before rocket lands
  - **1x 72'' diameter toroidal parachute with C_d = 2.2**
- *Payload Parachute*
  - 3 parachutes for stabilization
  - **3x 42'' diameter elliptical parachute with C_d = 1.5**

$$V_{Terminal} = \sqrt{\frac{(2m_{total}g)}{\rho C_1 A_1}}$$

$$m_{total(w/o\ payload)}g = \frac{1}{2}\rho v_{max}{}^2 C_1 A_1 + \frac{1}{2}\rho v_{max}{}^2 C_2 A_2$$

Calculating Final KE

- Avionics Bay and Booster
  - Avionics bay: 12.416 ft-lbf
  - Booster: 34.918 ft-lbf
- Payload
  - Payload: 27.1856 ft-lbf

Safety

Safety

General

Safety Officer: Grant Posner

We make sure the team follows codes and regulations and maintains safety, throughout construction, testing, assembly, and launch.

Responsibilities:

- Primary goals
- Others

Safety

Team Mentor

Mentor: David Raimondi

- President of Livermore Unit of NAR (LUNAR)

Mentor duties:

- Supports team
- Owns project

Safety

Personnel Hazards: Greatest Risks

- Construction injuries

- Launch safety: energetic devices
  - Subscale tests
  - Full-scale tests/launches

Environmental Risk Analysis

1. Minimize any environmental issues during the design phase.
2. Be aware of applicable laws and regulations.
3. Identify and rate all risks.
4. Have containment and remediation plans.

Safety

Environmental Ratings for Livermore

1.	Water Contamination	None
2.	Ground Contamination	Very Minimal
3.	Air Contamination	Very Minimal
4.	Ecosystem & Animal Risk	Very Minimal
5.	Human Risk	Very Minimal
6.	Noise	Very Minimal
7.	Community Risk	Minimal
8.	Rocket Engine	Minimal

Clean-Up and Disposal of Launch Waste

1. Identification of possible hazardous contaminants
2. Proper neutralization and disposal of hazardous contaminants
3. Post launch cleanup of launch site
4. Remediation of contamination, if necessary
5. Disposal of non-hazardous waste

Reports/ Outreach

Report

Requirement Compliance Plan

- Have complied with all design requirements
- Delegation of responsibility
- Redundancy
- Track progress
  - (Completed, In Progress, Planned, Not Started)
- Team Derived Requirements

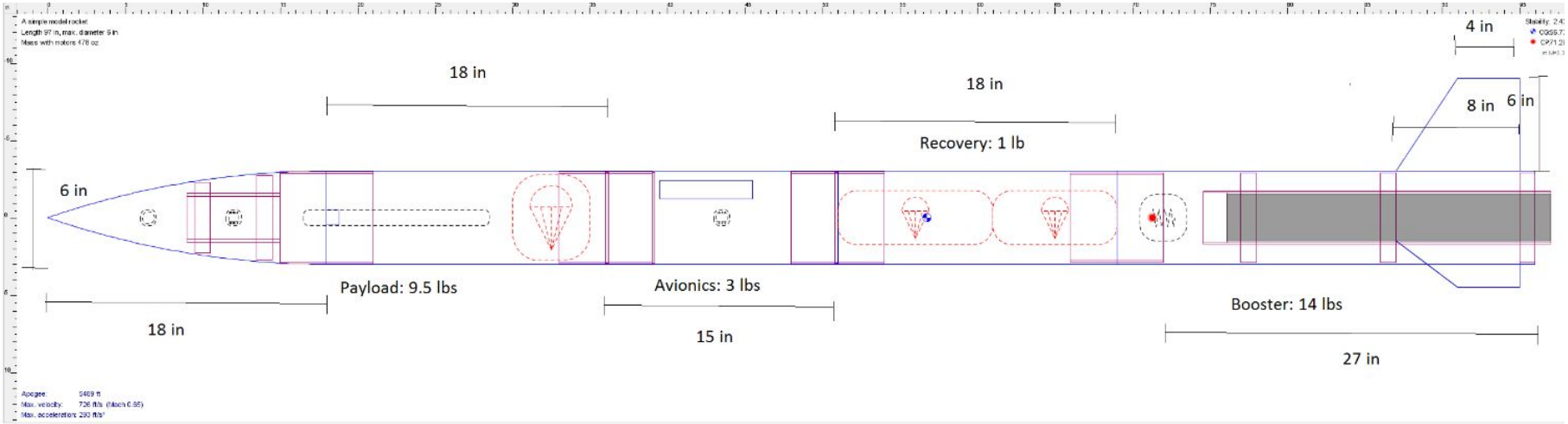
Outreach

Current Events:

- Habitat for Humanity School Trip
- KIPP Bay Area

Appendices

Dimensioned OpenRocket Flysheet


A simple model rocket
Length 97 in, max. diameter 6 in
Mass with motors 478 oz
Stability: 2.4
CG 69.7
CP 71.2
4 in
18 in
18 in
8 in
6 in
Recovery: 1 lb
6 in
Payload: 9.5 lbs
Avionics: 3 lbs
Booster: 14 lbs
18 in
15 in
27 in
Apogee: 9469 ft
Max. velocity: 726 ft/s (Mach 0.95)
Max. acceleration: 230 ft/s²

Milestone Review Flysheet

Institution	University of California Berkeley

Milestone	PDR

Vehicle Properties	
Total Length (in)	96
Diameter (in)	6
Gross Lift Off Weigh (lb)	29.25
Airframe Material	Blue Tube
Fin Material	Fiberglass
Coupler Length (in)	6

Motor Properties	
Motor Designation	L
Max/Average Thrust (lb)	303/259
Total Impulse (lbf-s)	791
Mass Before/After Burn	8.1/3.9
Liftoff Thrust (lb)	1262
Motor Retention	Aft and fore closure screws

Stability Analysis	
Center of Pressure (in from nose)	71.293
Center of Gravity (in from nose)	57.236
Static Stability Margin	2.34
Static Stability Margin (off launch rail)	2.38
Thrust-to-Weight Ratio	8.839
Rail Size and Length (in)	96
Rail Exit Velocity (ft/s)	67.4

Ascent Analysis	
Maximum Velocity (ft/s)	747
Maximum Mach Number	0.66
Maximum Acceleration (ft/s^2)	300
Target Apogee (From Simulations)	5697
Stable Velocity (ft/s)	45.25
Distance to Stable Velocity (ft)	4

Recovery System Properties			
Drogue Parachute			
Manufacturer/Model		Fruity Chutes	
Size		24'' Elliptical	
Altitude at Deployment (ft)		5280	
Velocity at Deployment (ft/s)		0	
Terminal Velocity (ft/s)		66.891	
Recovery Harness Material		Tubular Kevlar	
Harness Size/Thickness (in)		1/2''	
Recovery Harness Length (ft)		20	
Harness/Airframe Interfaces		U-Bolt of Boosters, Top and Bottom Quicklinks of L2 Tender Descender	
Kinetic Energy of Each Section (Ft-lbf)	Section 1	Section 2	
	Booster	avionics and payload	
	798.463	943.72	

Recovery System Properties				
Main Parachute				
Manufacturer/Model		Fruity Chutes; Iris Ultra Compact		
Size		72'' Toroidal		
Altitude at Deployment (ft)		1000		
Velocity at Deployment (ft/s)		66.891		
Terminal Velocity (ft/s)		13.988		
Recovery Harness Material		Tubular Kevlar		
Harness Size/Thickness (in)		1/2''		
Recovery Harness Length (ft)		20 (2x)		
Harness/Airframe Interfaces		U-Bolt of Avionics Bay, Bottom Quicklink of L2 Tender Descender		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2		
	booster	avionics		
	34.918	12.416		

Recovery Electronics	
Altimeter(s)/Timer(s) (Make/Model)	Perfectflite Stratologger CF Missileworks RRC3
Redundancy Plan	Having two different altimeters that can both launch the drogue and main chutes
Pad Stay Time (Launch Configuration)	2 hours

Recovery Electronics	
Rocket Locators (Make/Model)	Eggfinder GPS System
Transmitting Frequencies	***Required by CDR***
Black Powder Mass Drogue Chute (grams)	2.97 g
Black Powder Mass Main Chute (grams)	0.2 g

Institution	University of California Berkeley

Milestone	PDR

Payload	
	Overview
Payload 1	SAGITTA-VL is designed to execute a "Target Detection and Upright Landing" experiment using an onboard camera housed in the upper airframe and nose cone to identify and distinguish between three differently colored 40 ft. square tarps. The upper airframe section is then ejected, and landed under its own recovery system, deploying legs built into the airframe wall in order to land on the ground upright. The purpose of this experiment is to verify the capability to examine and differentiate features of the landing zone in order to verify safe landing sites or potential ground hazards, and perform an upright landing of a reusable payload.

Test Plans, Status, and Results	
Ejection Charge Tests	Have not yet been scheduled. Planning is in progress and first test will occur 1-2 weeks before first sub-scale test flight.
Sub-scale Test Flights	Scheduled for December 3rd at Livermore Unit NAR (LUNAR). Alternate/back-up launch date scheduled for December 17th at Fresno TRA.
Full-scale Test Flights	Scheduled for February 4th at Livermore Unit NAR (LUNAR). Alternate/back-up launch date scheduled for February 18th at Fresno TRA.

Questions?

Thank You