College of Engineering
LAMAR UNIVERSITY

LUNAR Rocketry – NASA University Student Launch

Mission Objectives

LUNAR's mission is to design, build and launch a high-powered rocket that while deliver an engineering payload capable of collecting and transmitting critical mission data to ground control. The project must meet several technical requirements and constraints including reaching an apogee between 4,000 – 6,000 feet, maintain a landing kinetic energy under 75 ft-lbs., ensuring vehicle stability and adhering to many other specified flight parameters outlined by the team and the 2025 NASA Student Launch Handbook. LUNAR is organized into sub-teams to meet all mission requirements as follows:

Recovery – Designs and tests dual-deployment systems for safe descent within energy limits.

Payload – Develops and integrates the scientific/engineering payload.

Vehicle – Handles rocket structure, propulsion, and system integration.

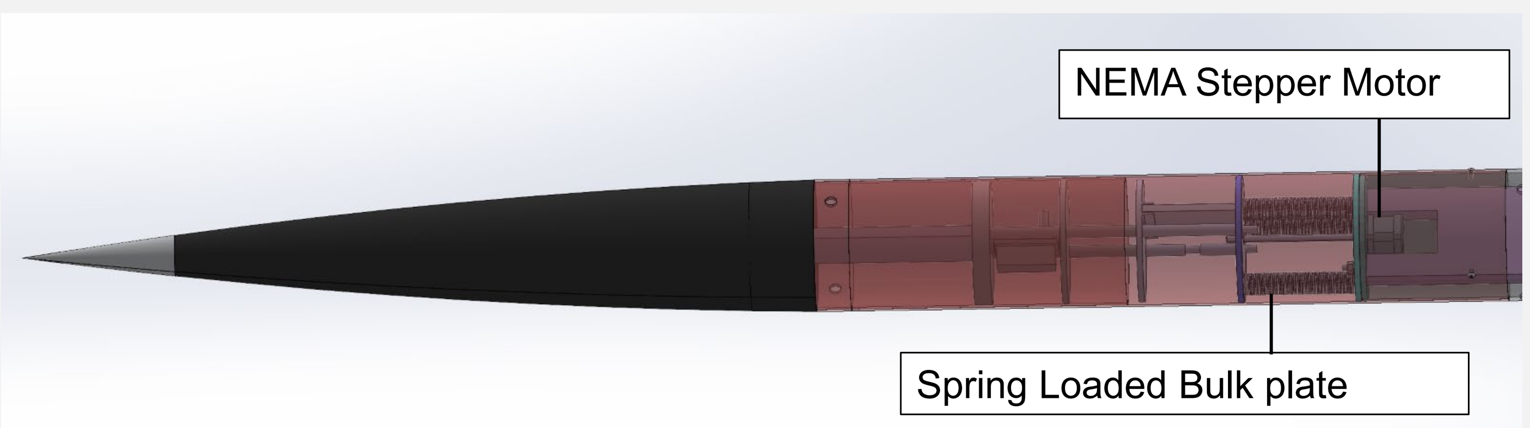
Avionics- Manages flight electronics, telemetry, and real time data tracking.

Business – Leads budgeting, fundraising, sponsorships, and outreach.

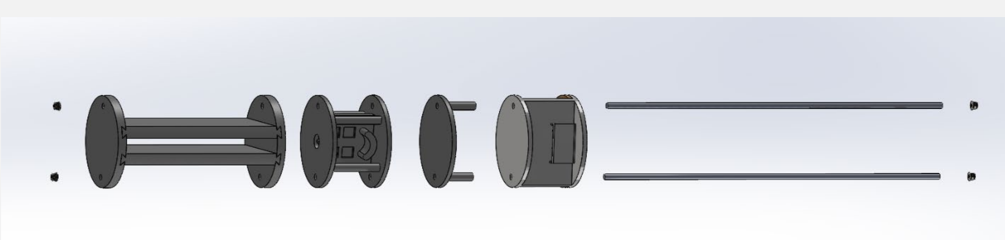
2025 Senior Design Team

Payload Design Overview - ECLIPSE

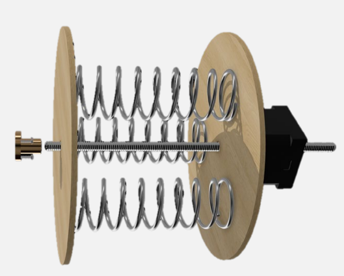
The payload mission requires creating a safe deployment mechanism, integrating sensors, and developing a communication system capable of live data transmission. The ECLIPSE payload is housed in the nose cone-coupler of the vehicle and is made up of 4 major bays that are integrated onto steel rods. The bays include the avionics bay, astronaut bay, additional ballast bay, and the recovery / camera bay. ECLIPSE is retained inside of the vehicle using a NEMA 17 stepper motor that drives a linear actuator inside the fore airframe of the vehicle. The aft end of ECLIPSE contains a nut that threads into the linear actuator and secures the payload inside the vehicle. When the team is ready to jettison the payload, a ground command is sent to the vehicle that unthreads the payload from the vehicle while a set of springs assist in ejecting the capsule from the vehicle. During its final descent, ECLIPSE will measure 5 selected data points about the landing surface and transmit them to NASA on the 2M band autonomously.



Fully Integrated ECLIPSE Payload



ECLIPSE Payload Exploded View

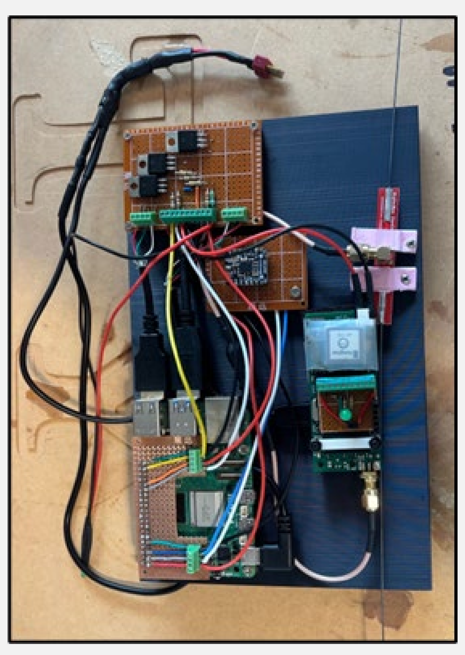


Retention Method Spring Plate

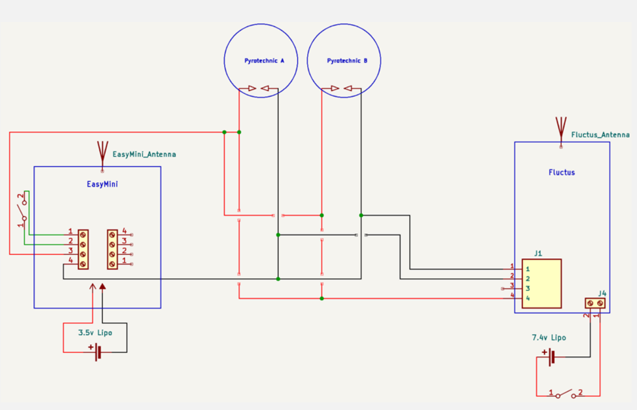
Avionics Systems

Vehicle – The Singularity vehicle utilizes redundant dual altimeters to record all flight data and initiate recovery events.

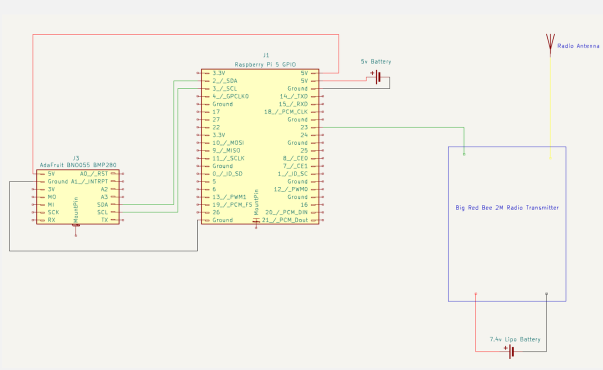
Payload – The ECLIPSE utilizes a raspberry pi, pressure and temperature sensors, an Arduino, and a transmitter to collect, package, and transmit multiple flight metrics to NASA after landing.



ECLIPSE Avionics Sled



Vehicle Avionics Electronic Schematics

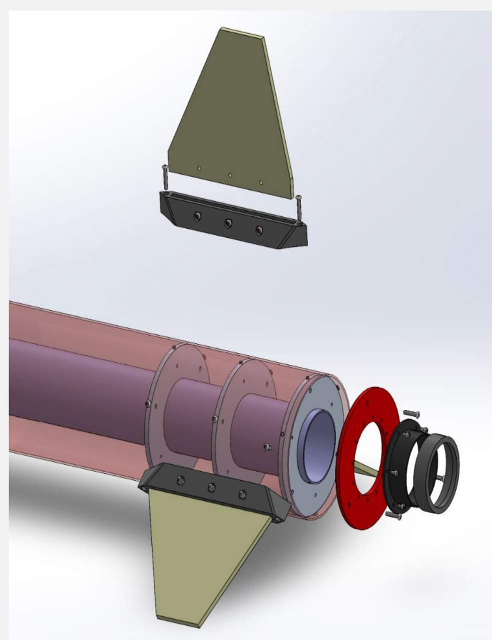


Payload Avionics Electronic Schematics

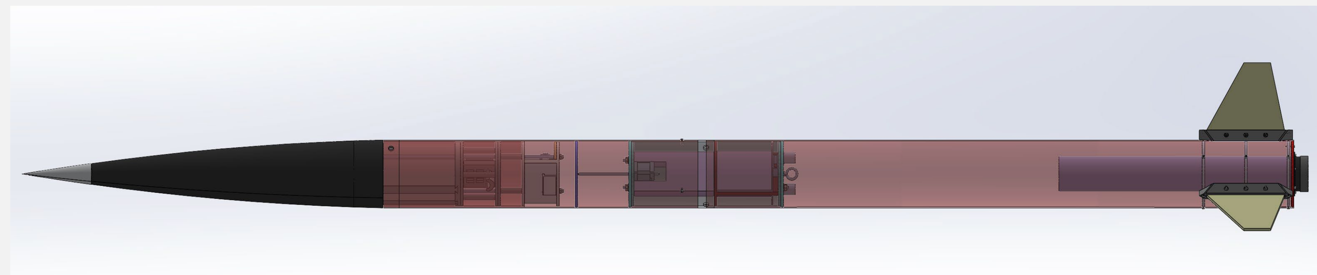
Launch Vehicle Design

The Singularity launch vehicle design is unique to the 2025 LUNAR team and was designed from scratch to fulfill all mission objectives. Singularity underwent the full engineering design process that NASA follows for their very own missions. This includes preliminary, critical, and final design reviews. The vehicle design produced by LUNAR aims at creating a reuseable, serviceable, and reliable launch vehicle. Some of the key features of the vehicle design are:

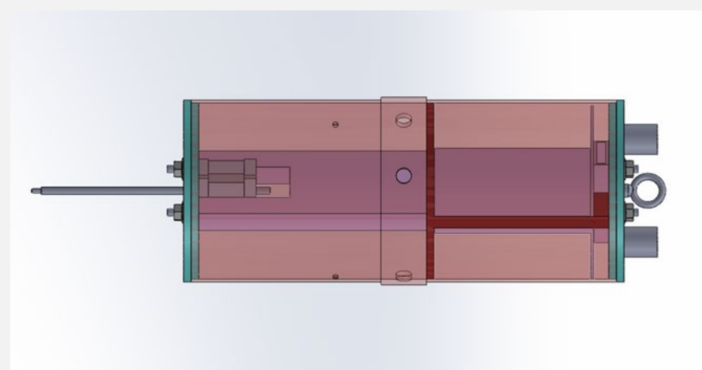
1. **Removable Fin-Can:** The fin-can design features an externally mounted fin utilizing a custom 3D printed fin bracket. The brackets are optimized to reduce aerodynamic drag, and they are mounted to the interior motor tube and custom aluminum centering rings.
2. **Composite Airframe:** The airframe of the vehicle is G12 fiberglass, which has a high strength-to-weight ratio that can withstand all flight forces, increasing durability.
3. **Modular Avionics Bay:** The aft of avionics bay features removable drawer components that allow for ease of access and serviceability of flight computers. The fore of the avionics bay holds all electronic components for payload retention and jettison.
4. **Reloadable motor system:** The motor system utilizes a reusable 75mm motor casing for an L class motor, and a thrust plate for even thrust distribution to the airframe.
5. **Singular Recovery bay:** Both the drogue and main parachute are housed within the aft of the vehicle, allowing the fore of the vehicle to house the payload retention method.



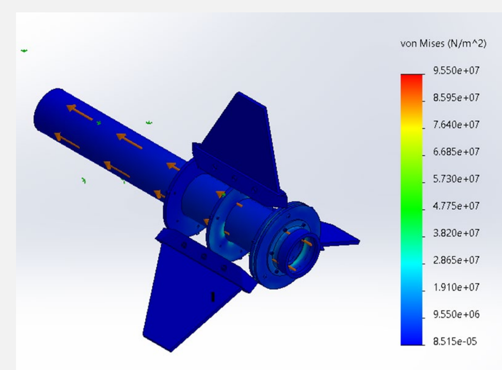
Fin-Can Design



Singularity Launch Vehicle Design



Modular Avionics Bay

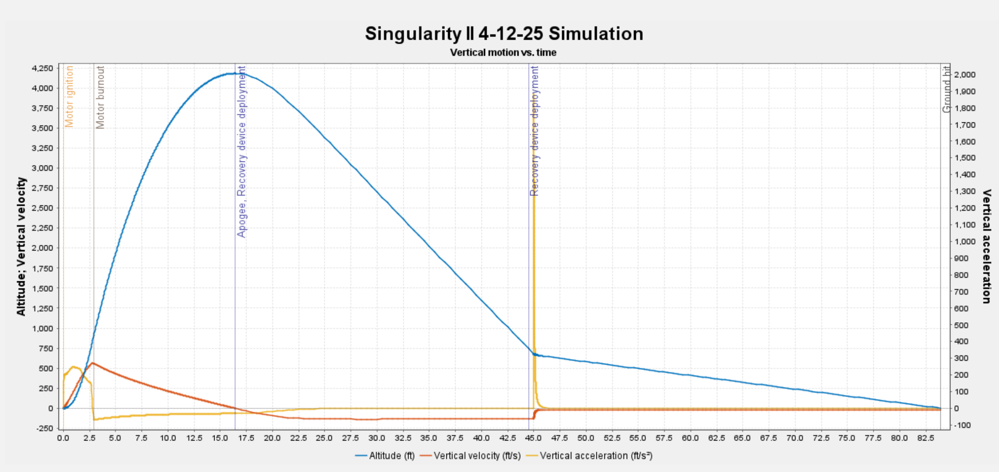


Fin-Can FEA Analysis

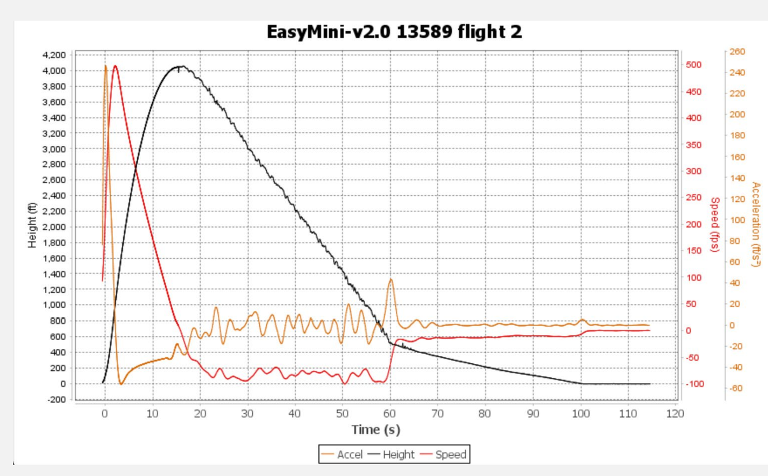
Test Flights & Data Obtained

The singularity mission contained 2 fully-constructed vehicles. The first vehicle that was manufactured, Singularity I, experienced a failure in parachute deployment and hit the ground at 250 mph destroying most of the vehicle. The Singularity II vehicle had a 100% successful flight where the LUNAR team demonstrated a safe ascent to 4000 ft., a stable descent, an on-time main parachute deployment, and a perfect payload jettison. This flight is what qualified the team to compete in the final stage of the NASA Student Launch competition. The simulated data was compared to the measured data from the test flight, and the team predicted the apogee of the vehicle with 99.75% accuracy.

Variable	Predicted	Actual	% Error
Apogee (ft.)	4078	4068	0.25%
Max Velocity (ft/s)	553	536	3.07%
Max Acceleration (ft/s²)	249	246	1.2%
Total Flight Time (s)	100.3	99.8	0.5%
Velocity Off Rod (ft/s)	71	68.2	3.94%
Time to Apogee (s)	16.4	16.9	3.04%



Simulated Flight Profile



Measured Flight Profile

Conclusion

From initial concept development to final launch execution, LUNAR successfully completed a full design cycle meeting all mission objectives. Through iterative design reviews, subscale and full-scale test flights, and real-time problem-solving, the team delivered a high-powered rocket that met all mission constraints. The project challenged the team to apply engineering principles, collaborate across teams, rigorously test and refine systems. Competing at the national 2025 NASA Student Launch Initiative validated LUNARS's technical capabilities.

Competition Location: Huntsville, Alabama **Competition Date:** May 3rd , 2025

Students & Faculty Advisors

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Sponsorships

TMAC, TotalEnergies, Plains All American Pipeline, Precise, Beaumont Professional Firefighters Local 399, Ansys, Cloeren Aerospace, HEB

Mechanical Engineering Department