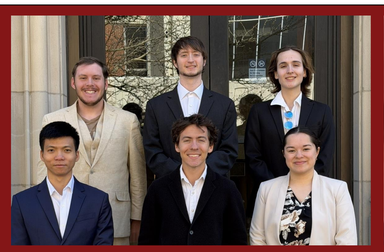
NASA Student Launch Initiative
Boomer Rocket Team

Leo Larsen - Captain
Moneka Norman - Vice-Captain
Colton McKinney - Manufacturing Lead
Austin Savage - Propulsion Lead
Huy Le - Aerodynamics Lead
Andrew Martinez - Integration Lead
Srikanth Bashetty - Faculty Advisor





Objectives & Constraints

The 2026 University Student Launch Initiative challenges schools to design, construct, and fly a launch vehicle with a payload capable of autonomous soil collection. The vehicle and payload are designed based on the following fundamental NASA requirements:

- Apogee must be 4000 to 6000 feet
- 50ml of soil must be collected and tested
- 90 Second Landing Time Post Apogee
- Maximum landing energy of 75 ft-lbf
- Static flight stability must be 1.8+
- Sub-Scale Model and Full-Scale Demonstration

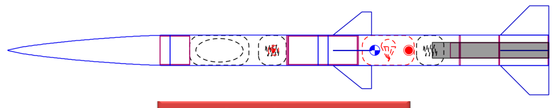
Standards Referenced:

- ANSI/ASME Y14.5 Drawing Standards
- NASA-STD-7002 Payload Test Requirements
- FAA Title 14, Ch 1 F, Part 101.C HP-Rocketry
- NFPA 1127 Code for HP-Rocketry and Fire Risk

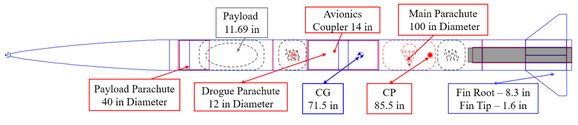
Launch Vehicle Design

Conceptual Design:

- Simulated design for 5000ft apogee
- 6-inch diameter for workspace and low weight
- HVAACK nosecone high volume, low impact
- Design configured for high payload weight



Subscale Design



Full scale Design

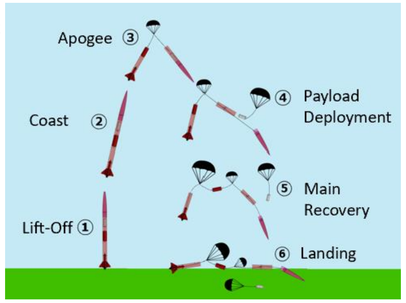
Design Considerations:

- Fiberglass switch band for retrievable RF
- Aluminum nose cone tip for increased durability
- 1390G Motor Chosen as powerful class (L) allowed and provides reliable thrust off rail.

Launch Vehicle Design

Concept of Operations

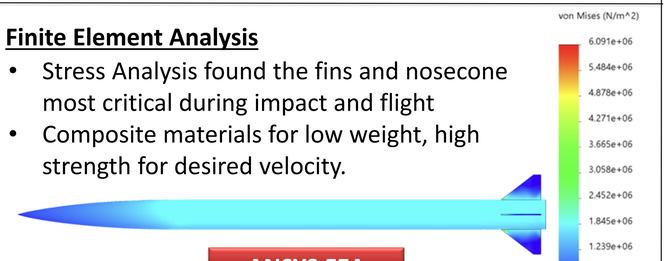
- Payload separation for easy soil access
- High velocity off rail for stability
- Dual deployment for low altitude recovery



Concept of Operations

Finite Element Analysis

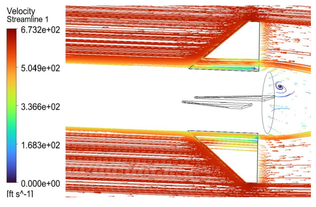
- Stress Analysis found the fins and nosecone most critical during impact and flight
- Composite materials for low weight, high strength for desired velocity.



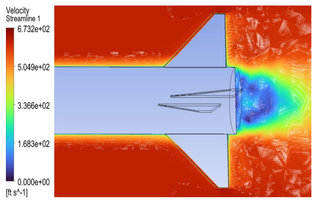
ANSYS FEA

Fin Design Fluid Dynamics

- Analysis proved chamfered fins greatly reduced drag
- Fin design optimized for high stability and velocity



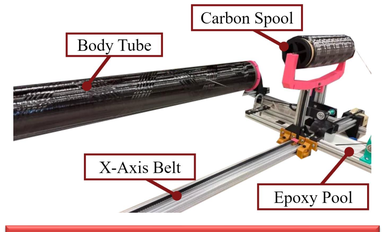
Fins Fluid Flow



Boundary Layer

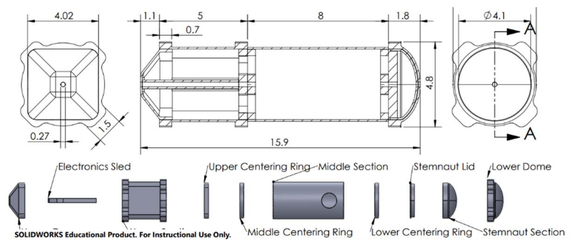
Custom Built Winding Machine

- High strength-to-weight ratio using Carbon fiber tubes
- Custom winding machine constructed for carbon fiber
- Provides cheap and long-term alternative to purchased tubes.



Custom Winding Manufacturing

Payload Design

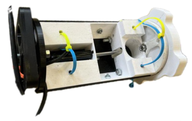


Rotating Auger Design:

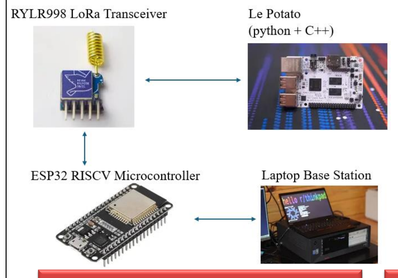
- Rotating Test Section to Enable Gravity Actuation Reducing complexity
- Augur Mechanism pulling soil autonomously into testing chamber.
- Retrieves 50 mL soil with Linear Actuating System
- Separation From Rocket to Decrease interference upon landing



Printed Auger



Collection & Test Chamber



Electronics



Avionics Layout

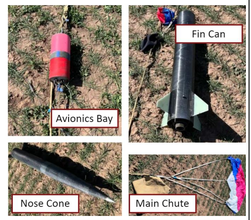
Electronics & Testing:

- 3 Node LoRa Communication System (GPIO)
- ESP32 Microcontroller + Linux Single Board Computer
- Laptop Base Station Via Serial
- Altimeter via I2C -> Microcontroller
- Soil Testing Via Modbus RTU Implementation
- Python Orchestration Layer and C++ Helper Functions. JavaScript + Tailwind CSS frontend.
- Linear Actuator + Auger Driver System
- Edge case scenarios tested through CI/CD evaluation
- Vertical Integration led to **2x ~ 4x cost reduction**.

Flight Demonstrations

Full Scale Demonstration Results

Results	
Altitude Apogee	4,771 ft
Touchdown Velocity	14.7 ft/s
Total Descent Time	72.3 s
Reusable Condition	Yes



Landing Config

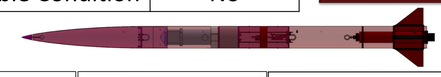


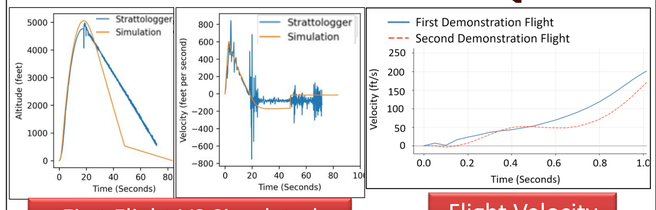
Payload Demonstration Flight Results

Results	
Altitude Apogee	638 ft
Descent Velocity	182.29 ft/s
Total Descent Time	6.25 s
Reusable Condition	No



Landing Config





First Flight VS Simulated

Flight Velocity Comparison

Results and Takeaways

- Loss of Launch Vehicle without NASA placement
- New manufacturing methods and materials proven
- Carbon Fiber Winding tubes proved viable and strong
- Soil testing proved successful
- Mass balancing needs careful checking

Project Budget

Budget Totals		Major Expenses	
Income	$4,103.89	Materials	$4113.41
Expenses	$5,849.21	Travel	$0
Carryover	$16,209.83	Motors	$1,129.88
Balance	$14,464.54	Winding Machine	$605.92

GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY of OKLAHOMA