Project
NOVA
2017 - 2018
Our Mission

Design a Rocket Capable of:
- Apogee of 5280 ft
- Deploying an autonomous Rover
Vehicle

REILLY B.
Vehicle Dimensions

- Total Length of 108 inches
- Inner Diameter of 6 inches
- Outer Diameter of 6.25 Inches
- Estimated Mass of 39.9 lbs
Material Selection

Carbon Fiber
- High strength to weight ratio
- Rated highest in team trade study

3D braided carbon fiber
- Lighter than a solid carbon fiber tube while still providing necessary strength
- Used to create an Open-Architecture Composite Structure (O-ACS)
Clipped-Delta Fins

- Easy to manufacture
- Proven design
- Performs well in subsonic flight
- Team experience
Ogive Nose Cone

- Low Coefficient of Drag
- Easy to manufacture
- Rated highest by team trade study
- Commonly used in professional and hobby rocketry
Stability Margin

- Static Stability Margin of 2.26 Calibers
- CG located 69.992 inches from nose cone
- CP located 84.13 inches from nose cone
Motor Selection and Performance Predictions

- Initial motor selection is a Aerotech L1420R
- Simulated altitude of 6034 ft (AGL)
- Thrust-to-weight ratio is 8:1
- Provides a rail exit velocity of 53 ft/s
Aerotech L1420R Thrust Curve

Motor thrust curves

![Thrust Curve Graph]

- **Time / s**: 0.00 to 3.25
- **Thrust / N**: 0 to 1,600

Graph represents the thrust output of the Aerotech L1420R motor over time.
### Aerotech L1420R Motor Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Aerotech</td>
</tr>
<tr>
<td>Motor Designation</td>
<td>L1420R</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.95 in</td>
</tr>
<tr>
<td>Length</td>
<td>17.4 in</td>
</tr>
<tr>
<td>Total Impulse</td>
<td>1038 lb·sec</td>
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<tr>
<td>Total Motor Weight</td>
<td>10.1 lb</td>
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<tr>
<td>Propellant Weight</td>
<td>5.69 lb</td>
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<tr>
<td>Propellant Type</td>
<td>Solid</td>
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<tr>
<td>Average Thrust</td>
<td>326 lbf</td>
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<tr>
<td>Maximum Thrust</td>
<td>374 lbf</td>
</tr>
<tr>
<td>Burn Time</td>
<td>3.18 sec</td>
</tr>
</tbody>
</table>
Testing Plans

- 2:3 Subscale
- Materials Testing
Subscale Testing Plans

- 1:2 Scale
- 11.4 lbs
- Loki - J820-P motor selection
Materials Testing
Recovery

BEN C.
Recovery Overview

Stage 1: Launch

Stage 2: Apogee – Drogue Deploys
- Nosecone
- Unemployed Upper Main Parachute

Stage 3: 750 ft - Mains Deploy
- Lower Main Parachute
- Lower Section
- Upper Main Parachute
- Upper Section
- Drogue Parachute

Stage 3: 750 ft - Mains Deploy
- Upper Main Parachute
- Upper Section
- Lower Main Parachute
- Lower Section
- Drogue Parachute
Parachutes

Three parachutes required

- Drogue – Circular – 31 inch diameter
- Upper Main – Hemispherical – 103.4 inch diameter
- Lower Main – Hemispherical – 34.3 inch diameter

Both Main parachutes will have a spill hole
Parachutes

Construction
- Gores

Ripstop nylon
- Tear resistant weaving
Parachutes

Upper Main parachute deployed with Jolly Logic Chute Release System
Attachment Hardware

- Nylon Slotted Pan Head Machine Screws
- Steel U-Bolts
- Quick Links
- Insulated Carbon Fiber Altimeter Board
Shock Cord

- 1 inch tubular nylon
- Excellent tensile strength
- Low weight
Electronics - Altimeters

Two altimeters
- Altus Metrum Telemega
- Altus Metrum Telemetrum

Two Jolly Logic Chute Releases
Electronics - Altimeters
Black Powder Ejection System

- Effective
- Reliable
- Tested
- Low volume
Black Powder Ejection System

Ideal Gas Law

- $PV = nRT$
- $P = \frac{pins \times F}{A}$
- $N = 0.00052 \times F \times L$ (grams)

Charge cups
Recovery Testing

- Wind tunnels
- Ejection
- Materials
Deployable Rover

DAVID T.
Goal

Rover will be housed in rocket body until being remotely activated when it will travel at least five feet from the rocket and deploy solar panels.
Mechanical

- 3D printed
- Lightweight
- Design easily changed
Body

- Top and bottom sections
- Onyx
Solar Panel Deployment

- Accordion design
- Fits with rover body
Treads

- 2 Drive Wheels
- 2 Idle Wheels
- 2 Treads for Traction
- Onyx
Electrical

- Arduino Uno
- 3 Motors
- 1 Motor Shield
- 2 XBee Communication Devices (Respective Attachments)
- 2 9V Batteries
Control

- Arduino Uno
Motors

- Pololu Micro Metal Gearmotor
- 1000:1 Gear Ratio
- 125 oz-in at Stall Torque
Communication

- Xbee Pro
- Up to 1 Mile Communication Distance
- Two-Way Communication
Altitude Control

TANNER O.
Design

- New path this year
- Previous drag implemented fins
- Current iteration will be completely internal with drag plates
Internal Plate Drag System (IPDS)
Bottom-Up View
Electronics

- Arduino Uno
- Adafruit 9-DOF IMU
- AndyMark NeveRest 40
Considerations

- Drag plates must deploy simultaneously
- Plates must not deploy during motor burn
- Rocket is stable
Officer Overview

- Worked previously with safety and recovery
- Briefs team, updates and supplies MSDS, ensures availability of PPE
- Creates checklists to ensure proper safety protocols and consistency
Team Liaisons

Liaisons have been established with each team to effectively and efficiently monitor all components of the project.

- Jake R. with Recovery
- Ruth A. with Systems
- Alex D. with Vehicle Body
- Rhett R. with Rover
- Sydney F. with Testing
Testing
Completed Testing

- Materials testing
  - All materials used in structural components of the rocket
  - Tension, compression and three point bend
- Ground separation testing for subscale
- Electronics interference
- Battery duration tests
Planned Testing

- Subscale and Full Scale launches
- Ground separation testing for full scale
- Checking electronics for interference on full scale
- Rover ability to cross rough terrain
- Rover ability to deploy from any orientation
- Drag measurements on altitude control system plates
Educational Outreach

KATHERINE M.
Educational Outreach Events

- Drake Middle School 7th Grade Rocket Week: Spring, 2018
- Samuel Ginn College Engineering Day: February 23, 2018
- Boy Scout and Girl Scout events: Spring 2018
- Auburn Junior High Engineering Day: November 9, 2017
Project

- Timeline
- Funding
- Budget