Project Tiger Launch

2016-2017
Our Mission

• Design a rocket capable of
  ▫ Apogee of 5280 feet
  ▫ Inducing a roll that completes two rotations
Airframe

Luke Compton
Vehicle Dimensions

- Total Length of 85 inches
- Inner Diameter of 6 inches
- Outer Diameter of 6.25 Inches
- Estimated Mass of 25 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
NOTE: 10 REVOLUTIONS PER WIRE OVER LENGTH
Stability Margin

- Static Stability Margin of 2.02 Calibers
- CG located 53.053 inches from nose cone
- CP located 66.186 inches from nose cone
Motor Selection and Performance Predictions

- Initial motor selection is a Loki-L480-LR
- Simulated altitude of 5488 ft (AGL)
- Thrust-to-weight ratio is 5:1
- Provides a rail exit velocity of 53 ft/s
Loki-L480-LR Thrust Curve
**Loki-L480-LR Motor Specifications**

<table>
<thead>
<tr>
<th>Motor Specifications</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Loki</td>
</tr>
<tr>
<td>Motor Designation</td>
<td>Loki-L480-LR</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.95 in</td>
</tr>
<tr>
<td>Length</td>
<td>19.6 in</td>
</tr>
<tr>
<td>Impulse</td>
<td>720 lb·sec</td>
</tr>
<tr>
<td>Total Motor Weight</td>
<td>7.8 lb</td>
</tr>
<tr>
<td>Propellant Weight</td>
<td>3.8 lb</td>
</tr>
<tr>
<td>Average Thrust</td>
<td>113 lbf</td>
</tr>
<tr>
<td>Maximum Thrust</td>
<td>127.5 lbf</td>
</tr>
<tr>
<td>Burn Time</td>
<td>6.37 sec</td>
</tr>
</tbody>
</table>
Testing Plans

- 1:2 Subscale
- Materials Testing
Subscale Test Plans

• 1:2 Scale
• 11 lbs
• Loki-J300LR motor selection

Launch:
- 9239 ft
- Max. velocity: 594 km
- Max. accelerometers: 2390 ft/s²
Materials Testing

- Three-point bend test
- Compression test
Recovery Overview

Stage 1: Launch

Stage 2: Apogee - Drogue Deploys

Stage 3: 750 ft - Main Deploys
Parachutes

- Two parachutes required
  - Drogue – Circular - 25 inches
  - Main – Hemispherical – 89 inches
- Main parachute will have a spill hole
Parachutes

- Construction
  - Gores
- Ripstop nylon
  - Tear resistant weaving
Parachutes

• Main parachute deployed with the Tinder Rocketry Tender Descender
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 - Altimete

- Two altimeters
  - Altus Metrum Telemega
  - Altus Metrum Telemetrum
- Patch antennae
  - Taoglas FXP240 433 MHz ISM
Electronics - Altimeters

<table>
<thead>
<tr>
<th>Table 1 Specifications for four Altimeter Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Dual deployment</td>
</tr>
<tr>
<td>Telemetry Downlink</td>
</tr>
<tr>
<td>Barometric Pressure Sensor</td>
</tr>
<tr>
<td>Accelerometer</td>
</tr>
<tr>
<td>Gyro</td>
</tr>
<tr>
<td>On-board GPS</td>
</tr>
<tr>
<td>On-board non volatile memory for flight storage data</td>
</tr>
<tr>
<td>Power, configuration, data recovery interface</td>
</tr>
<tr>
<td>Board size</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Microcontroller</td>
</tr>
<tr>
<td>Regulator</td>
</tr>
<tr>
<td>Range</td>
</tr>
<tr>
<td>Precision</td>
</tr>
<tr>
<td>Inertial Sensor</td>
</tr>
<tr>
<td>Magnetometer</td>
</tr>
</tbody>
</table>
Black Powder Ejection System

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

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

- Charge cups
Testing

- Wind tunnels
- Ejection
- Materials
Grid Fins

Garrett Knecht
Design (Fins)

• Similar to last year
• Increase width
• Include Roll
Design (Fins)

- 4”x5.82”x1.5”
Design (Fairings)

- 4”x1.5”
- 13.5” curvature
- Lengthened to prevent local shock
Design (Actuation)

- 2 separate systems
- Pitch only
- Pitch and roll
Testing

• Water and wind Tunnel Testing
Electronics

- Arduino Uno
- IMU Breakout
- SC-1258TG
Safety

• Need to Make Sure
  ▫ Grid fins deploy simultaneously
  ▫ Grid Fins do not deploy before burnout
  ▫ Rocket is stable
Safety Team

• Safety Officer: Ryan McWilliams
  ▫ Worked under previous Safety Officer
  ▫ Briefs team, updates and supplies MSDS, ensures availability of PPE

• Team Liaisons:
  ▫ Zach Wadzinski with Recovery
  ▫ Tanner Oakes with Grid Fins
  ▫ Liam Hamilton with Vehicle Body
Safety Details

- Initial Safety Briefing and Waiver
- Preliminary Checklists
  - Assembly and Launch procedures
- Hazard Analyses
- Continuous Training via ORM
  - Specific online courses
    - Laser Safety
    - Hand and Power Tool
    - Lab Safety
  - OSHA Workshop Course available during regular meeting hours
- MSDS, Inventory Sheets, NAR/TRA Safety Codes all available through team website
- Additional briefings are held prior to launch opportunities to review safety procedures, finalize checklists, and discuss location and travel
Education

Bryce Gardner
Educational Outreach Events

• Drake Middle School 7th Grade Rocket Week - Spring, 2017
• Samuel Ginn College Engineering Day - February 24, 2017
• Boy Scout and Girl Scout events
• Space Club Day, Spring 2017
Project

• Timeline
• Funding
• Budget