TOLEDO

ROCKETRY CLUB

# CRITICAL DESIGN REVIEW

# Team Structure

- Team Leader:
  Michael Blackwood
  NAR #101098 L2 Certified
- Safety Officer:
  Jay Nagy
- Team Mentor:
  Art Upton
  NAR #26255 L3 Certified
- NAR Section:
  Jackson Model Rocketry Club
  Section #620

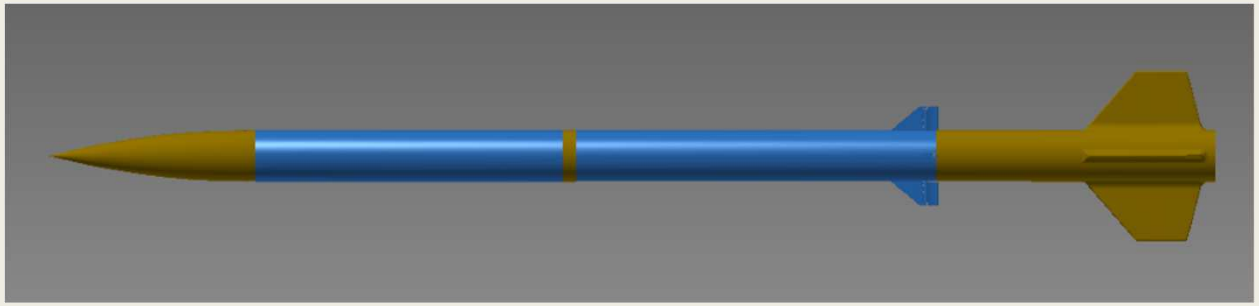
Team Leadership:

- Michael — Team Lead, Payload System Lead
- Andrew — Vehicle Body Lead, Treasurer
- Peter — Propulsion Lead, Secretary
- Jay — Safety Officer
- Patrick — Recovery Lead
- Marwan — Payload Electronics Lead
- William — Education/Outreach Lead

# Agenda

- Vehicle Design Overview
- Flight Overview
- Stability
- Recovery Subsystem
- Payload Subsystem
- Propulsion Subsystem
- Scale Model Flight
- Educational Engagement
- Budget
- Timeline
- Future Work

# Vehicle Design Overview



Details

- Length: 90.73 inches
- Diameter: 4 inches
- Weight with motor: 20.25 lbs

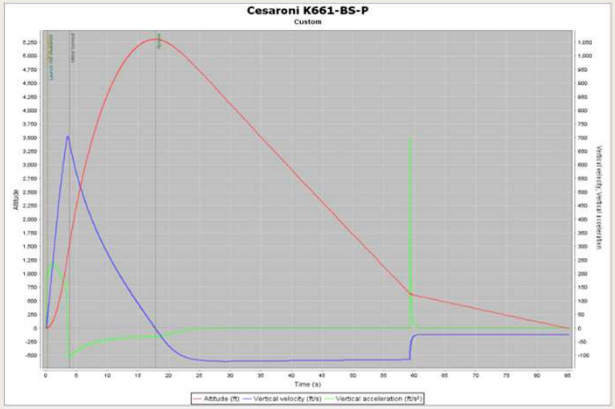
Materials

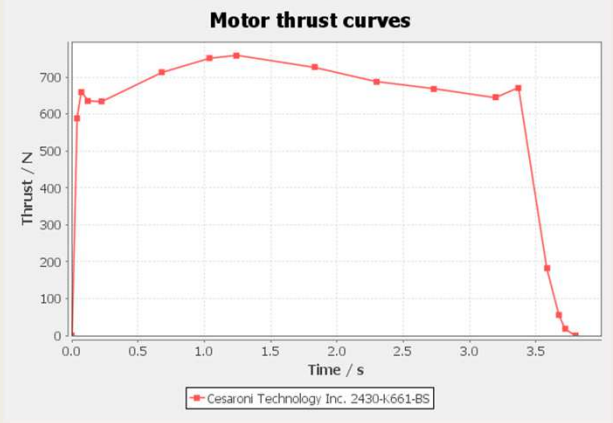
- Airframe: G12 Fiberglass
- Fins: G10 Fiberglass

# Flight Overview and Motor Choice

- Cesaroni K661-BS-P
  - *89.2 oz*
  - *Projected apogee of 5,300 ft.*
  - *58 ft/s off launch rod*
  - *Max velocity 703 ft/s*
  - *0.63 Mach*

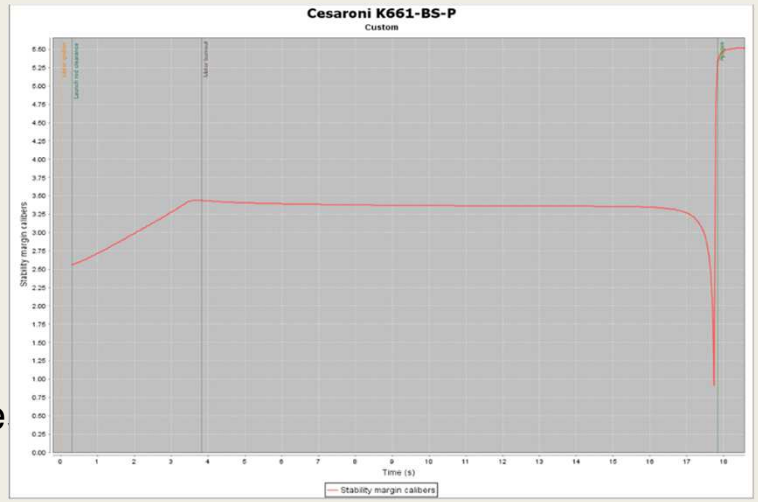
- Thrust Curve
  - *Maximum thrust: 750N*
  - *Burn Time: 3.6 s*

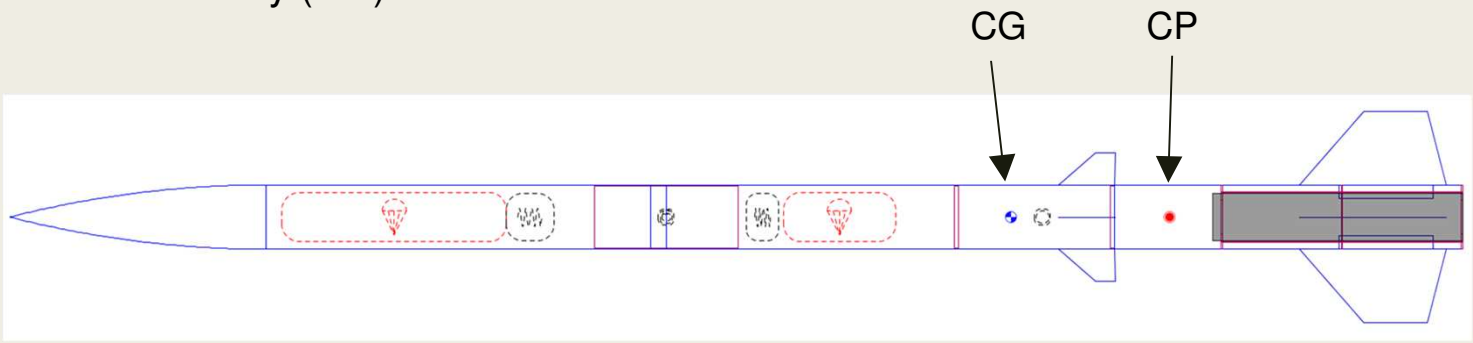


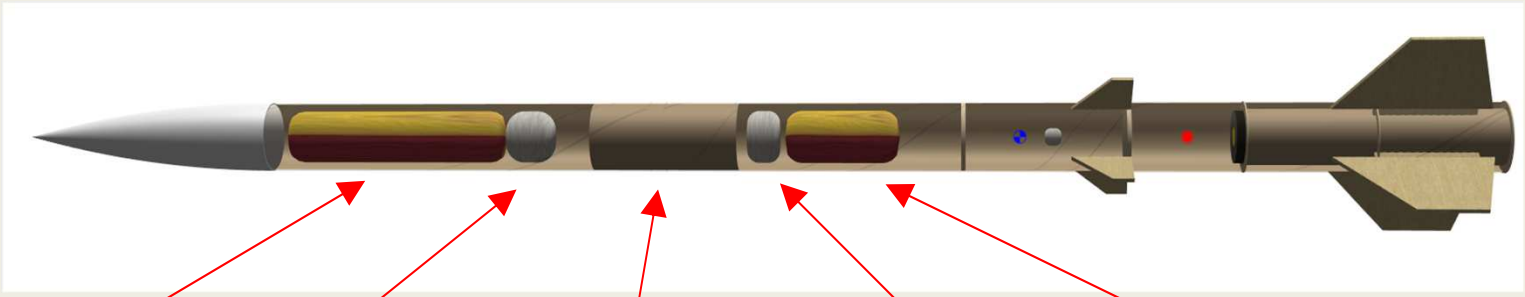
# Stability

- Static Stability Margin: 2.6
- Distance to stable velocity: 3.8 feet
- Rail exit velocity: 58 ft/s
- Center of Pressure (CP): 72.4 inche
- Center of Gravity (CG): 62.4 inches

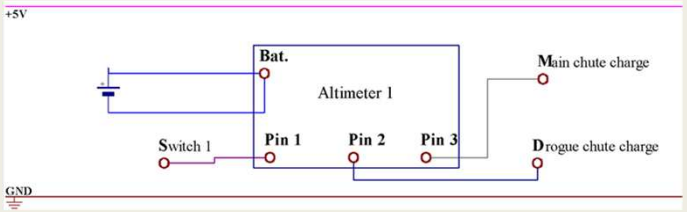


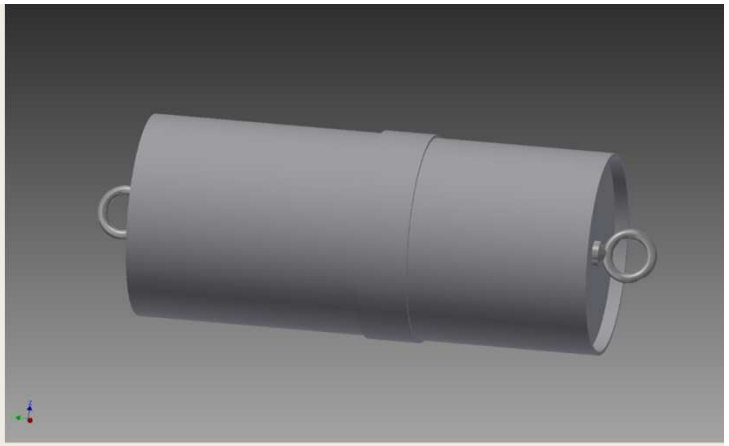
# Recovery Subsystem




- Drogue Chute:
  - 24”
  - Deploys at apogee
- Main Chute:
  - 60”
  - Deploys at 700ft
- Altimeter
  - StratologerCF
  - Programmed to trigger blast caps at apogee for drogue and 700 ft for main.
  - Two units
    - 2 grams of black powder are used for each blast cap.
    - Each unit given independent battery.
    - Each unit connects to a blast cap for the drogue and main chutes.

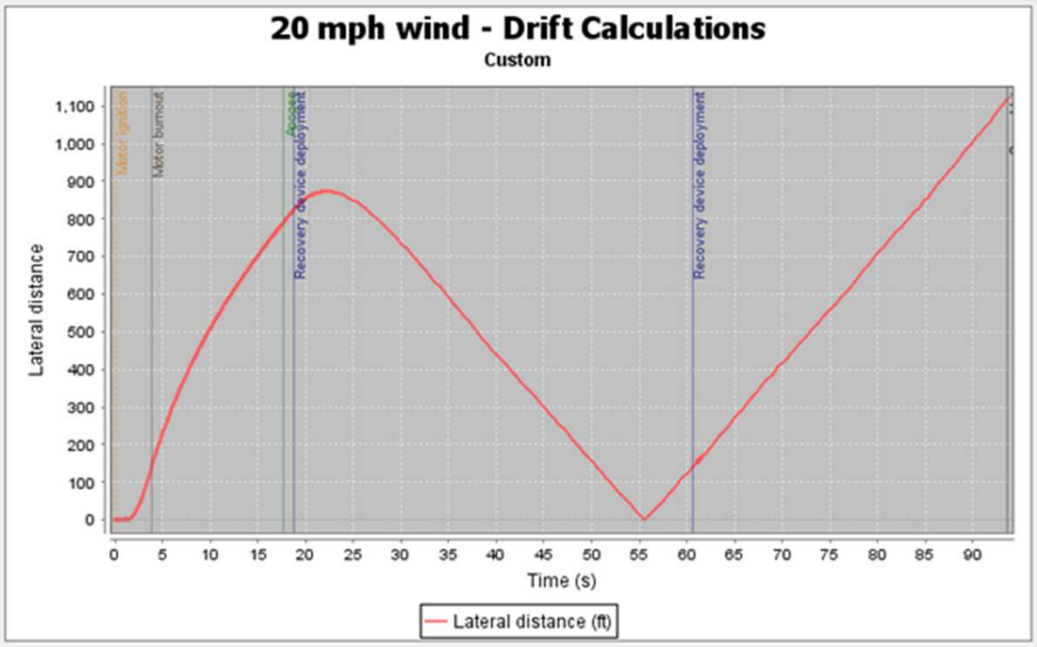


# Recovery Subsystem (Cont.)



- TeleGPS Tracker unit
  - *434.55 MHz Ham Band*
  - *Interfaces with ground station to output altitude, velocity, and GPS location*
- Kinetic Energy at Impact
  - *Energy: 41.44 ft-lbf*
  - *Maximum permissible Energy is 75 ft-lbf*
- Nylon Rip Stop Shock Cords
- Nomex Fire Resistant Blankets
- 2 StratologgerCF altimeters

# Drift Distances

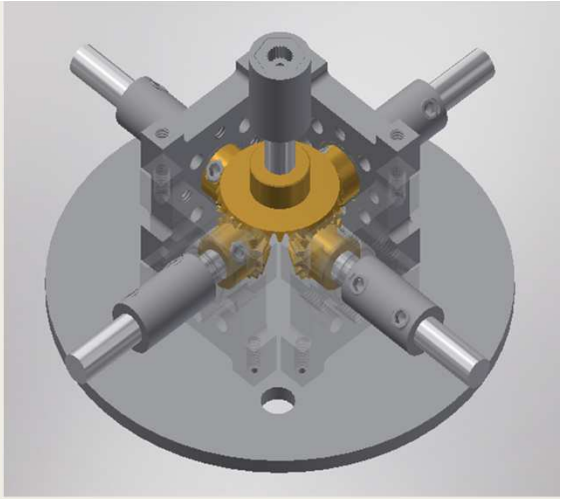


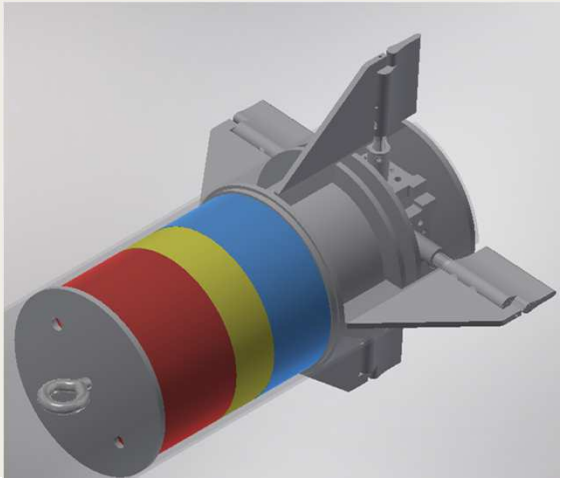

| Wind Speed (mph) | Drift Distance (ft.) |
|---|---|
| **0** | 6 |
| **5** | 80 |
| **10** | 300 |
| **15** | 600 |
| **20** | 1,150 |

# Payload Subsystem

- The payload will consist of an active surface controlling the roll of the rocket during flight.

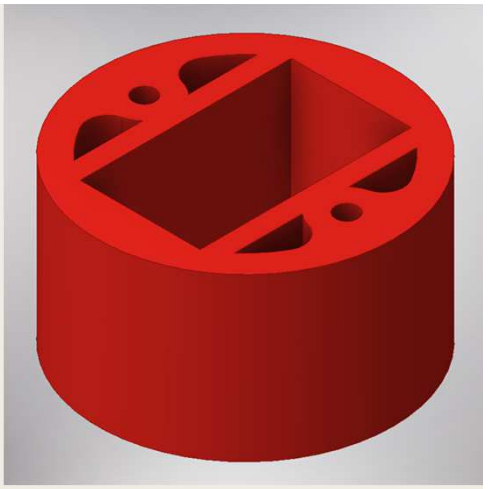
- Single Servo controlling a differential
  - All four control surfaces will move in sync
- Control surfaces will be connected via a rod system which will secure using set screws
  - Control surfaces are 3D printed with high strength ABS plastic
- Electronics
  - Reads and stores sensor data
  - Directs control loop
  - Includes 9DOF inertial measurement unit
    - Gyroscopes
    - Accelerometer
    - Magnetometer

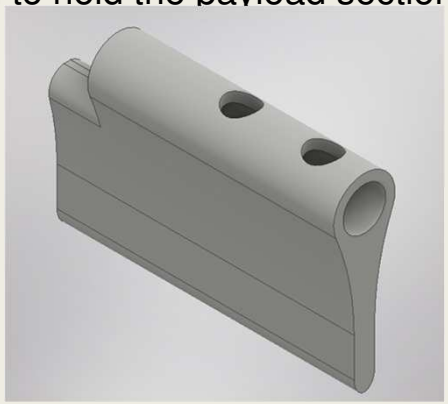


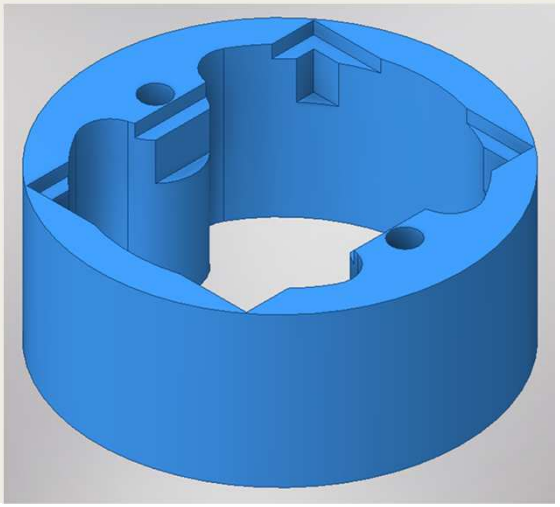


# Payload Integration

- Electronics bay sits above the motor mount
- Electronics will be held in place by a series of 3D printed parts
  - *The red section is used to hold the batteries*
  - *Blue and yellow will hold the PCB between them*
- The servo will be fixed to a fiberglass support mount
- A second fiberglass support mount will hold the eye bolt and one side of the threaded rods used to hold the payload section together

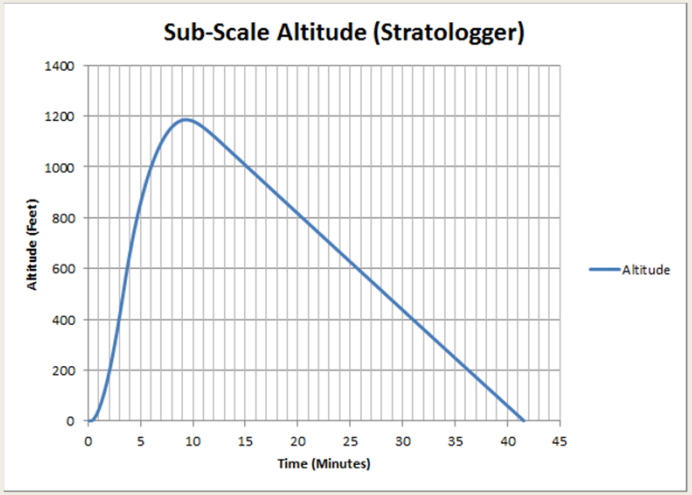


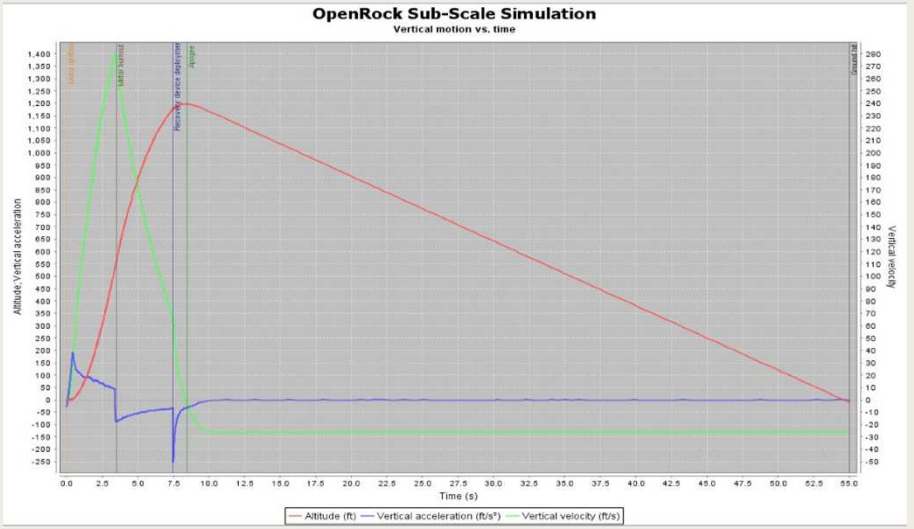




# Sub-Scale Model Flight

- The Sub-scale flight proved successful in proving the design of the rocket
- An altitude of 1164 feet was reached during launch (Using an F15-8 motor)
- The recorded altitude was able to be simulated in OpenRocket with near precision
  - *Adjusted simulation to match rocket (Weight, height, finish)*
  - *Adjusted launch variables (Temp, wind, barometric pressure, etc)*
- The Coefficient of drag needed to be adjusted to better compensate for the differences in altitude



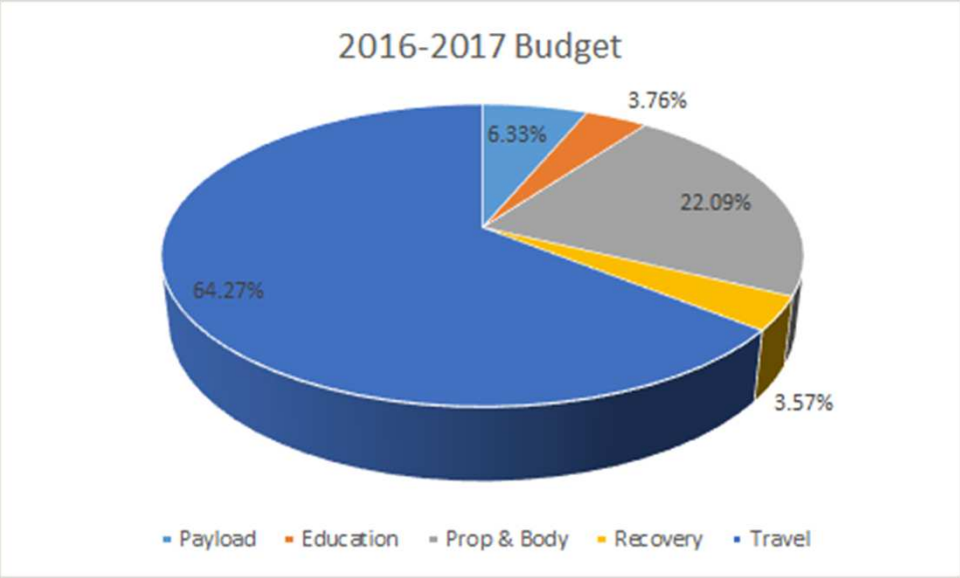



# Educational Engagement

- Clay High School
  - *Presentation and Rocket Launch*

- Future Plans:
  - *E-Week (Engineering Week) on campus*
  - *UTEC Easter Egg Hunt*
  - *Present to St. Bernard Junior High Students*

# Budget




| 2016-2017 Funding Plan | | |
|---|---|---|
| **Source** | **Amount** | **Status** |
| 2015-2016 Excess | $ 2,658.31 | Acquired |
| Marathon | $ 2,000.00 | Acquired |
| DTE Energy | $ 250.00 | Awaiting |
| Rotary Club | $ 500.00 | Awaiting |
| UT MIME Department | $ 1,500.00 | Acquired |
| | | |
| Total | $ 6,908.31 | |

# Future Work

- Continue construction of full scale rocket
- Conduct full scale test launch
- Gain extra sources of funding
- Continue testing of payload
- Continue testing of rocket body
- Begin work on Flight Readiness Review
- Continue educational outreach

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Questions?