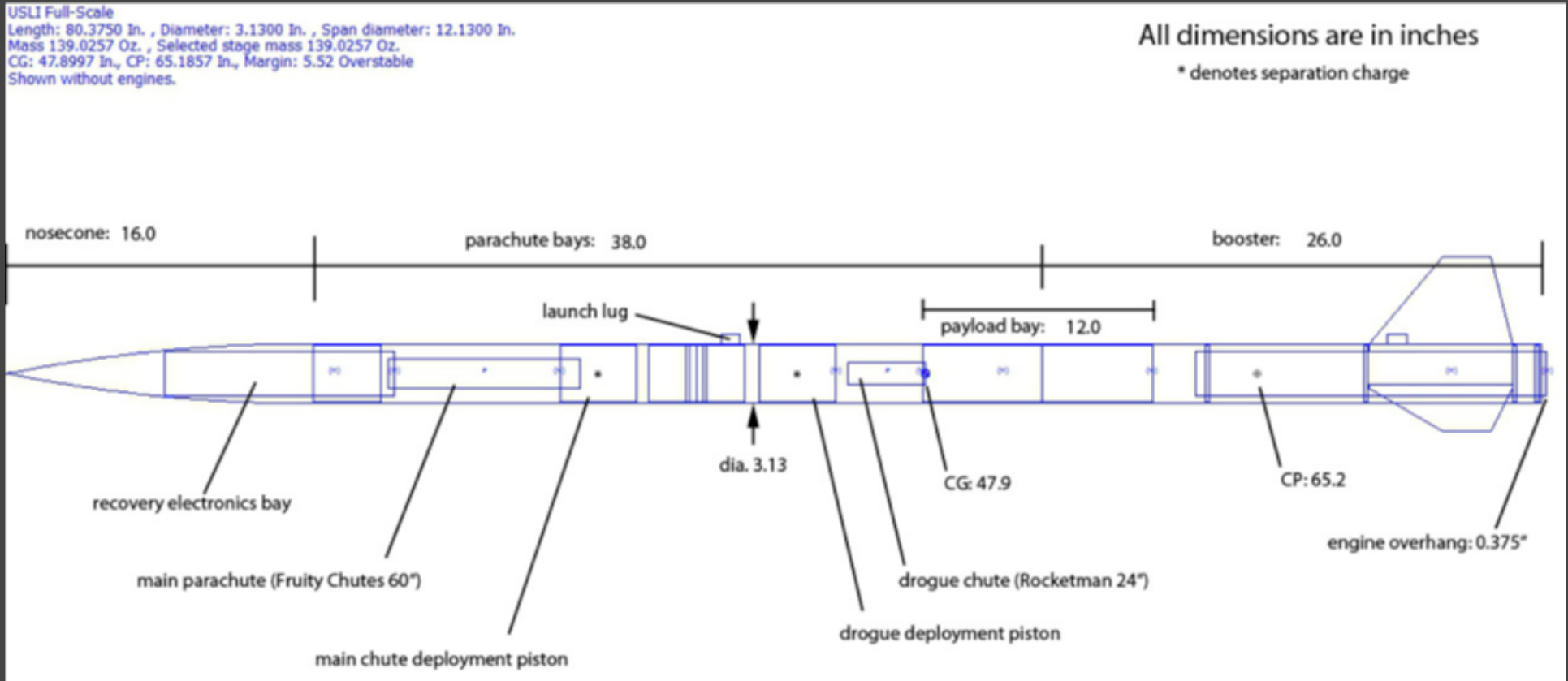


Harvey Mudd College USLI  
PDR Presentation

# The Launch Vehicle

# Vehicle Summary:



## Materials:

- Main Body - 3" Phenolic tubing with ultra-lightweight kevlar and indus cloth
- Fins - 1/16" G10 fiberglass with carbon-fiber-reinforced structural fillets, and carbon fiber laminations across adjacent fins
- Pistons - Blue Tube
- Payload - industrial-grade G12 Filament-Wound fiberglass
- Nose Cone - lightweight fiberglass
- Critical Bulkheads - 2024-T6 Aluminum

# Performance Predictions

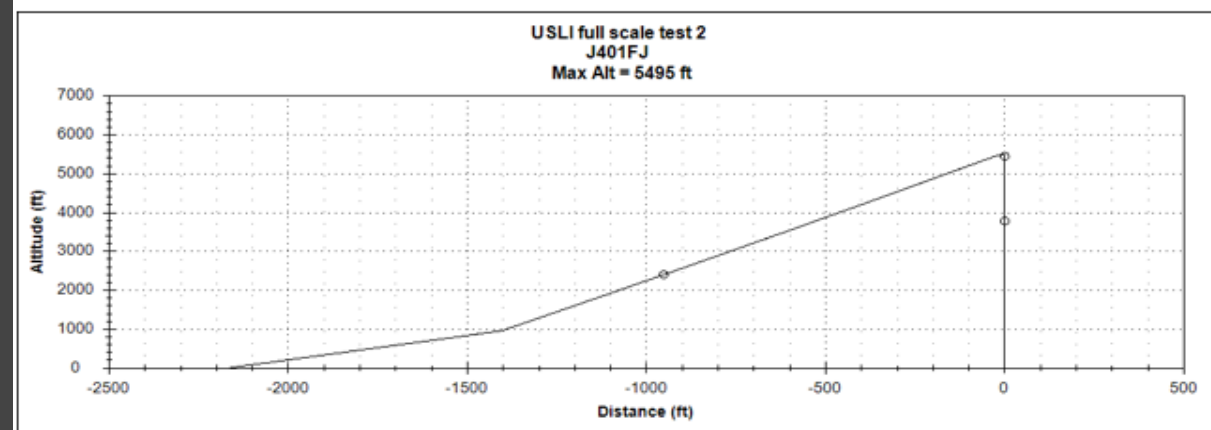
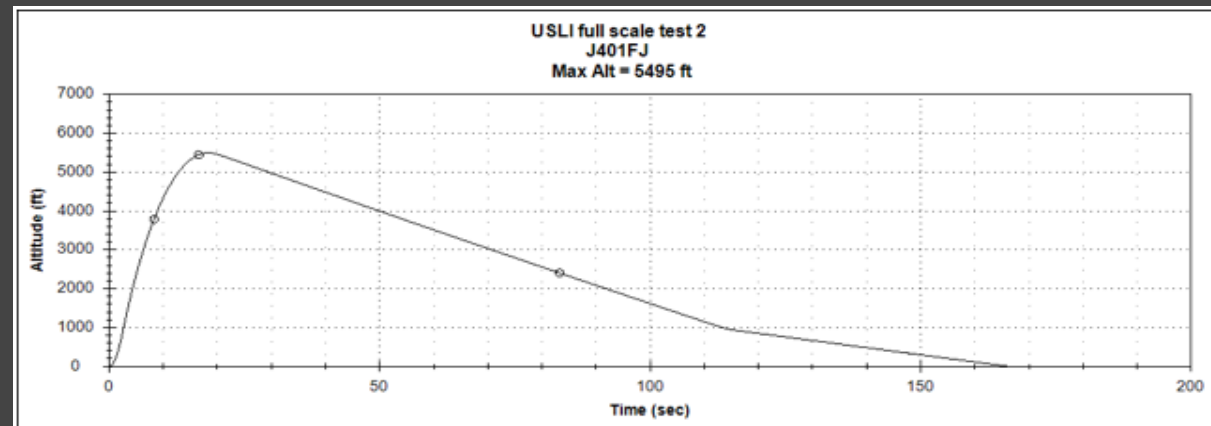
RASAero Predictions for Different Wind Speeds:

Wind Speed (mph)	Drift (ft) (launch angle = 0)	Launch Angle/Drift (ft)
0	0.024	---
5	1019	---
10	2037	---
15	3058	5 deg/ 1862 ft
20	4078	8 deg/ 2141 ft

Using the Aerotech J401 motor, RockSim projects an altitude of ~5630'.

RASAero Predictions:

(altitude vs. time),  
(altitude vs. distance)



# Motor Justification

- Motor Selection: Aerotech J401
- Expected Apogee: 5356 ft
  
- Thrust-to-Weight Ratio: 10.1
- Rail Exit Velocity: 46 ft/s
  
- Smallest possible to reduce cost
- 3" tube, 54mm motor mount

# Static Stability Margin

- Center of Gravity: 47.9" from tip unloaded
- Center of Pressure: 65.2" from tip
- Static Stability Margin: 5.52 caliber overstable

# Launch Vehicle Verification and Test Plan Overview

Subscale Ejection Tests: Completed November 5th, 2011

1. First Test - incomplete ejection, not enough black powder
2. Second Test - successful ejection

Subscale Launch - Completed November 12th, 2011

1. First Launch - Moderate success, early main deployment
2. Second Launch - Moderate success, dual deployment success but shock cord damaged

Full Scale Ejection Tests - Scheduled for February 3rd, 2012

Full Scale Launch - Scheduled for February 11th, 2012

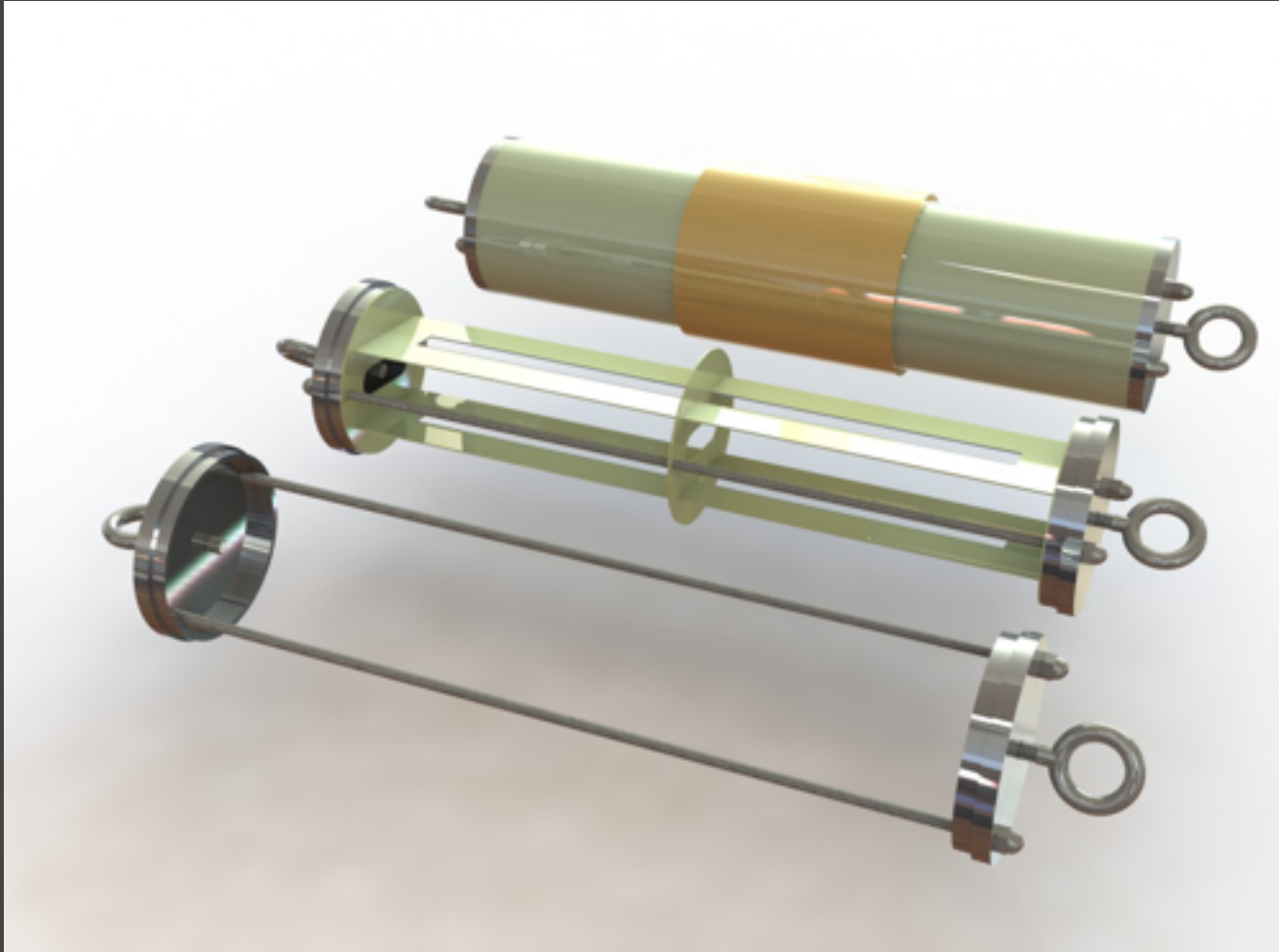
# The Recovery System



# Recovery System Summary

- Featherweight Electronics Raven2 altimeters
  - Independent power supplies with shared parallel outputs
- Accelerometer-based apogee deployment
- Barometric-based main deployment at 1000 feet
- Piston Deployment System for Drogue and Main
  - Tubular Nylon outside of pistons
  - Nomex-shielded Tubular Kevlar inside pistons
- Pre-manufactured medium-current Ejection Canisters
  - All wiring connections made in screw-terminals on pistons
- Drogue: 24" Rocketman
- Main: 60" Fruity Chutes (elliptical)

# The Payload

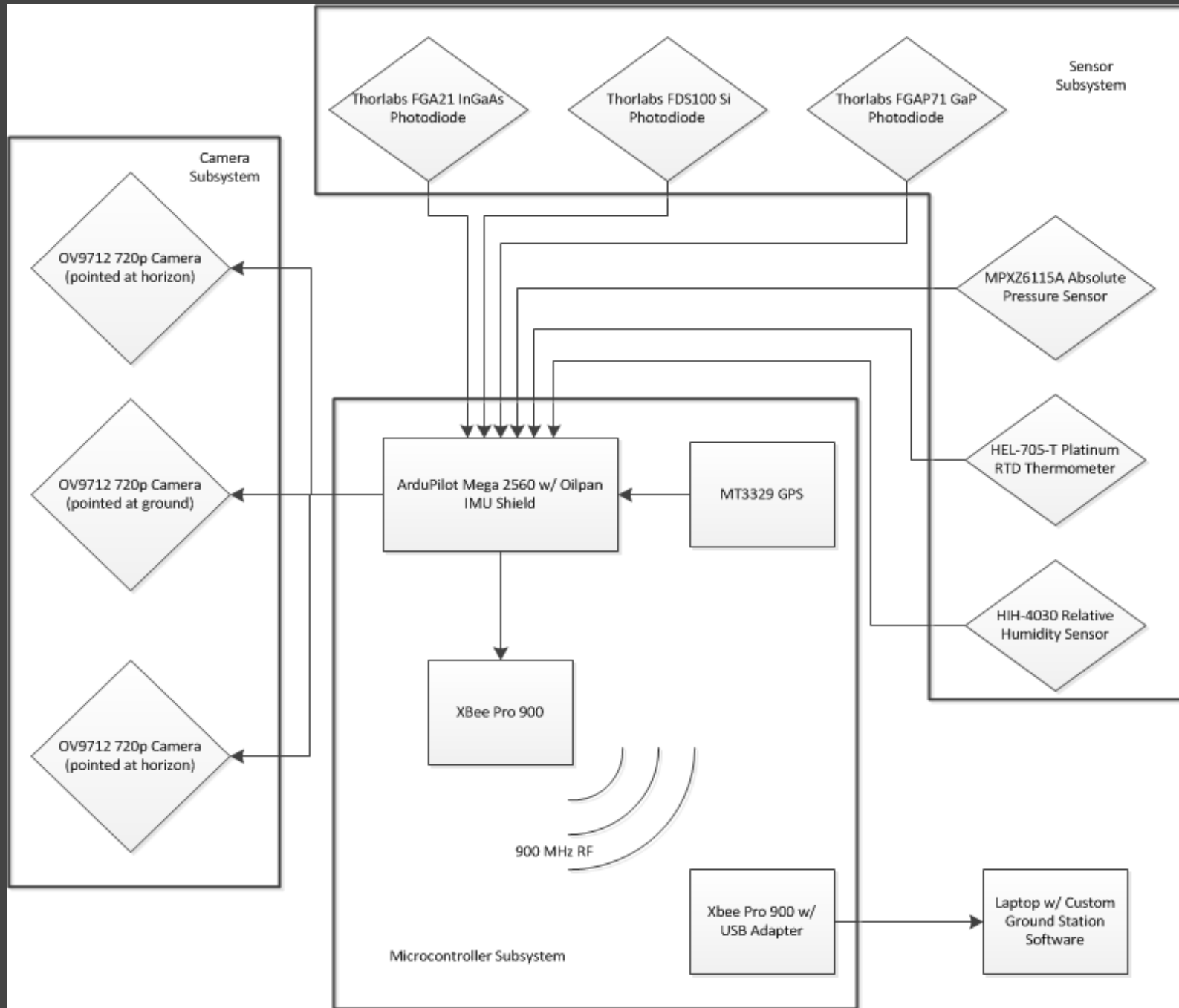


# Payload Summary

## SMD Payload:

- Primary Electronics
  - ArduPilot Mega
  - ArduPilot Mega IMU Shield
  - XBee Pro 900
  - MediaTek MT3329 10Hz GPS
  - 3x OmniVision 720p HD Cameras
- Sensor Package
  - Honeywell HEL-705-T Platinum RTD Thermometer
  - Freescale MPXZ6115A Absolute Pressure Sensor
  - Thorlabs FGAP71 GaP Photodiode
  - Thorlabs FDS100 Si Photodiode
  - Thorlabs FGA21 InGaAs Photodiode
  - Honeywell HIH-4030 Relative Humidity Sensor

# Payload Dataflow



# Payload Verification and Test Plan

## Overview

- Sensors will be calibrated in labs
  - A suite of calibration metrics will ensure that each sensor returns appropriate understandable values
- Sensors will be tested individually in the lab
  - Individual tests will ensure that each component functions before completing the payload system
- Sensor system will be tested in lab as a whole
  - A whole system test will ensure that the microprocessor can handle all of the sensor input
- Payload transmission will be tested at ground level
  - Transmission range will be tested to ensure connectivity during flight
- Payload will be tested during a full test flight
  - A full test will verify that our payload is fully operational

Safety

# Vehicle Safety Verification and Testing

- During assembly we will ensure that our rocket components comply with NAR high powered safety code
- We will perform ground tests to ensure all components function safely before flights.
- We will conduct all flights in accordance with state, local, and NAR/Tripoli rules.

# Launch Operation Procedures

## Launch System and Platform:

- Aluminum tripod base - 3 ft spread
- Rail: 3 ft length of 8020 extruded aluminum bar

## Final Assembly and Launch Procedures:

1. Prep Motor and load black powder charges
2. Tape igniter to motor case
3. Pack pistons and parachutes
4. Carry motor and rocket to RSO/LCO station
5. Place rocket on launch rail
6. Load motor and igniter (leads shorted)
7. Arm SMD payload microcontroller
8. Arm deployment electronics
9. Reassemble rocket and secure upright
10. Connect Igniter