CRITICAL DESIGN REVIEW

NASA SLI 2017-2018

UND Frozen Fury Rocketry Team

What will be covered

- Final launch vehicle & payload specs.
- Final motor choice
- Rocket flight stability, thrust-to-weight ratio and rail exit velocity
- Mass statement and mass margin
- Recovery subsystem components (parachute size, recovery harness, etc.)
- Drift simulations
- Test plans
- Scale flight data
- Tests of the staged recovery system
- Final payload design overview/payload integration
- Status of requirements verification

Launch Vehicle Dimensions

Mass of Launch Vehicle (Unloaded)	**24.44 lbs.**
Mass of Launch Vehicle (Loaded)	32.94 lbs
Length of Launch Vehicle	107 in.
Diameter of Launch Vehicle	6 in.
Center of Pressure (CP)	77.61 in. from nose cone
Center of Gravity (CG)	64.70 in. from nose cone
Stability Margin	2.15 cal
Mass of Rover Payload Bay (w/ Rover)	7 lbs
Mass of Rover	4 lbs
Apogee	5566 ft
Max. Velocity	673 ft/s
Max. Acceleration	
Time to Apogee	18.4 seconds (s)
Velocity at Deployment	64.6 ft/s
Altitude of Deployment of Drogue	5566 ft. (Apogee)
Altitude of Deployment of Main Parachute	1000 ft.
Ground Impact Velocity	20.2 ft/s

Payload Dimensions

Height (in)	1.91
Length (in)	8
Width (in)	5.4
Mass of Rover (lbs)	4
Mass of Deployment System (lbs)	3

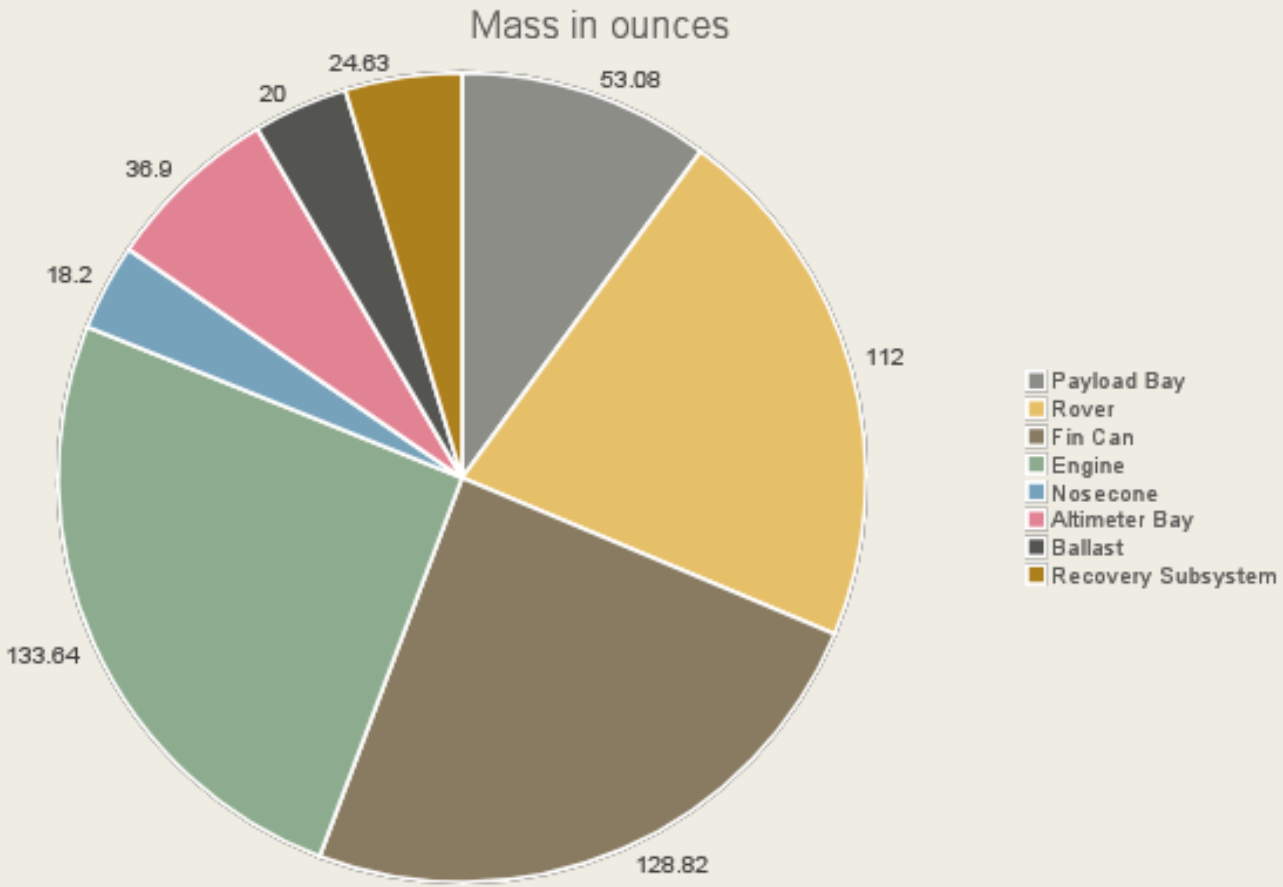
Final Motor Choice

Manufacturer	AeroTech
Entered	May 25, 2006
Last Update	Jul 22, 2015
Mfr. Designation	L1150R
Common Name	L1150
Motor Type	Reloadable
Delays	P
Diameter	2.95 in.
Length	20.9 in
Total Mass	130 ounces (oz.)
Empty Mass	56.7 oz.
Average Thrust	1148 N
Total Impulse	3489 Ns
Max. Thrust	1310 N
Burn Time	3.1 s

Rocket Stability/Thrust-to-weight ratio/Rail Exit Velocity

- Rail exit velocity: 78.6 ft/s
- Thrust-to-weight ratio: 7.84
- Stability: 2.15

Mass statement and mass margin

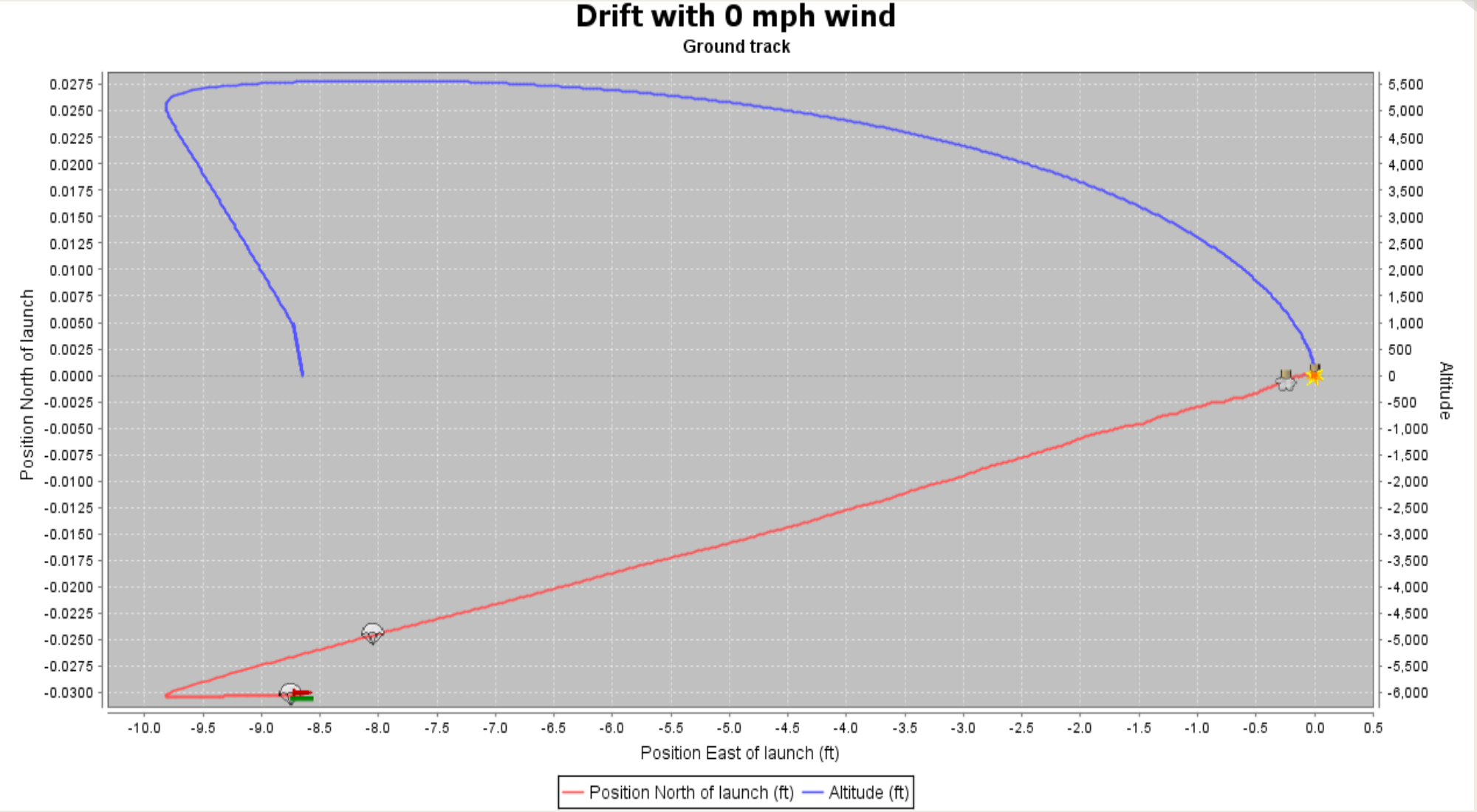


Section	Mass in ounces
Payload Bay	53.08
Rover	112
Fin Can	128.82
Engine	133.64
Nosecone	18.2
Altimeter Bay	36.9
Ballast	20
Recovery Subsystem	24.63

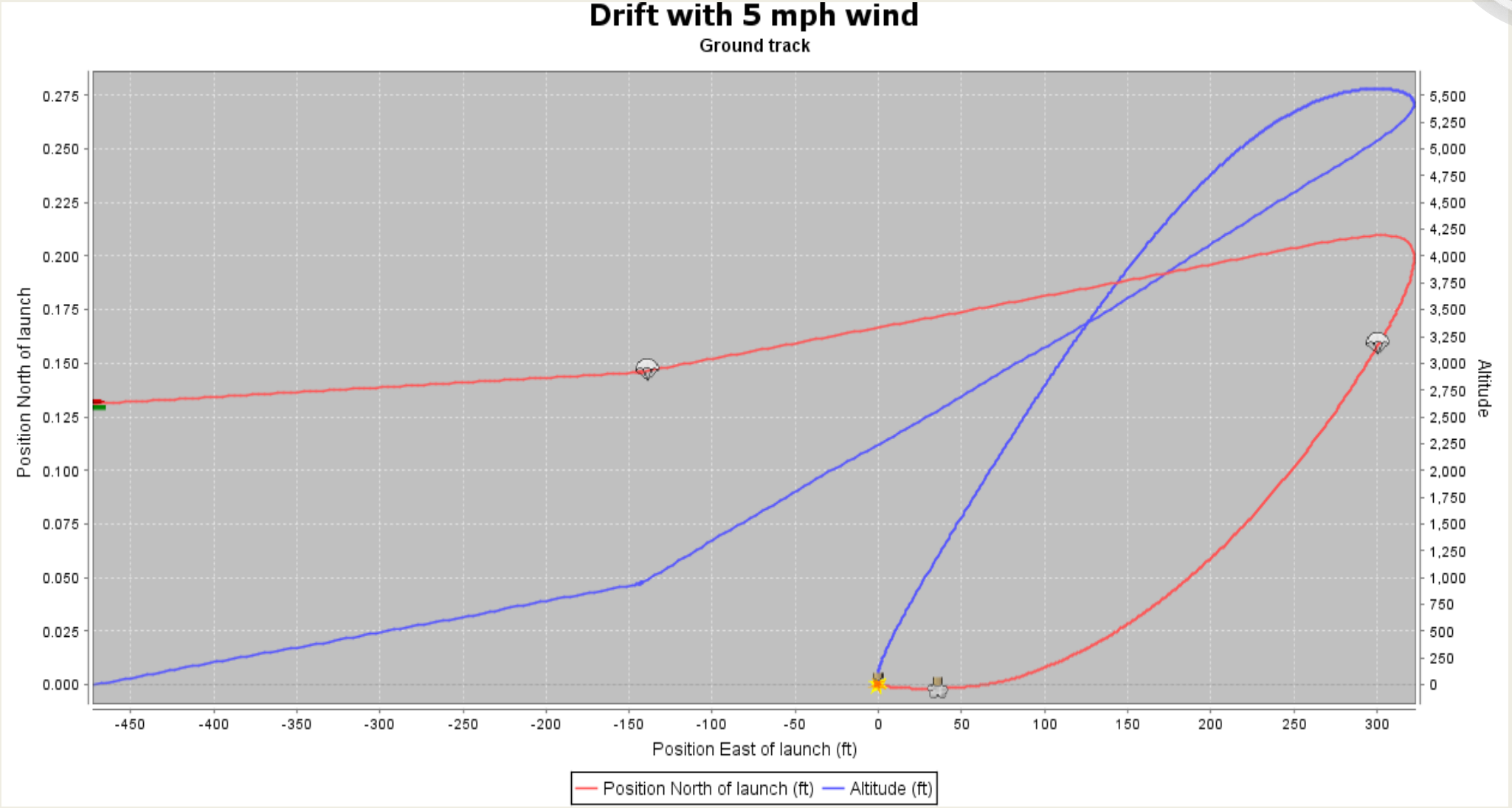
Drift Simulations

- 5 separate drift simulations
  - *0 miles per hour (mph) drift ~ 10 feet (ft)*
  - *5 mph drift ~ 450 ft*
  - *10 mph drift ~ 1000 ft*
  - *15 mph drift ~ 1400ft*
  - *20 mph drift ~ 2000ft*

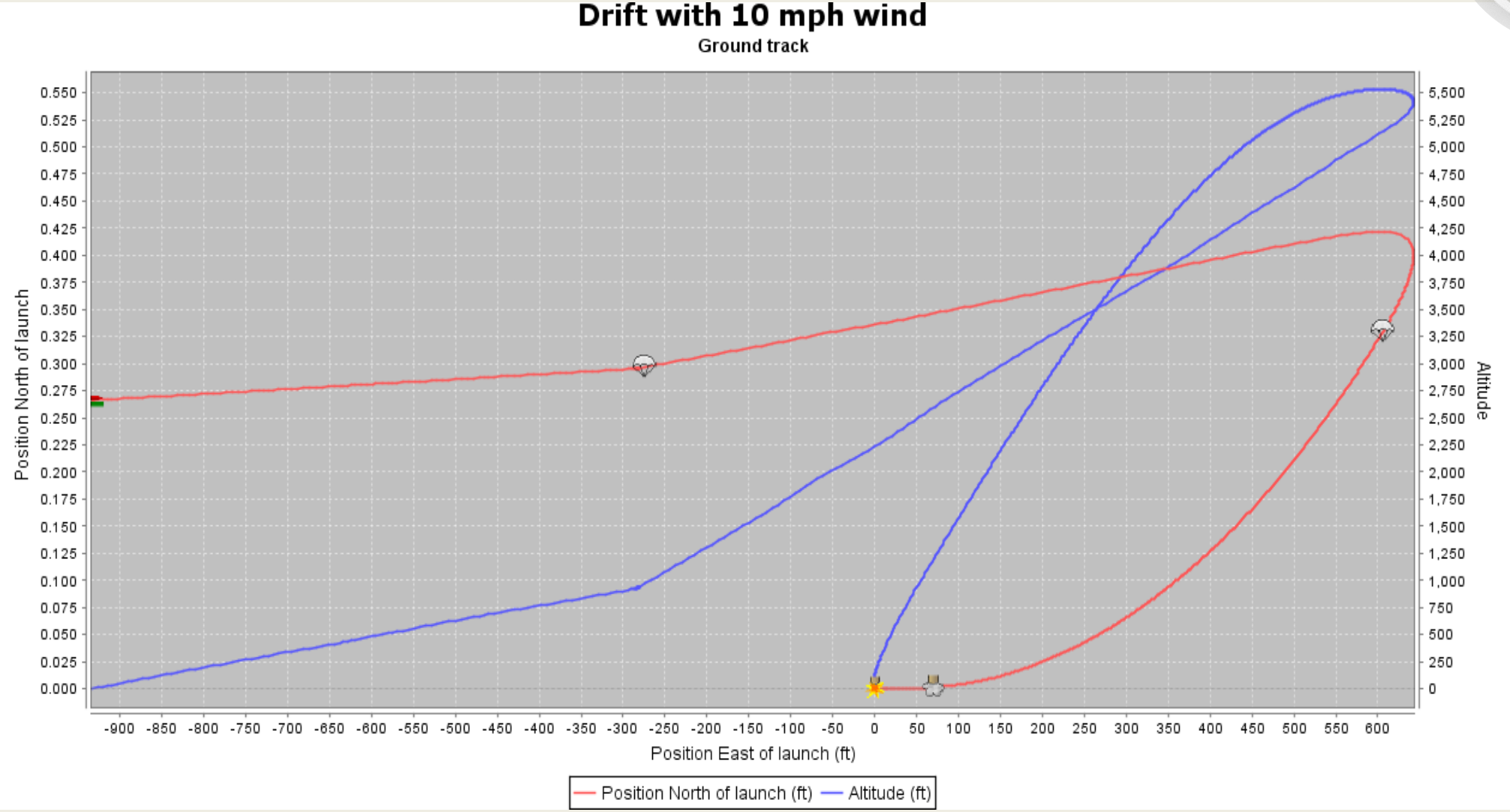
Drift with 0-mph wind



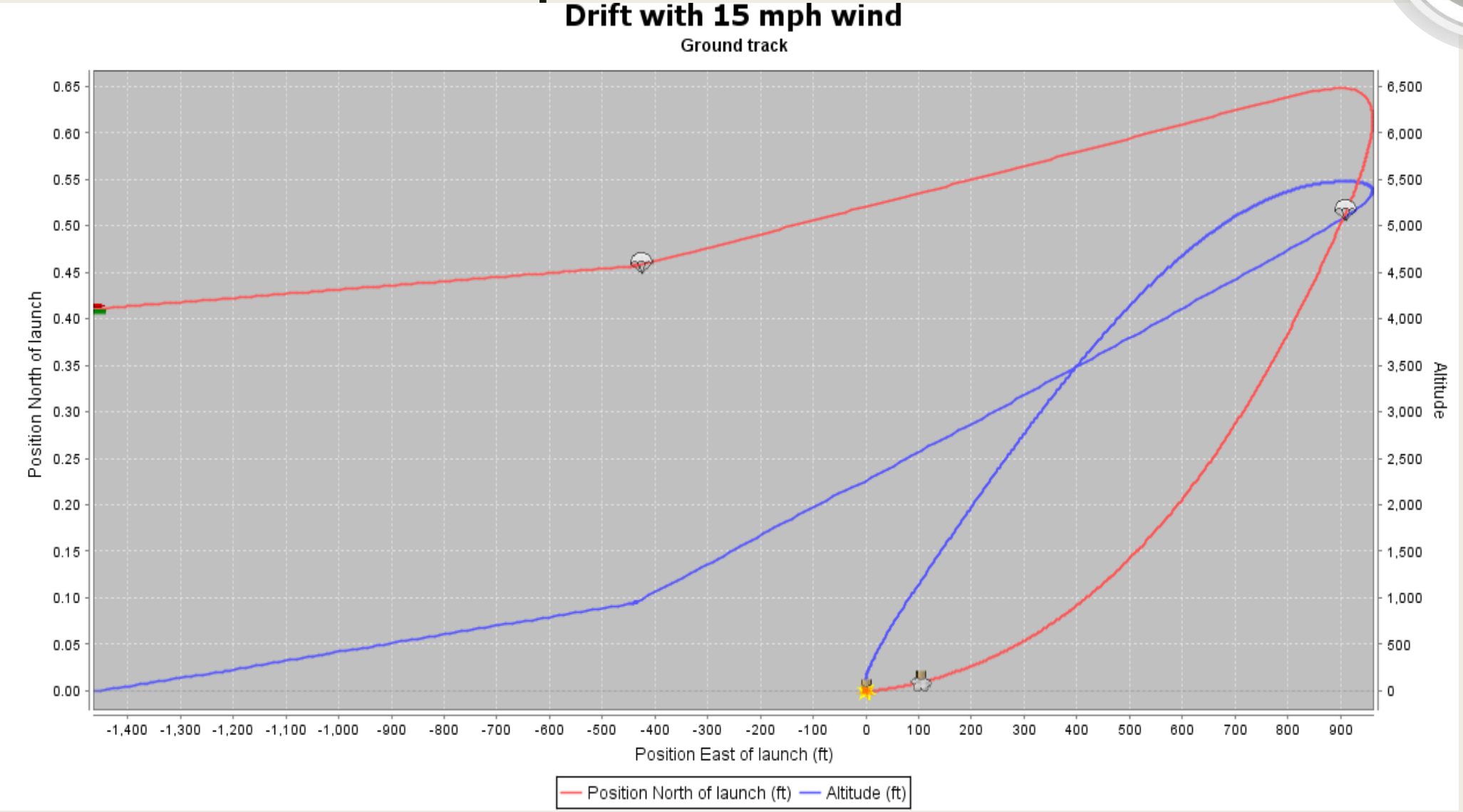
Drift with 5-mph wind



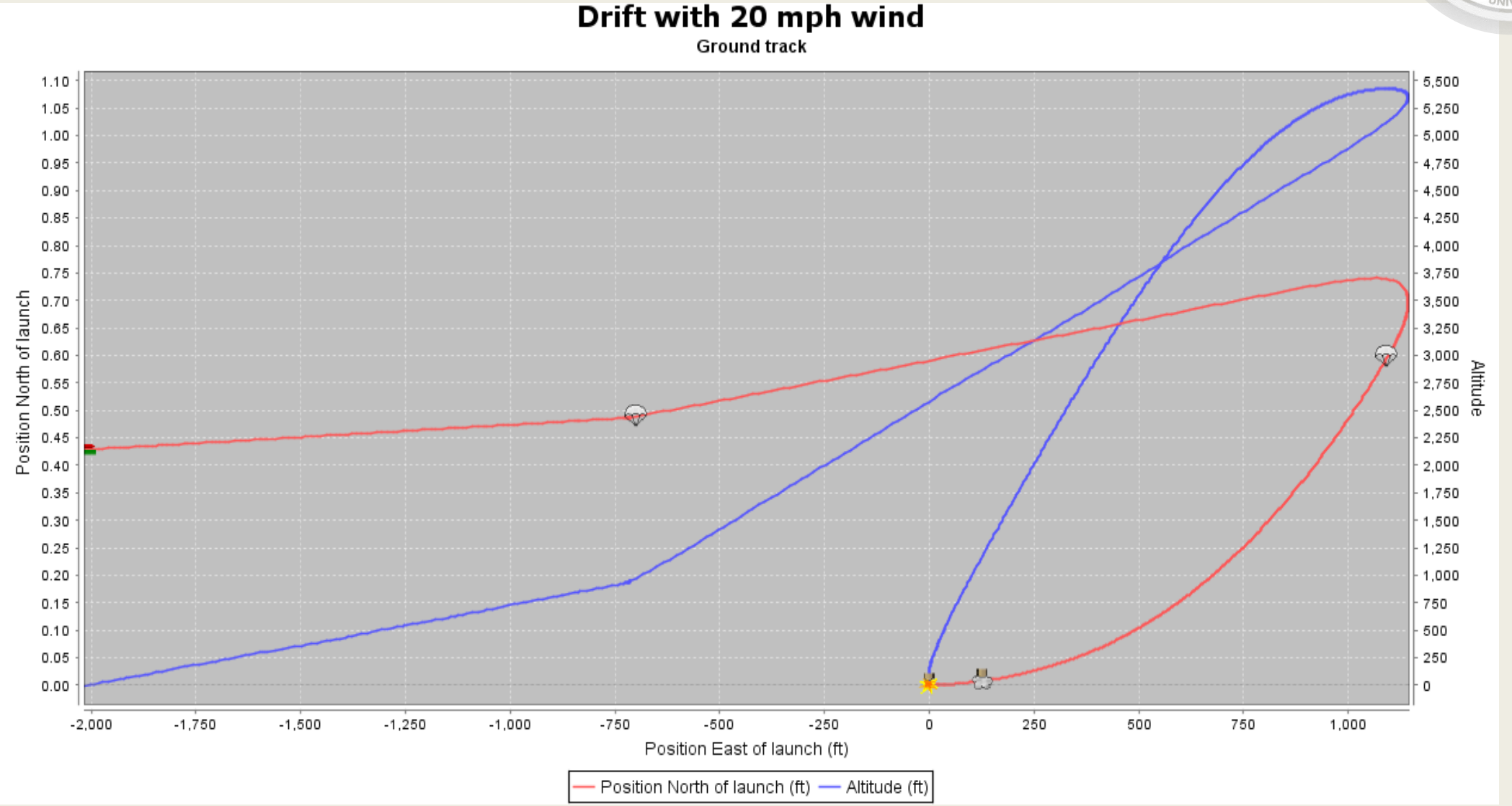
Drift with 10-mph wind



Drift with 15-mph wind

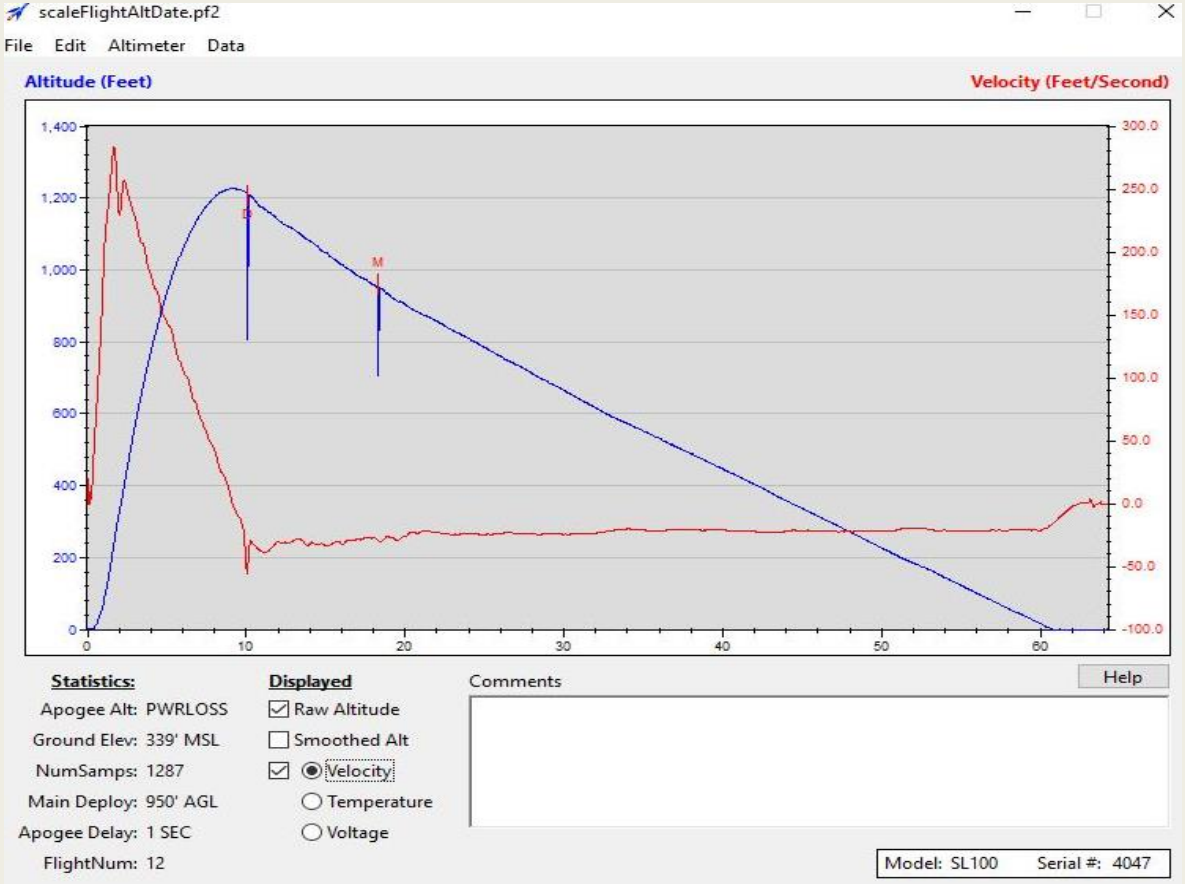


Drift with 20-mph wind



Scale Flight Data – Altimeter Flight Data

- Apogee of scale ~ 1250 feet AGL
- Successful deployment of recovery subsystems

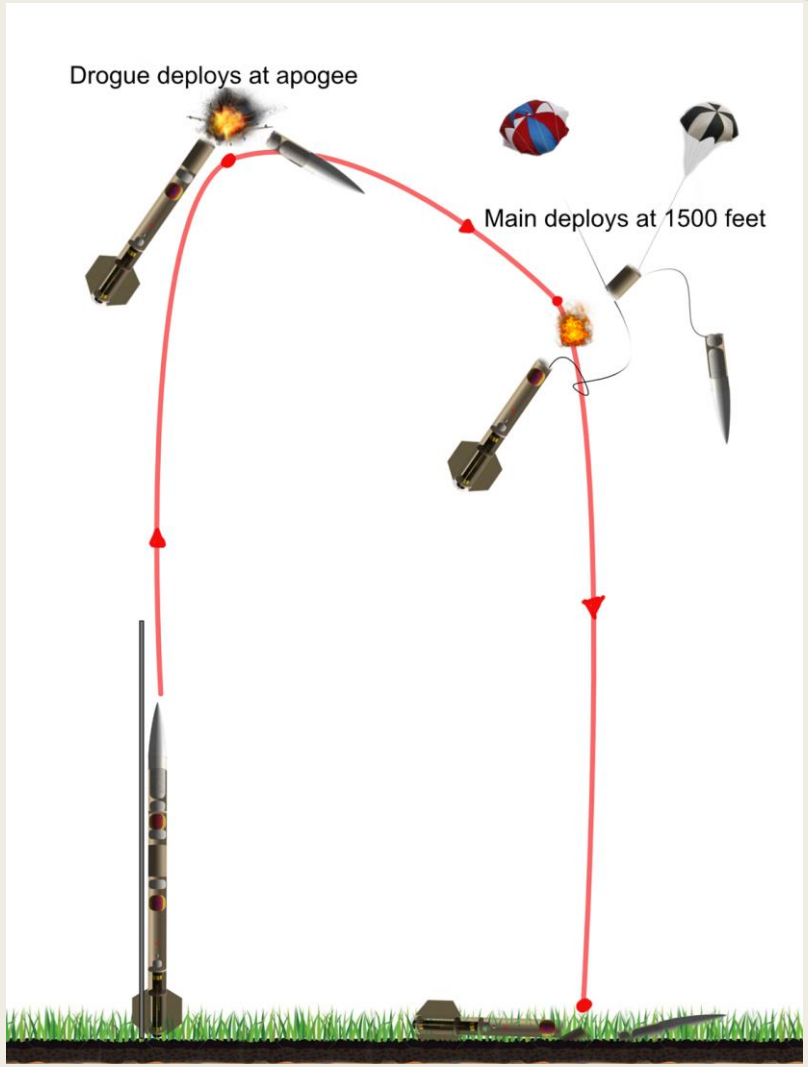


Test Plans & Procedures

- On schedule
- Remaining tasks to be completed:
  - *Building and testing of experimental payload*
  - *Ground test of recovery subsystem*
  - *Building full-scale launch vehicle*
  - *Full-scale test launch*

Recovery subsystem testing

- Still in progress, awaiting parts for fabrication



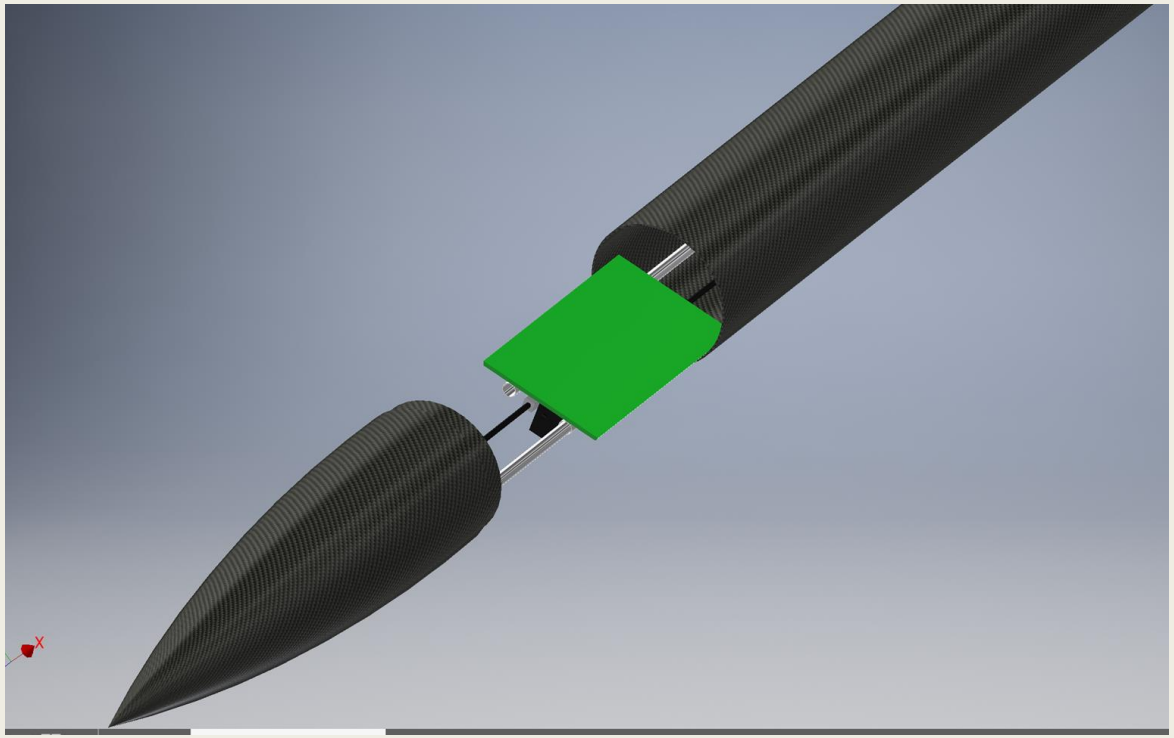
Final payload design overview

- For this year's experiment the UND Frozen Fury team selected the deployable rover challenge.

- Objectives:
  - *Deploy from internals of launch vehicle*
  - *Drive five feet and deploy solar panels*
  - *Must be fully autonomous except to initiate deployment*

Payload integration

- Has two subcomponents
  - *Rover Deployment System*
  - *Rover System*



Rover Deployment System Integration

Deployment system

- The deployment system has three functions.

- The first function is to hold the rover stable during the duration of the rocket's flight.

- Function two of the deployment system is to orientate the rover in the correct position for extraction.

- Function three of the deployment system is to extract the rover from the rocket.

- The rover will be sitting on the deployment plate when it is extracted from the rocket.

Rover Deployment System Integration cont.

- Will be integrated just below nose cone
- Will be within the air frame
- Deployment system will be attached to bulkhead

Rover Integration

Rover - Main functions

1. Deploy from the internal airframe

1. Autonomously drive five 5

1. Deploy solar panels

Rover Integration

- Will be placed on plate on the rover deployment system
- Will not protrude the the exterior of the air frame
- Foam pellets will fill the area around the rover to prevent movement in flight

Status of requirements verification

- General Requirements: 14/17 completed
- Vehicle Requirements: 30/45 completed
- Recovery System Requirements: 10/17 completed
- Experiment Requirements: 4/7 completed
- Safety Requirements: 7/17 completed
- Team Derived Requirements: 1/15 completed

Thank you

Questions/Concerns