# Project Hermes

## 2023 NASA Student Launch Initiative
## Flight Readiness Review Addendum

## Vehicle Demonstration Re-Flight

**ResistoJets Rocketry 4-H Club of Morris County**

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# 1. Summary of FRR Addendum

## 1.1 Team Summary

Name of team and mailing address:
ResistoJets Rocketry 4-H
[redacted]

Mentor: Luke McConoughey
[redacted]

Our team has spent 90 hours working on the FRR Addendum.

## 1.2 Purpose of Flight

Our team is completing a Vehicle Demonstration Reflight to resolve recovery issues in our previous flights.

## 1.3 Changes Made since FRR

The original Spherachutes 24” (15.28” diameter) drogue was replaced with a Spherachutes 36” (22.92” diameter) parachute.

We built a new fin can to serve as a backup to the original, which sustained damage on the last flight, but was repaired. The purpose of this was so that we could have up to two reflight attempts this window in case we had another recovery failure. This new fin can was approximately 100 grams (3.7%) lighter.

We also implemented changes to the checklists to prevent mistakes from occurring during parachute packing.

# Vehicle Demonstration Reflight

Pictured right: Launch of VDF Reflight


## Summary of Flight

On Friday, 3/31, our team carried out a VDF Reflight of our SLI rocket at MDRA. This was the third flight of the vehicle, intended to demonstrate a safe recovery after issues caused by an undersized drogue on the last flights. The original Spherachutes 24” (15.28” diameter) drogue was replaced with a Spherachutes 36” (22.92” diameter) parachute. Additionally, this flight flew a newly built fin can to prove its integrity to serve as a backup to our original fin can, which sustained damage on the last flight, but was repaired. This new fin can was approximately 100 grams (3.7%) lighter. Like the previous flight, this flight flew in the final configuration, with the complete payload hardware installed (but not intended to operate on this flight).

Winds at the time of launch were approximately 19 mph, with gusts exceeding 28 mph. Because of this, we had to angle our pad ~8 degrees upwind to ensure a safe recovery. This contributed to a lower apogee than in previous flights.

All aspects of the vehicle performed optimally and we demonstrated that the drogue parachute changes, however due to launch conditions our apogee was lower and descent time was higher than would be normally expected. We reached an apogee of 2951 ft, a descent time of 75 seconds, and a drift of about 1.8k ft. Our ground hit velocity was about 20 fps, in line with expectations.

## Preflight Info

| Request | Information |
|---|---|
| Identify whether the flight was conducted to fulfill the requirements for the Vehicle Demonstration Flight, Payload Demonstration, or Both. | Vehicle Demonstration reflight. |
| Date of Flight | 3/31/23 |
| Location of Flight | Maryland Delaware Rocketry Association Higgs Farm - Red Glare |
| Launch Conditions | 70*F, 20-30 MPH Wind, Overcast, low clouds, |
| Motor | Aerotech K1100T RMS |
| Ballast - sand bags in base of nose | 0.925 LB |
| Dry Weight | 17.4 LB |
| Wet Weight | 18.2 |
| Final payload flown? | Yes |
| Airbake flown? | N/A |
| Target Apogee | 3800 ft |
| Black powder charge sizes | Drogue Main: 1.5g \| Drogue Backup: 2g<br>Main Main: 4g \| Main Backup: 4.5g |
| Simulated apogee | 3500 ft |

Table 1: Vehicle Demonstration Flight

## Preflight Simulation

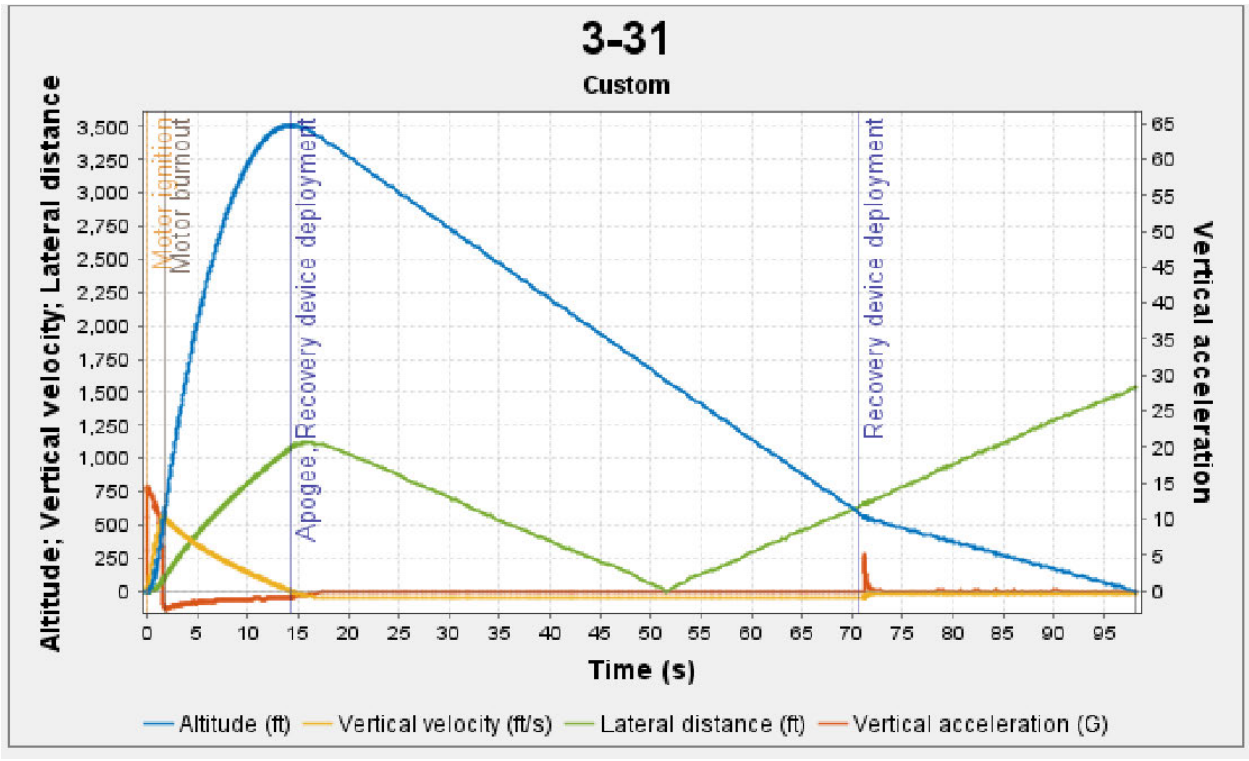


Figure 1. Preflight simulation

## Flight Information

| Request | Information |
|---|---|
| Measured Altitude: | 2951 ft |
| Total Flight time: | 88s |
| Descent time: | 75s |
| Drift: | 1865ft |
| Ground hit velocity: | 20fps |
| Landing kinetic energy (Sustainer, Payload, Nose) ft-lb: | Sustainer: 25.4 \| Payload/upper: 40.8\| Nose Cone: 14 |

## Flight Data

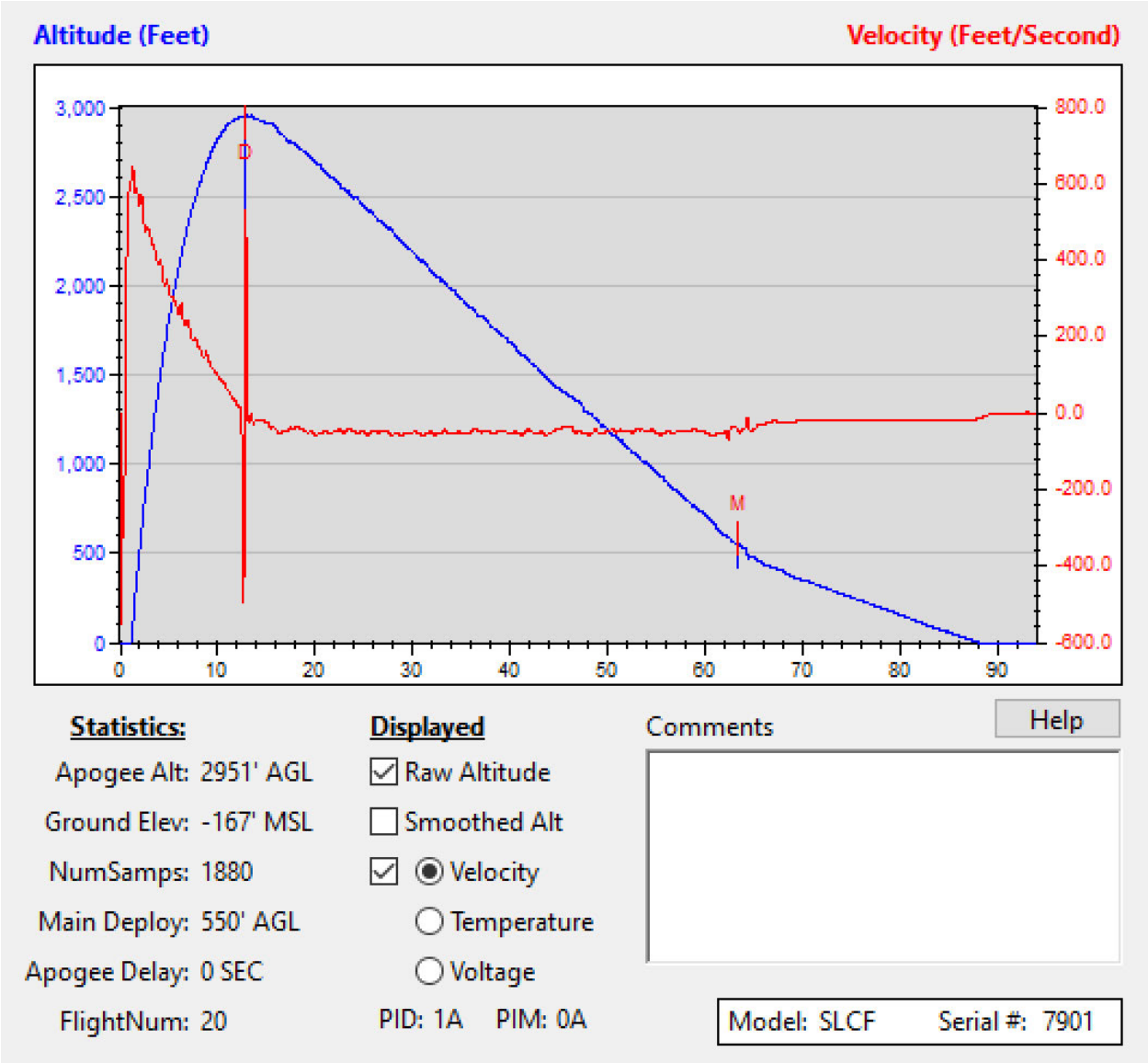


Figure 2. Data from primary Stratologger

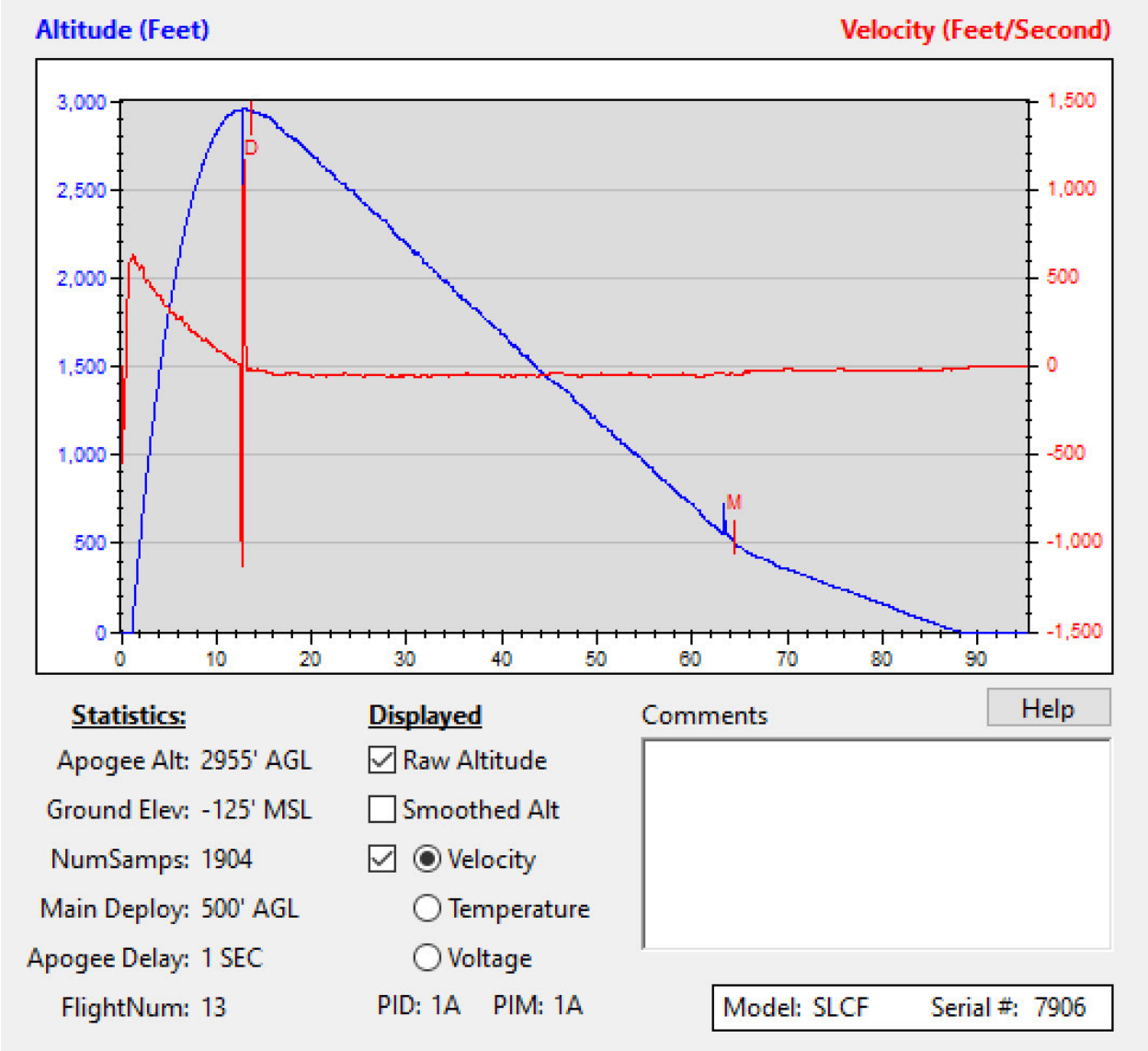


Figure 3. Data from backup Strattologger

## Post-Flight Simulation

Due to launch conditions, we are not able to estimate an accurate drag coefficient. This post-flight simulation was conducted using weather, pad angle information, and an unrealistic coefficient of drag to accurately recreate the flight.

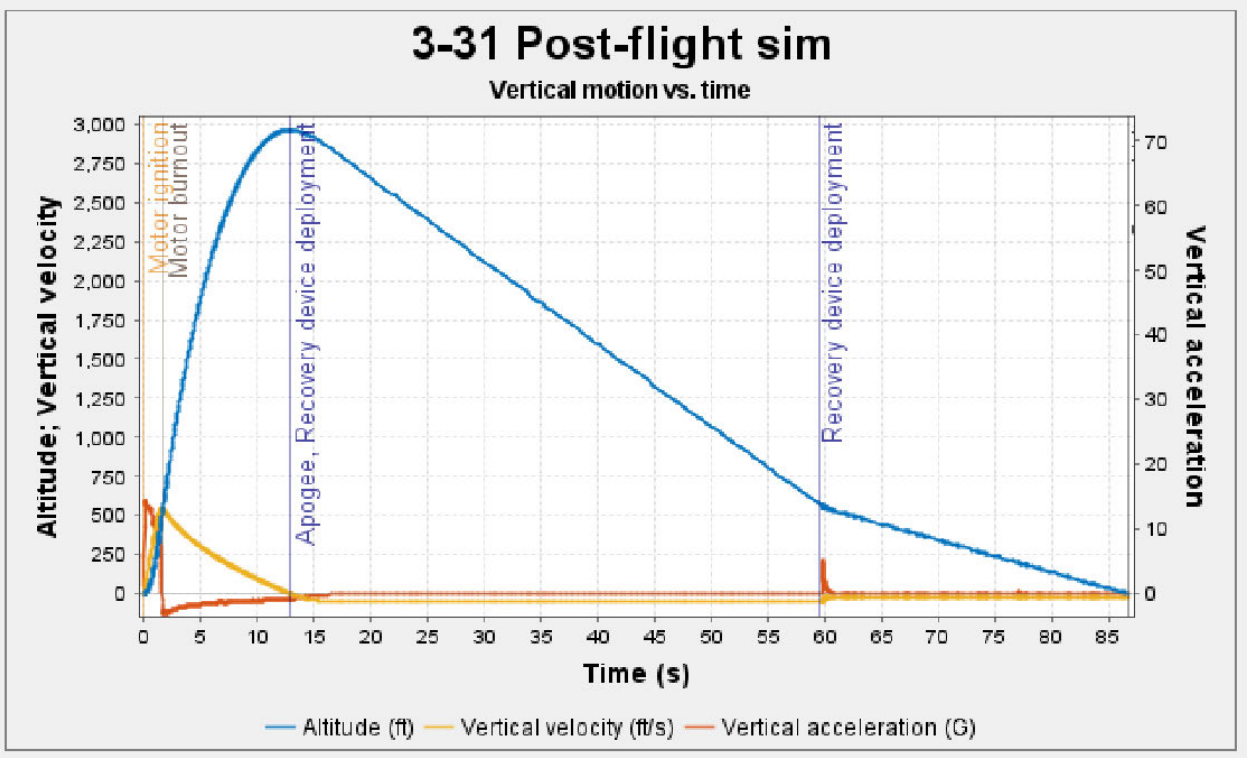


Figure 4. Post-flight simulation

## Images of landed configuration

Image 1. Complete landing configuration of vehicle

Image 2. Payload and upper airframe landing config

Image 3. Payload landed configuration

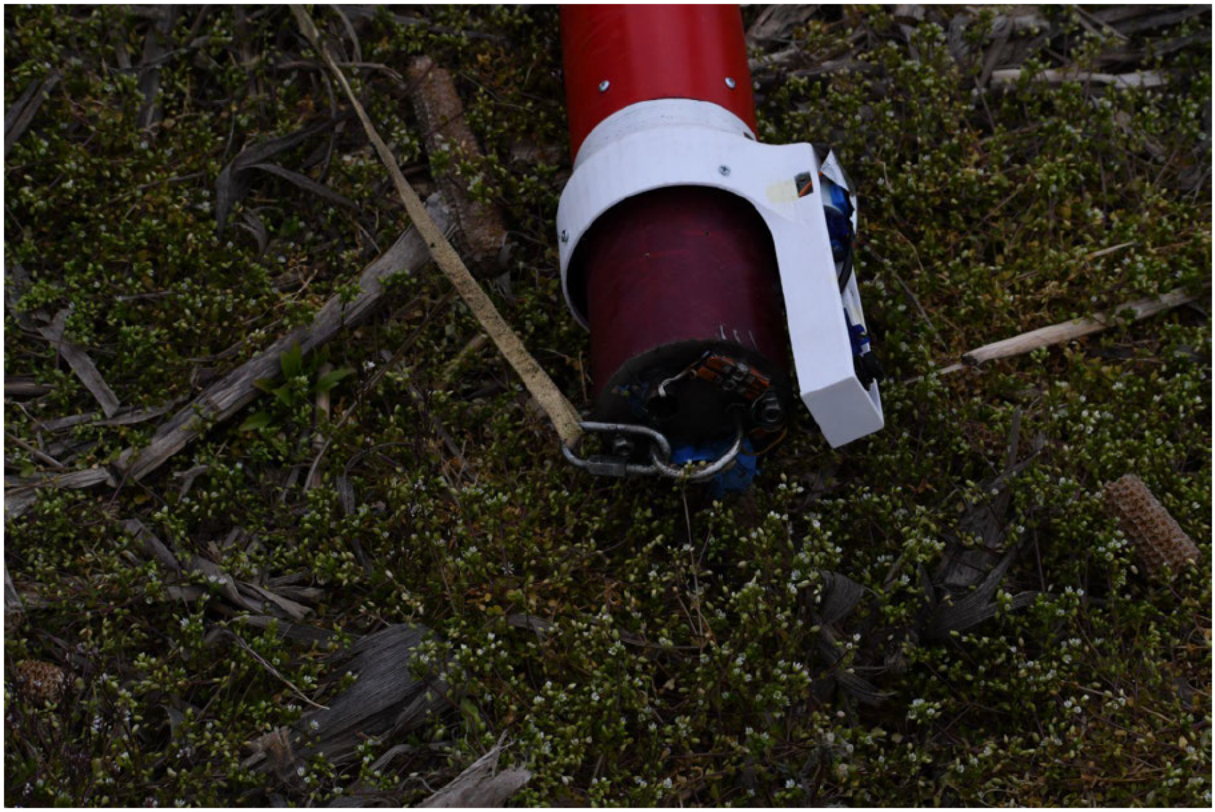

Image 4. Drogue parachute bulkhead

Image 5. Main Parachute landed

Image 6. Nose cone landed configuration

Image 7. Landing config of sustainer, with Runcam on the bottom

Image 8. Landing config of sustainer

Image 9. Drogue parachute landed configuration

## Additional images of flight

Image 10. Drogue parachute descent

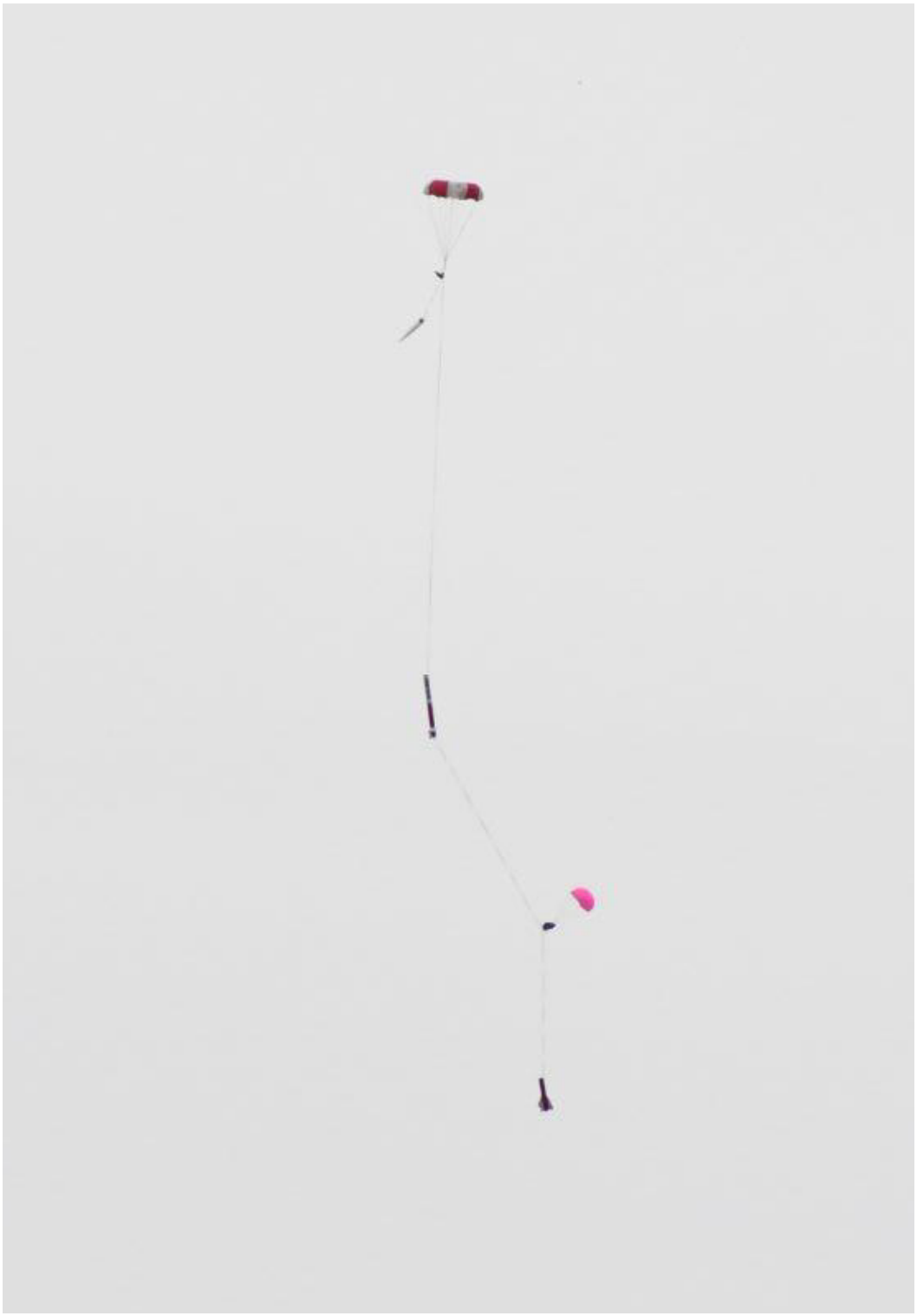

Image 11. Descent during main parachute phase

## Analysis of flight

In this flight, all systems functioned as intended. This includes, but is not limited to:

- The dual redundant Strattologger flight computers
- All four ejection charges
- The drogue parachute
- The Main Parachute
- The GPS Tracker
- Shear pins
- The avionics bay hardware
- The payload retention
- The extended rail buttons
- Runcam retention

There was no damage to the vehicle requiring repairs or further work before the next flight.

For future flights we will avoid launching in such adverse weather, however on flights like this it was necessary.