



Astronomy Club AY22 Balloon Launch



Nolan Pearce '22, N2WU

HDVN:LIVE

2000-2100 02 March 2022



Cadet Amateur Radio Club, W2KGY

- Oldest club on post – 1932 with W2JIG!
- Licenses 10-12 cadets per semester via Laurel
- Combines ham radio with military training
- *Impressive station!*

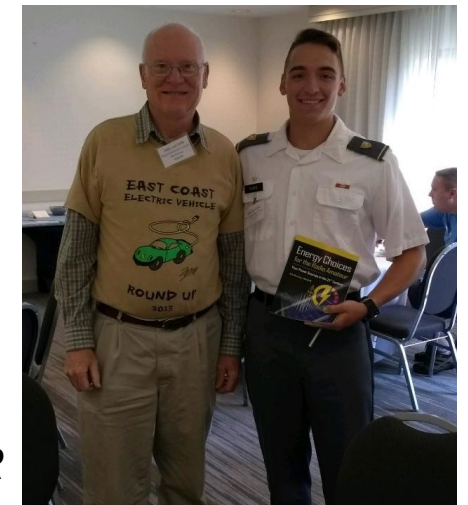
*W2KGY after ISS contact
w/ COL Drew Morgan KI5AAA*



CDT Nolan Pearce, (soon N2WU)

- Ham since 2018 (Cleveland, OH)
- Electrical Engineering Major, Space Science Minor at USMA
- Cadet-in-charge of Amateur Radio Club, Astronomy Club
- Active member on Triathlon team
- SOTA, CW, QRP Interests
- N2WU.com

Nolan N2WU with Bob WB4APR



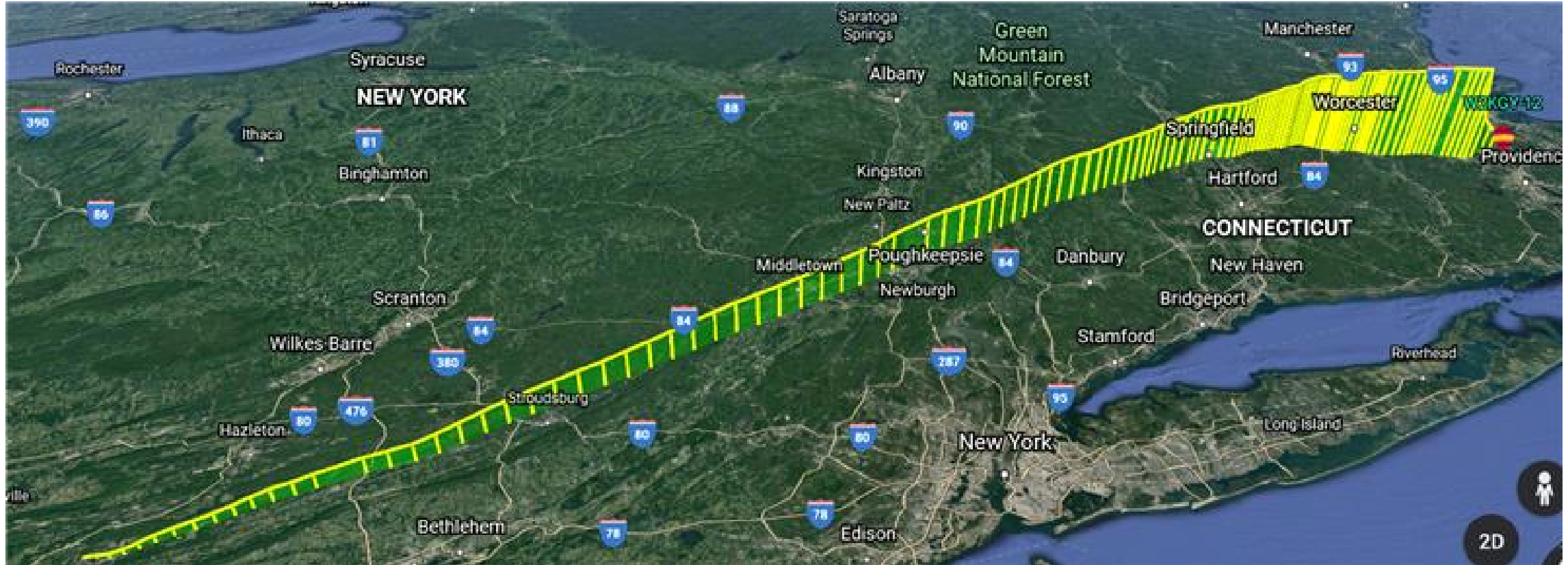


BLUF: The USMA Astronomy and Amateur Radio Club successfully designed, built, tested, and launched their 12th High-Altitude Balloon to train Cadets on mission planning and conduct high-altitude research.

- **WHO** – 14 Cadets and 4 Faculty of the Astronomy Club and Amateur Radio Club
 - 4 Cadets with licenses (through Laurel), 3 Faculty!
- **WHAT** – Designed, simulated, built, and launched a High-Altitude balloon with astronomy and radio-related research modules
- **WHEN** – 12 FEB 2022, launch at 0945 EST. Landing at 1300, recovery on 19FEB
- **WHERE** – Launch at Minersville High School in Minersville PA. Recovery in Sharon MA
- **WHY** – Conduct high-altitude experiments and teach cadets about mission planning required for space launch operations



- Google Earth launch data – max elevation of 104,000ft!



APRS Data into Google Earth KML

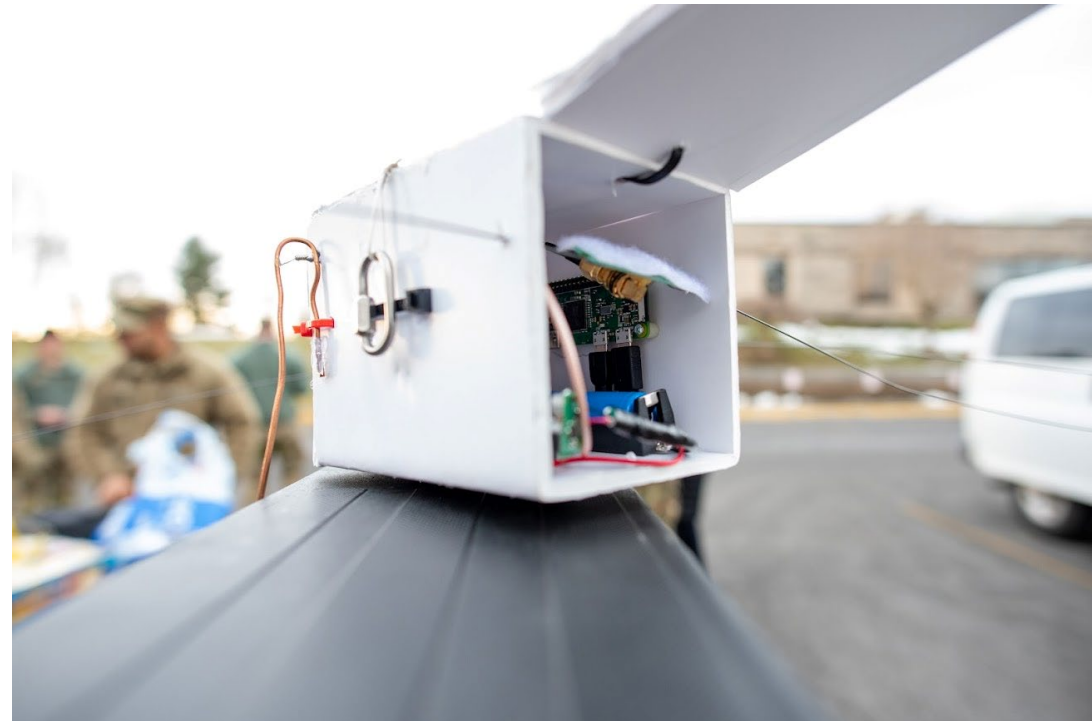
6 States (PA,NJ,NY,CT,RI,MA)



- Successive string concept from [Edge of Space Science](#)
- Independent modules allow for higher weight and customization
- Construction from foamcore, steel screws, and hot glue

Payload Breakdown

1. Geospatial Time Dilation (GTD): Analyzing relativity from 100,000ft
2. [ADS-B Logger](#)
 1. Airplane Radar
3. [SSTV Live Beacon](#)
 1. Live transmitting timestamped image



*Image Credits: CDT Josh Reece
MAJ Rob Gramer*



- Helium is in finite supply, expensive, and required for MRI machines.
- Hydrogen (though flammable) has higher lift, lighter weight, cheaper cost
- Safety issues (static buildup, sparking, air mixing) introduced new safety measures



Balloon Filling



- New filling method, new payload construction, new weight calculation
- Murphy’s Law has to happen, but it only has to happen once

Successes

- Liftoff, albeit much later than expected
- Close to target altitude
- Safe launch

Failures

- Challenges in new connectors for PVC filling system
- Late start
- Underfilled balloon – incredibly long distance with wind
- Battery operation failure

	0.000 kg	0.00 lb		
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Gross Mass	3.823 kg	8.43 lb	Student Total	0.720 kg 1.59 lb
Neck Load	1.823 kg	4.02 lb	Remaining (if exempt)	4.120 kg 9.08 lb
Gross Lift	45.364 N	10.20 lbf	Neck Load Remaining	10.177 kg 22.44 lb
Neck Lift	25.751 N	5.79 lbf	Lift Factor	1.21
Free Lift	7.873 N	1.77 lbf	NECK LIFT (lb)	5.79
MSL Volume at 0C	3.90 m ³	138 ft ³		
Ascent Rate	4.06 m/s	799 ft/min		
Burst Alt	35.2 km	115.4 kft		

Neck Lift calculation, used to get the payload off the ground.

NOTE: Incorrect, average ascent was closer to 2 m/s





- Calculated weight included “lift factor” but still had less-than-expected ascent rate
- Long time in airstream caused top speeds >130 mph
- Batteries inserted incorrectly by EE101 cadets
 - Backup existed for APRS, but halted potential data from two payloads

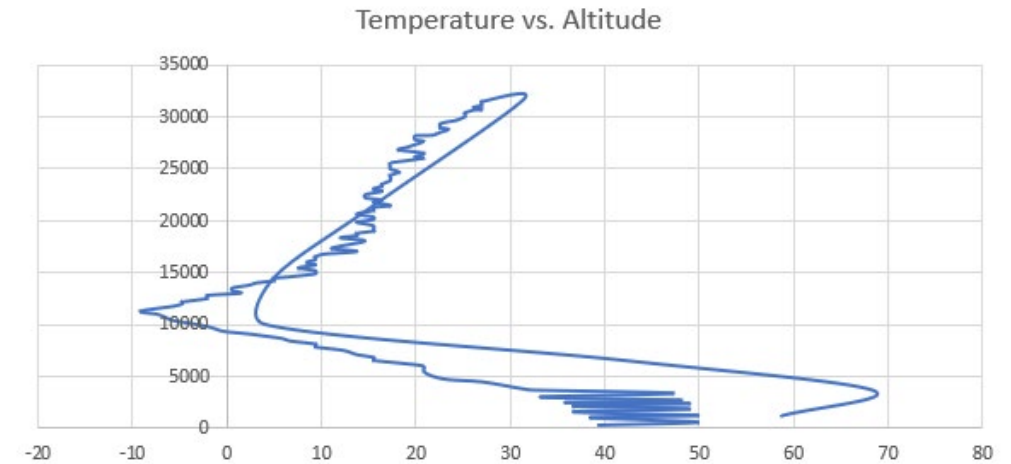
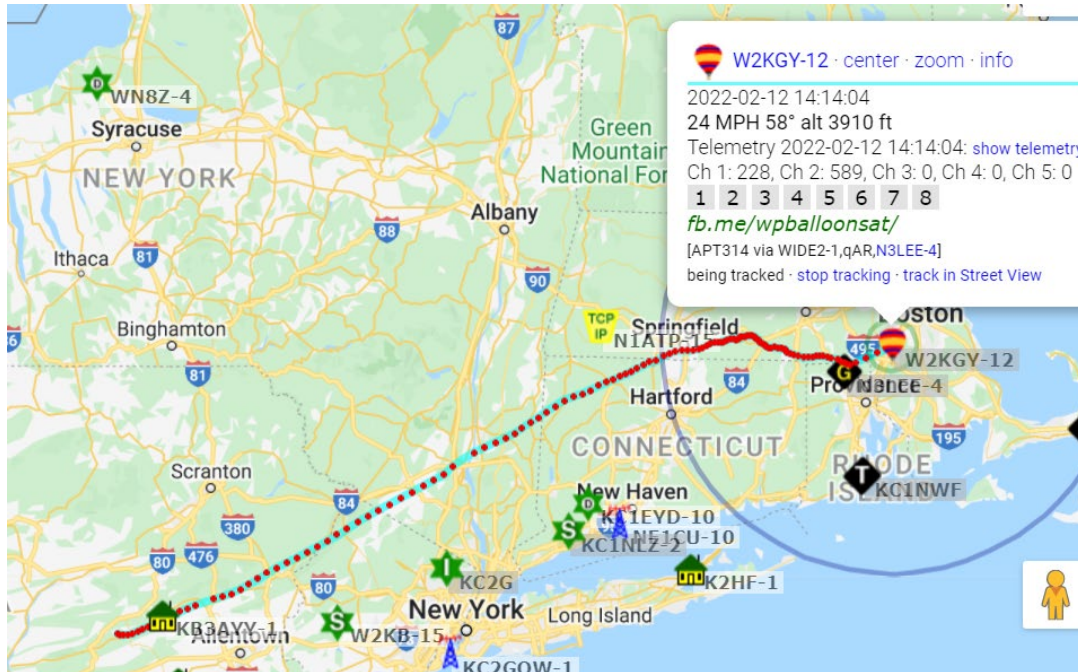
Superlatives

- **Top Speed: 130 mph**
- **Highest recorded altitude: 103.98 kft**
- **Coldest Temperature: -9.11 deg F**
- **Fastest ascent: 6.11 m/s**
- **Fastest descent: -84.1 m/s (PBC)**





- [APRS](#) telemetry only available data source from [MT-3000](#)
- More to follow on data manipulation in R studio, etc.
- Last “uploaded” position in Foxboro, MA at 4000 feet from **SSTV Payload**



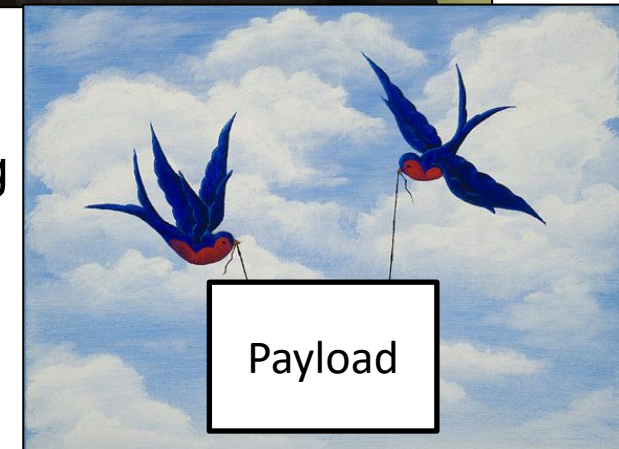


- After last upload, Stephen KH5HY “sniffed” along ground to get stationary packet
- Tree in Sharon MA: too high and dark, so retrieval with club on 19FEB





- Last TX: 4000ft in Foxboro MA
- 2 Payloads found in Sharon MA (5 miles away)
 - Missing chute and ads-b payload
- ADS-B Payload found by ATV in Foxboro MA
- Mid-flight separation?
 - No damage to either payload from 2000 vertical drop
 - Considerable separation distance
 - Why break at 2000 feet? Not 104k?
- “Migration”
 - African/European Swallows (or ATV)
 - Considerable wind during week that could remove payload/break string
 - No visual on parachute on 12FEB
- More forensics to be analyzed...





Future: Cross-band repeaters and DATV!
Next launch tentatively April 9th!



Questions?

<https://n2wu.com>