Orbital Results of Globalstar Link on Recent Satellites, First Black Box, and ThinSat Constellation Launches

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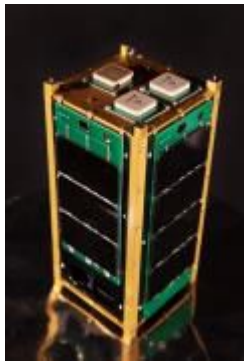
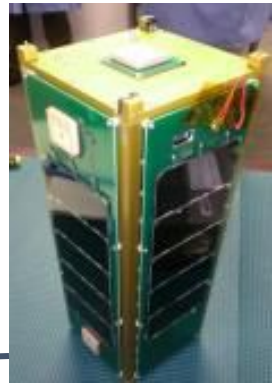
4/17/2019

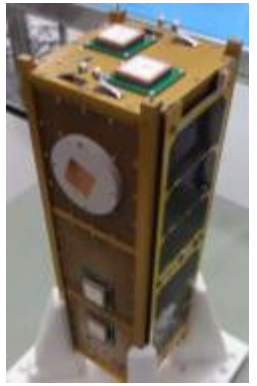
NearSpace Launch

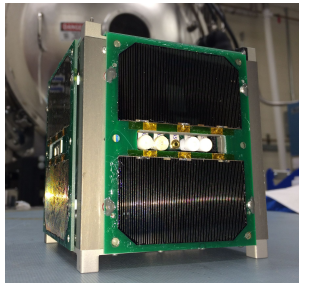
CubeSat Developers Workshop 2019

NearSpace Launch (NSL) History









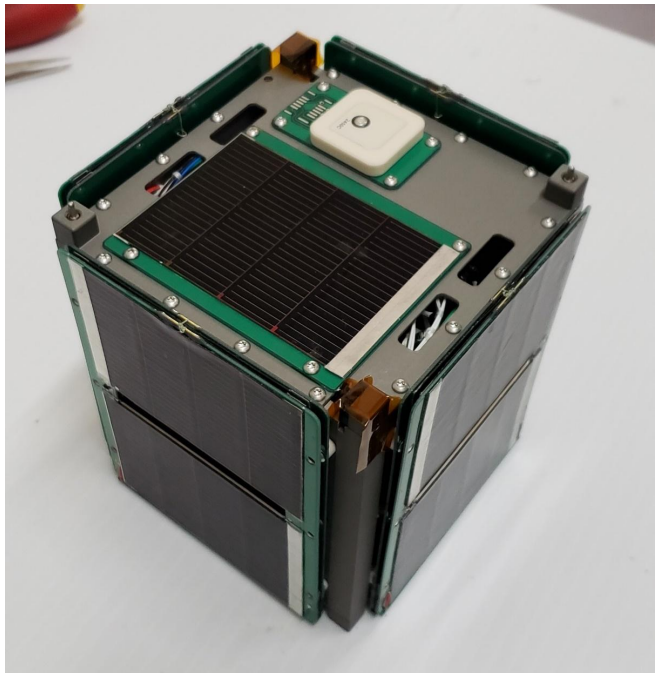
- Previous Launches
  - 2014: TSAT
  - 2015: GEARRS1 and GEARRS2
  - 2017: SHARC, Asgardia-1, MakerSat-0
  - 100% success on 29 previous systems in orbit
- Late 2018 and early 2019 launches presented today
  - 100% success on orbit with what is now 228 systems in space!
  - Includes FastBus CubeSats, EyeStar Simplex and Duplex Comm Systems, Power Systems, and custom payloads

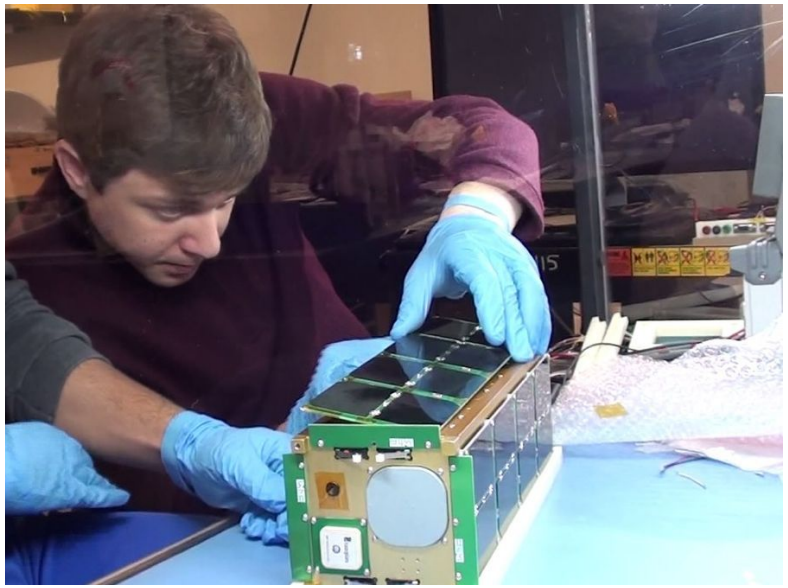
Recent Launches – 100% Success!

- **11/29/2018 – PSLV-C43 - Polar Orbit**
  - EyeStar-S3 on 3U CubeSat
- **12/3/2018 – Spaceflight SSO-A - Polar Orbit**
  - 2x EyeStar-S3 and D2 on 150+ kg satellite and 3U CubeSat
  - Black Box on 3rd Stage Payload Dispenser
  - 1U FastBus CubeSat, WeissSat-1, with The Weiss School
- **12/5/2018 – SpaceX CRS-16 - 51.6°**
  - 3U FastBus CubeSat, with University group, and FatSat payload, including EyeStar-S3, with NASA Ames
- **12/12/2018 – Rocket Lab VCLS-1 - Polar Orbit**
  - EyeStar-D2 on 3U CubeSat
- **4/17/2019 - Northrop Grumman CRS-11 - 51.6°**
  - 60 Unit ThinSat Constellation, and EyeStar-D2 on 3U CubeSat

NSL FastBus CubeSat Launches

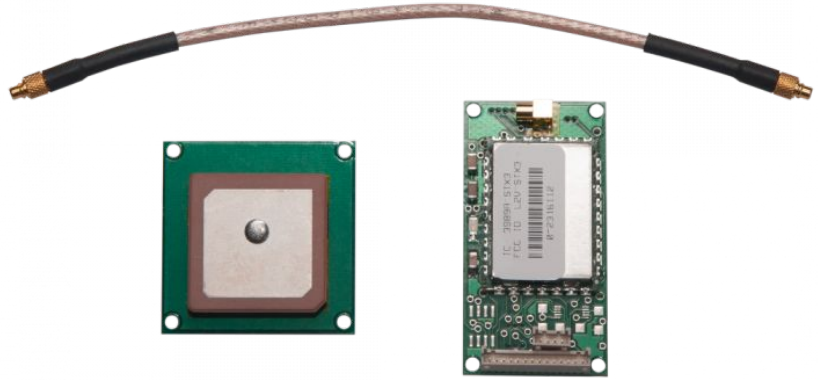
- WeissSat-1, with The Weiss School, launched on 12/3/2018 on Spaceflight SSO-A
  - 1U FastBus CubeSat included middle school biological payload, as well as NSL EPS, EyeStar-S3, and NSL Receiver
  - Polar Orbit
- University satellite launched on 12/5/2018 on SpaceX CRS-16
  - 3U FastBus CubeSat included university payload, as well as NSL EPS, EyeStar-S3, EyeStar-D2, and Plasma Probe
  - Deployed from ISS on 1/31/2018

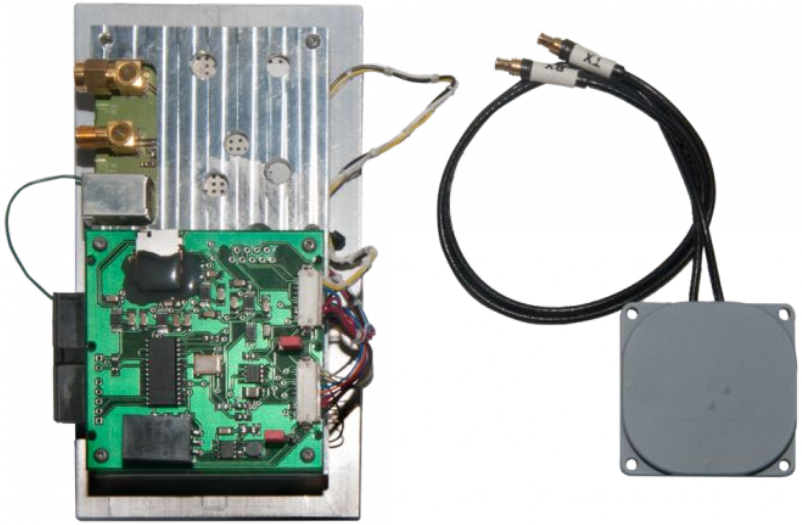




NSL EyeStar Radio Launches

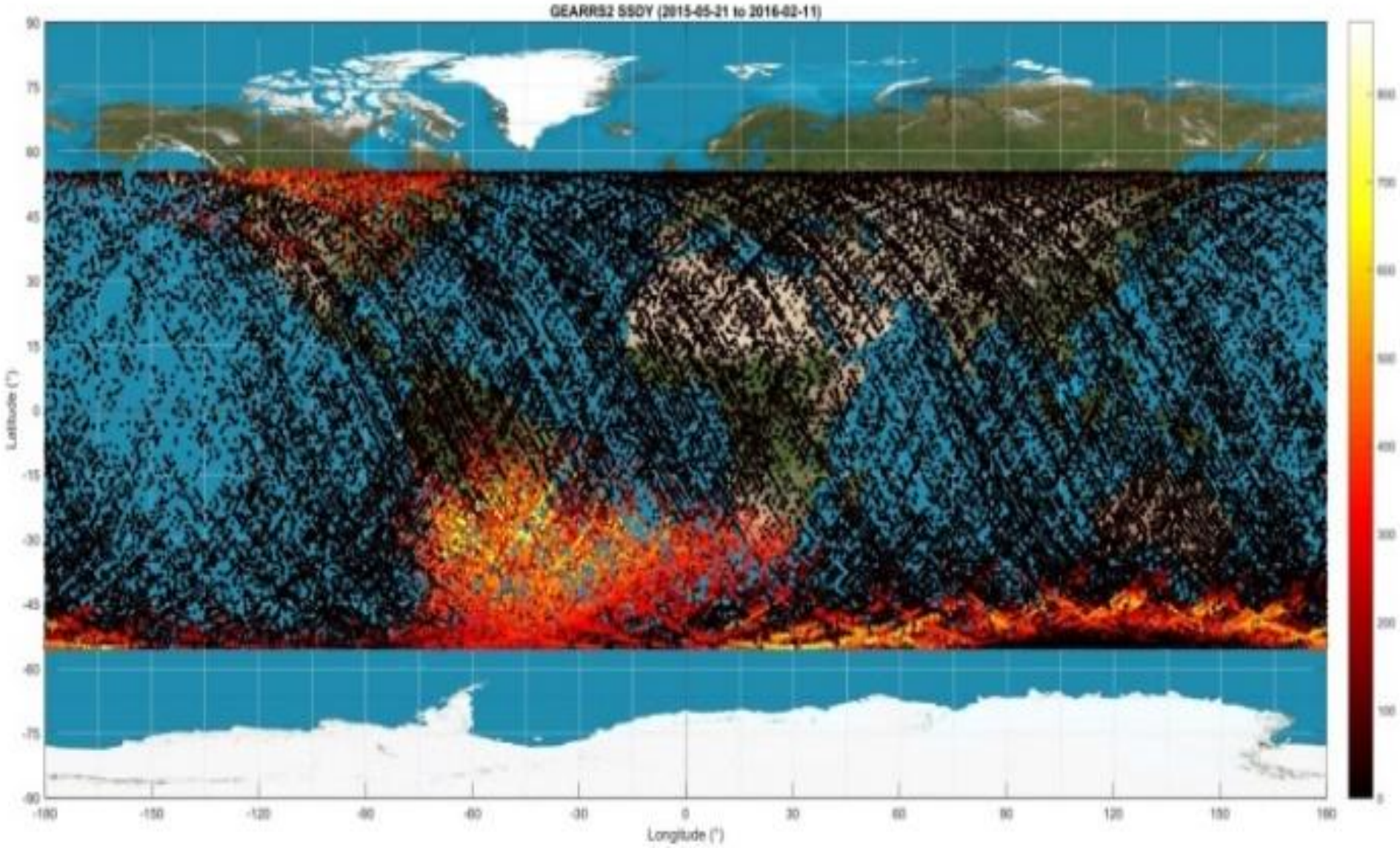
- 7 EyeStar-S3 and 4 EyeStar-D2 Radios on:
  - 3U CubeSat launched on 11/29/2018 on PSLV-C43
  - 3U CubeSat launched on 12/3/2018 on Spaceflight SSO-A
  - 150+ kg satellite launched on 12/3/2018 on SSO-A
  - 3U CubeSat launched on 12/12/2018 on Rocket Lab VCLS-1
  - 3U CubeSat launched on 4/17/2019 on NG CRS-11
- Data
  - 11/11 orbital success
  - Up to 6,000 bytes/day, and up to 8 bytes/sec
  - All polar orbits
- Not including 60 EyeStar-S3 units launched in constellation





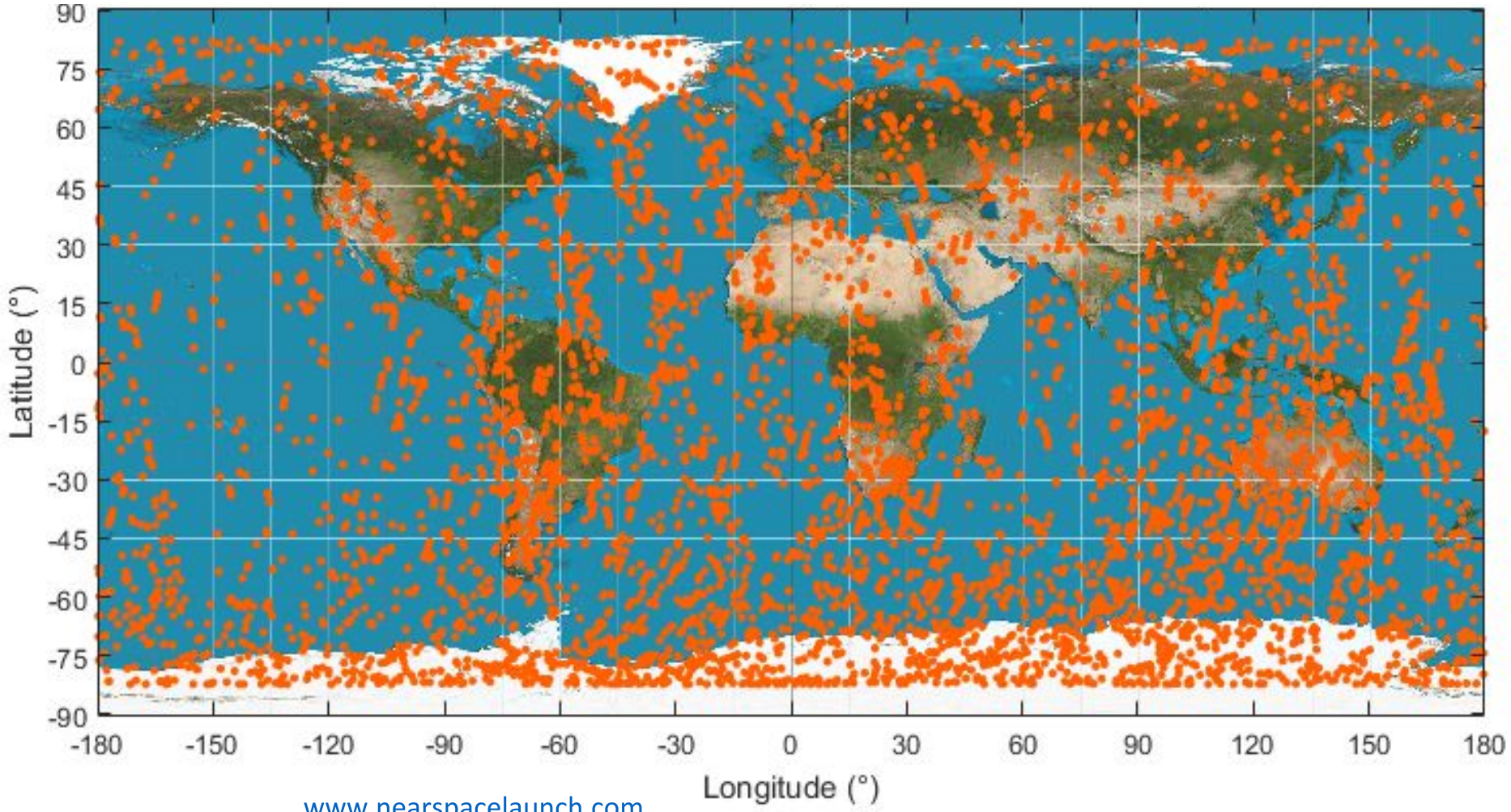
Previous Link Performance

- NSL EyeStar Simplex energetic particle data from several orbits of GEARRS2.
- Nearly evenly distributed over globe.
- No information over poles



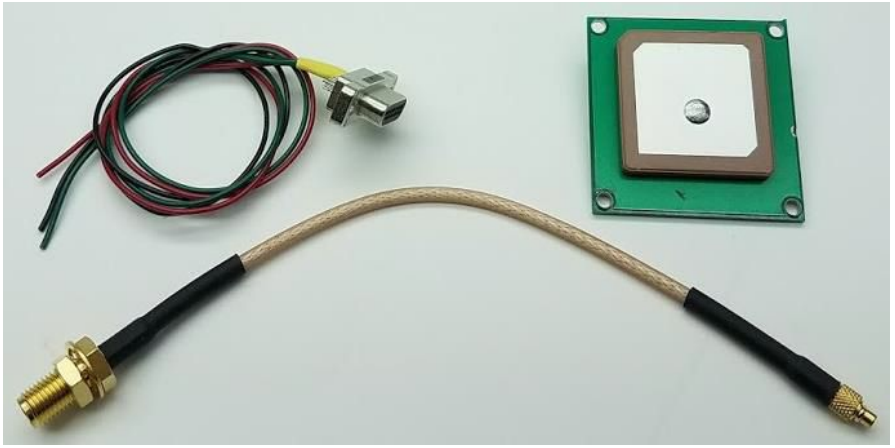
Recent Polar Link Performance

- Recent Simplex data from a polar orbit satellite mission, from January 2019.
- Note the good transmission throughput over the poles.
- Globalstar works well over the poles for satellites.



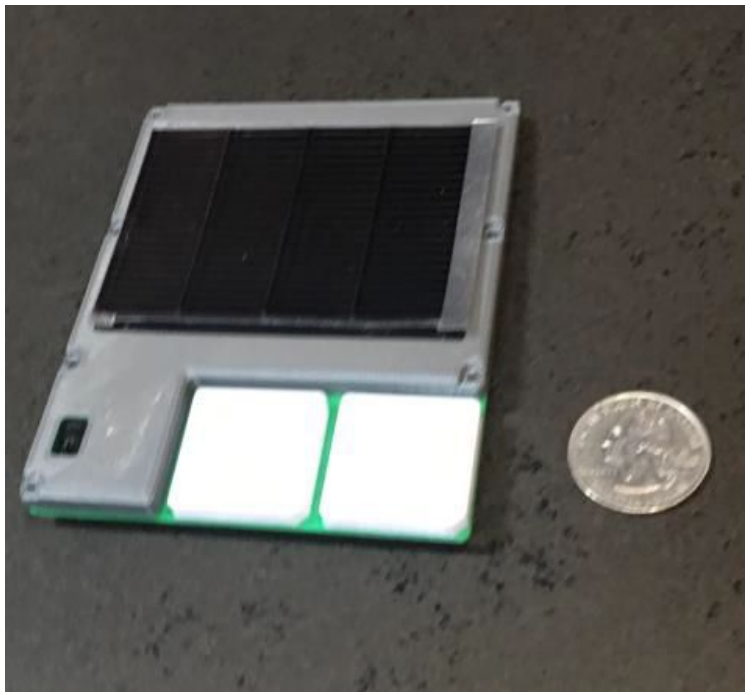
New NSL Black Box

- Black Box - Standard launched on 12/3/2018 on Spaceflight SSO-A
- Mounted to 3rd stage payload dispenser
- Provided location and telemetry for 11 hrs, sending 800 bytes
  - Until booster batteries died
- In a polar orbit
- Achieved full mission success
- First launch of new Black Box product line

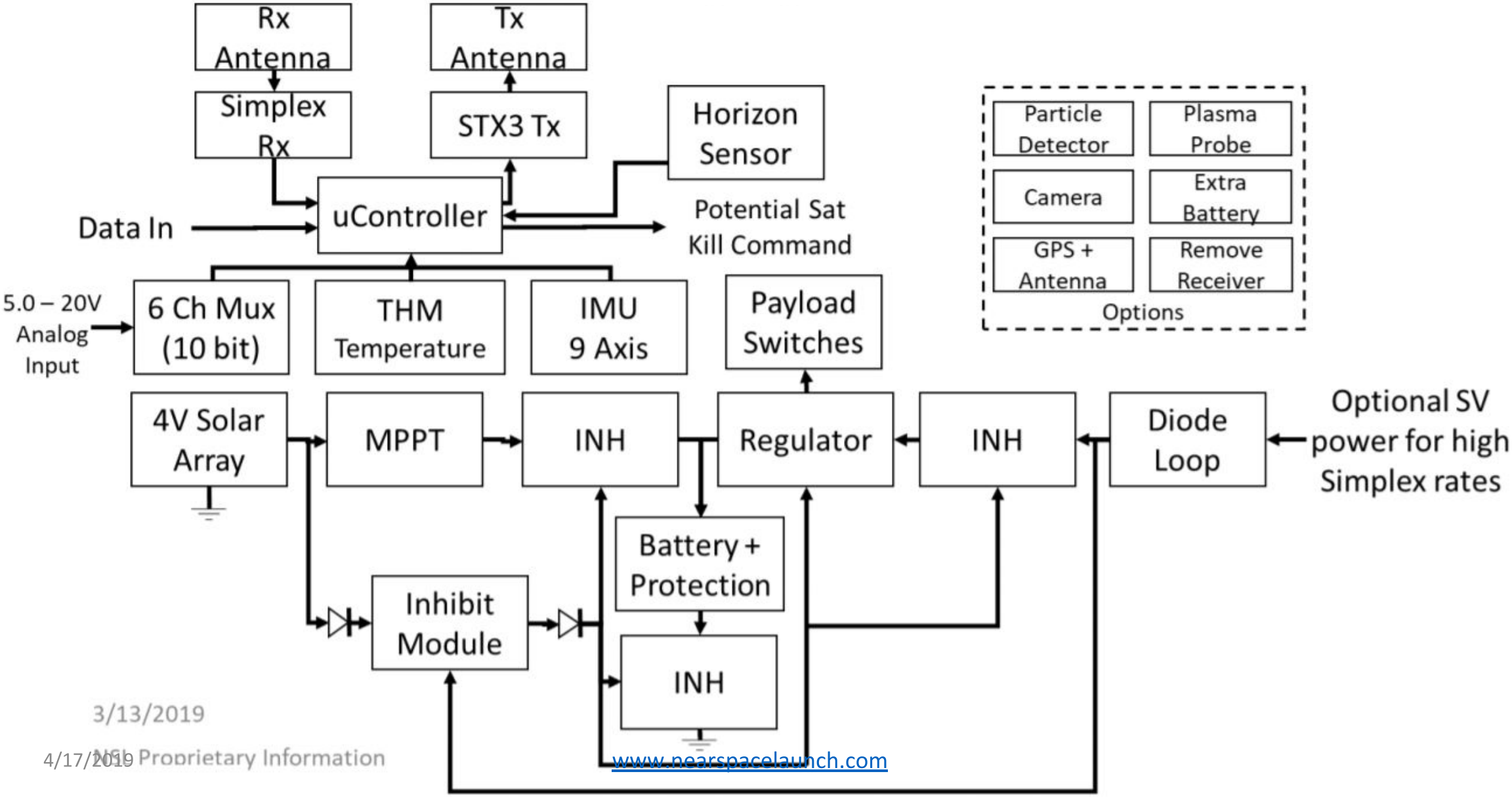


Black Box

- Description
  - Independent power and RF link module, for live telemetry and diagnostics
- Purposes
  - Secondary redundant link
  - Tracking orbital debris with GPS
  - Diagnostics of satellite problems and recovery
- Two Form Factors
  - Black Box - Standard: Larger, with integrated GPS
  - Black Box - Patch: Miniaturized to fit within outer 6.5 mm volume of CubeSat

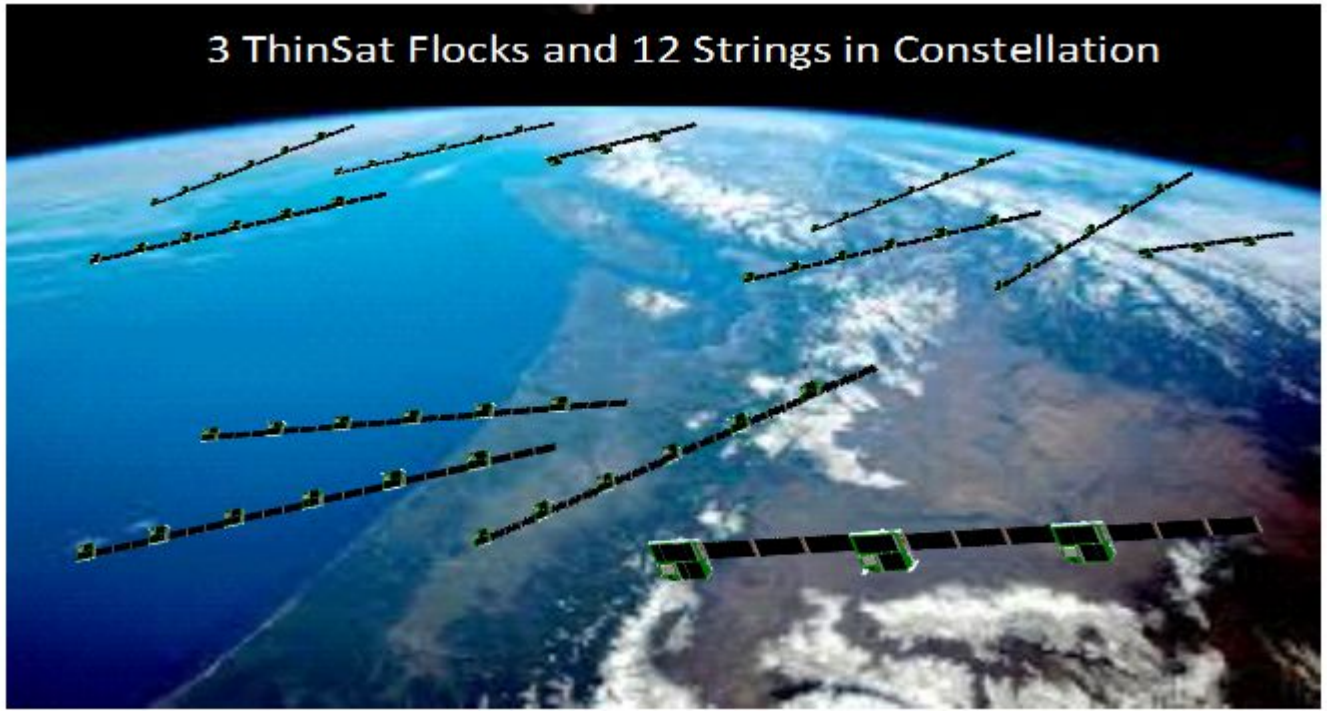


Black Box - Patch Block Diagram



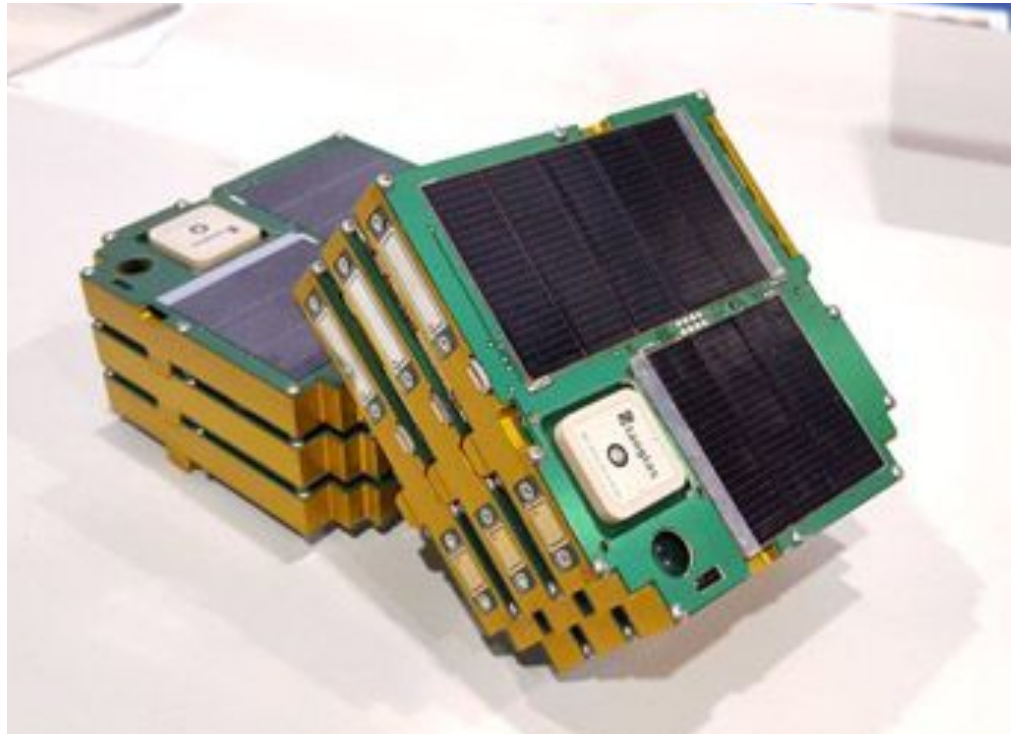
Recent ThinSat Constellation Launch

- 60 ThinSat units launched on NG-11 on 4/17/2019 from Wallops Island, VA
- Considered full mission success
- Orbit Info:
  - Inserted into 51°, 190 x 290 km orbit
  - Expected lifetime of 10 days
- STEM Outreach
  - 60+ schools (middle, HS, Uni)
  - Over 200 people at launch

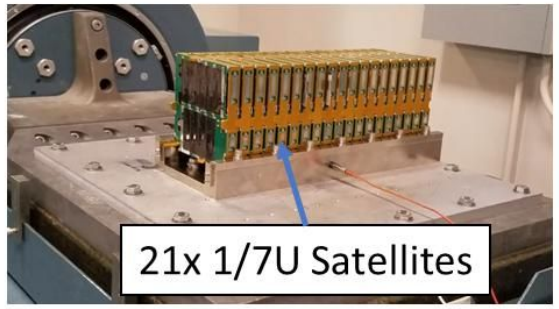


Current and Future Forms

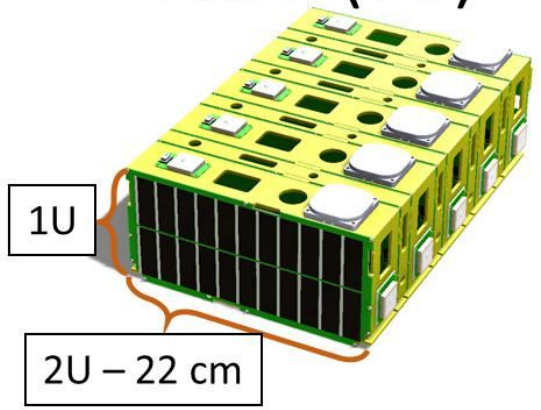
- Fully independent, 1/7U CubeSats
- 21 “slices” stack in a 3U “loaf”



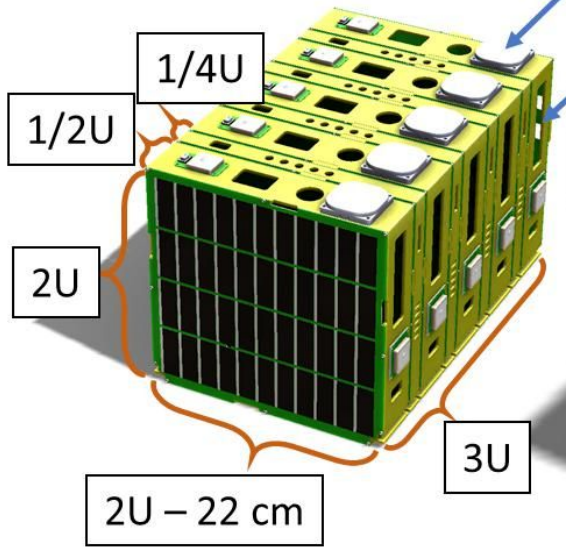
1x3U (3U)



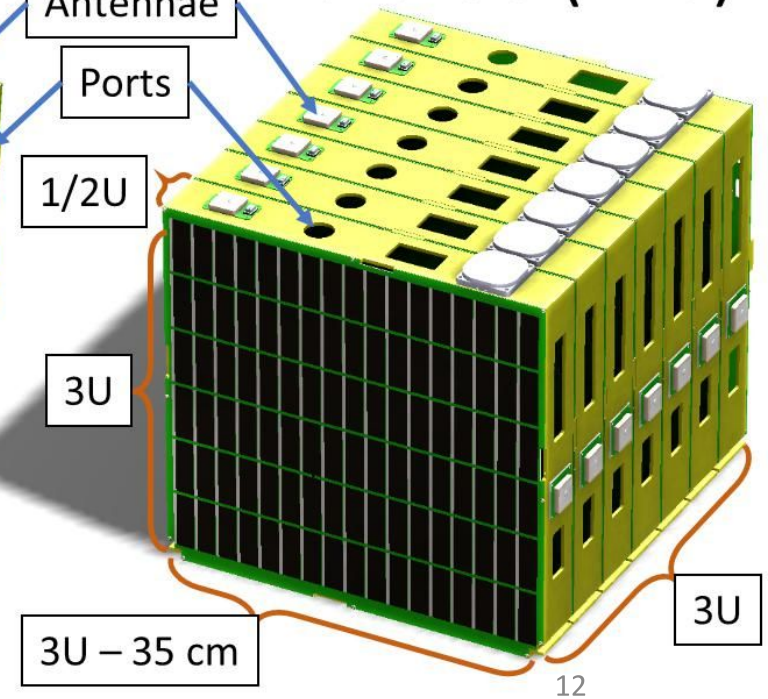
2x3U (6U)



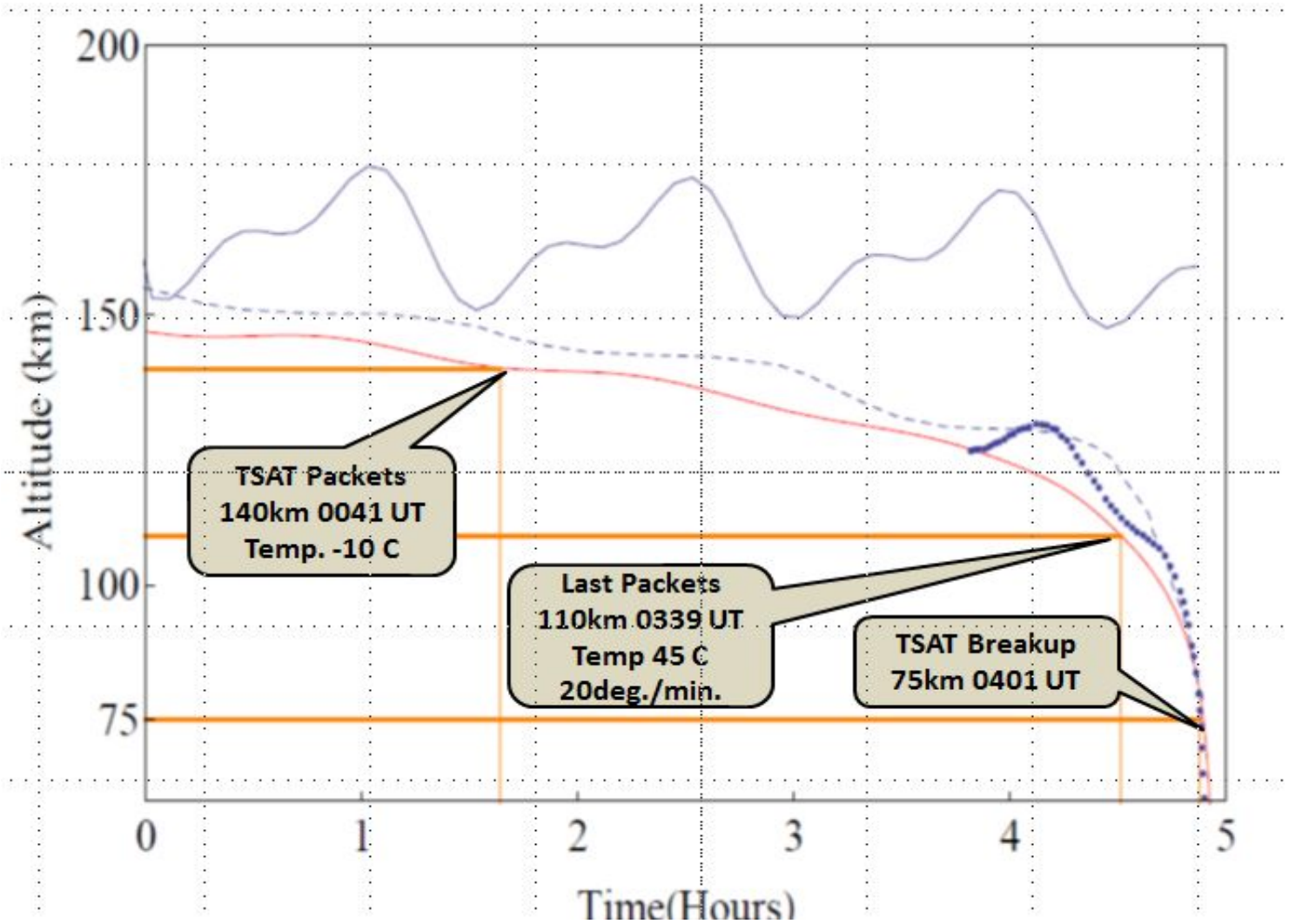
2x2x3U (12U)

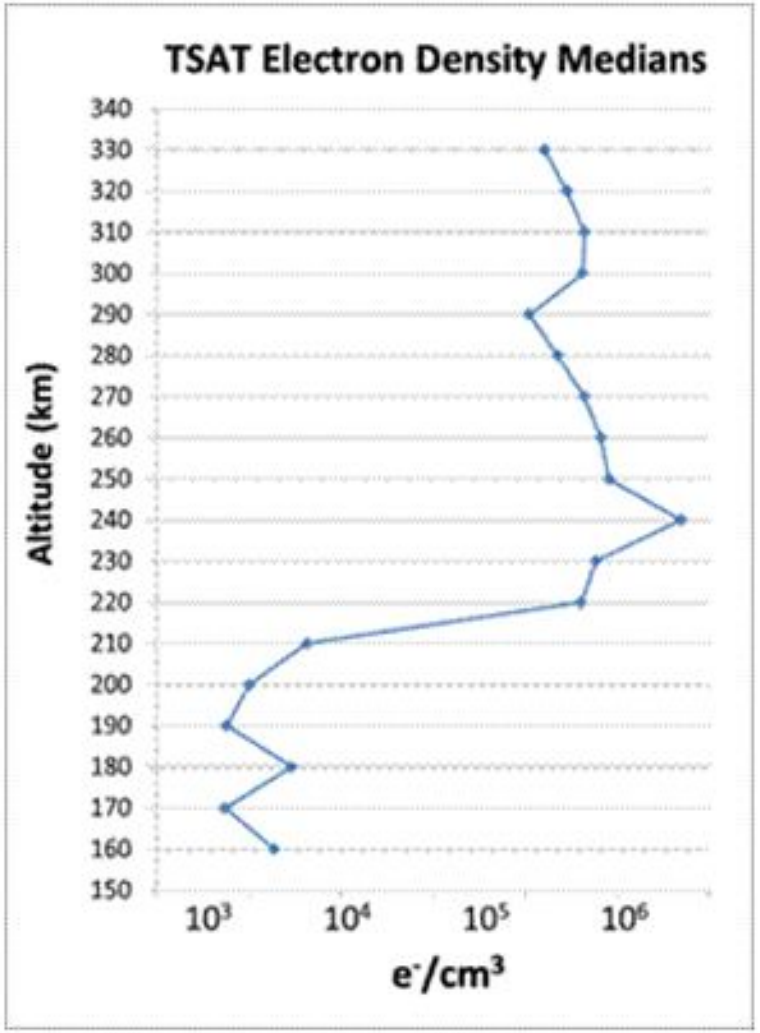


3x3x3U (27U)

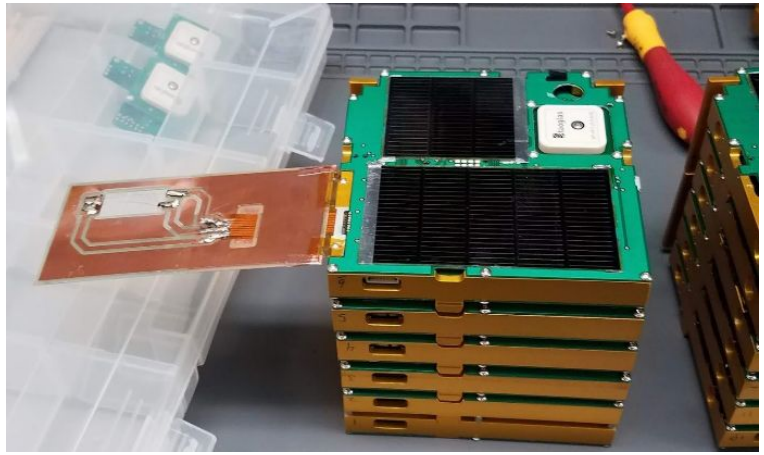


Previous Reentry Performance

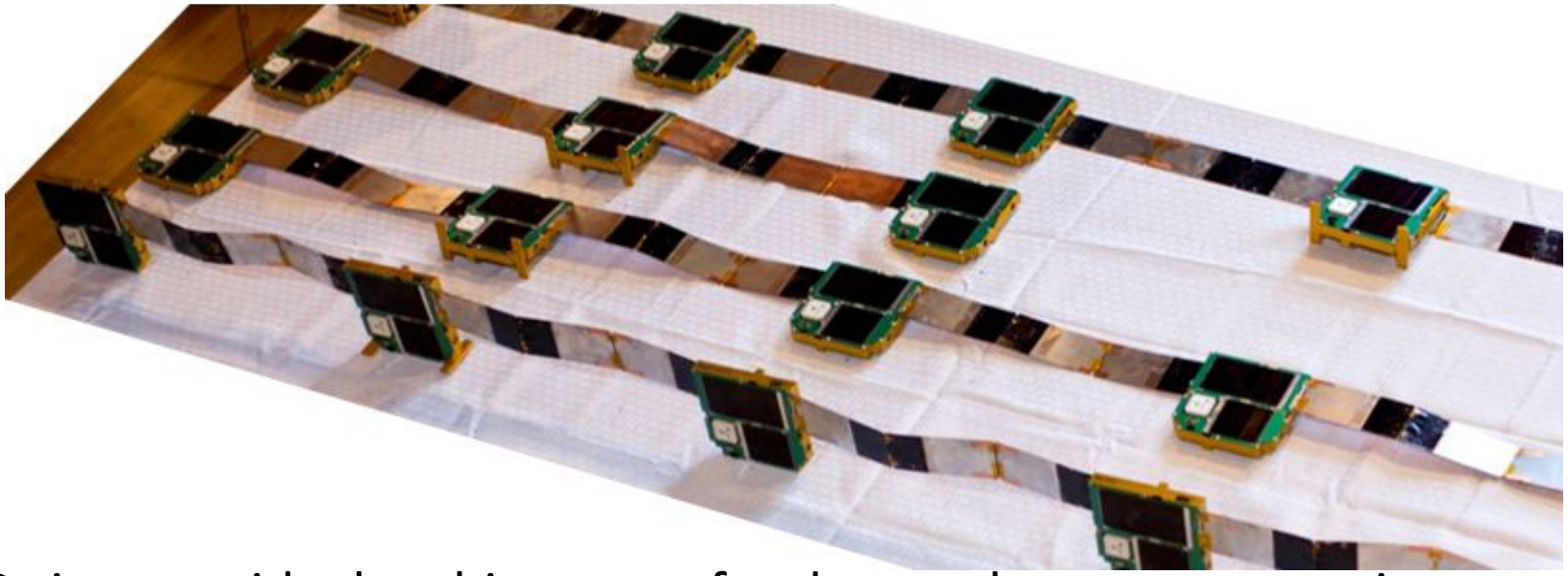




ThinSat Foldouts



Example of small boom used for electron emission using a hot wire connected to the flex bus to transfer current along a magnetic field line.



Strings are ideal architectures for data and power connection between individual ThinSats for coordinated experiments with different purposes such as 1) ThinSat with GPS, IMU, cameras, 2) Propulsion unit like a train and extra batteries (like coal car), 3) Space weather experiments plasma and particles, and 4) Space Weather experiment with B and E field deployables etc. The string with the flex cable bus can also act as a boom for plasma experiments. Can also get gravity gradient stabilization with longer strings and various flying angled and circular geometries.

ThinSat: New Architecture & Features

- Ease of assembly using automation and two exterior, parallel PC Boards
- Globalstar/NSL product with 24/7 real -time monitoring for ordered database of SW constants
- Larger solar array area for more efficient fit
- Aerodynamic for less drag when small edge is pointing into ram direction
- Radiation shielding of atmosphere in ELEO orbits greatly reduces radiation damage (Resilience)
- Much lower cost (up to a factor of 10) for constellations to manufacture compared to using many smaller PC boards with connectors. One main PCB with few connectors
- A ThinSat is like a FlatSat for easy testing and debugging
- Advanced manufacture and robotic assembly with modular ThinSat frames and 3D printing
- Ideal for constellations since easy to mass produce and launch with existing CubeSat launchers
- Improved thermal heat dissipation and isothermal shorting with aluminum frame
- Great for pushing new technologies to smaller smartphone sizes
- Can have much greater radar cross section, especially with the foldouts
- Ease of calibration, charging, Burn-in, and environmental Testing
- Can separate noisy Bus and payload sections with a foldout: Isolation of sensitive low power plasma, magnetic, and cooled experiments.

Questions?

Come see us at our booth downstairs