NASA Balloon Program Office

Sarah Roth / Chief Technologist

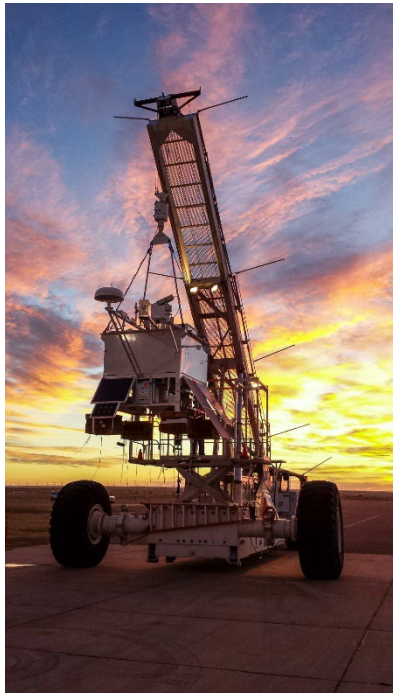
Launch of SuperBIT 2023 Wanaka, NZ

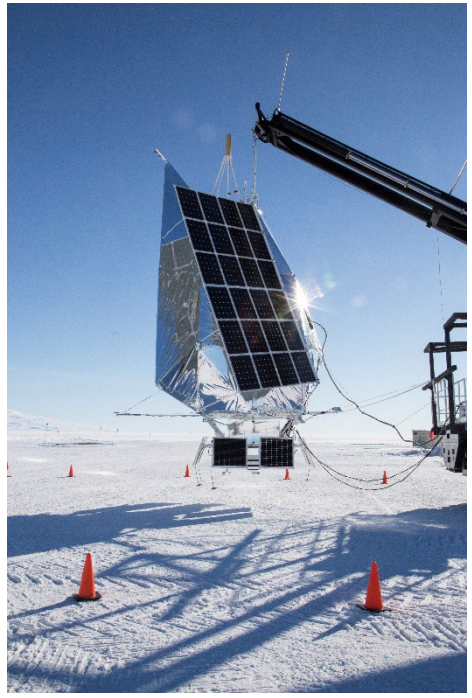
11/9/2023

Mission of NASA's Balloon Program

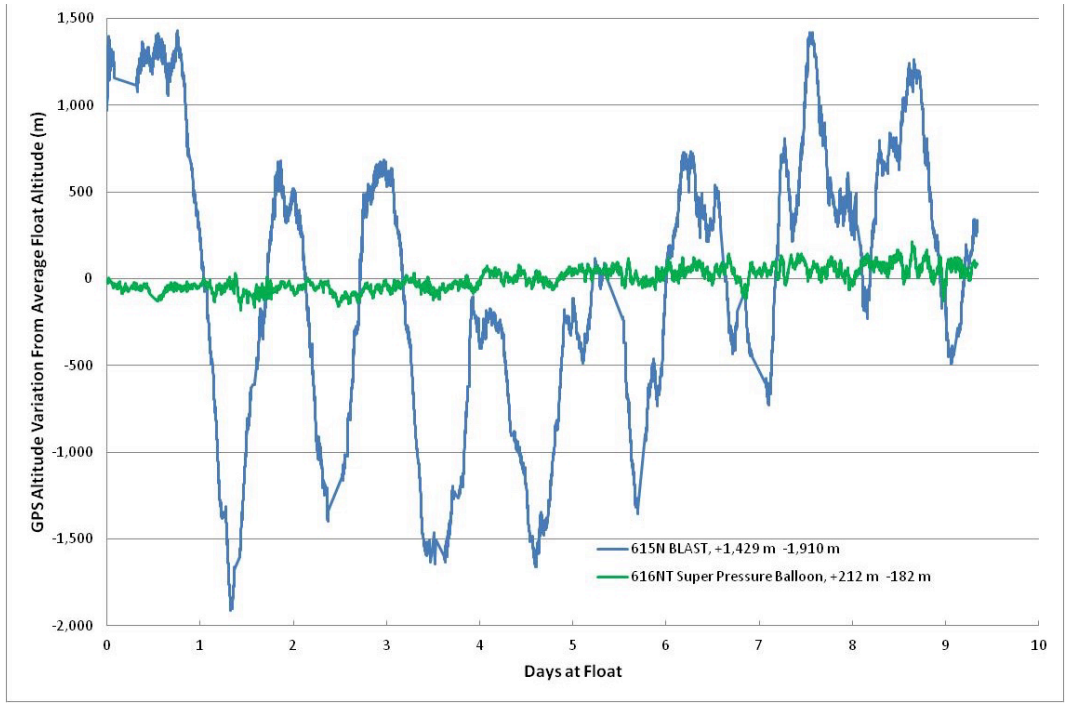
Goddard Space Flight Center — Wallops Flight Facility

- *The NASA Balloon Program provides low-cost, quick response, near-space access to NASA's science Community for conducting Cutting Edge Science Investigations*
  - *Observatory-class Payloads With Advanced Technologies and Large Aperture/Mass*
- *Serve as a technology development platform for future space missions*
  - *Instrument & Subsystem development for NASA Flight Projects*
- *Provide hands-on training for Educators, Students and Young Scientists*





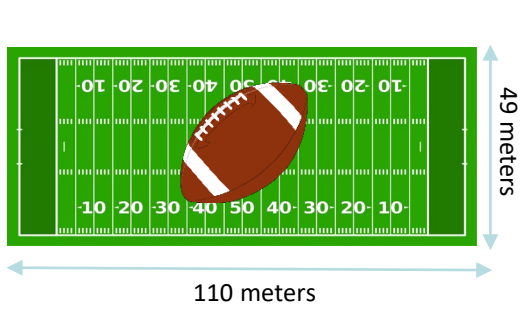
Two Types of Balloons

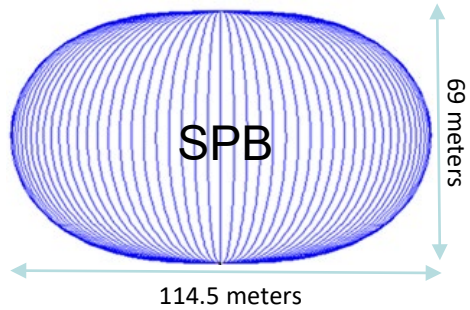


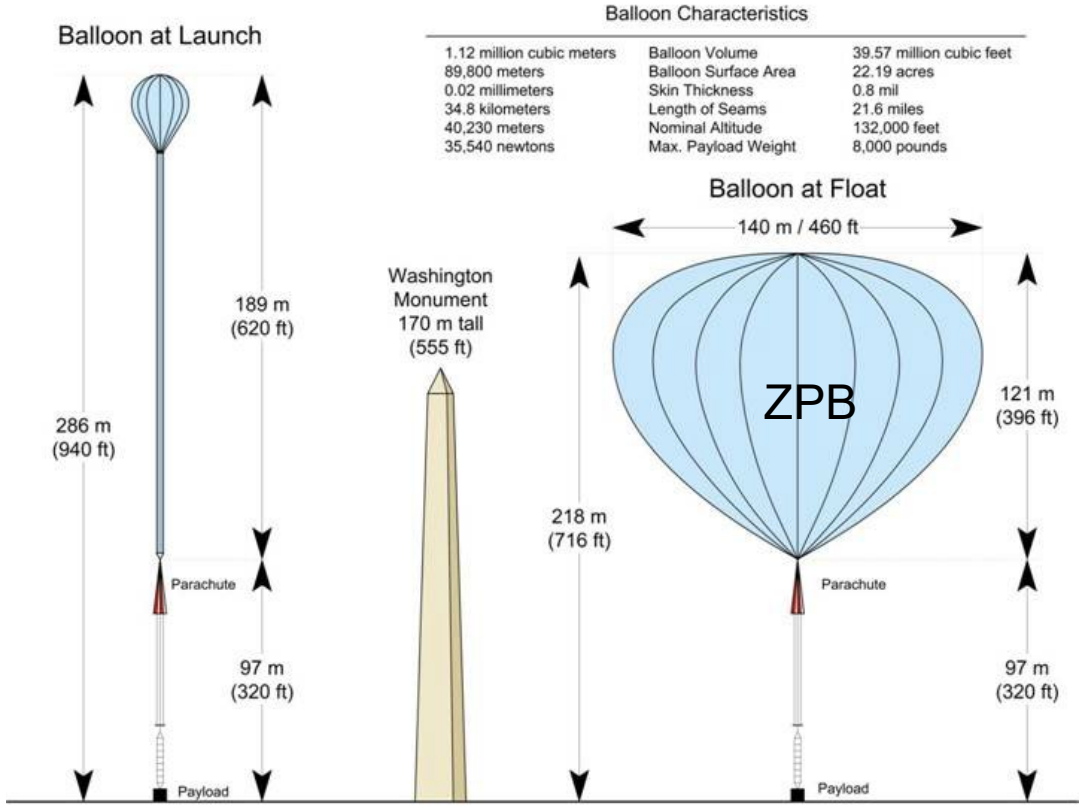
- Super Pressure Balloon provides a stable platform at mid-latitudes
- Zero Pressure Balloons are used for short duration and polar flights
  - Gas vents during the day and ballast drops are required every night to maintain altitude

How BIG is big?

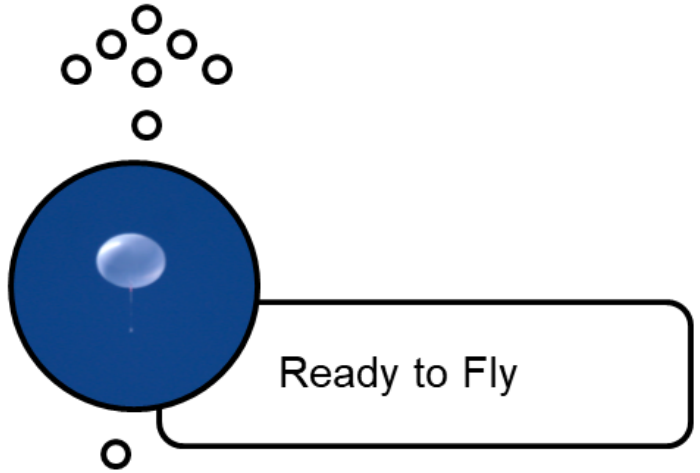
- *NASA balloons stand up seconds before launch*
  - *Taller than the Washington monument!*
- *NASA measures balloon size by inflated volume at float*
  - *39mcf = 39,000,000 ft³*
  - *A football field can fit inside of the equator of a balloon*
- *For a 39mcf, 22.2 acres (~8.98 hectares) of film are used!*
  - *21.6 miles (34.8 km) of seams!*

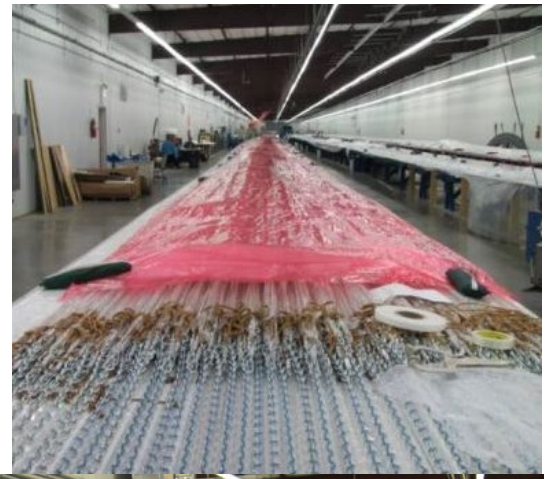


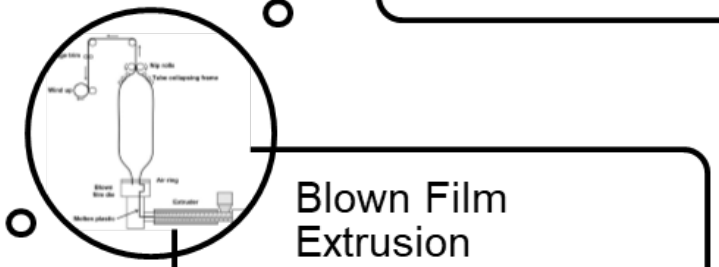


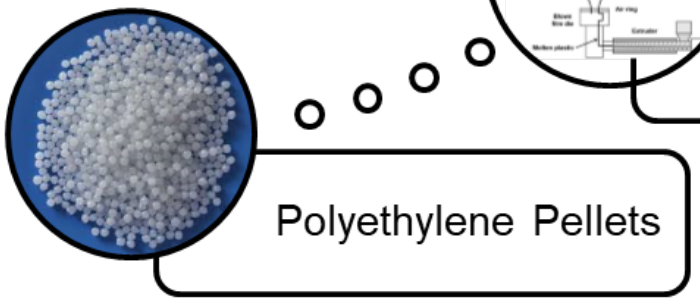


“How its Made”



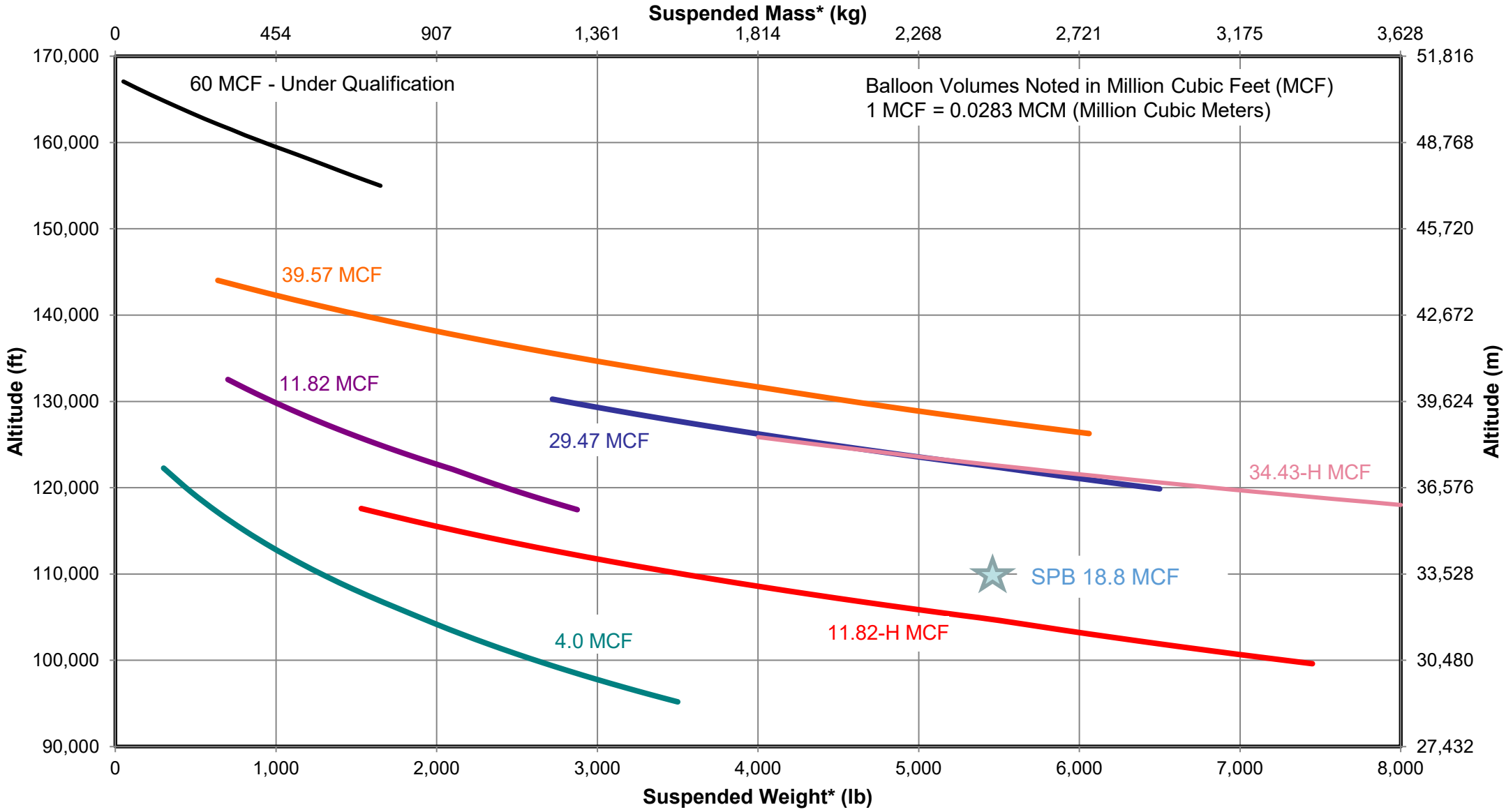






https://blogs.nasa.gov/superpressureballoon/2017/04/05/seal-team-6-constructing-a-super-pressure-balloon/
And random uncited google images

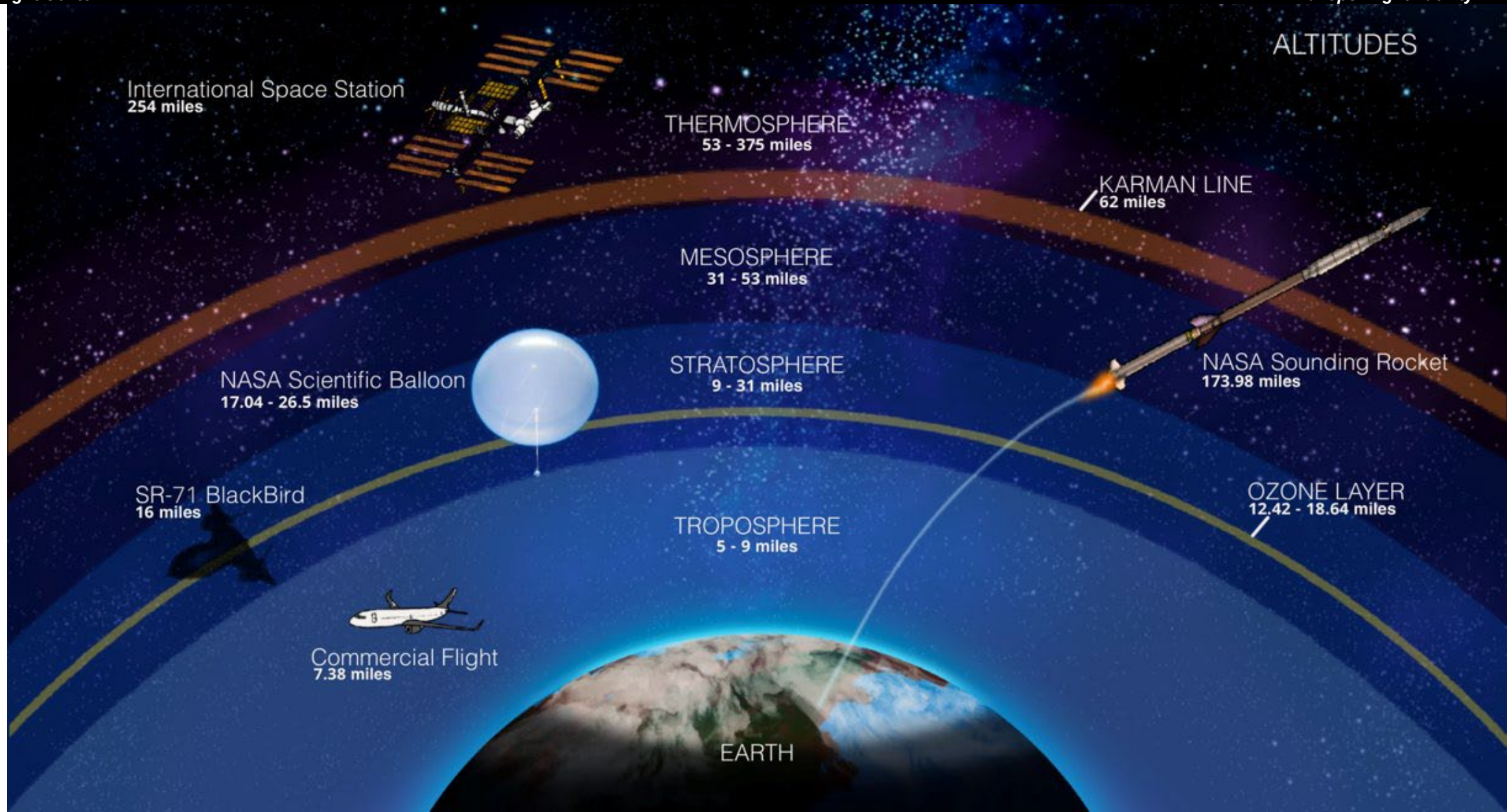
Program Capabilities



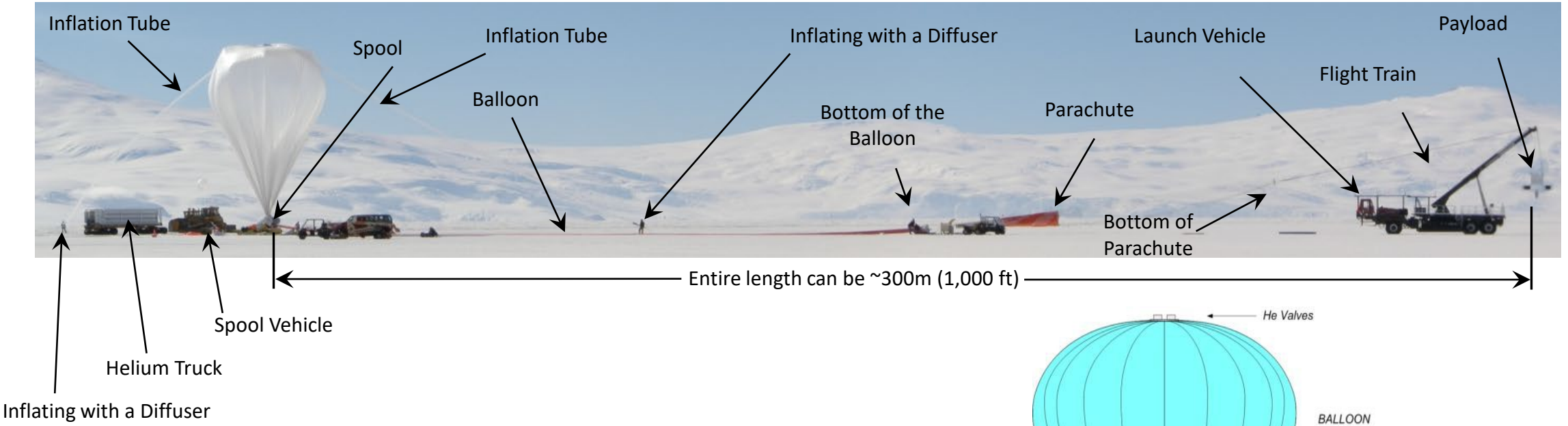
*denotes total mass, including science, flight support equipment, ballast, etc.

How High?

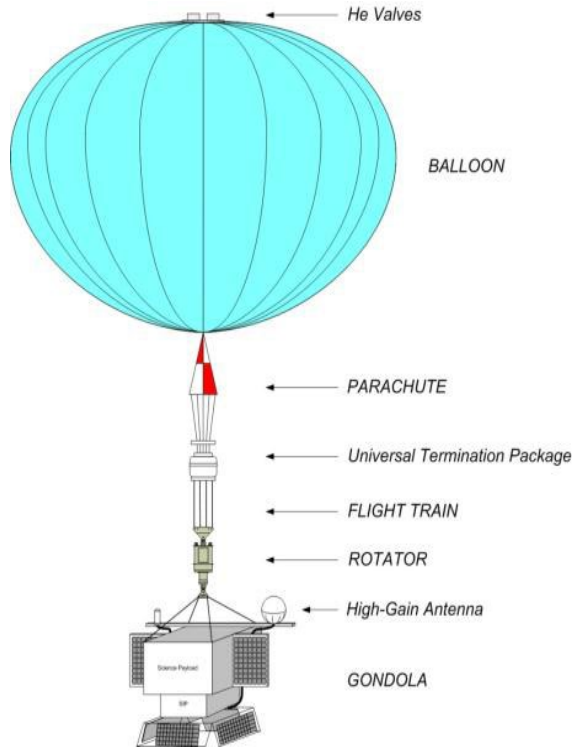
Goddard Space Flight Center *Wallops Flight Facility*



Flight System Launch Configuration



- *Before rotating into its vertical configuration for launch, the balloon system is laid out horizontally during balloon inflation.*
- *The balloon system is so large that the payload may be as far as 300 m (1,000 ft) away from the balloon!*



Launch Video

Sailboat in the Sky

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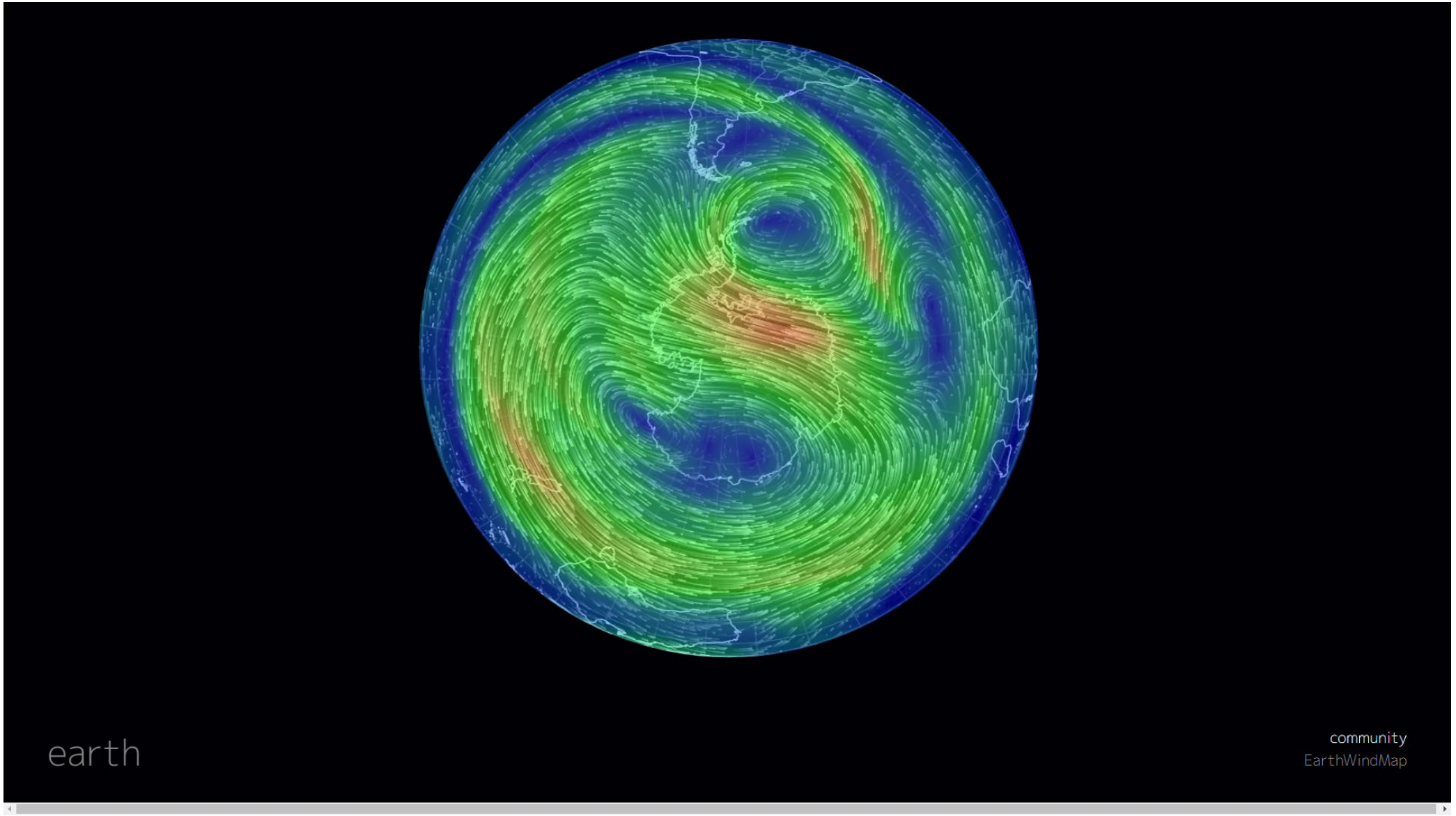

Worldwide Operations

McMurdo Station, Antarctica

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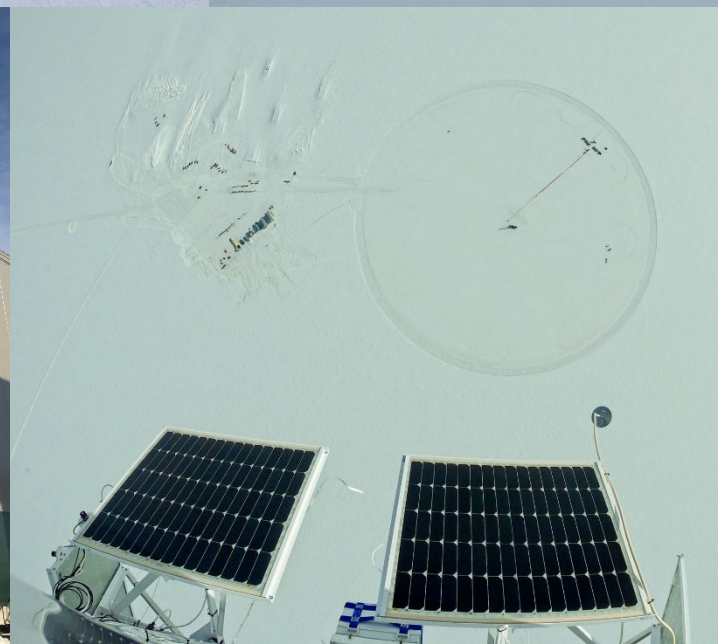
Flight Season	Dec – Jan
Lat/Long*	77.8500° S, 166.6667° E
Trajectory	West
Float Speed	5 – 30 kts (9 – 55 kph)
Science Mass	6000 lbs (2722 kg)



Wanaka, New Zealand

Flight Season	April – Aug
Lat/Long*	44.7222° S, 169.2455° E
Trajectory	East
Float Speed	10 – 120 kts (18 – 222 kph)
Science Mass	3000 lbs (1361 kg)

Esrange, Kiruna, Sweden

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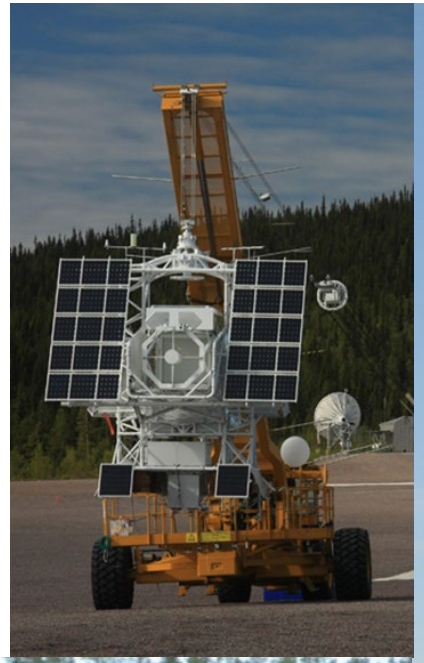
Flight Season	May - July
Lat/Long*	67.8833° N, 21.1167° E
Trajectory	West
Float Speed	10 – 30 kts (18 – 55 kph)
Science Mass	6000 lbs (2722 kg)



Ft Sumner, New Mexico, USA

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Flight Season	Aug - Oct
Lat/Long*	34.4731° N, 104.2422° W
Trajectory	West / East
Float Speed	10 – 70 kts (18 – 129 kph)
Science Mass	6000 lbs (2722 kg)

Palestine, Texas and Alice Springs, Australia

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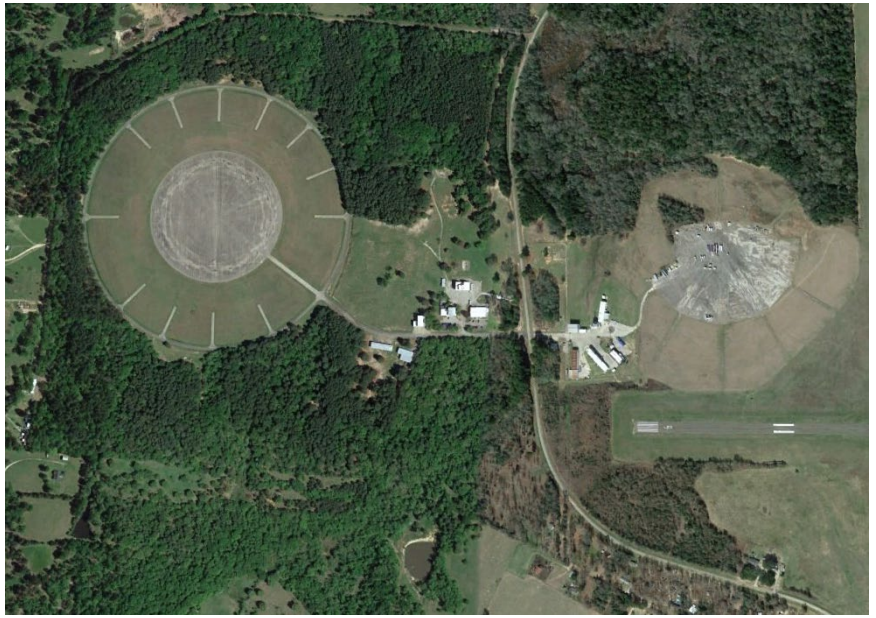
Palestine, Texas

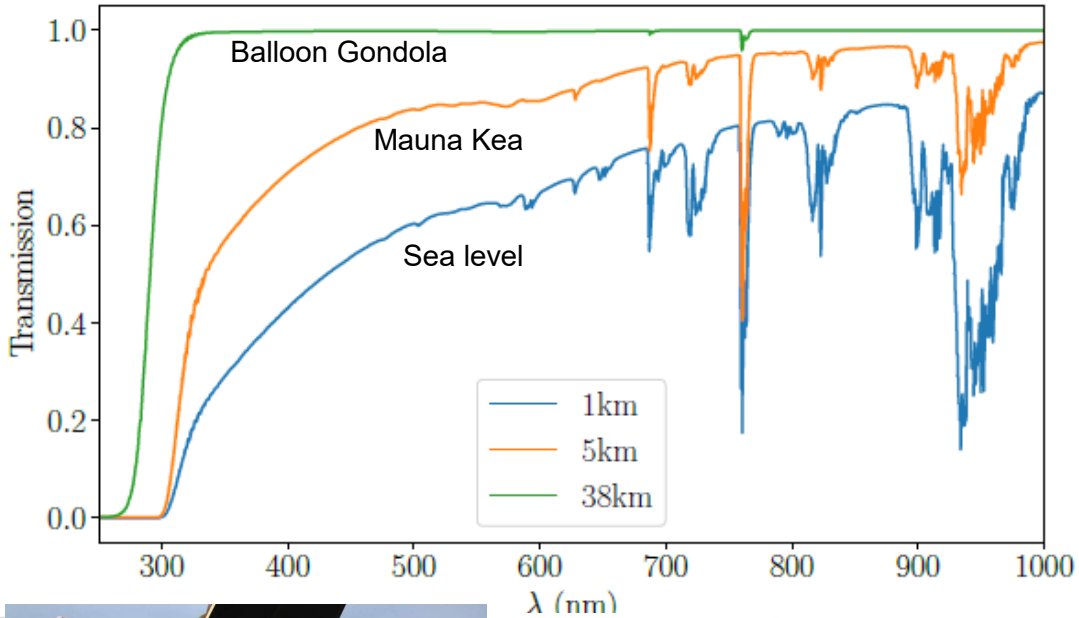
Flight Season	May - Jul
Lat/Long*	31.7786° N, 95.7144° W
Trajectory	West
Float Speed	20 – 70 kts (37 - 130 kph)
Science Mass	2000 lbs (907 kg)

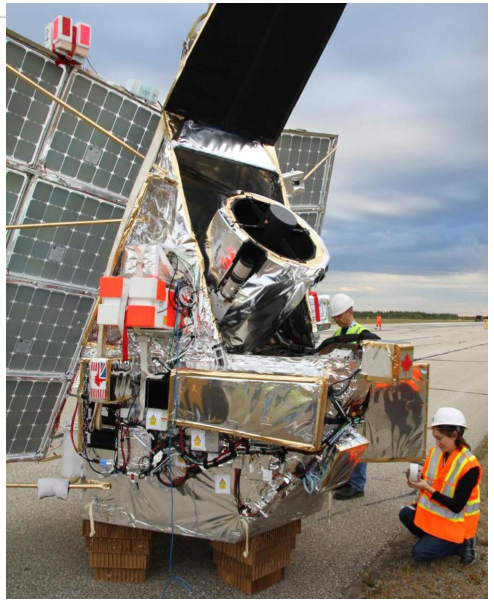


Alice Springs, Australia

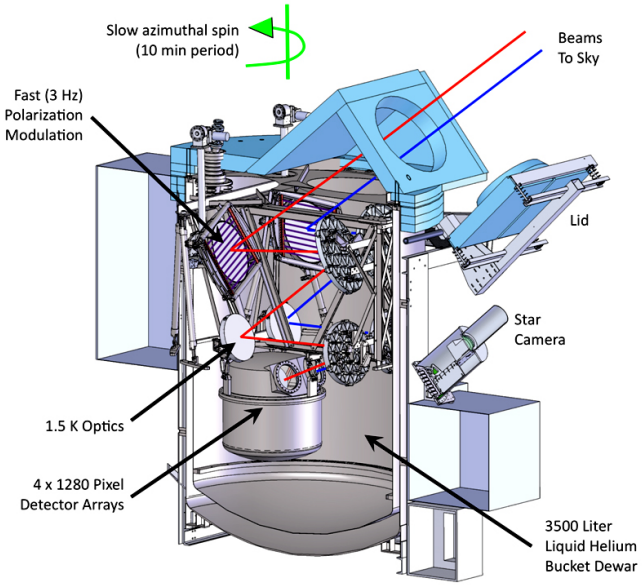
Flight Season	Mar - May
Lat/Long*	23.80° S, 133.89° E
Trajectory	Turnaround
Float Speed	0 – 70 kts (0 – 130 kph)
Science Mass	6000 lbs (2722 kg)

Why stratosphere?





Credit: STEVEN BENTON / PRINCETON UNIVERSITY



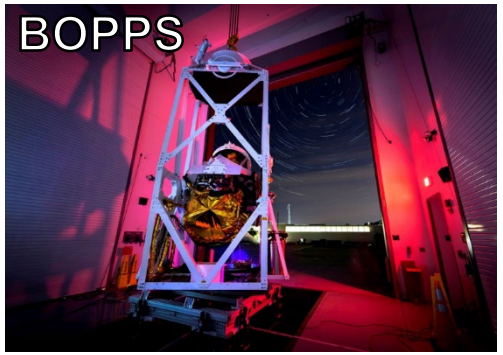
Credit: PIPER GROUP / GSFC

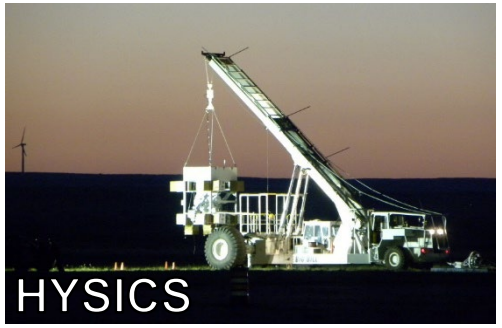
- *Light is blocked by the atmosphere*
  - *Stars and galaxies cannot be seen from the ground*
  - *SOPHIA (aircraft observation platform) is ~35kft (~10.7km), still not high enough*
- *Balloons fly at the edge of space, above 99.9% of the atmosphere!*
  - *Enables new science and new wavelengths at a fraction of the cost of satellites*

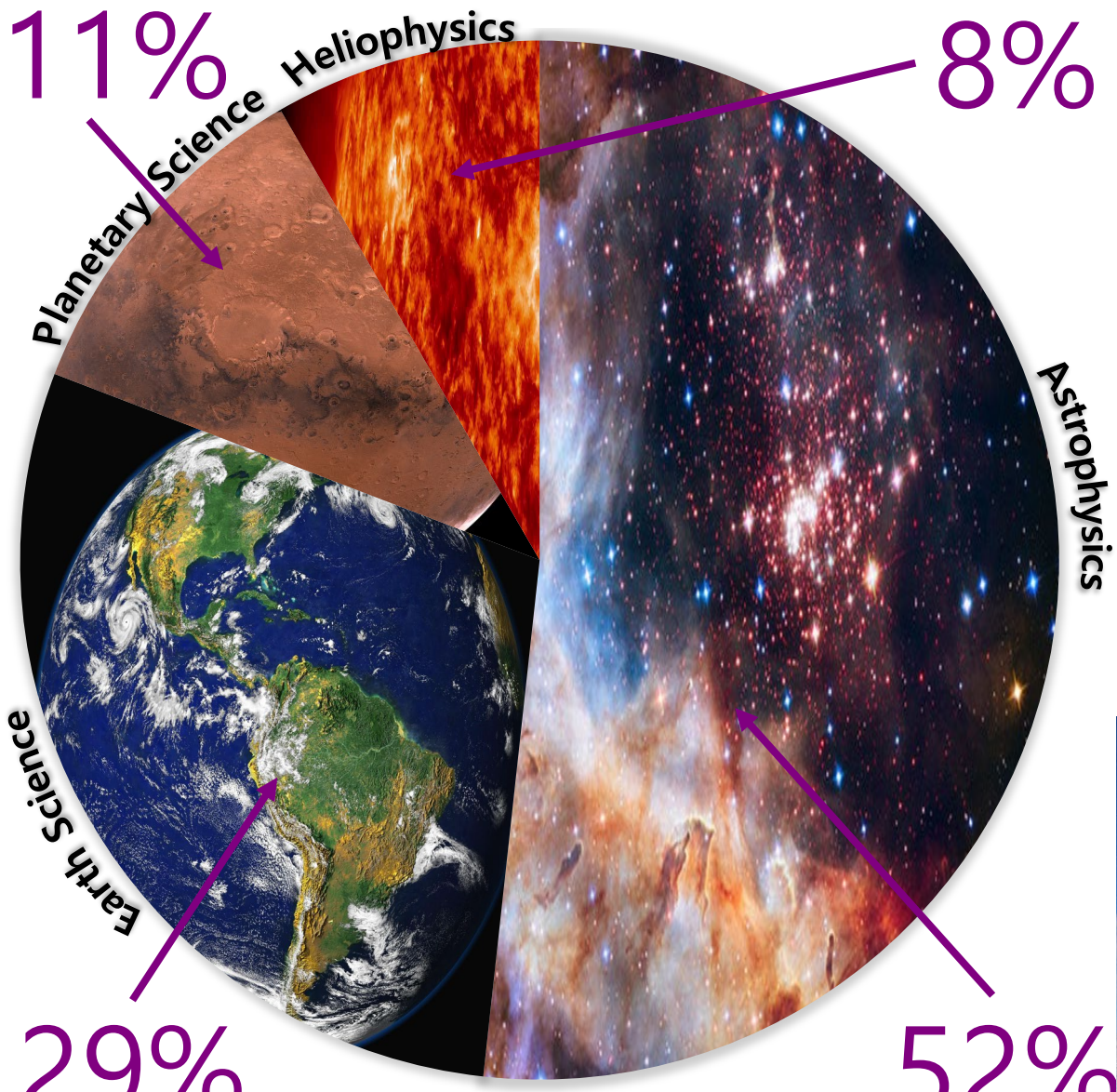
Mission Science Overview

Goddard Space Flight Center

Wallops Flight Facility







Super Pressure Balloon Imaging Telescope

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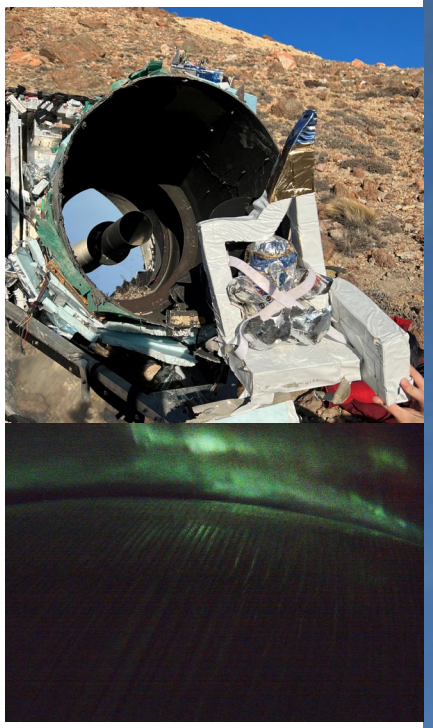
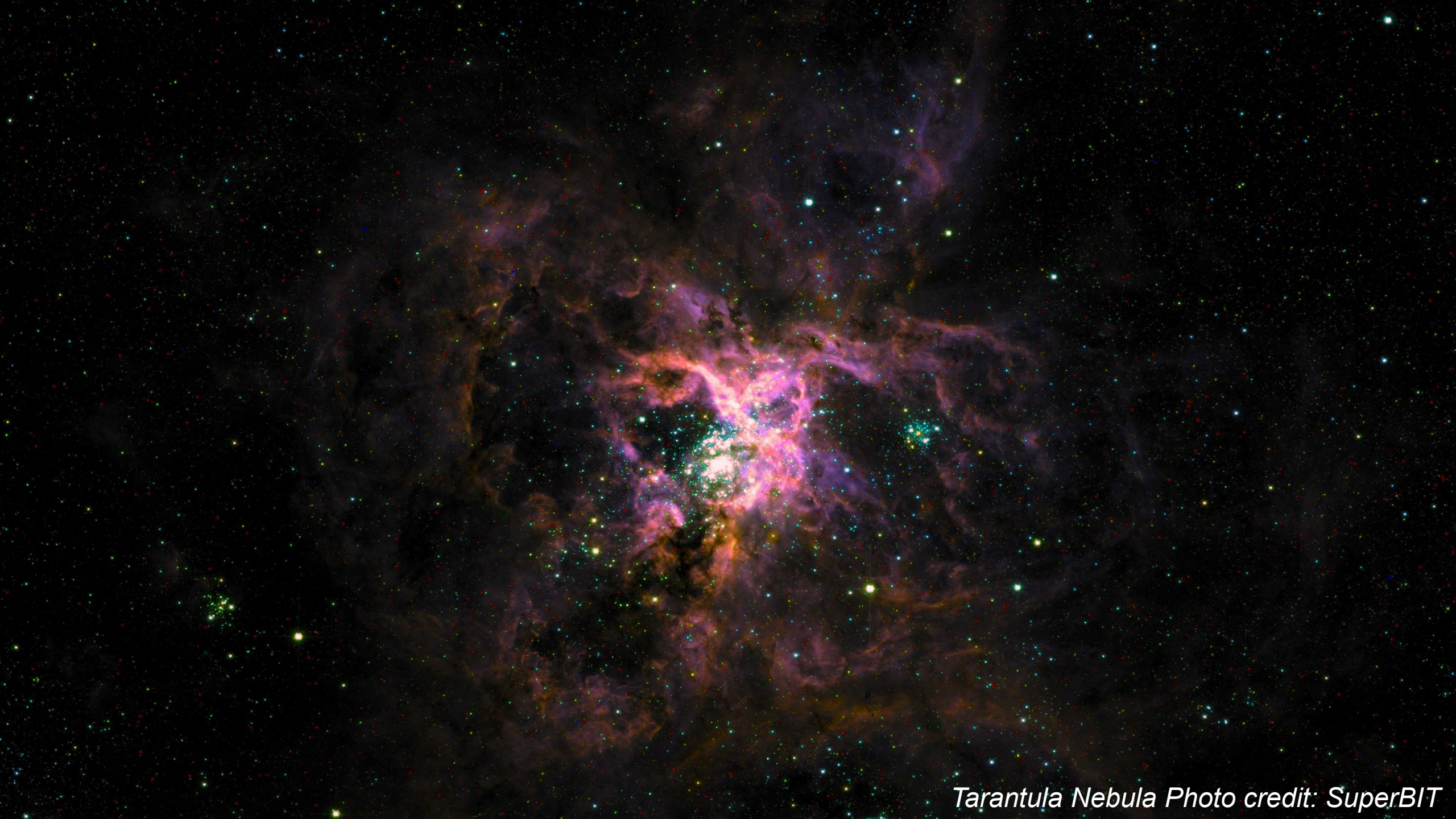
- *Wide-field, sub-arcsecond resolution imager for the SPB platform*
- *Demonstrate SPB capable sub-arcsecond pointing platform*
- *Provide a lensing data for a comprehensive catalog of galaxy clusters*
- *SuperBIT micro-capsule (< 1 kg) 'drop' packages proposed as overflight of land masses occur*
- *SpaceKiwi*
- *Launched April 15, 2023 – 39 day flight circling globe 5.5 times*





Tarantula Nebula Photo credit: SuperBIT

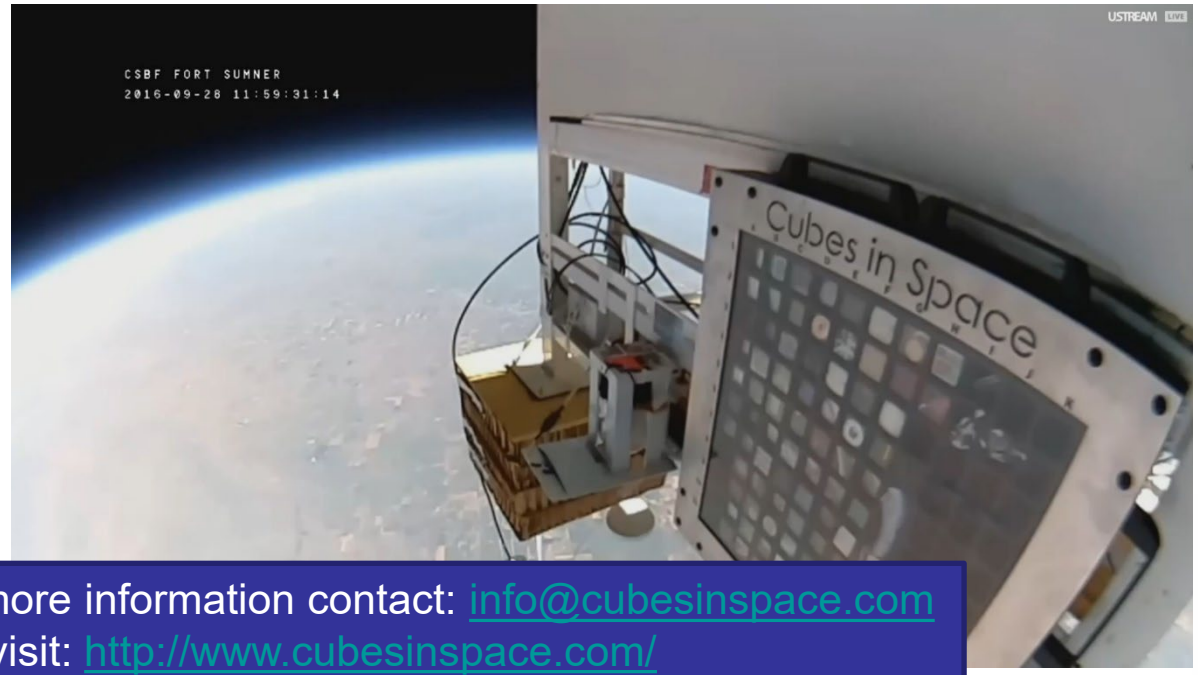
Cubes in Space

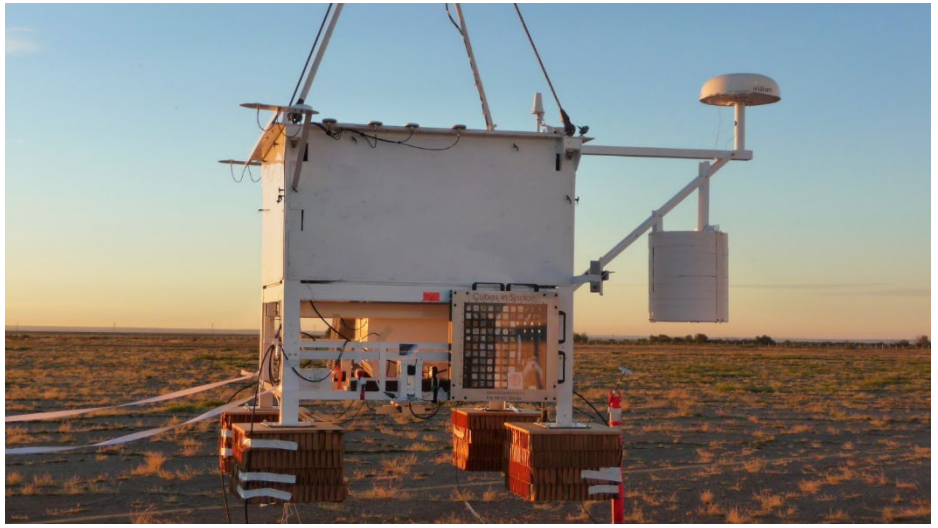
Opportunity to fly on Sounding Rocket or Scientific Balloon

- *Free program begins each fall*
- *Ages 11-18*

Past experiment examples

- *Effect of space radiation on teeth, electronics, fabrics, other materials*
- *Tilapia skin dressings*
- *Effect of g-force on bone*
- *Effect of space flight on concrete*
- *Effects of temperature on certain fabrics*





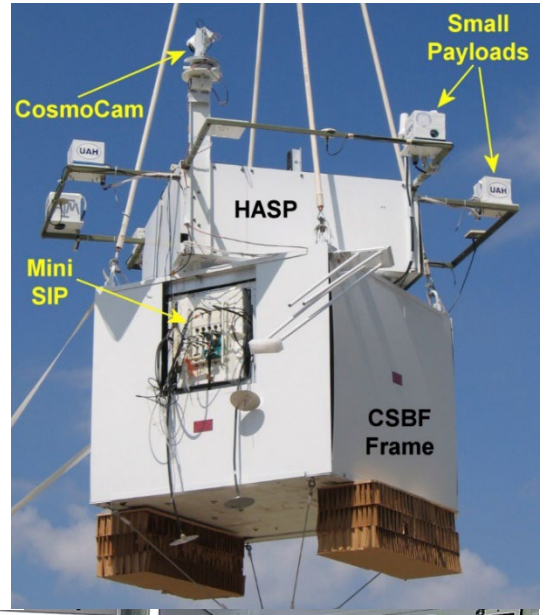
For more information contact: info@cubesinspace.com
And visit: http://www.cubesinspace.com/

High Altitude Student Platform [HASP] Features

- ***Typically University Driven***
- *Support & flight test up to 12 student built payloads*
- *Provide payloads with serial uplink/downlink, 28 VDC power, & analog downlink*
  - *Downlink available in near real time*
- *Include CosmoCam for real time video during launch & flight, past flights can be found on YouTube*
- *NASA partnership supports flights since 2006*
- *More than 1,230 students have been involved with the development and flight of more than 110 payloads. A total of 47 institutions from 22 state plus Puerto Rico, Canada, Belgium, and the United Kingdom have been involved with HASP over the years.*

Past experiment examples:

- *Multi-sensor CubeSat prototype*
- *Flow characterization of flow nozzles w.r.t. altitude*
- *IR imaging of balloon thermal characteristics*
- *Remote sensing camera system*
- *Cosmic ray detector*



For more information visit: https://laspace.lsu.edu/hasp/

Intern.NASA.gov

Goddard Space Flight Center

Wallops Flight Facility

BPO hires at least one intern for spring, summer and fall of each year, the intern is heavily involved in lab work through the Balloon Research and Development Lab. They do hands on materials research, coding, electronics development, data mining, CAD and manufacturing.

INTERN

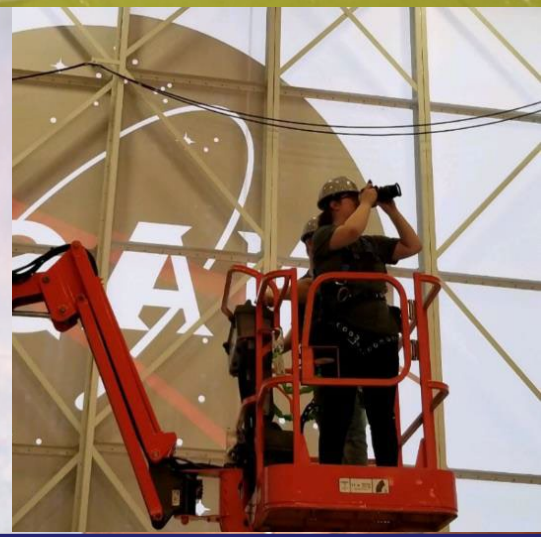
NASA Office of STEM Engagement (OSTEM) paid internships allow high school and college-level students to contribute to agency projects under the guidance of a NASA mentor.

LEARN MORE

PATHWAYS INTERN

The Pathways program offers current students and recent graduates paid internships that are direct pipelines to full-time employment at NASA upon graduation. Launch your career with a Pathways internship.

LEARN MORE



For more information contact: Pat Benner patricia.a.benner@nasa.gov
And visit: https://intern.nasa.gov/

Questions?

For more information visit : https://sites.wff.nasa.gov/code820/