

Overview of the NASA Scientific Ballooning Activities

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Strategic Objective:

Enable discovery through conduct of frequent scientific balloon flight opportunities for NASA scientific, technology development, and educational investigations.

Balloons provide low-cost, quick response, near space access for:

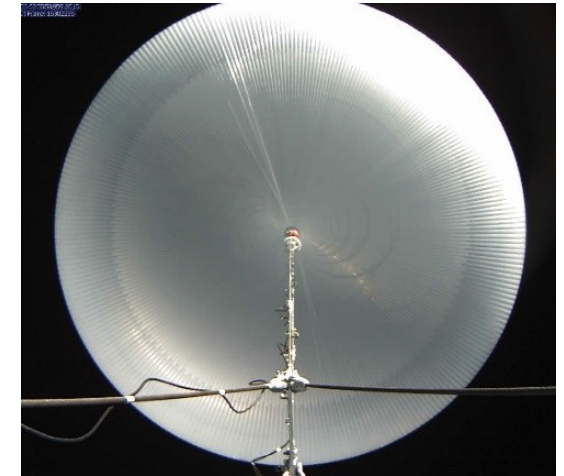
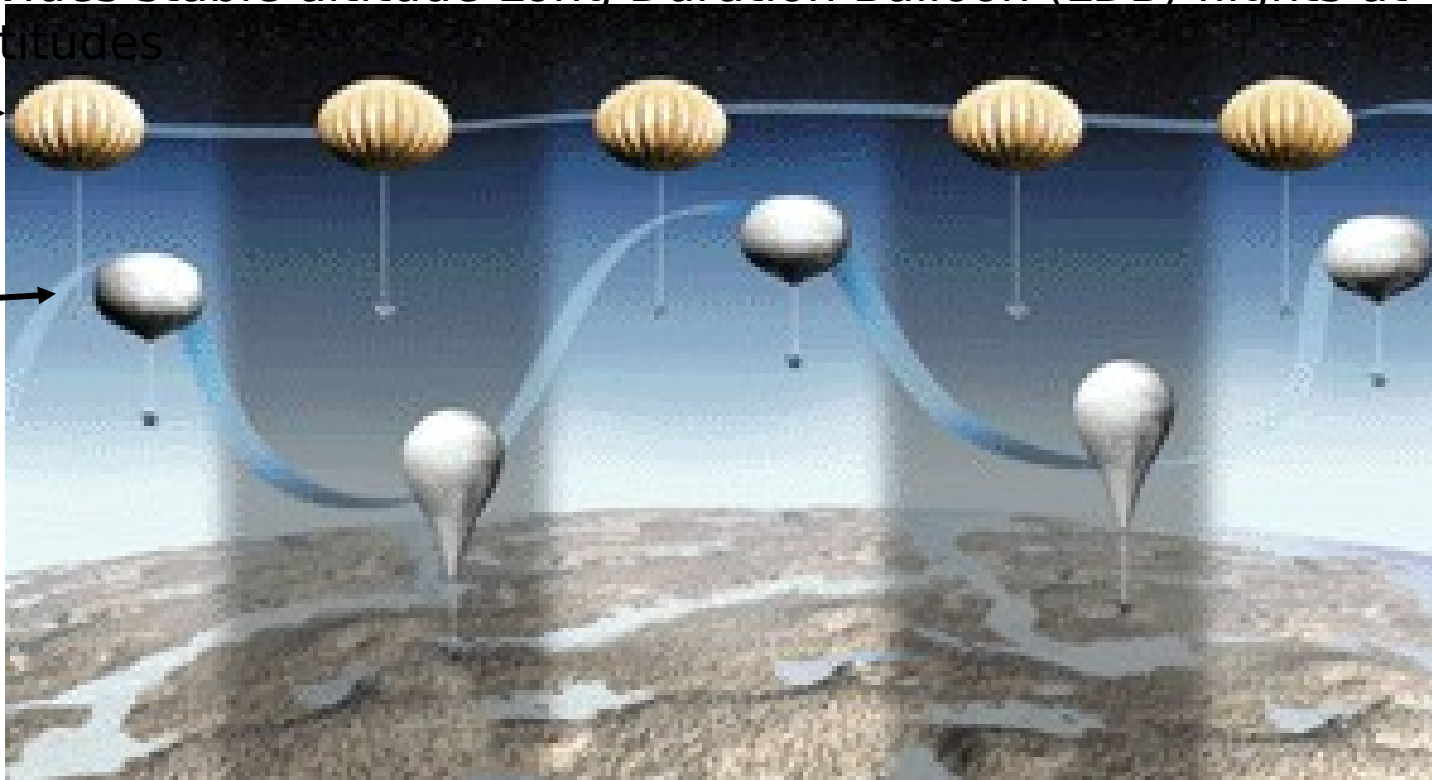
- Conducting cutting-edge research.
- Developing technologies to enable future spacecraft science missions.
- Advancing lighter-than-air platform technologies.
- Providing Calibration and Validation of on-orbit instrumentation.
- Enabling Hands-on Training of the next generation of scientists and engineers.

Annual Program Snapshot
8-12 Launched
3+ campaigns
300+ ugrad/grad students participate
40+ Research Institutions



Super Pressure Balloon maintains nearly constant volume - *under development*

- Allows Ultra Long Duration Balloon (ULDB) Flights
- Provides stable altitude Long Duration Balloon (LDB) flights at mid-latitudes



Zero-Pressure (ZP) Balloon changes volume due to radiative input

- Used for Conventional Flights and Polar LDB Flights

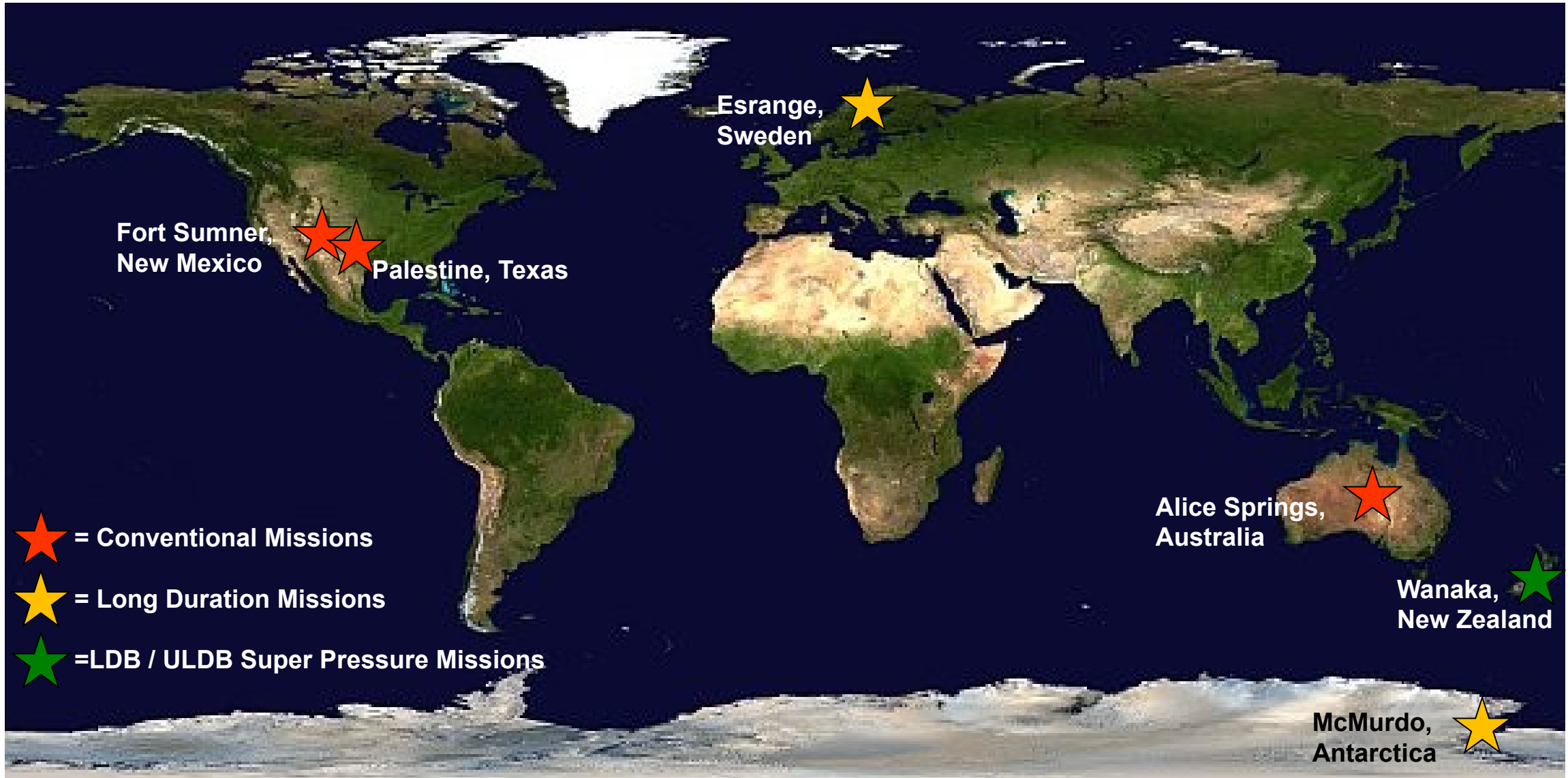


NASA Launch Locations



Goddard Space Flight Center

Wallops Flight Facility



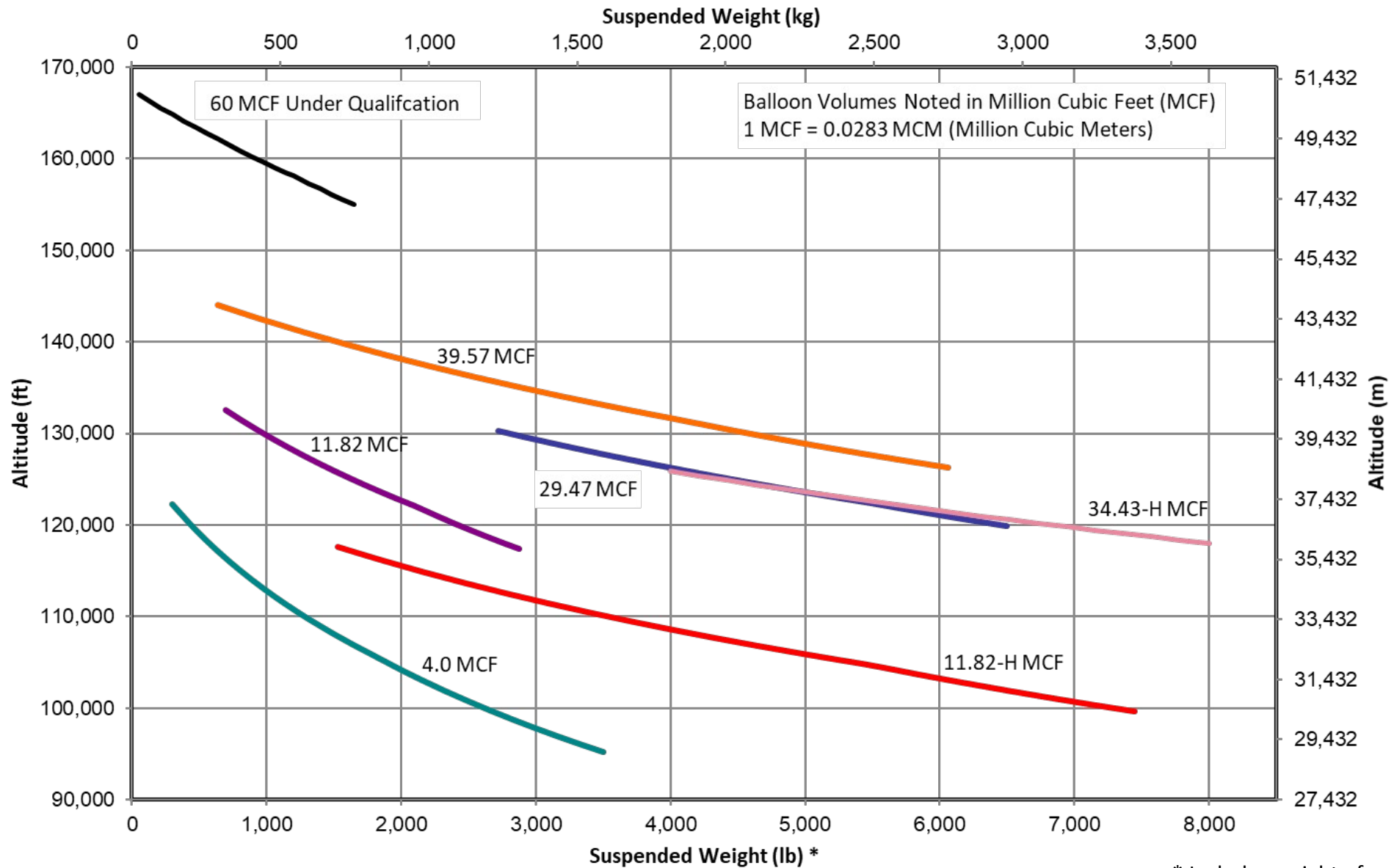


NASA Zero Pressure Standard Balloons



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* Includes weight of parachute and flight train



Super Pressure Balloon Next Flight



Goddard Space Flight Center

Wallops Flight Facility

SPB with COSI as a mission of opportunity was scheduled to fly from New Zealand 2020 when the coronavirus pandemic began. The campaign was cancelled, and the team was brought home.

The next mission, SPB SN07, is now scheduled for New Zealand 2022 with Super-BIT as the mission of opportunity:

- SN07 Maintains the overall key design characteristics of the recent SPB builds:
 - Nominal inflated dimensions:
 - Diameter of 376 feet
 - Height of 233 feet
 - 280 Gores
- SN07 incorporates several design and manufacturing enhancements:
 - Extended balloon cap to accommodate collar placement
 - Improved end fitting capture and gas seal approach
 - Eliminated through-hole penetrations to eliminate potential leak paths.



Super Pressure Balloon (SPB) Instrumentation:

- Diagnostic instrumentation package was developed to provide general health & status, measurement/observation of critical areas of the balloon systems, and in-flight data to validate current modeling tools.
- The following instrumentation has been developed and qualified for the next test flight of the SPB:

PTZ Internal Camera

Fixed Gondola Camera

Balloon Internal Gas Temp

Net Radiometer

Fixed Internal "global" camera

Film Temperature Sensors

Ambient Temp & Pressure

GPS

Fixed "targeted" cameras

Film Strain Sensors

Differential Pressure

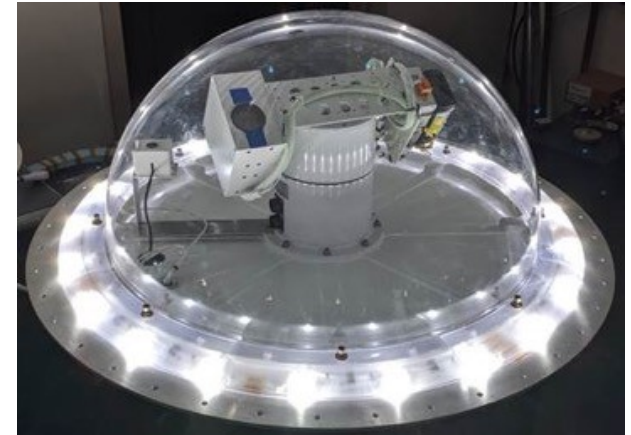
He Flow Meter

PTZ Gondola Camera

Tendon Load Pins

Balloon Height

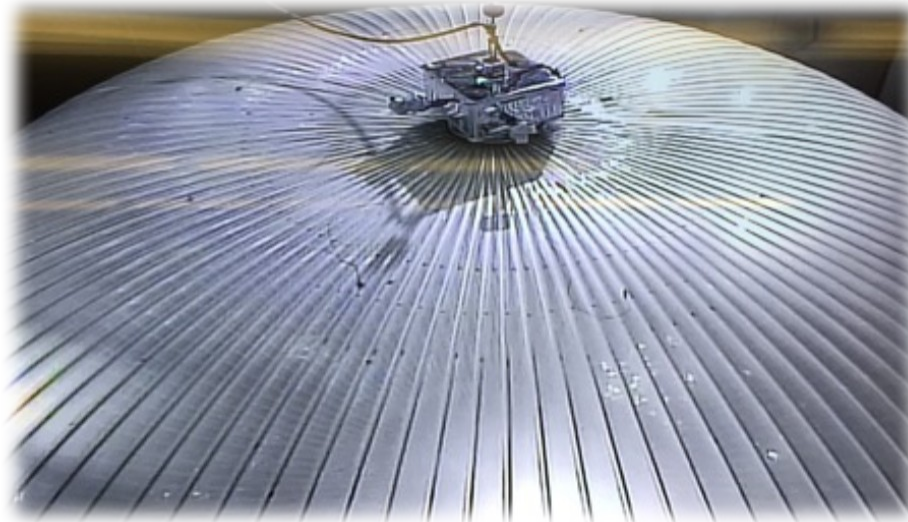
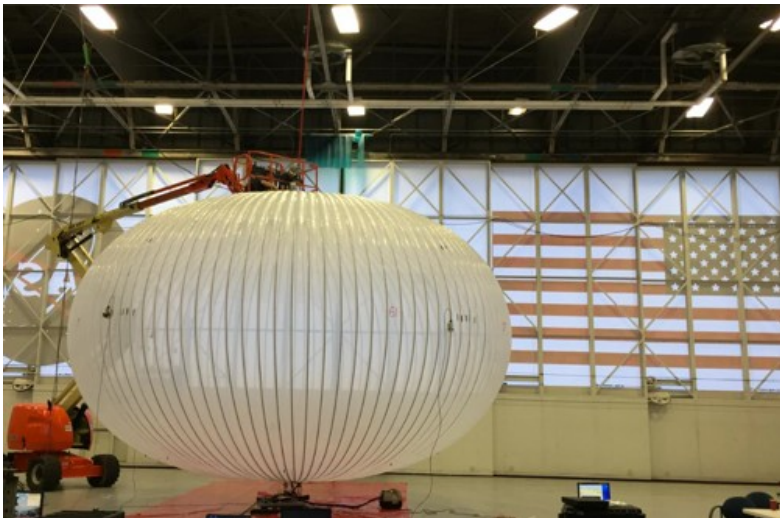
Ballast Load Cell



Base Plate Instrumentation Assembly w/
PTZ Camera Assembly

- One complete set of instrumentation has been fully qualified for flight; Second set of instrumentation is undergoing preparations and qualification for subsequent test flights.

- Three different configured model balloons tested at room temperature and in Plum Brook Station thermal vacuum chamber.
- Increased instrumentation developed and implemented





NASA Support Systems



Balloon Type	Zero Pressure (ZP)	ZP	Super Pressure (SP)
Mission Type	Conventional	LDB	ULDB (In development)
Duration	2 hours to 3 days	4-6 days for Sweden 7-15 for Antarctica up to 55+ days	Up to 100 days 2016 Mid-Latitude Flight = 46 Days
Science Payload Weight	Up to 2,948 kg (Up to 6,500 lbs)	Up to 2,948 kg (Up to 6,500 lbs)	18.8 MCF* – 907 kg (2,000 lbs)
Typical Float Altitude	29.2 to 38.7 km (96 to 127 kft)	36.5 to 38.7 km (120 to 127 kft)	18.8 MCF – up to 34 km (~110 kft)
Support Package	Consolidated Instrumentation Package (CIP) <ul style="list-style-type: none"> Line of Sight (LOS) Up to 12 Mbps direct return 	Support Instrumentation Package (SIP) <ul style="list-style-type: none"> Line of Sight (LOS) - Up to 12 Mbps direct return Over The Horizon (OTH) 6 kbps / 92 kbps TDRSS Downlink** 80 kbps Iridium option*** 	
	Small Launch Package <ul style="list-style-type: none"> Stand alone package for small payload support LOS and OTH TM & Command (Iridium) 255 byte/min packets Up to 12 Mbps LOS option System without batteries ~20 lbs (9 kg) 		

* MCF – Million Cubic Feet **300kbps/1Mbps in development ***Iridium – limited support



FY19 Flight Manifest



Goddard Space Flight Center

Wallops Flight Facility

Mission	Discipline	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
McMurdo, Antarctica	Winter '18												
Rauch/WUSTL/SuperTIGER	Cosmic Ray/Particle			◆ Balloon Leak									
Krawczynski/WUSTL/X-Calibur	Gamma Ray/X-Ray			◆ Balloon Leak									
Salter/CSBF/Trajectory Pathfinder	Test Flight			◆ Success									
Devlin/UPENN/BLASTPOL	Gamma Ray/X-Ray			◆ Readiness Late Preventing Launch – Payload Winter-overed									
Wanaka, New Zealand	Spring '19	Campaign Cancelled due to Government Shutdown											
Palestine, Texas	Summer '19	Campaign Cancelled due to Increased Risk from Leaking Balloons											
Fort Sumner, New Mexico	Fall '19												
Kogut/GSFC/BOBCAT	IR-Submillimeter						Second Flight Cancelled				Success	◆	◆
Fields/CSBF/LDB test	Test Flight												Success ◆
Gopalswamy/GSFC/BITSE	Solar and Heliophysics												Success ◆
Guzik/LSU/HASP	Student Flight Project												Success ◆
Fischer/GSFC/11 MCF Piggyback	Test Flight												Success ◆
Chakrabarti/UMass/PICTURE-C	UV/Visible												Success ◆
Fischer/GSFC/Big 60 Qual	Test Flight						Cancelled out by PI						
Kerber/UMB/MATTADOR	Upper Atmosphere						Cancelled out by PI						



FY20 Flight Manifest



Mission	Discipline	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Fort Sumner, New Mexico	Fall '19												
Toon/JPL-Remote/Bailey/VATech/GLO	Upper Atmosphere	◆ Success											
Kogut/GSFC/PIPER	IR-Submillimeter	◆ Success											
Young/SwRI/THAI-SPICE (Hand Launch)	UV/Visible	◆ Success											
Tang/JPL/RECKTANGLE (Hand Launch)	IR-Submillimeter	◆ Success											
Livesey/JPL/SWITCH (Hand Launch)	IIP/Upper Atmosphere	◆ Successful Ground Test											
McMurdo, Antarctica	Winter '19												
Rauch/WUSTL/SuperTIGER	Cosmic Ray/Particle			◆ Success									
Devlin/UPENN/BLASTPOL	Gamma Ray/X-Ray				◆ Collar Impact/ Science Anomaly								
Salter/CSBF/TRAVALB	Test Flight		Abort	◆	◆ Success								
Wanaka, New Zealand	Spring '20	Campaign cancelled by BPO after initiated due to COVID-19.											
Palestine, Texas	Summer '20	Campaign cancelled by BPO due to COVID-19.											
Fort Sumner, New Mexico	Fall '20	Campaign cancelled by BPO due to COVID-19.											



FY20 Fort Sumner: Small Balloon Platform

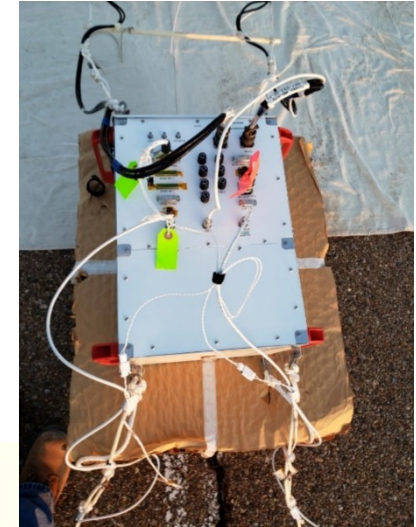


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New Small Balloon Package for “Hand Launches” Introduced

- ❖ Science package ~ 70 pounds
- ❖ Balloon: 1.128 MCF
- ❖ Float Altitude: 125 kft
- ❖ Duration: hours



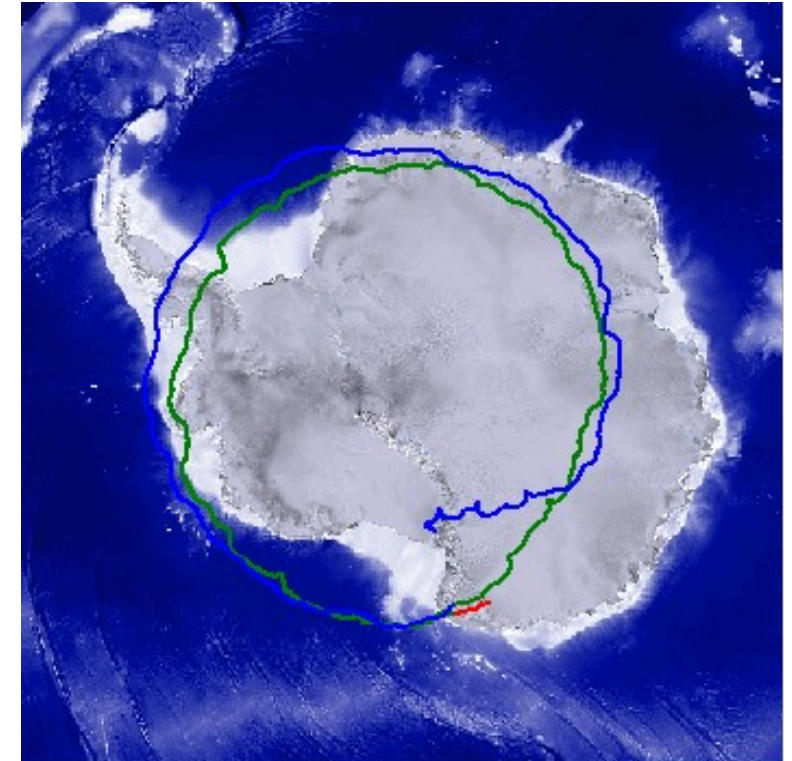
Super-Trans Iron Galactic Element Recorder II (SuperTIGER II)– Flight 706N *Dr. Brian Rauch, Washington University in St. Louis, Astrophysics – Cosmic Rays*

The primary objective is to test the OB-association model of the origin of galactic cosmic rays by measuring the abundances of nuclei heavier than iron. SuperTIGER uses plastic scintillator dE/dx detectors and Cherenkov counters with differing refractive indices. It consists of two modules, each having approximate dimensions 1.8 meters x 3 meters with height 1 meter mounted side by side.

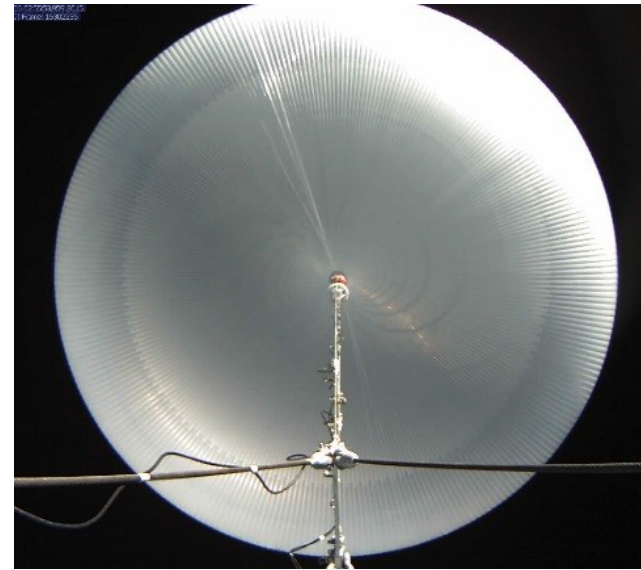
- ❖ Balloon: W39.57-2-118
- ❖ Weight
 - Science: 4,755 lb.
 - Suspended: 5,983 lb.
- ❖ Float Altitude: 126 kft.
- ❖ Launched: December 15, 2019 / 13:55 Z
- ❖ Total Float Time: 32 days



SuperTIGER II pick up on launch day.



- The NASA Balloon Program has continued to provide stable platforms for science.
- The NASA Balloon Program encourages feedback from the science community on future needs.
- Balloons provide an excellent training ground for scientists and engineers.
- After the standing down due to the coronavirus pandemic in 2020, the BPO is back into flying science.



For more information
or flight monitoring:
www.csbf.nasa.gov

