2023 Updates from the NASA Balloon Program Office

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Launch of SuperBIT 2023 Wanaka, NZ

Balloon Program Overview

Goddard Space Flight Center | Wallops Flight Facility

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


SPB SN/07


SUNRISE III

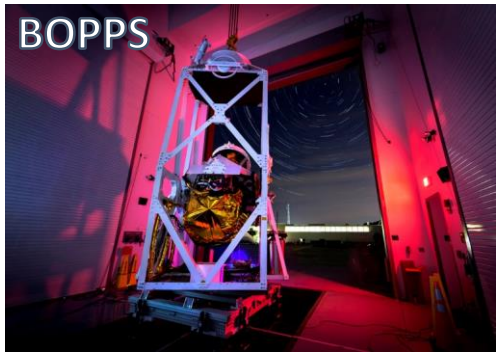

XL-Calibur/WASP

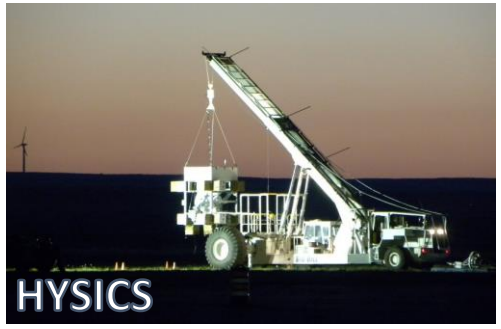

SPIDER

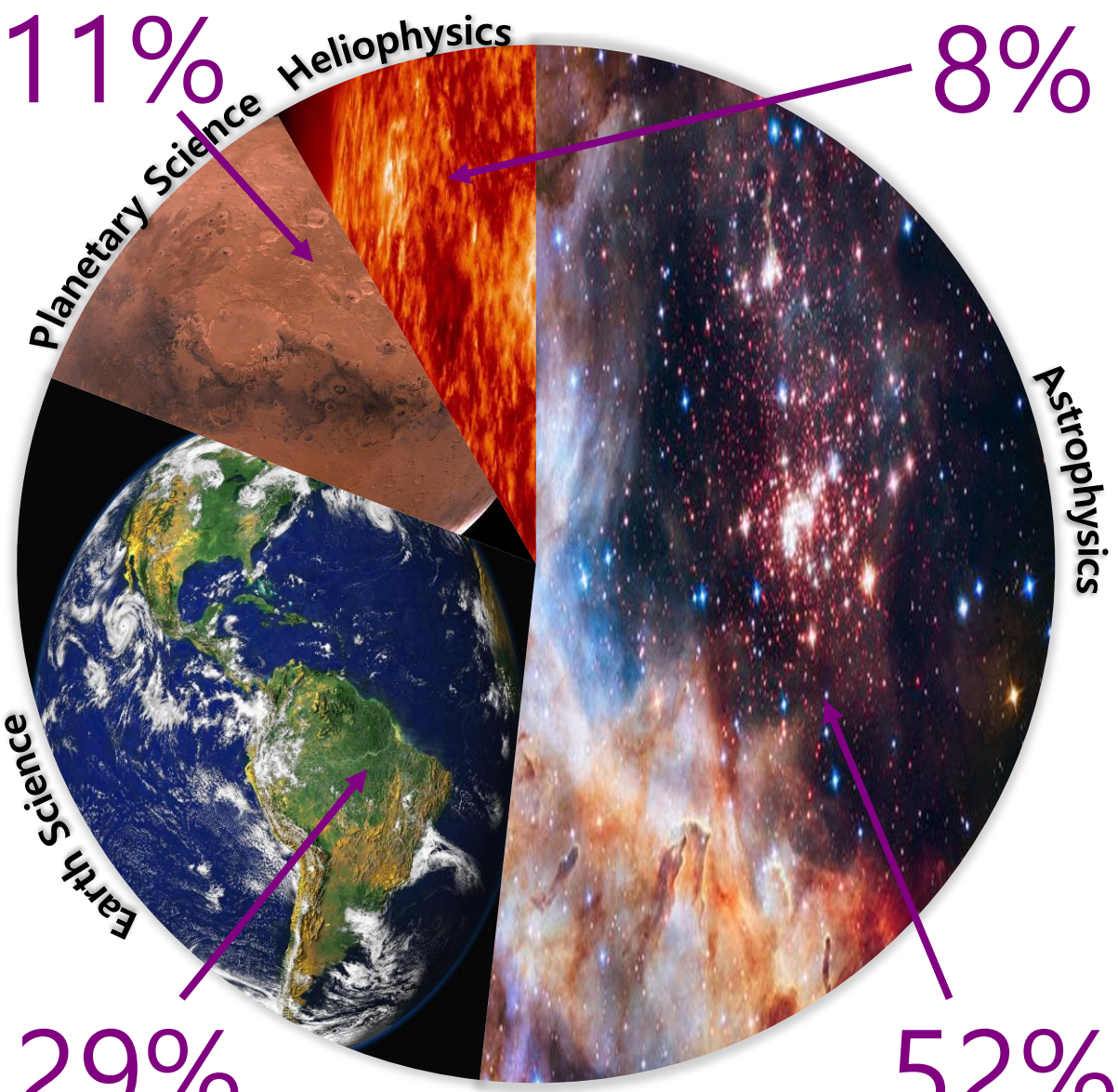
Mission Science Overview

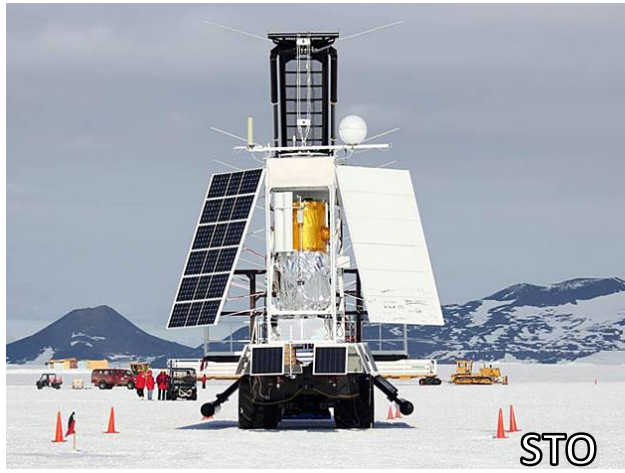
Goddard Space Flight Center

Wallops Flight Facility



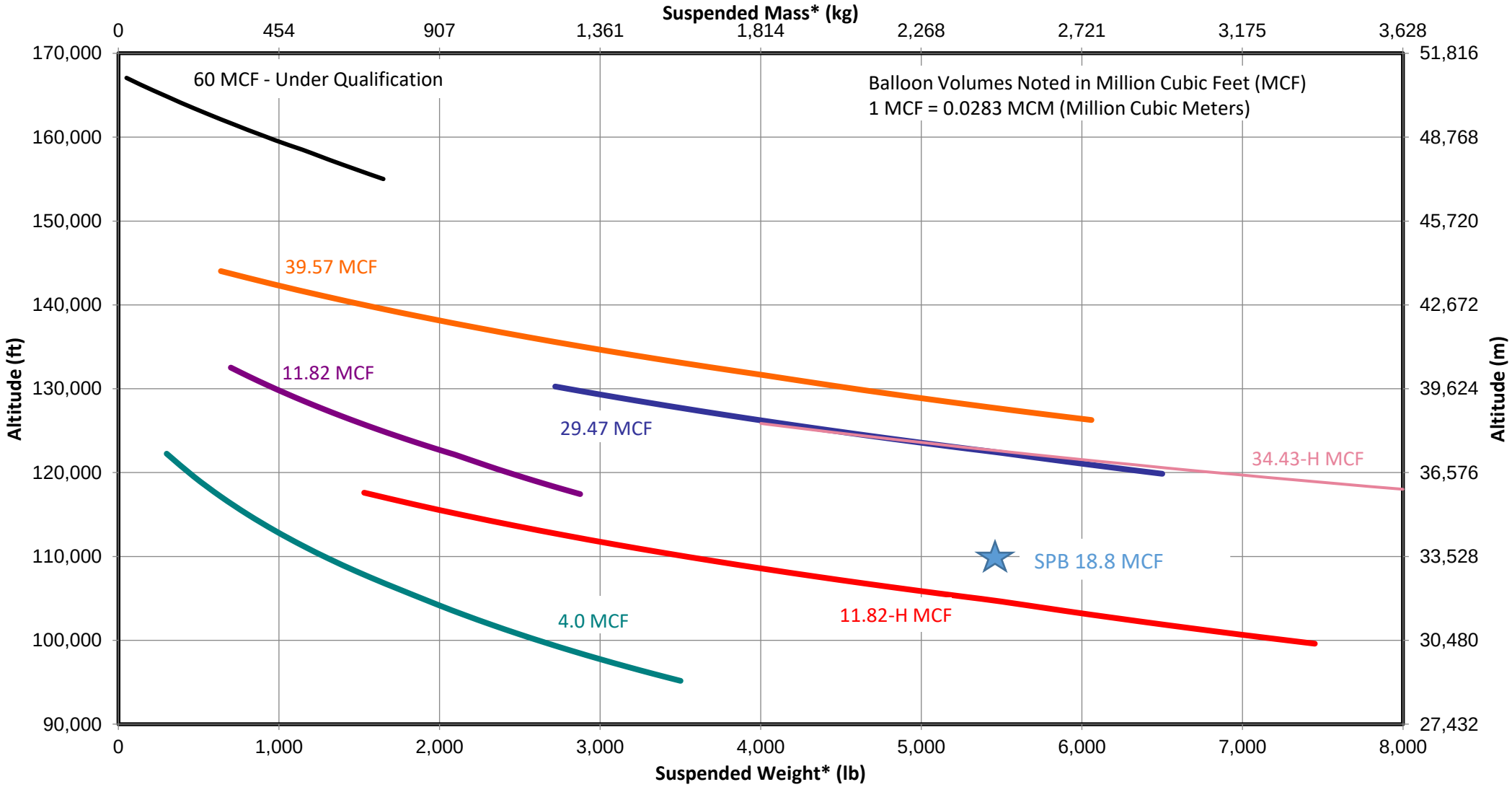




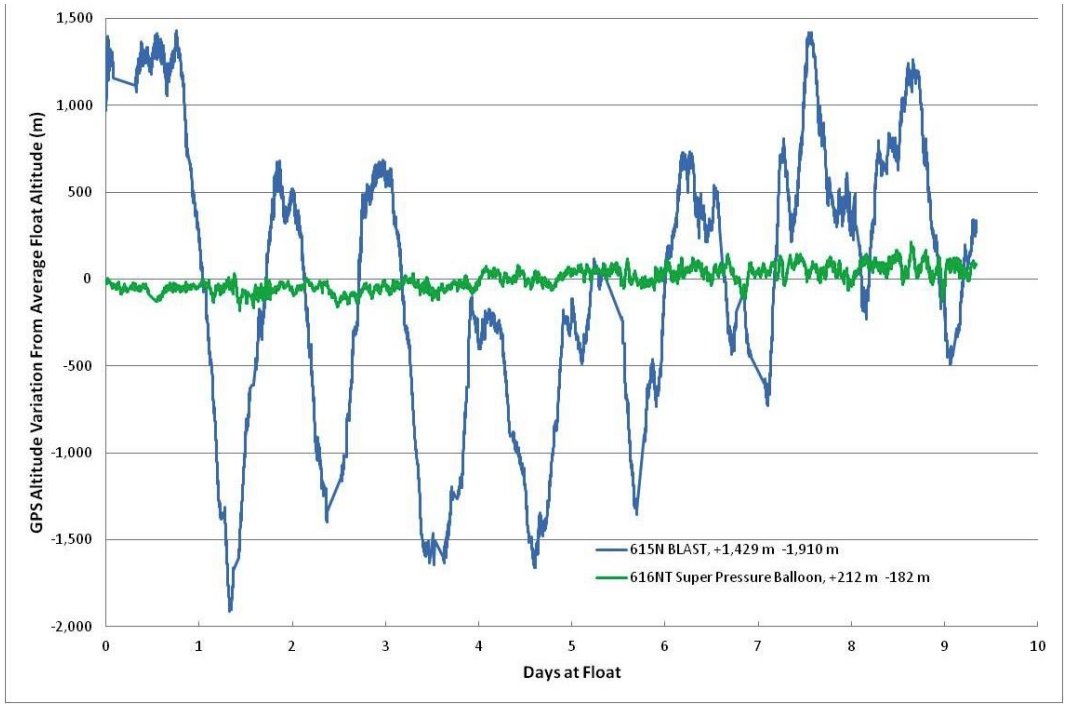


Worldwide Operations

Program Capabilities



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

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)** • Line of Sight (LOS) • Up to 12 Mbps direct return	**Support Instrumentation Package (SIP)** • 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 • 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		

FY22 Flight Manifest

Goddard Space Flight Center — Wallops Flight Facility

Mission	Discipline	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wanaka, New Zealand	***Austral Fall '22***												
Jones / PU / SuperBIT [Payload of Opportunity]	SuperBIT (PO)												
Fairbrother / WFF / SPB SN07	Qualification Flight												
Fairbrother / WFF / SPB SN08	Qualification Flight												
Esrange, Sweden	***Summer '22***												
Roth / WFF/ 60MCF Test	Qual.Flight												
Krawczynski / WUSTL / XL-Calibur	Gamma-Ray												
Wakely / UC / HELIX	Cosmic Ray, Particle												
Solanki / MPS / SUNRISE-III	Heliophysics												
Fort Sumner, New Mexico	***Fall '22***												
Fries / JSC / CDCP	Solar System (ETF) [H/L]												
Wender / LANL / TinMan	Gamma Ray [H/L]												
Salter / CSBF / CSBF Test Flight Salter	Test Flight												
Kogut / GSFC / BOBCAT	IR, Submillimeter, Radio												
Zhou / UCLA / BALBOA	Heliophysics (ETF)												
Guzik / LSU / HASP	Student Outreach												
Mullenax / CSBF / CSBF TF Mullenax	Test Flight												
Boering / UCB / MATTADOR-TF	Upper Atmosphere												
Martin / CalTech / FIREBall-II	UV and Visible												
Chakrabarti / UMASS / PICTURE-C	UV and Visible												
Young / SWRI / THAI-SPICE	UV and Visible												
Switzer / GSFC / EXCLAIM	IR, Submillimeter, Radio												
Kogut / GSFC / PIPER	IR, Submillimeter, Radio												

Cancelled by PI
Launch Abort
Postponed to FY23 by PI
Cancelled by BPO
Inflight Anomaly
Delayed by PI
Science Pointing Anomaly
Delayed by PI
Delayed
Delayed by PI
Delayed
Delayed by PI
Delayed by PI
Delayed

FY23 Flight Manifest

Goddard Space Flight Center — Wallops Flight Facility

Mission	Discipline	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
McMurdo Station, Antarctica	***Austral Summer '22***												
Fillippini / UI / SPIDER	IR, Submillimeter, Radio			◆									
Wanaka, New Zealand	***Austral Fall '23***												
Fairbrother / WFF / SPB SN08 • Jones / PU / SuperBIT [Payload of Opportunity] • Youngberg / WFF / WALRUSS	Qualification Flight						◆						
Fairbrother / WFF / SPB SN09 • Olinto / UC / EUSO [Payload of Opportunity] • Choquette / WFF / Starlink	Qualification Flight							◆					
Palestine, Texas	***Summer '23***												
Fries / JSC / CDCP (ETF) [Hand Launch]	Solar System							*Delayed by PI*		◆			
Wender / LANL / TinMan [Hand Launch]	Gamma Ray							*Delayed to FTS*		◆			
Tang / JPL / WHATSUP [Hand Launch]	Solar System									◆			
Fort Sumner, New Mexico	***Fall '23***												
McConnell / UNH / GRAPE	Gamma Ray											◆	
Krawczynski / UWStL / DR-TES	Gamma-Ray									*Delayed by PI*		◆	
Boering / UCB / MATTADOR-TF	Upper Atmosphere											◆	
Salter / CSBF / CSBF Test Flight Salter	Test Flight											◆	
Granger / LSU / HASP	Student Outreach											◆	
Klienboehl / JPL / JPL-Remote (T)	Earth Science											◆	
Nagler / GSFC / EXCITE (T)	IR, Submillimeter, Radio											◆	
Martin / CalTech / FIREBall-II (T)	UV and Visible											◆	
Young / SWRI / THAI-SPICE (T)	UV and Visible											◆	
Fort Sumner, New Mexico - PIGGYBACKS													
John / UA / IRCSP	Upper Atmosphere											◆	
Zhou / UCLA / BALBOA	Geospace Sciences											◆	
Kierans / GSFC / ComPair	Gamma-Ray											◆	
Agee-DeHart / Idoodlelearning.com / CiS	Student Outreach											◆	
Barcenas / NPI / EMIDSS-4	Upper Atmospher											◆	
DRAGON / BPO	Student Outreach											◆	

FY24 Flight Manifest

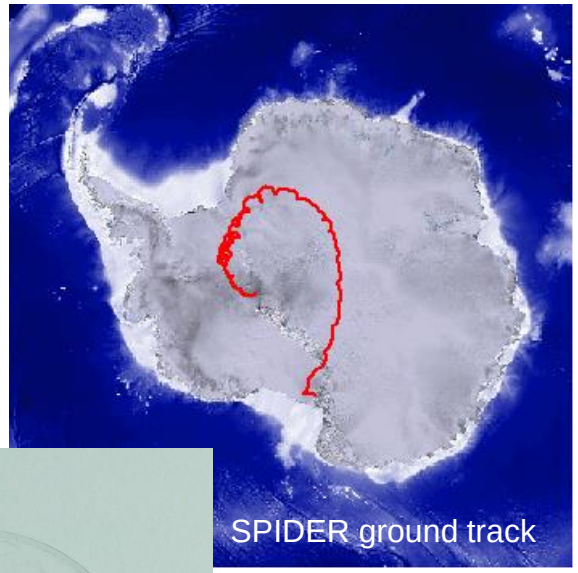
Goddard Space Flight Center *Wallops Flight Facility*

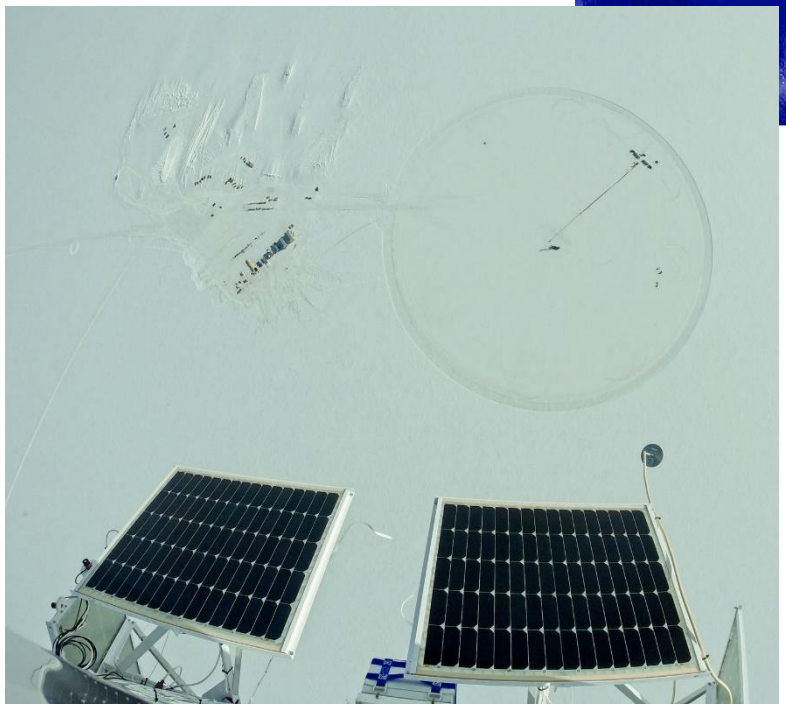
Mission	Discipline	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
McMurdo, Antarctica	***Winter '23 (FY 24)***										
Walker/UArizona/GUSTO	IR-Submillimeter									◊	
Clem/UDelaware/AESOP-60 mcf	Cosmic Ray										◊
Salter/WFF-CSBF/LAURA-1.1MCF	Test Flight (H/L)										◊
Esrange, Sweden	***Spring '24***										
Sample/Montana State/BOOMS	Geospace Sciences			◊							
Krawczynski/WashU/XL-Calibur	Gamma Ray			◊							
Wakely/UChicago/HELIX	Cosmic Ray			◊							
Solanki/MPS/SUNRISE 3	Heliophysics				◊						

FY23 Antarctic Campaign

Campaign: Successful launch of SPIDER!

- Launched on December 21st, 2022 at 21:28 UTC on a 34mcf
- Total duration of 16.25 days at nominal 118 kft altitude
- Science:
  - Balloon-borne sub-millimeter polarimeter using large format arrays of cryogenic bolometric detectors.
  - Goal: To produce high fidelity images of the southern sky on angular scales from 20 degrees to 30 arcminutes.
  - Goal: To provide high signal to noise maps of the total intensity and linear polarization of the 10% of the full sky that is most free of Galactic emission.


SPIDER ground track


LDB camp as viewed from the SPIDER gondola during ascent. Photo credit: SPIDER team collaboration

https://spider.princeton.edu/

Antarctica Photos

Photo credit: SPIDER Team collaboration

FY23 New Zealand

The NASA SPB is being developed to provide a stable platform at constant density altitude for extended duration science investigations at polar and mid latitudes.

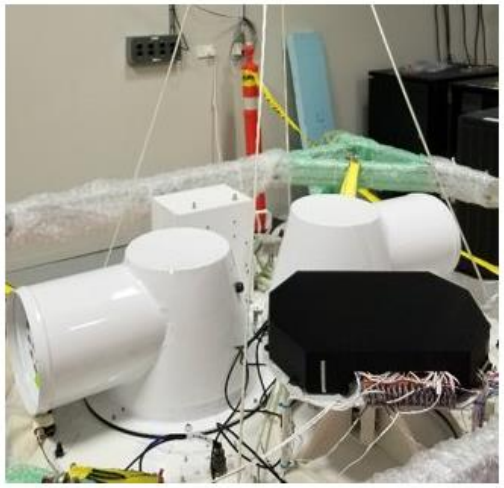
Mission Objective:
- Demonstrate the 18.8 MCF Super Pressure Balloon system
- Goal is to conduct a SPB test flight demonstration (SN08, SN09)

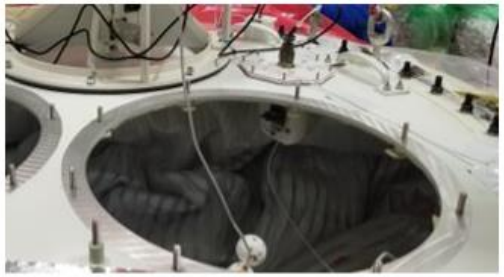
Diagnostic Instrumentation:
- Instrumentation on Apex plate, Base plate, and Gondola
- Provides data to characterize the performance of the SPB system

Flight Duration:
- Program seeks to demonstrate up to 100 days of flight time
- Minimum criteria of 5 days
  - Based on minimal engineering data collection to assess SPB performance
  - Comprehensive criteria targeting 50+ days of flight

Recovery:
- SPB desires recovery of the balloon carcass, but not required
- Realtime decision based on mission performance status, safety and location

Apex:





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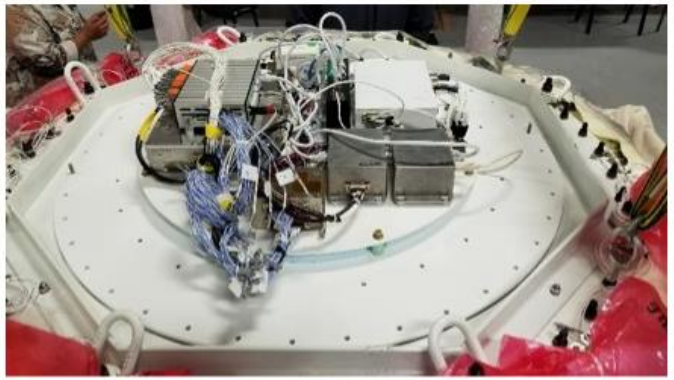
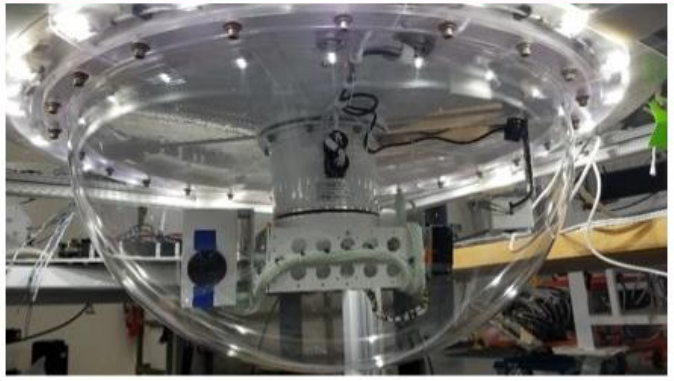




FY23 New Zealand Science

Super Pressure Balloon Imaging Telescope – SuperBIT

- Mission Description:
- 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. Testing physical data drops.

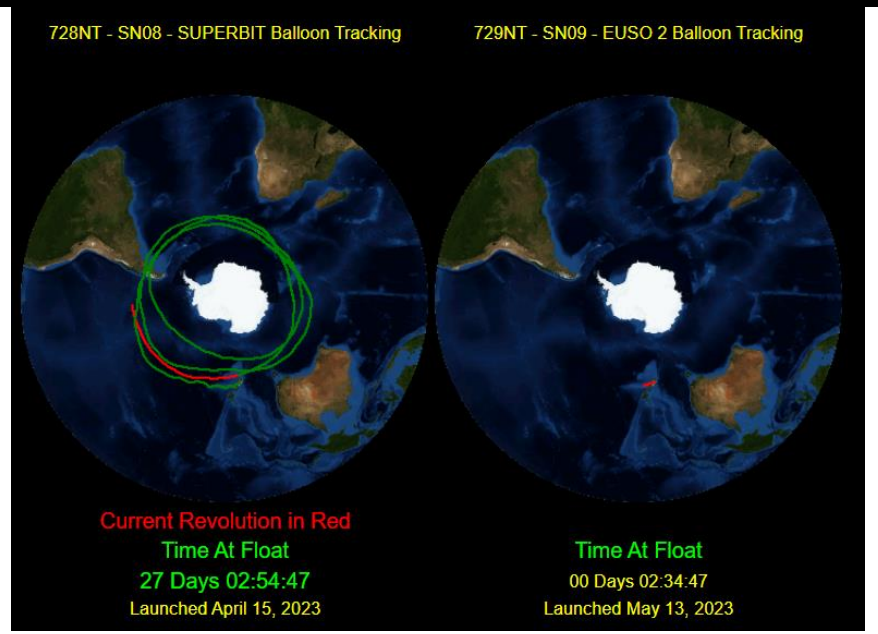
- Additional Notes:
- SuperBIT micro-capsule (< 1 kg) 'drop' packages proposed as overflight of land masses occur.
- WALRUSS is a piggyback.

Extreme Universe Space Observatory 2 – EUSO2

- Mission Description:
- This payload will include two optical astroparticle “telescopes”, one pointing near the Earth’s Limb with sensitivity to direct Cherenkov Light, the other looking in the Nadir with a sensitivity to UV fluorescence light.
- Make the first observations of high energy extensive air showers with the optical fluorescence technique. Make the first observations of direct Cherenkov light from extensive air showers. Search for tau neutrinos below the limb and measure optical backgrounds to this signature.

New Zealand Photos

Goddard Space Flight Center *Wallops Flight Facility*



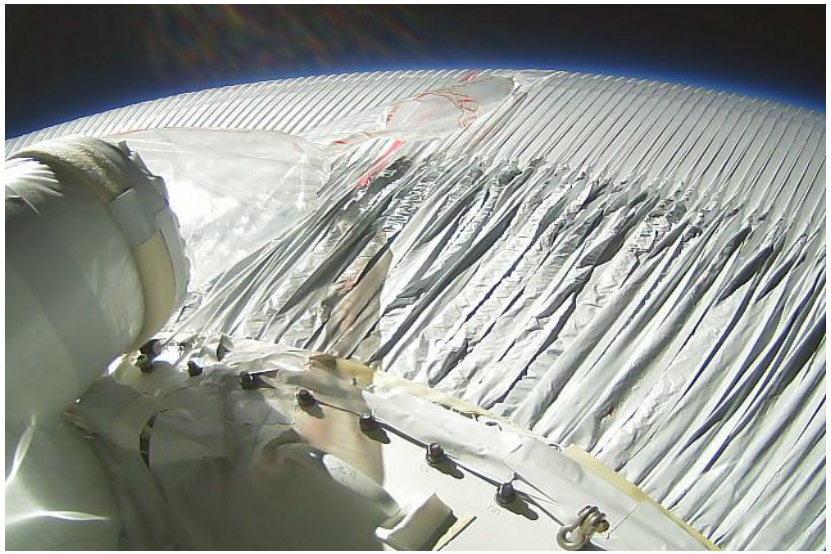
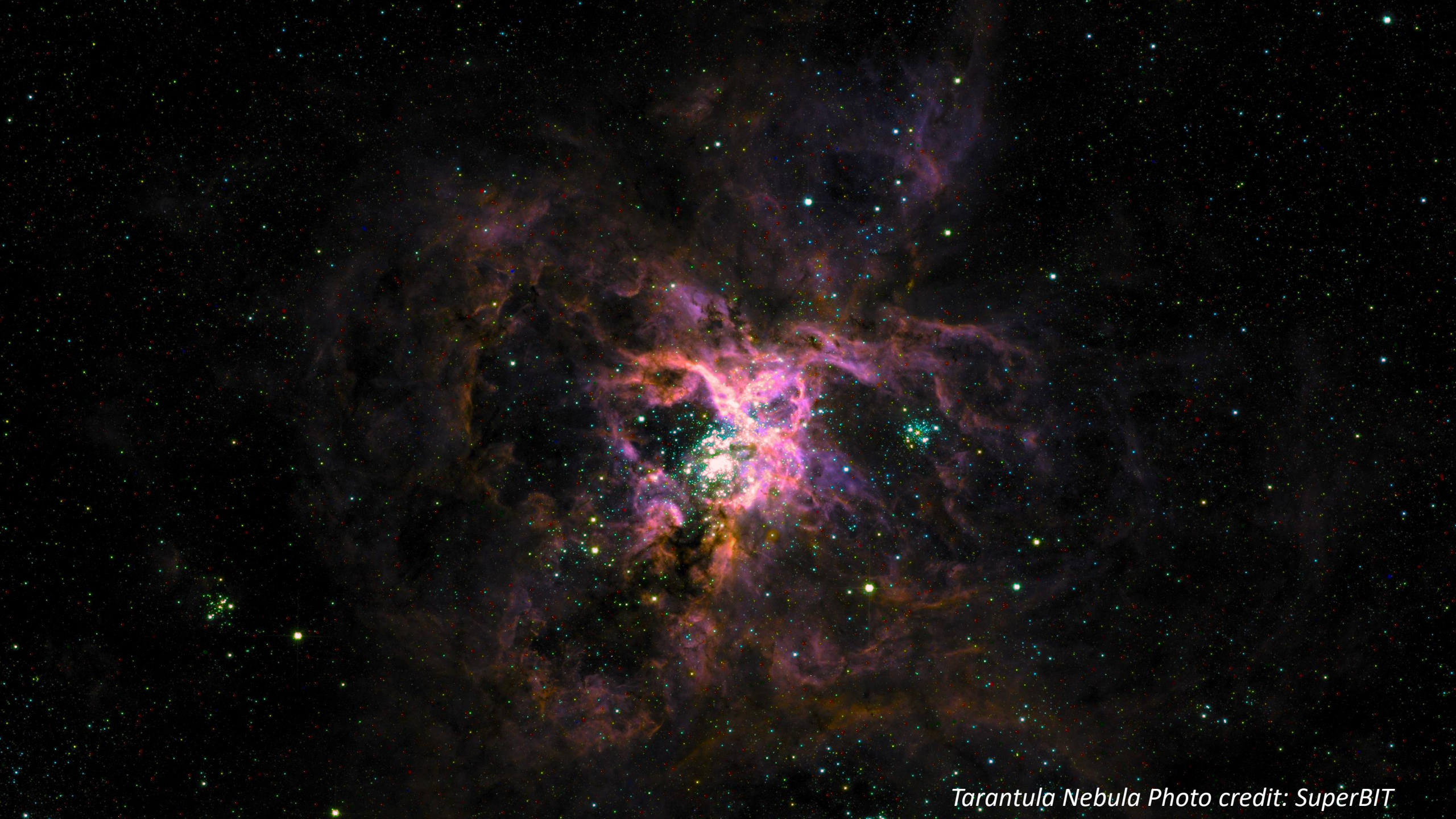


Photo credits: Bill Rodman, CSBF website, SPB instrumentation cameras



Tarantula Nebula Photo credit: SuperBIT

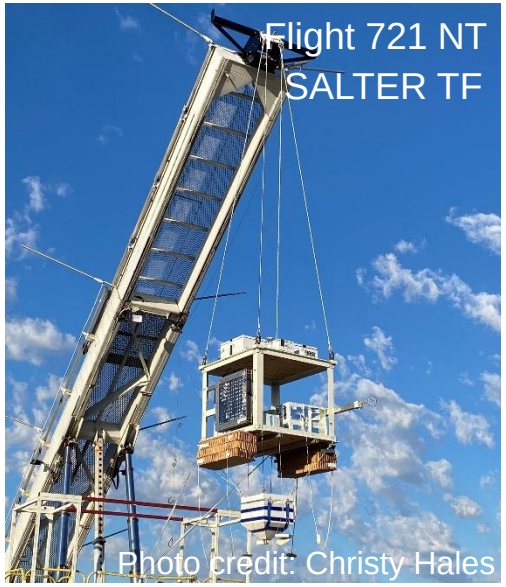
FY23 Palestine

The FY23 Palestine mission features a return to flight from CSBF. This campaign will consist of a hand launch campaign with three missions utilizing a smaller balloon and launch configuration.

FY23 Ft. Sumner

Goddard Space Flight Center | Wallops Flight Facility

The FY23 Ft. Sumner campaign will feature fifteen science/student missions on nine flights (with four turnaround missions). This is the busiest manifest since before COVID-19. Supply chain issues continue to impact science team readiness.



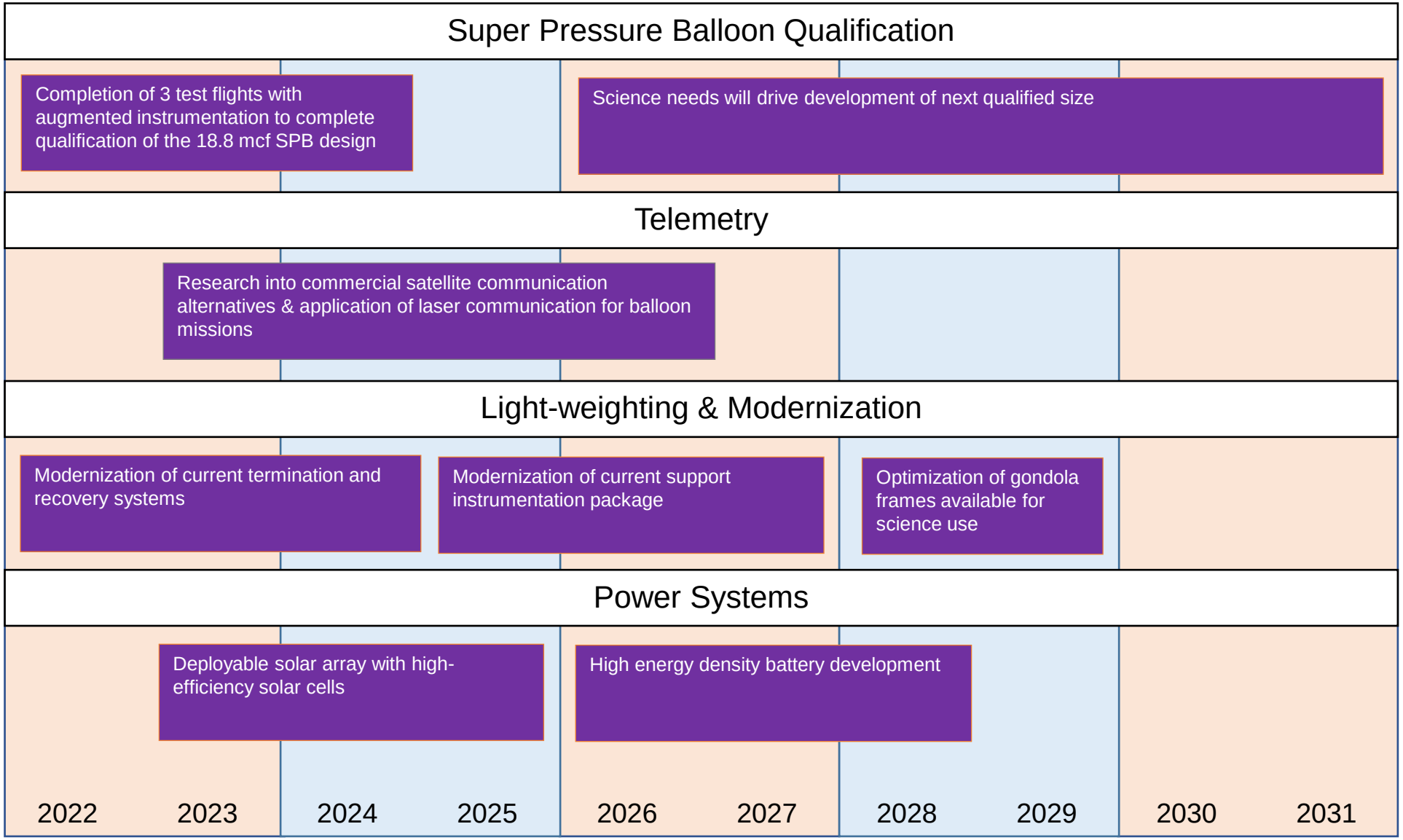
Technology Development

- Priority Determination
  - Science requirements
  - Obsolescence
  - Risk reduction
  - Capability enhancement
- Funding
  - Program funds
  - Internal Research And Development, Small Business Innovation Research, Reimbursable projects
- Annual Test Flight Opportunity
  - Will include piggybacks if space allows
  - Fall Fort Sumner, New Mexico
- Personnel
  - Management through NASA Balloon Program Office
  - Matrixed engineers from NASA Engineering & Technology Directorate and NASA Balloon Operations Contract

Technology Development Priorities

Goddard Space Flight Center — Wallops Flight Facility

Technology Roadmap

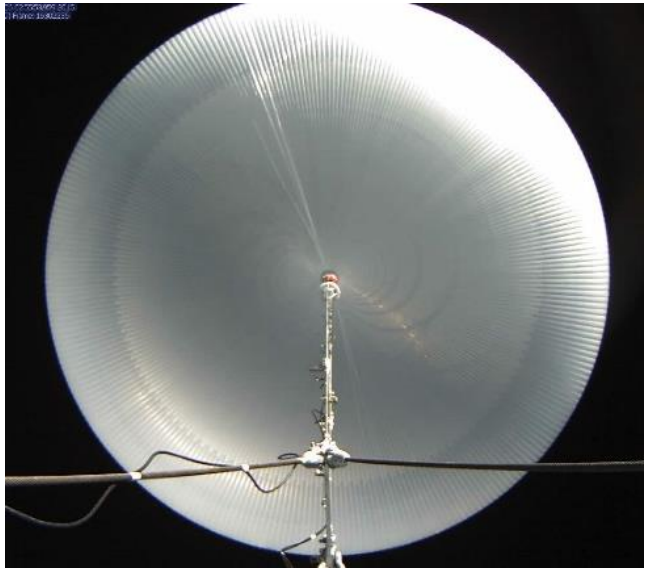


GOALS

- Super pressure balloon qualification
- High data rate telemetry
- Increase available science mass
- Push state-of-the-art for solar panels and battery chemistries
- Modernization and standardization of support equipment

Summary

- 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.
- The Program has been busy trying to catch up after the downtime due to the coronavirus pandemic.



Acknowledgements

The activities reported today would not have been possible without the dedication and support from NASA, NSF, the Balloon Program Office, the CSBF, Raven Aerostar, the National Institute of Aerospace (NIA), the science community, and our support contractors!

Photo credit: Andy Hynous

Tell us what you think:

What capabilities, technology, services, etc. do **YOU** want to see from the NASA Balloon Program Office in 5-10 years?

Tell us!
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