Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

BLAST

Balloon-borne Large Aperture Submillimeter Telescope

Photo: Mark Halpern

Northwestern
Peter Ashton
Erin Cox
Giles Novak

NRAO
Laura Fissel

ASU
Chris Groppi
Phil Mauskopf
Sam Gordon
Adrian Sinclair
Matt Underhill

UPenn
Gabrieli Coppi
Mark Devlin
Simon Dicker
Nate Lourie
Ian Lowe
Javier Romualdez

NIST
Jason Austermann
Brad Dober
Jiansong Gao
Gene Hilton
Hannes Hubmayr
Christopher McKenney
Michael Vissers

UBC
Douglas Scott

Cardiff University
Peter Ade
Giampaolo Pisano
Carol Tucker

CEA/IRFU/SAp, France
Juan Soler

Toronto
Peter Martin

Nagoya
Yasuo Fukui

University of Virginia
Zhi-Yn Li

BLAST Level 1 Requirements

Altitude:

120kft desired. 110kft Minimum.

Altitude Stability:

+/- 1000 ft desired. +/- 3000 minimum.

Duration:

28 day desired. 14 day minimum.

Launch Date:

Later is better. No earlier than December 15th.

We plan to be ready early.

CSBF Component Requirements

Thermal:

CSBF Components hang below telescope – No thermal issues with BLAST.

Pointing:

CSBF does not point the telescope – No pointing requirements.
- BLAST will use CSBF GPS data.

Telemetry:

- TDRSS Direct (115.2 kbps over high gain antenna)
- TDRSS (COMM 1/2) high rate (92 kbps) and low rate science port (6 kbps)
- Iridium Pilot (nominal 128Kbs, typical 80/100 Kbps)
- Iridium low rate science ports (2 kbps)
- 2 Science dedicated LOS L-Band/S-Band return TM
    - 1 Mbps - LOS Bi-Ø downlink (2Mbps if possible).
    - 1 video – LOS.
- Science stack interface for commands only

Recovery:

- Minimum – Recover Hard Drives
- Desired
    - Receiver
    - Attitude Control System
    - Electronics
    - Primary mirror (not with Twin-Otter)
- IDEAL - recovery of the entire instrument

Experiment Performance - Detectors, Pointing Systems

Pointing

- Acquire target and determine array position on star camera
- 4 arcsecond pointing reconstruction
- Target – beam patterns and sensitivity

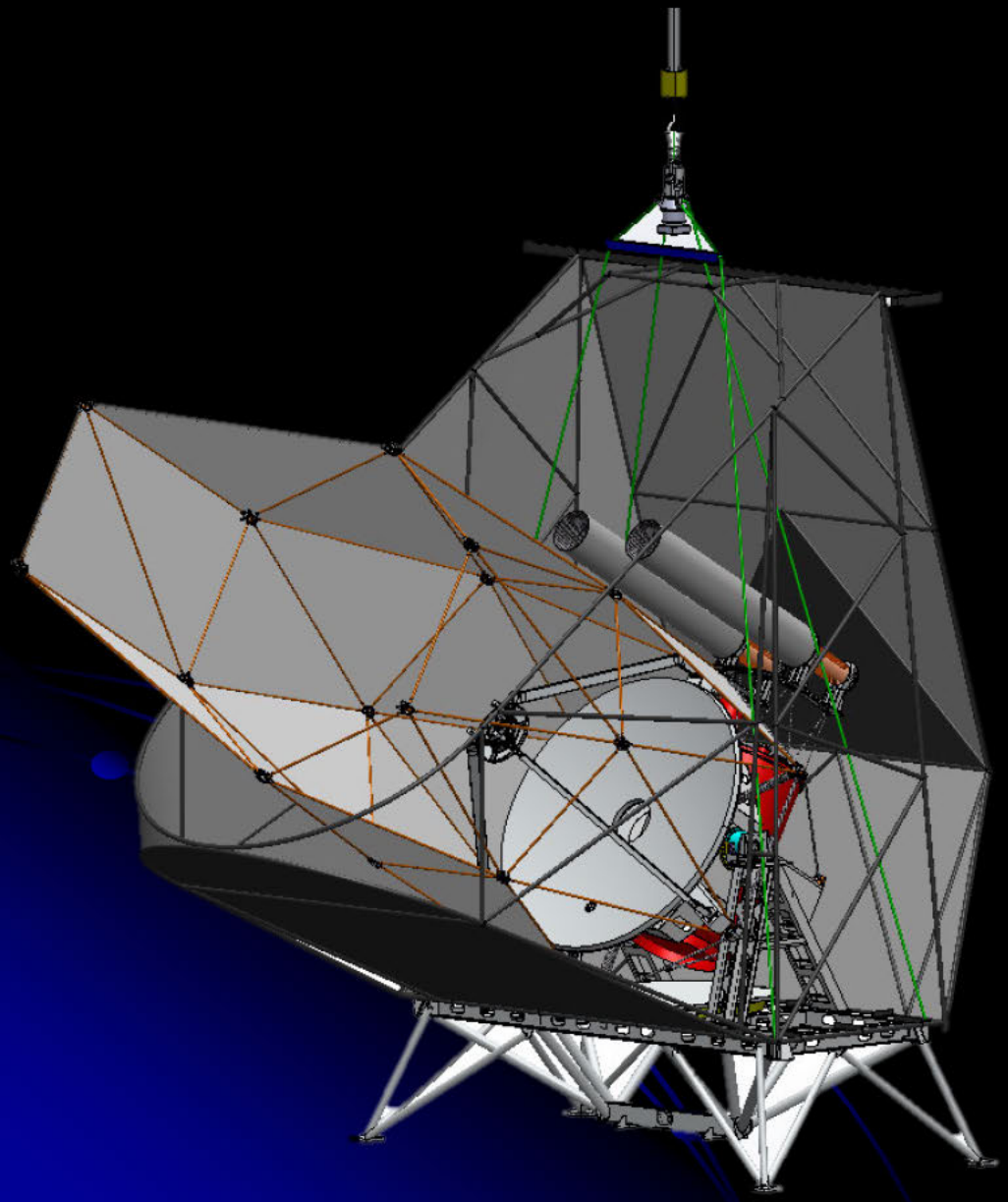
Detectors

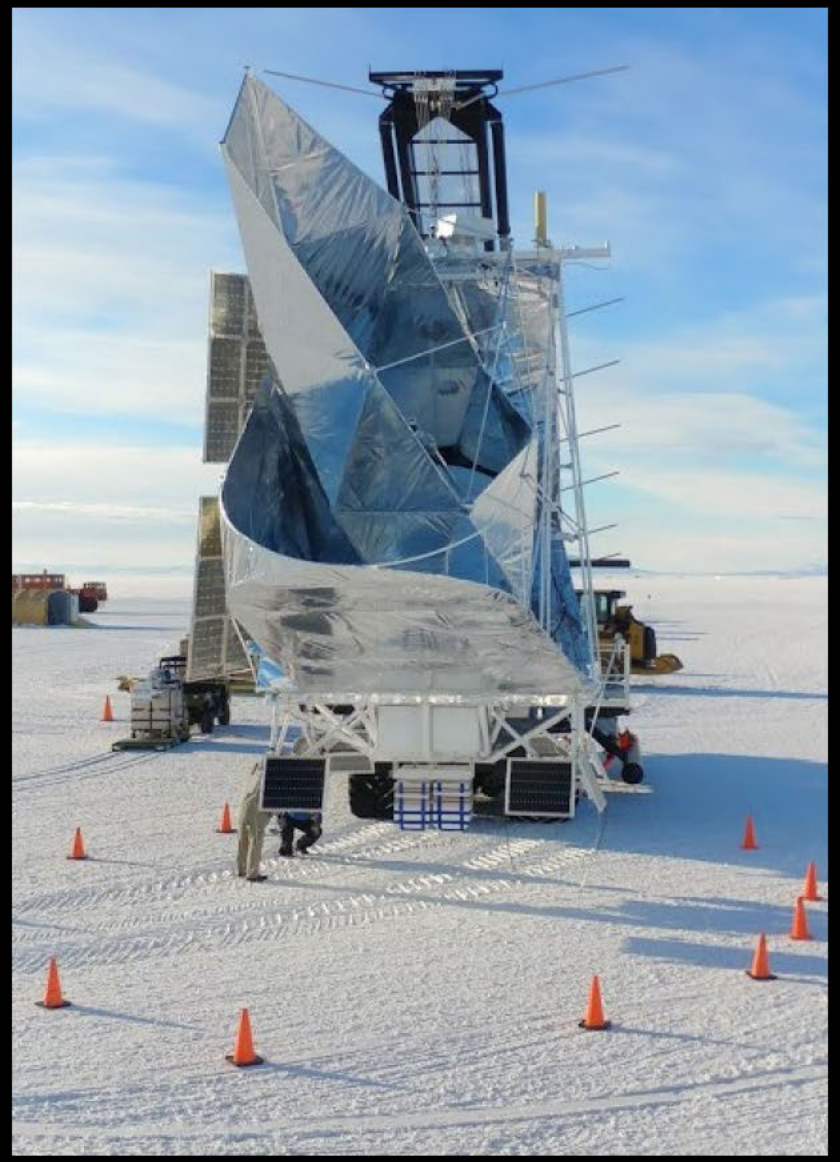
- 250, 350, 500 micron arrays functioning normally.

Science:

- Measure star forming cores
- Measure Polarized dust
- Total: 10 regions

The Balloon-borne Large Aperture Submillimeter Telescope – BLAST





SPECIFICATIONS:

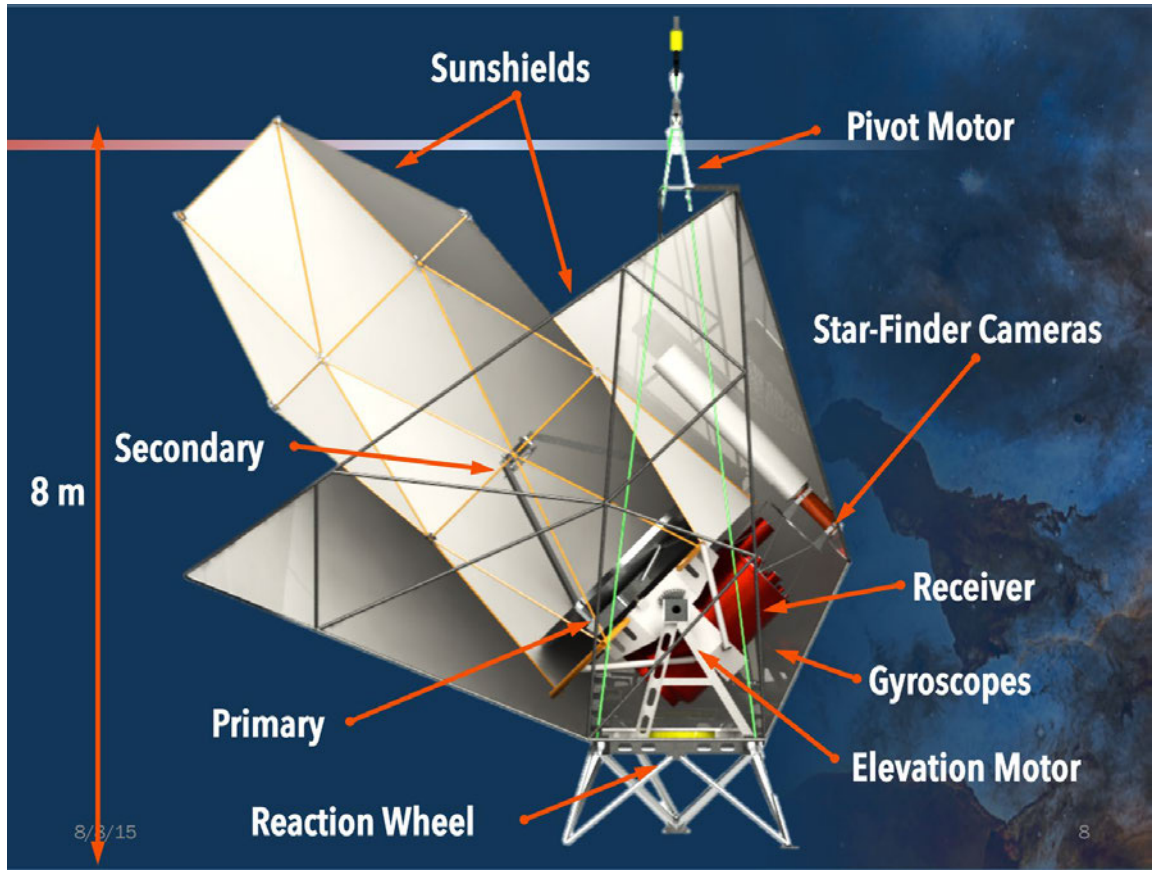
- 2.5 meter Carbon Fiber Mirror
- 2200 KID detectors
  - 250, 350 and 500 μm
  - Polarization Sensitive
  - 280 mK
- 22 arcsec resolution at 250 μm
- 28 day flight!

Science:

- Polarized dust emission in star forming regions in our Galaxy.
- Polarized dust emission in low dust regions for CMB polarization foregrounds.

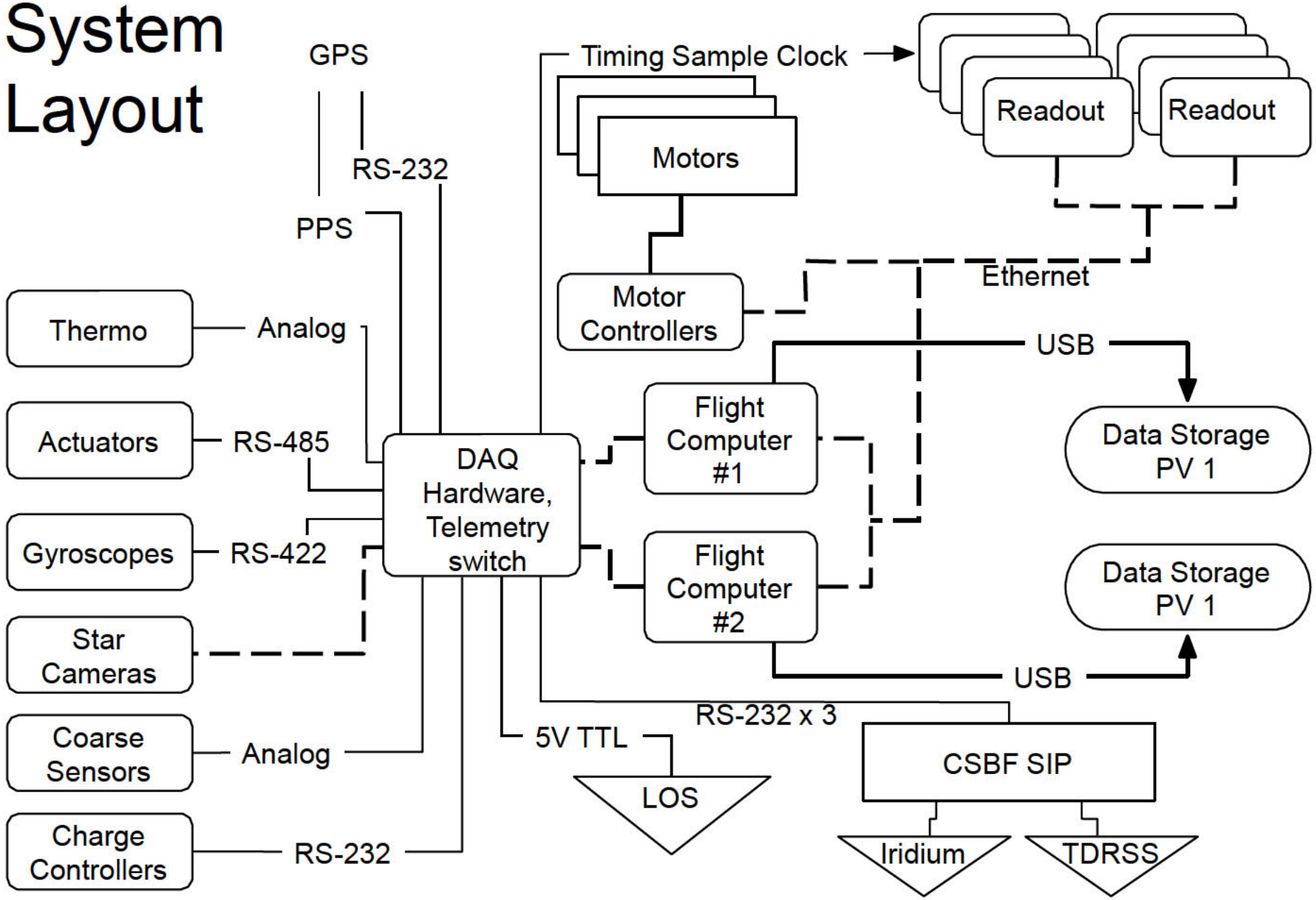
Flight from Antarctica December 2019

Summery of Ice Schedule



- Advance team arrives late October.
    - Remove receiver and replace cold LNA.
    - Update plumbing at top of receiver.
    - Cool receiver
    - 3 days of testing.
    - Install on gondola.
- Mirror repair in parallel with the receiver cooldown.
- All together and doing pointing tests by November 20th
- Flight ready December 1st with two weeks contingency.

System Layout



Mass Budget

TOTAL MASS = 4885.44 (Not Including Misc)

Inner Frame		IF Total =		2255
Item	Weighed	Estimate	Number	Total
Inner Frame		409	1	409
Scoop / Sunshields		125	1	125
Vanguard Telescope		305	1	305
Balance Bricks		25	4	100
Cryostat	800	1022	1	800
Optics Box		150	1	150
Roach Motel	115	70	1	115
Preamps/Heaters		20	1	20
Wiring		20	1	20
Gyro		3	2	6
Star Cameras	36	40	2	72
Full Set of Cryogens	70		1	70
Star Camera Baffle		6	2	12
Star Camera Mount		25	1	25
IF BOB		10	1	10
IF UEI		1	1	1
IF Power		15	1	15

Outer Frame		OF Total =		2488.2
Item	Weighed	Estimate	Number	Total
Battery	60		4	240
Charge Controllers	7.6		2	15.2
Solar Panels/Supports		65	0	0
FLC		3	1	3
OF UEI		1	1	1
OF BOB		10	1	10
OF Power		15	1	15
Electronics Racks		20	1	20
Cables/Other Electronics		30	1	30
Sunshields		337	1	337
Lock Motor and Ring		30	1	30
Sun Sensors		20	0	0
Pivot	95		1	95
Elevation Mount (Pyramid)		90	2	180
Elevation Bearing		15	1	15
Motor Yoke		30	1	30
Bearing Yoke		35	1	35
Base Frame		452	1	452
Base Frame Legs		15	4	60
Elevation Motor + Gear Box		70	1	70
Flywheel and Cover	250		1	250
CSBF Stuff		600	1	600

Suspension System		Suspen
Item	Weighed	Estimate
1/2" Cable/ft		0.0
3/4" Cable/ft		0.1
1/2" Cable Turnbuckle		10.0
Spreader Bar Ends		10.0
Spreader Bar Ends		25.0
1/2" Closed Spelter	1.5	
1/2" Open Spelter	2.25	
3/4" Closed Spelter	4.25	
3/4" Open Spelter	5.83	

Confidence Level on Value:
- Confident
- Some Uncertainty
- Poor Estimate

At CSBF in July 2018 we weighed in at: 5150 lbs including the SIP.

- Add, SIP batteries, Mylar, front scoop ~ 150 lbs.

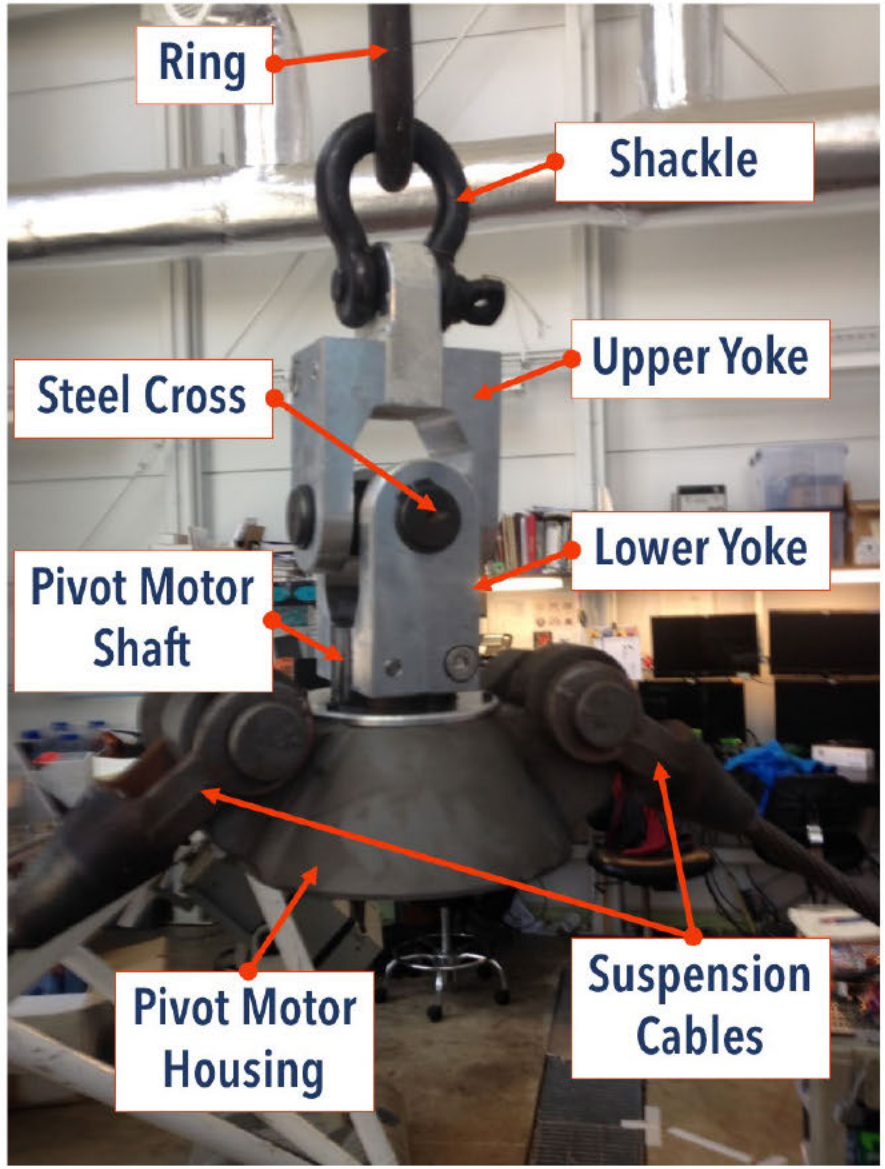
- WEIGH-IN for Launch Attempt #2 – **January 2, 2019**
  - Payload Mass = 5,775
    - No CSBF Solar Arrays
    - No Ballast Hoppers
    - Including Wheels (~25 lbs)

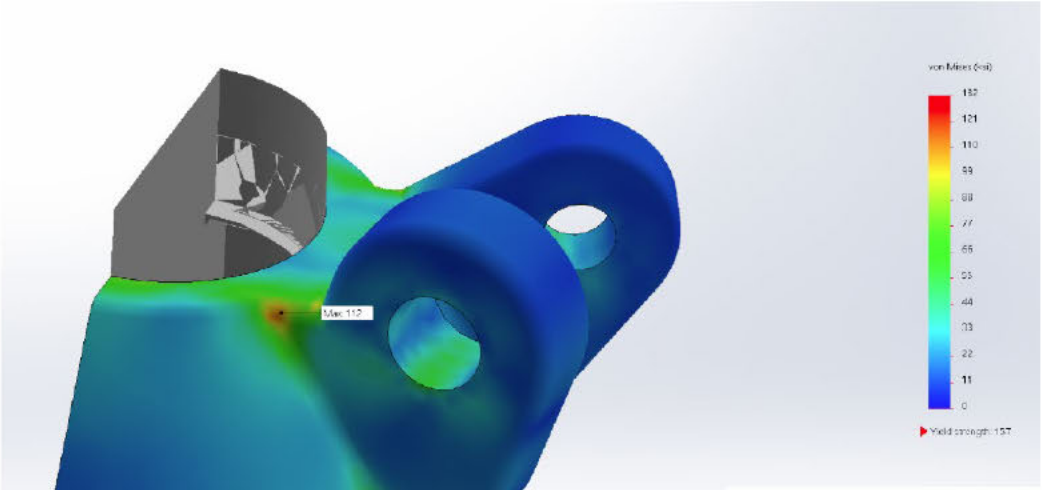
Table 3: Summary of Mechanical Element Simulation Results

Actual Suspended Weight <5700 lbs

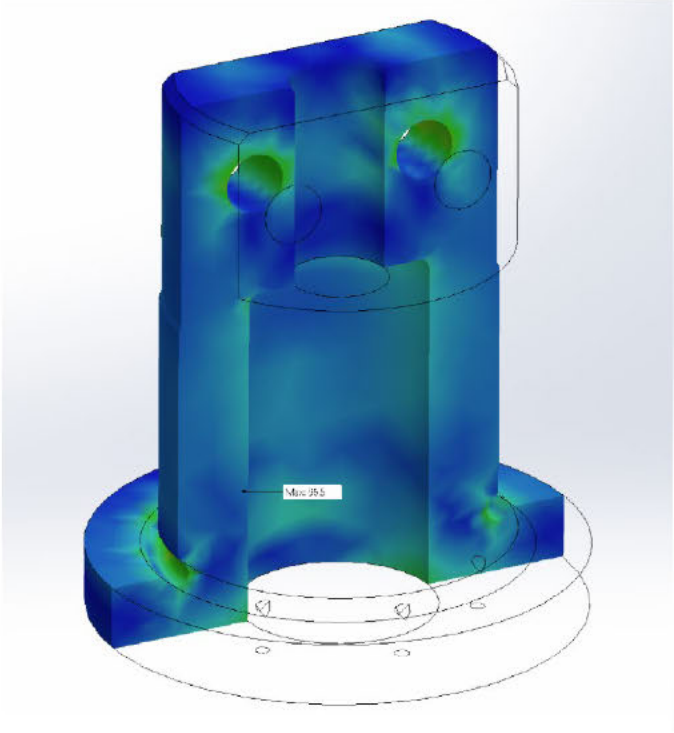
Element	Acceleration Case	Simulation Filename	Simulated Load	Material	Min FOS	Simulation Updated
Outer Frame Assm	10g Vert	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.4	9/23/18
	5g Horizontal	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.6	9/23/18
	5g @ 45deg Front	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.4	9/23/18
	5g @ 45deg Side	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	2.2	9/23/18
	5g @ 45deg Back	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.5	9/23/18
	5g @ 45deg Front Corner	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.5	9/23/18
	5g @ 45deg Back Corner	Outer_Frame_v18.SLDASM	2500 lbs IF Mass + 600 lb SIP + 1379 lbs misc	AL 6061-T6	1.4	9/23/18
Inner Frame Assy	10g Vert	Inner Frame FEA_As Built.SLDASM	1000 lb cryo + 370 lb telescope	AL 6061-T6	2.3	4/28/18
	5g Hor	Inner Frame FEA_As Built.SLDASM	1000 lb cryo + 370 lb telescope	AL 6061-T6	8	4/28/18
	5g @ 45deg Front	Inner Frame FEA_As Built.SLDASM	1000 lb cryo + 370 lb telescope	AL 6061-T6	5.5	4/28/18
Pivot Housing	5g Pull - Front Ear	Spreader Bar Pivot Assembly.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 44.5	1.1	4/27/18
	5g Pull - Rear Rear	Spreader Bar Pivot Assembly.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 44.5	1.4	4/28/18
	10g Pull - All Ears	Spreader Bar Pivot Assembly.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 44.5	1.8	4/27/18
	5g @ 45deg - All Ears	Spreader Bar Pivot Assembly.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 44.5	5.5	4/28/18
Pivot Shaft	10g Vert	Rotor_Shaft_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	2.5	5/23/18
	5g Hor	Rotor_Shaft_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	1.7	5/23/18
	5g @ 45deg	Rotor_Shaft_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	31	5/23/18
Spreader Bar End Fitting	5g Pull	Spreader_Bar_End_Fitting.SLDPRT	7000 lbs (Payload Mass)	AL 7075-T6	1.1	9/23/18
U-Joint Ends	10g Vert	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	2.4	5/29/18
	5g Hor	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50		5/29/18
	5g @ 45 Deg Front	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	3.1	5/29/18
	5g @ 45 Deg Side	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	3.1	5/29/18
U-Joint Cross	10g Vert	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	2.3	5/29/18
	5g @ 45 Deg Front	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	4.1	5/29/18
	5g @ 45 Deg Side	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	2.1	5/29/18
U-Joint Shackle Block	10g Vert	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	2.5	5/29/18
	5g @ 45 Deg Front	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	4.4	5/29/18
	5g @ 45 Deg Side	U-Joint_FEM.SLDASM	7000 lbs (Payload Mass)	4340 Steel HRC 50	4.1	5/29/18

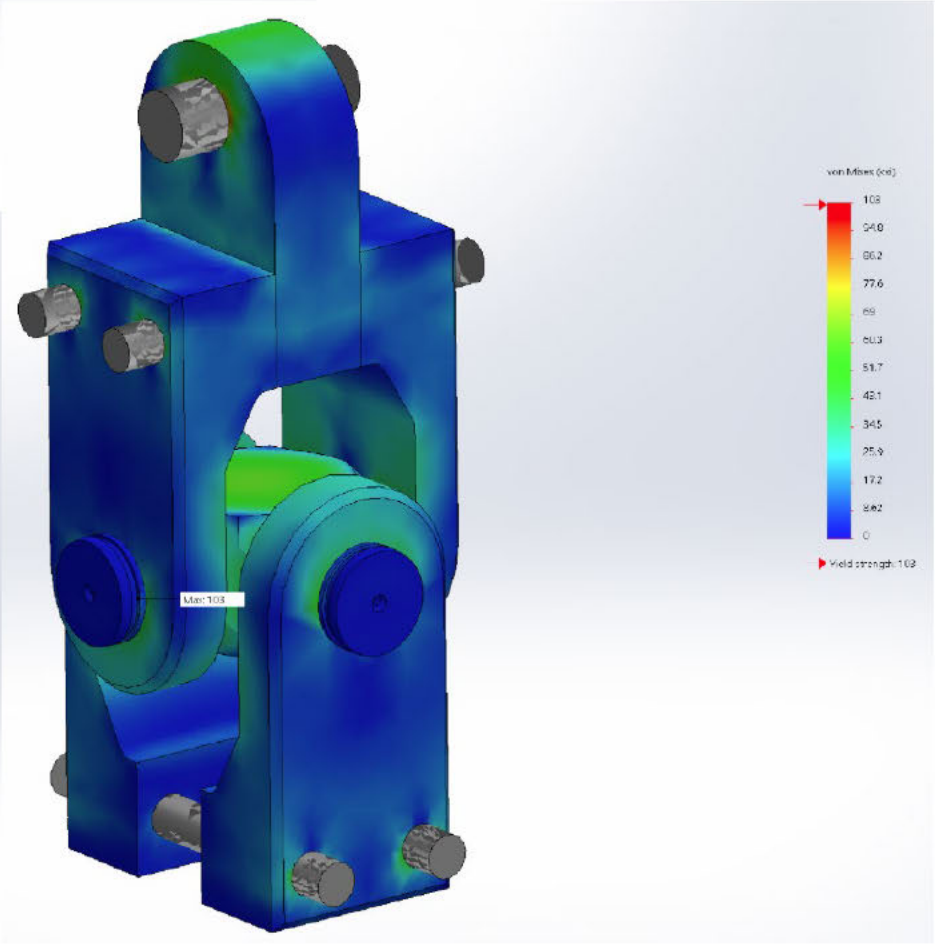
Pivot





Details in:
BLAST-TNG Mechanical Element Certification





Outer Frame

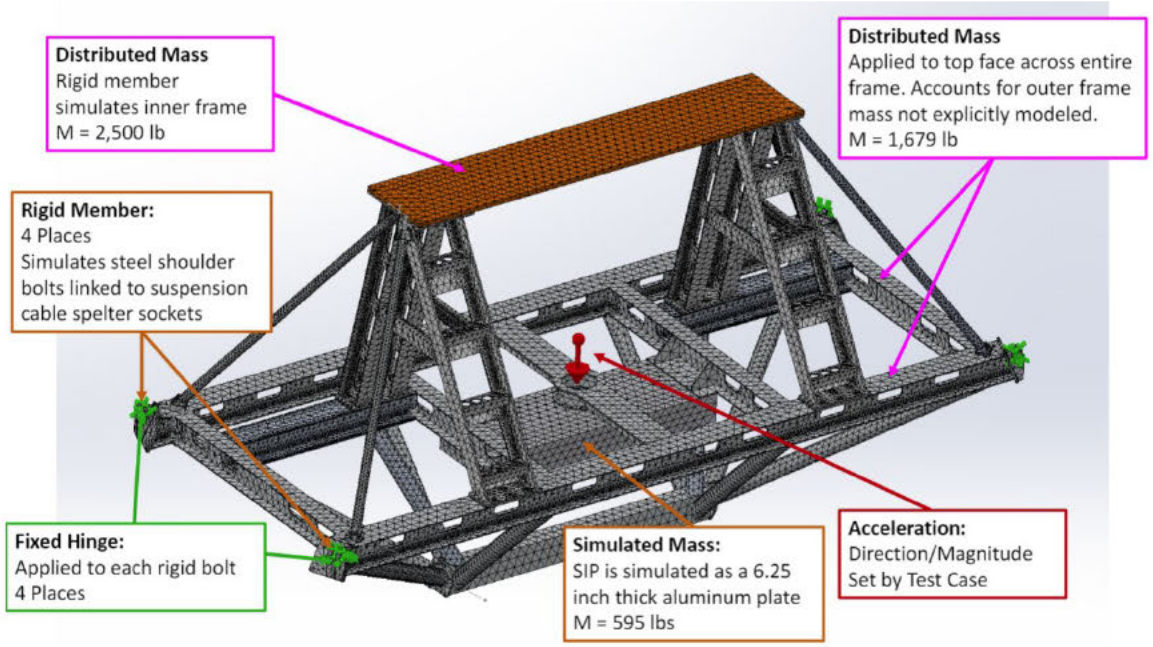
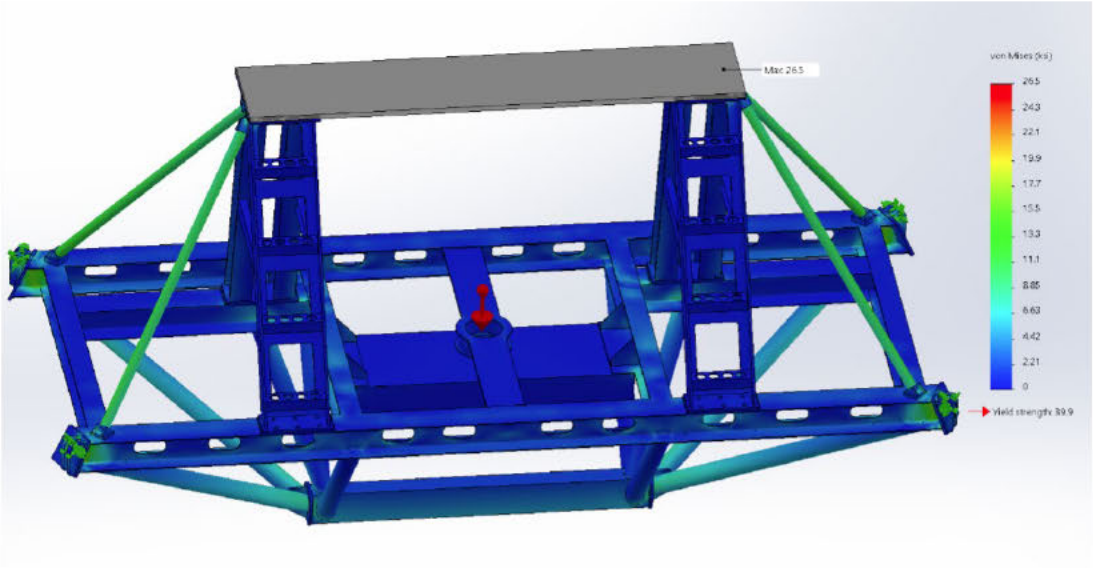
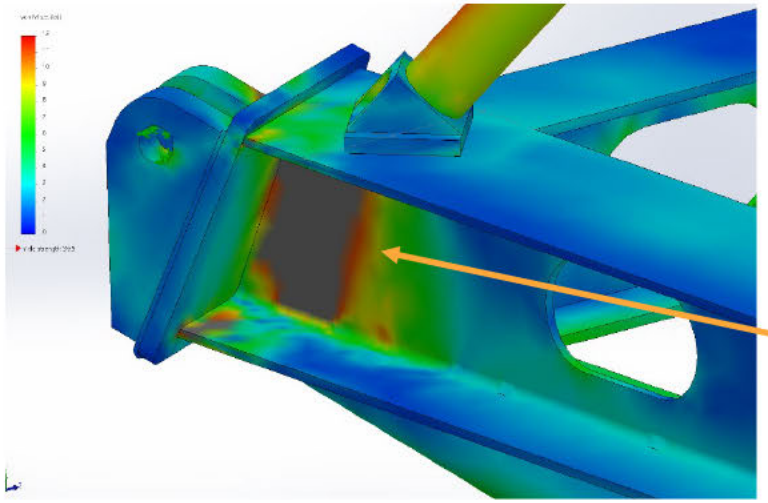


Figure 9: Outer frame simulation parameters and mesh used for analysis.



10G Loading, assuming 2700 lb Inner Frame
Min FOS = 1.4



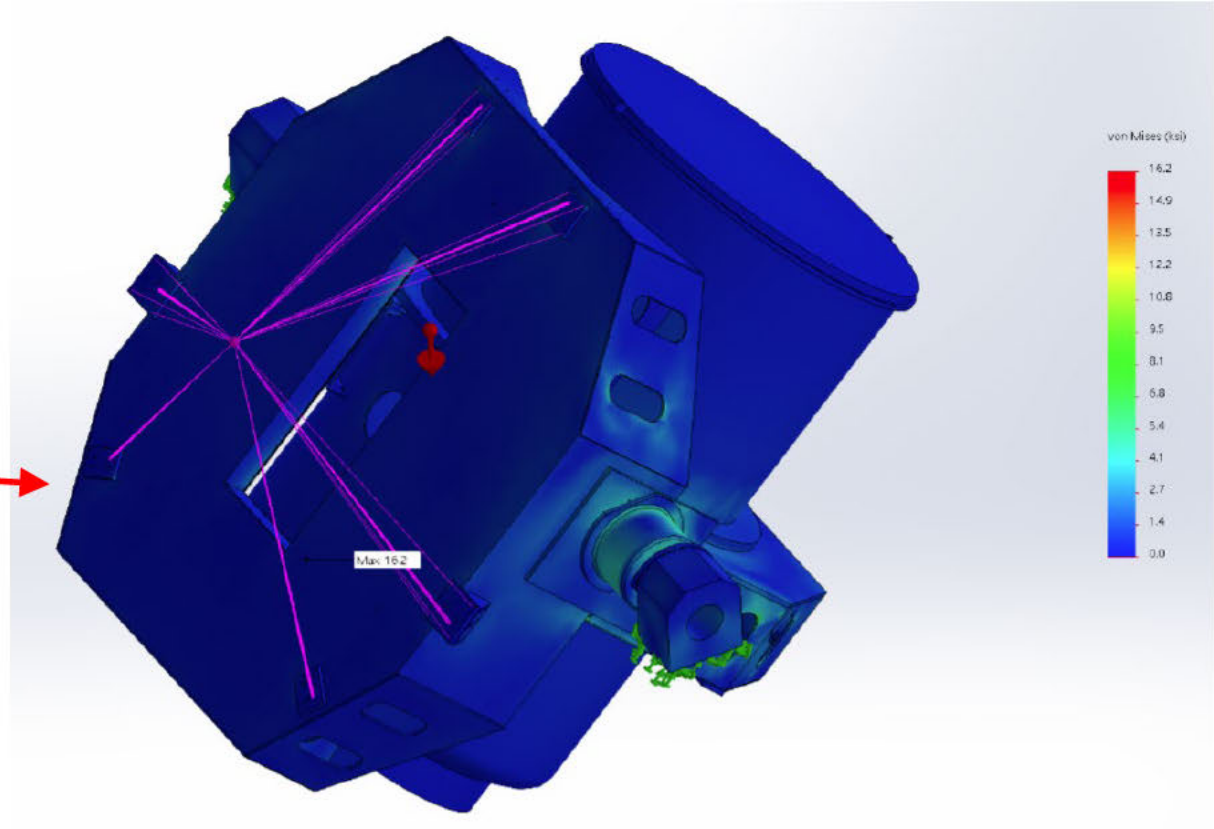
If this is deemed to be a problem we can add a “safety line” from the cable to the frame.

Inner Frame

Welded Al 6061-T6 Construction

Driving strength case is 10G chute load

10G Vertical Load: Min FOS = 3.0



BLAST-TNG rigidity requirement far exceeds failure requirement.

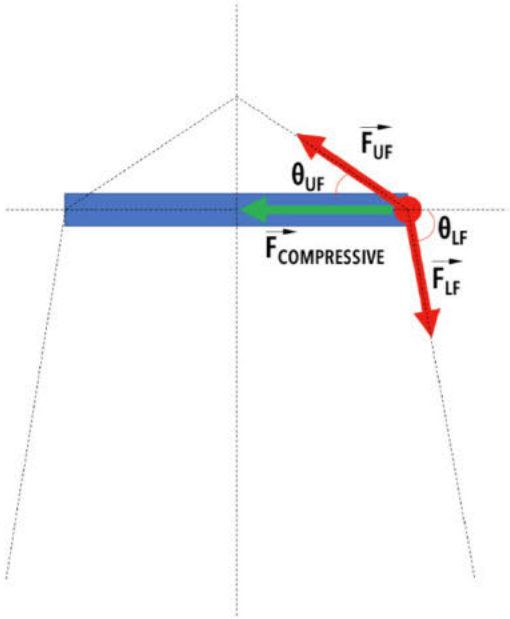
Cable Suspension

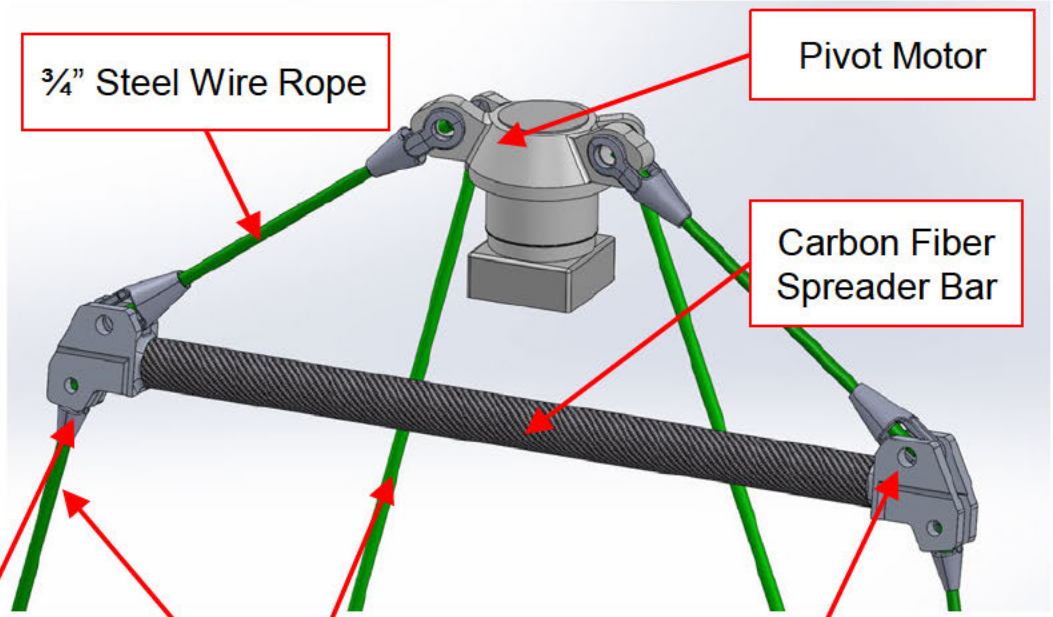
Suspension Element	Angle with Horizontal (°)	Rated Capacity (lbf)	Ultimate Tensile Strength (lbf)	10 G Force (lbf)	5 G Cable Pull Forc (lbf)
Upper Front Suspension Cables	33.68	90,400	452,000	31,557	63,114
Lower Front Suspension Cables	75.22	40,800	204,000	18,099	36,198
https://v2.overleaf.com/16367682sqnrghqynyfm Rear Suspension Cables	70.70	40,800	204,000	18,542	37,084

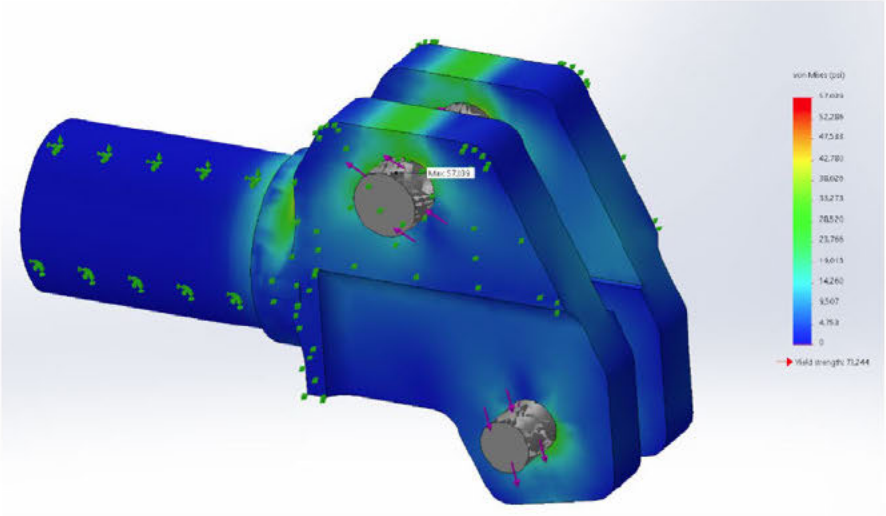
Table 4: Suspension cable geometry and forces experienced under critical load cases.

Suspension Element	Material	Manufacturer	10 G Min FOS	5 G Cable Pull Min FOS
Upper Front Suspension Cables	⌀18 mm CASAR Betalift Steel Wire Rope	WireCo	14.5	7
Lower Front Suspension Cables	⌀13 mm CASAR Betalift Steel Wire Rope	WireCo	11.5	5.5
Rear Suspension Cables	⌀13 mm CASAR Betalift Steel Wire Rope	WireCo	11	5.5
Spreader Bar	Filament-Wound Carbon Fiber Tube	CST Composites	2.6	

Table 5: Summary of the suspension cable and spreader bar design summary.







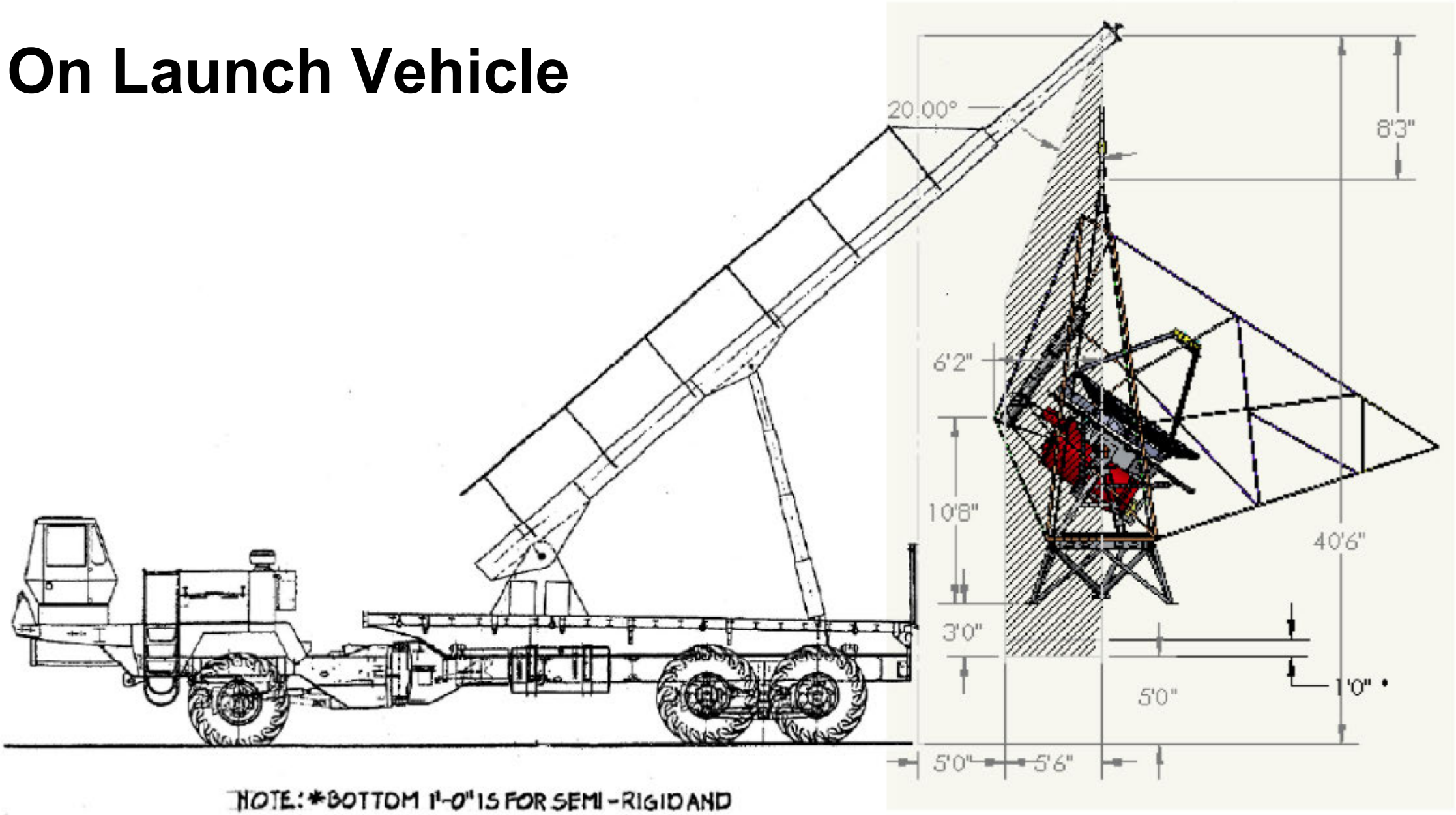
Material Testing

Part	Rockwell Scale	Hardness Measurements
Pivot Housing - Front Ear	C	50
Pivot Housing - Body	C	44*, 45*
Rotor Shaft	C	52
Universal Joint Cross	C	50*, 51*
Universal Joint Yoke A	C	51, 54
Universal Joint Yoke B	C	50, 50
Universal Joint Yoke C	C	48, 49
Universal Joint Yoke D	C	45, 49
Universal Joint Yoke Average	C	50
Spreader Bar End Fitting - A	A	56
Spreader Bar End Fitting - B	A	55

**Star indicates measurement made at Acme Heat Treating Co in Philadelphia, PA*
All other measurements made at NASA/CSBF in Palestine, TX.

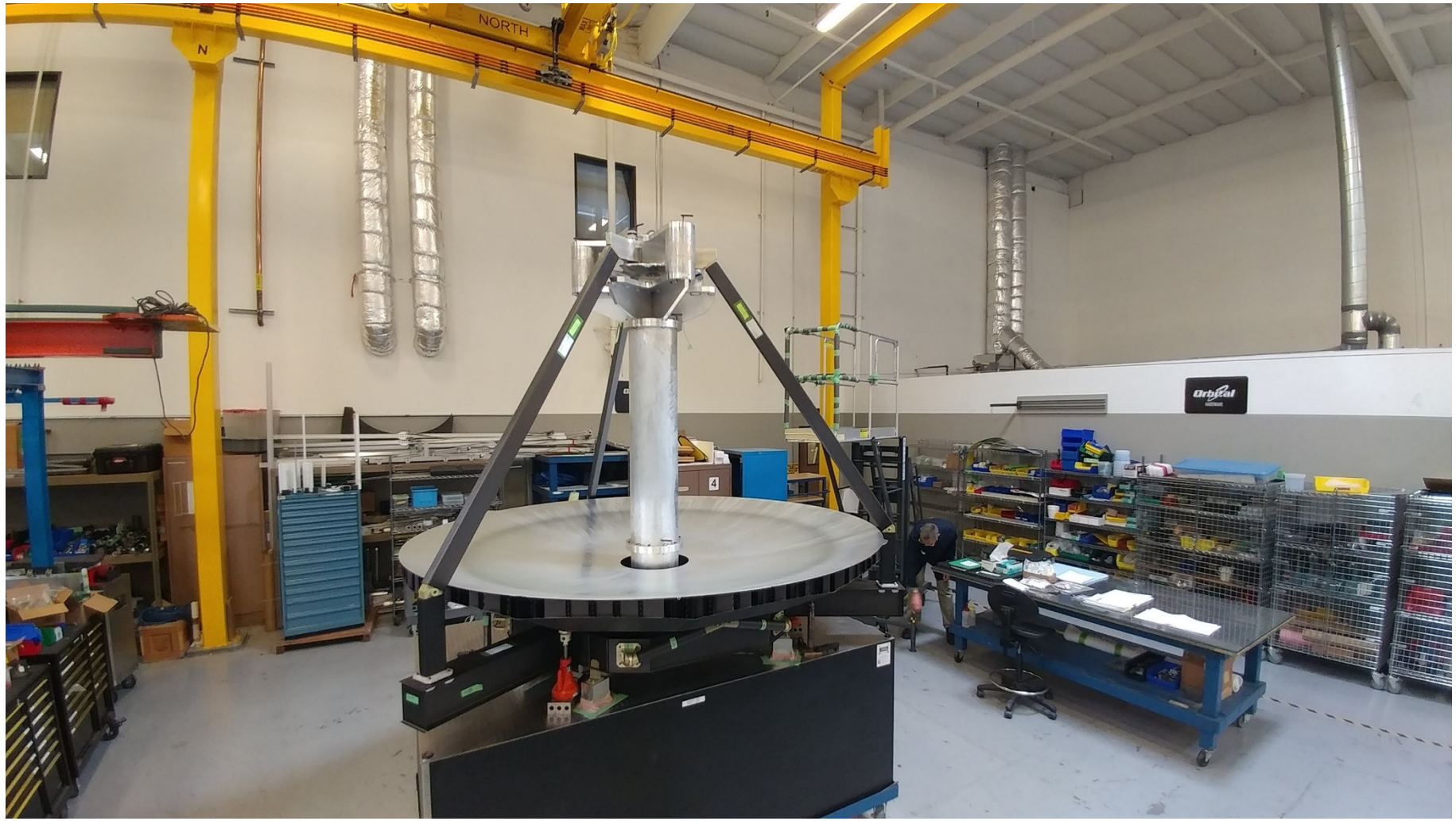
Table 2: Measured Hardness of Critical Suspension Elements

On Launch Vehicle



NOTE: *BOTTOM 1'-0" IS FOR SEMI-RIGID AND FLEXIBLE ANTENNAE ONLY

Telescope



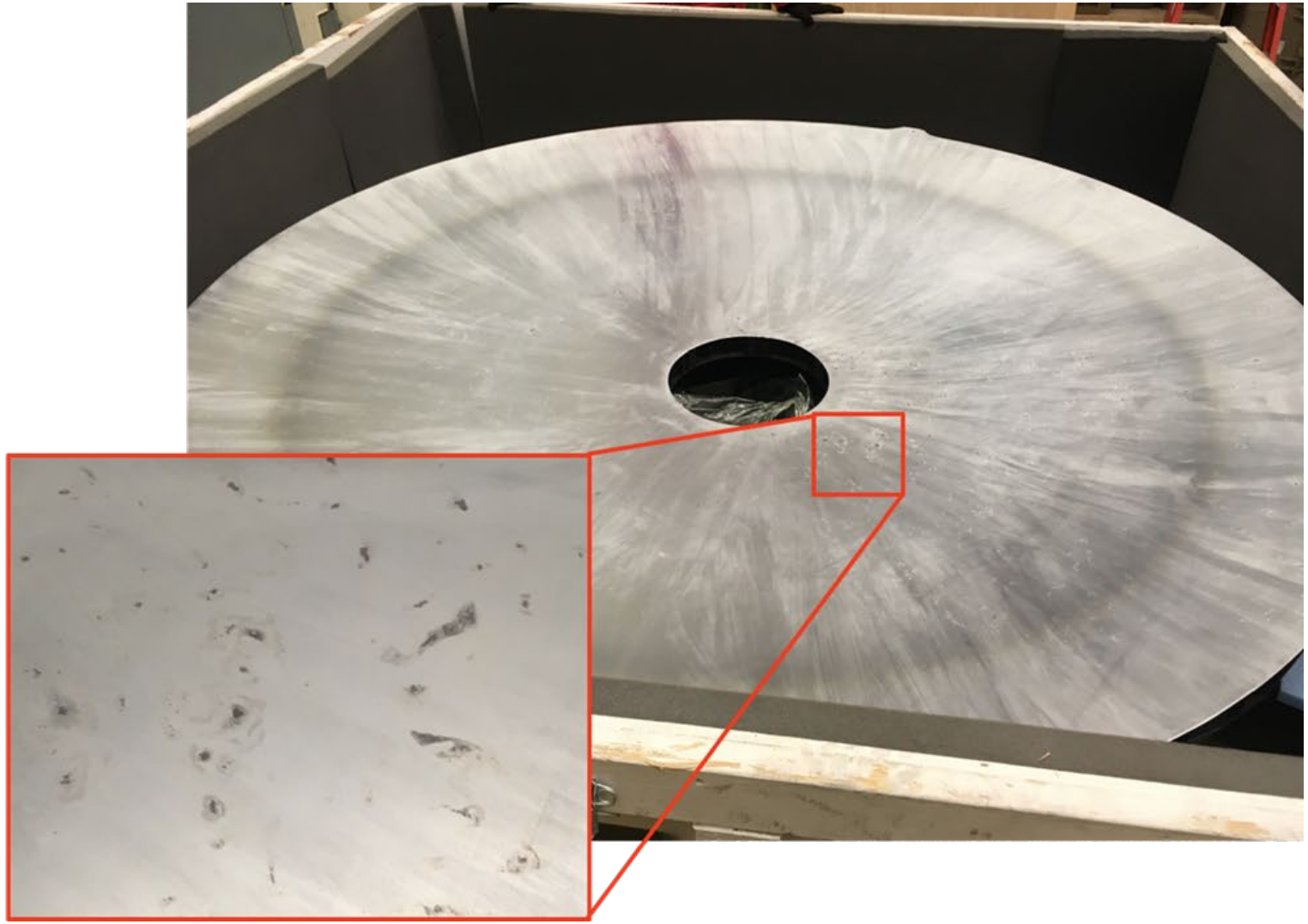
- Manufactured by Vanguard Space Technologies under an SBIR Phase II award.
- Mold polished to 4 microns RMS.
- Expect a total of <9 microns RMS total wave front error.
- Status: Installed at CSBF in July. Shipped to the Ice.

Damage to Primary Mirror

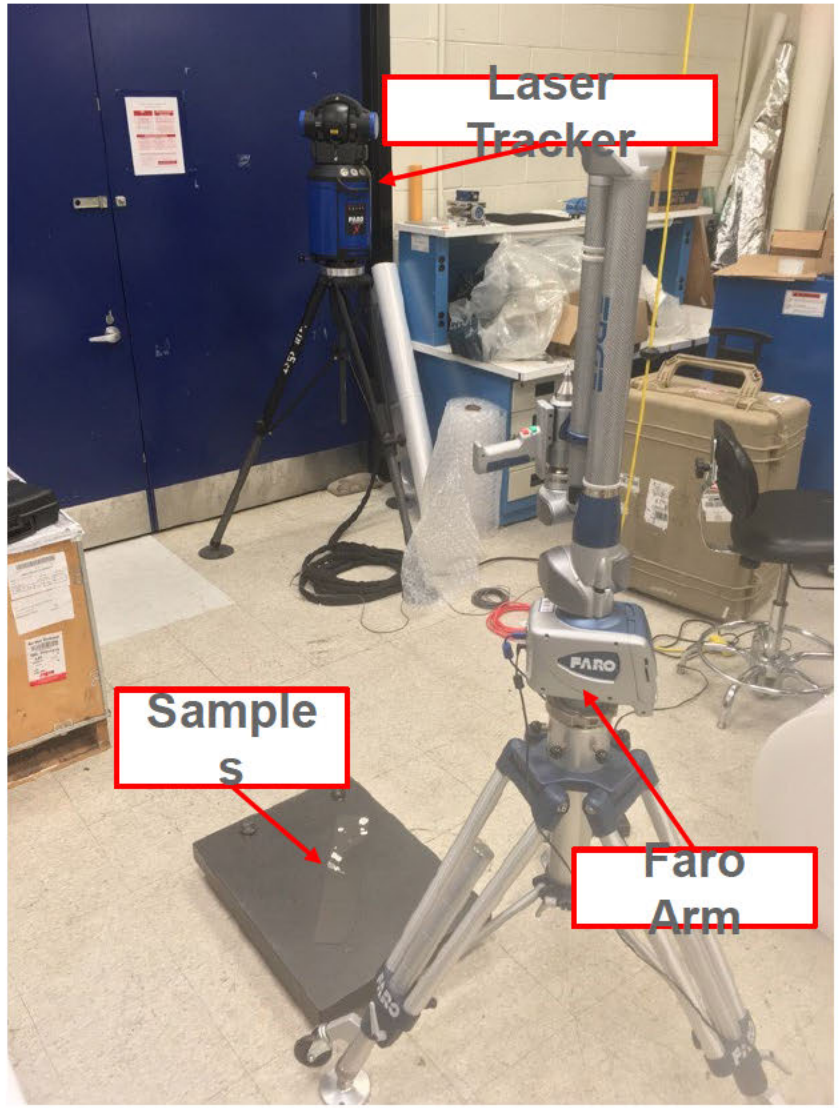
- Problem:
  1. Primary mirror crate was left in the rain in CHCH during transport to ice
  2. Water seeped onto mirror surface causing galvanic corrosion between carbon fiber and aluminum coating over ~1-2 % of surface area
  3. Corroded areas look like “hot spots” to our detectors, and cause optical aberrations

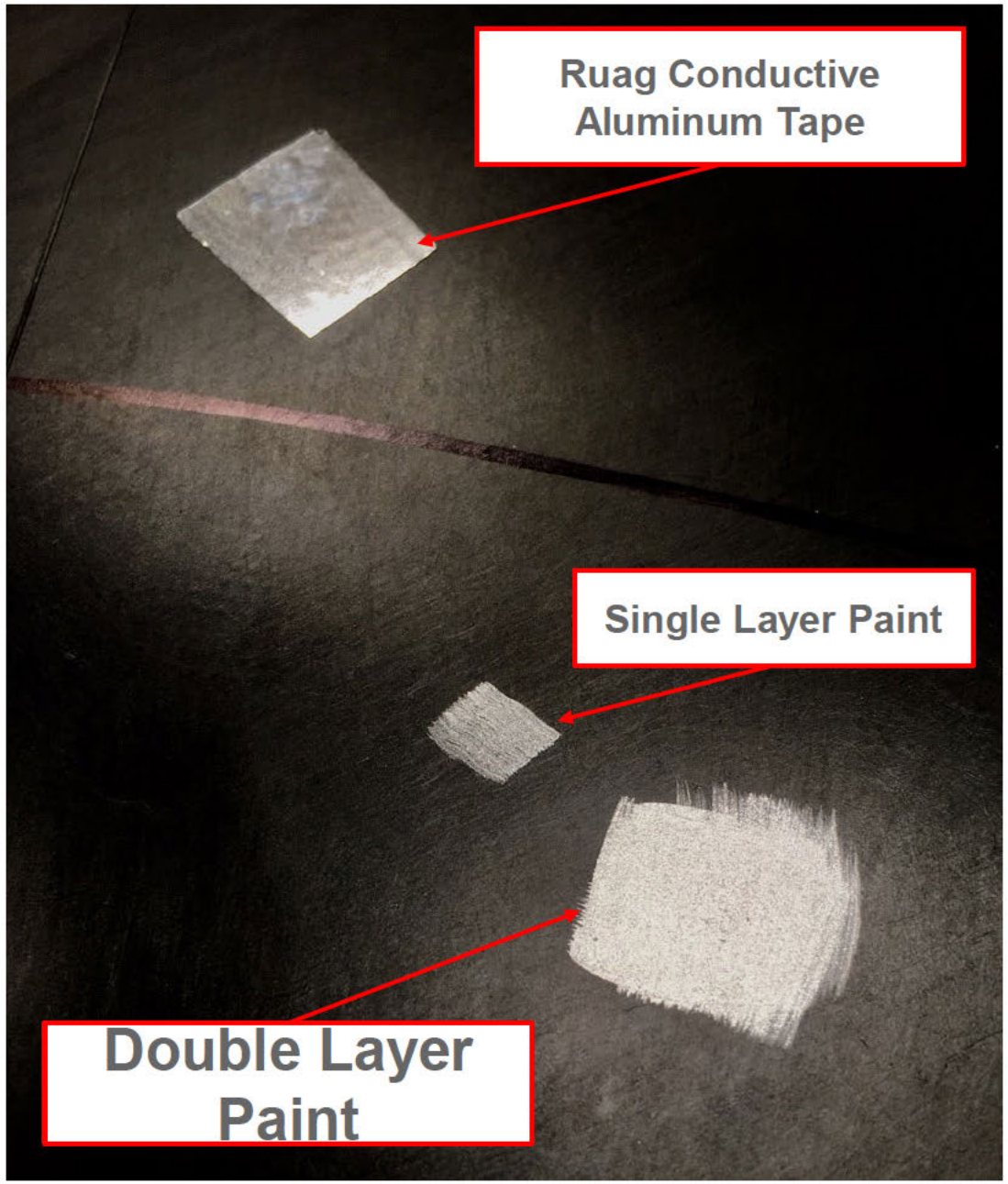
- Options for Moving Forward:
  1. Do Nothing
     - This was our baseline plan on the ice during 2018/2019 season
  2. Put aluminum tape over the bad spots
     - Example: Ruag Space CoolCat BR-50 (nominal thickness 50-60 μm)
  3. Paint bad spots with conductive paint
     - Example: RS PRO Silver Conductive Paint

Water Damage on Mirror

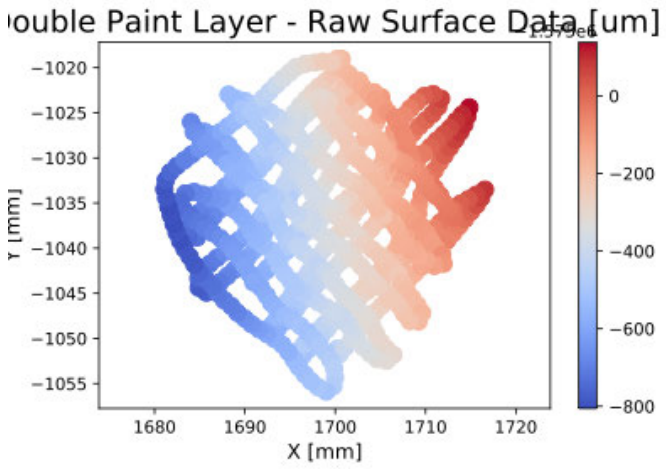


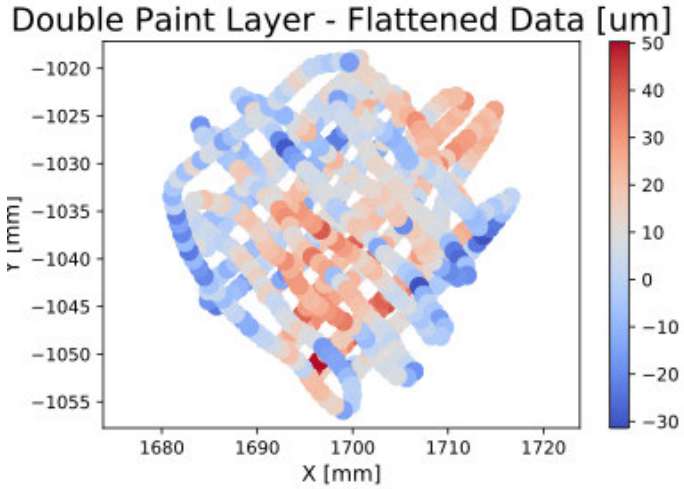
Surfaces Measured

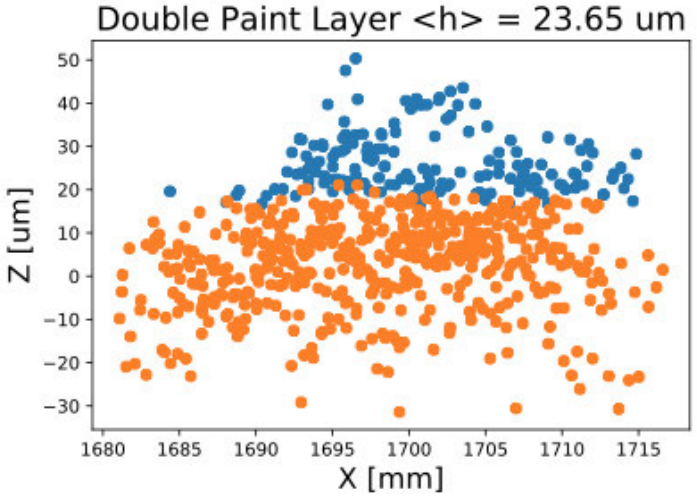


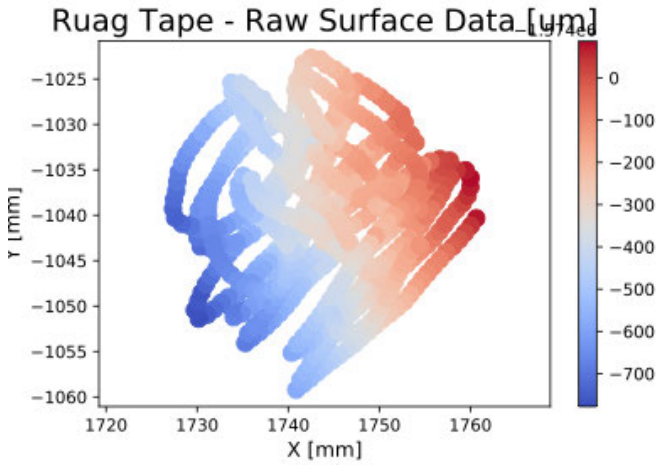


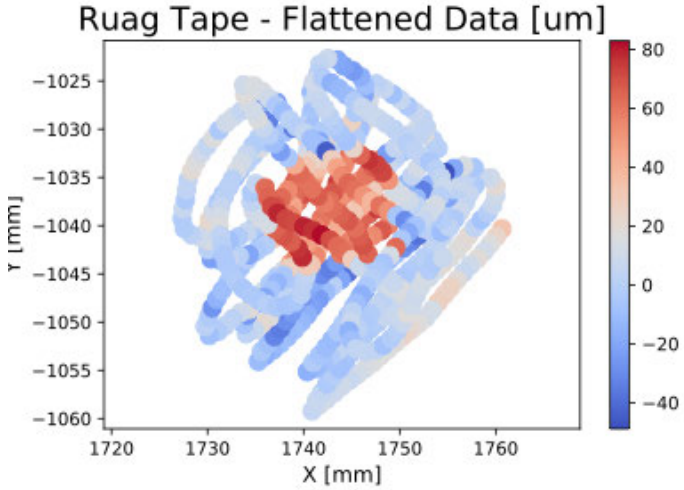
Measurement Results

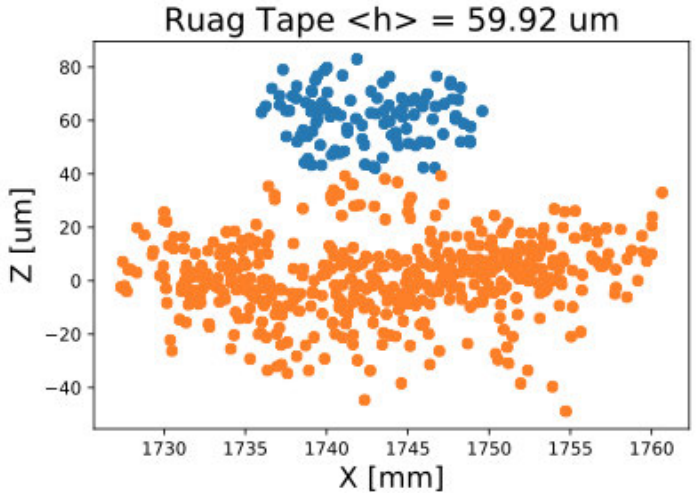






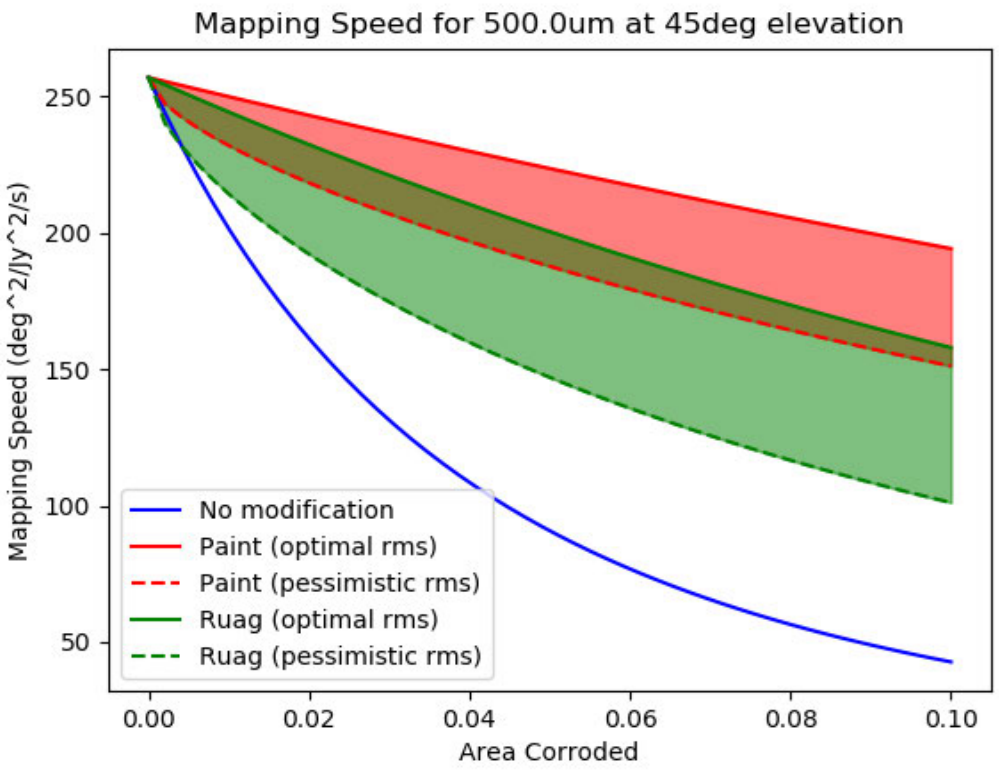






Effect on Performance

- Estimates of mirror effect on optical performance estimate large improvement with some damage mitigation, especially at BLAST's longest wavelengths
- Paint solution looks most promising, and easiest to implement
- Still working on improving optical modeling

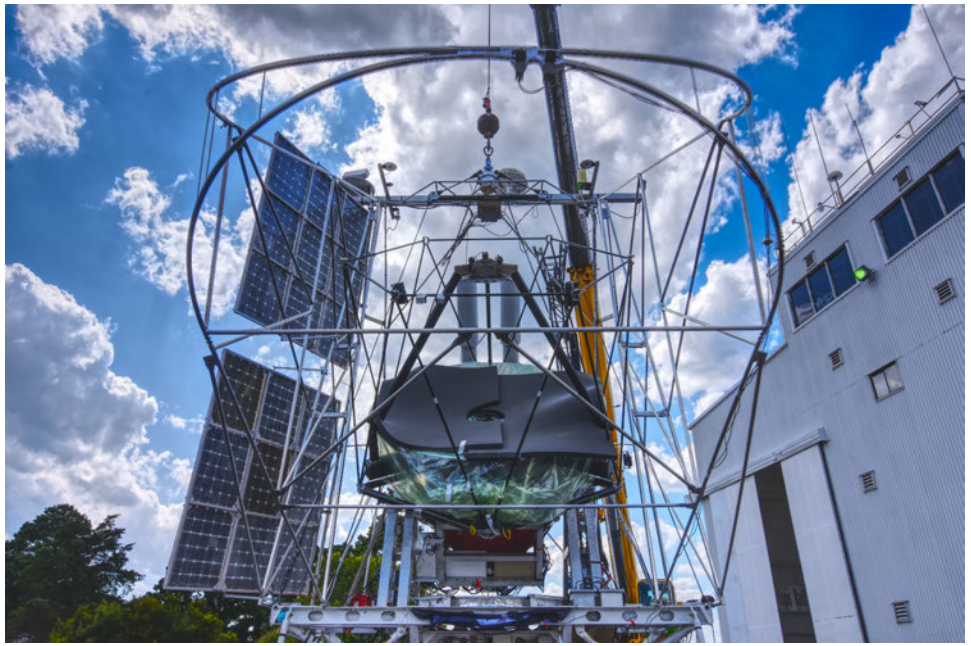


Plan for Moving Forward

- Baseline plan is to paint bad spots with conductive paint on the ice
- Investigating different painting methods
  - Brush vs airbrush, thinning with solvents, etc
- Improving optical modeling to fully characterize anticipated performance

BLAST-TNG Pointing Systems

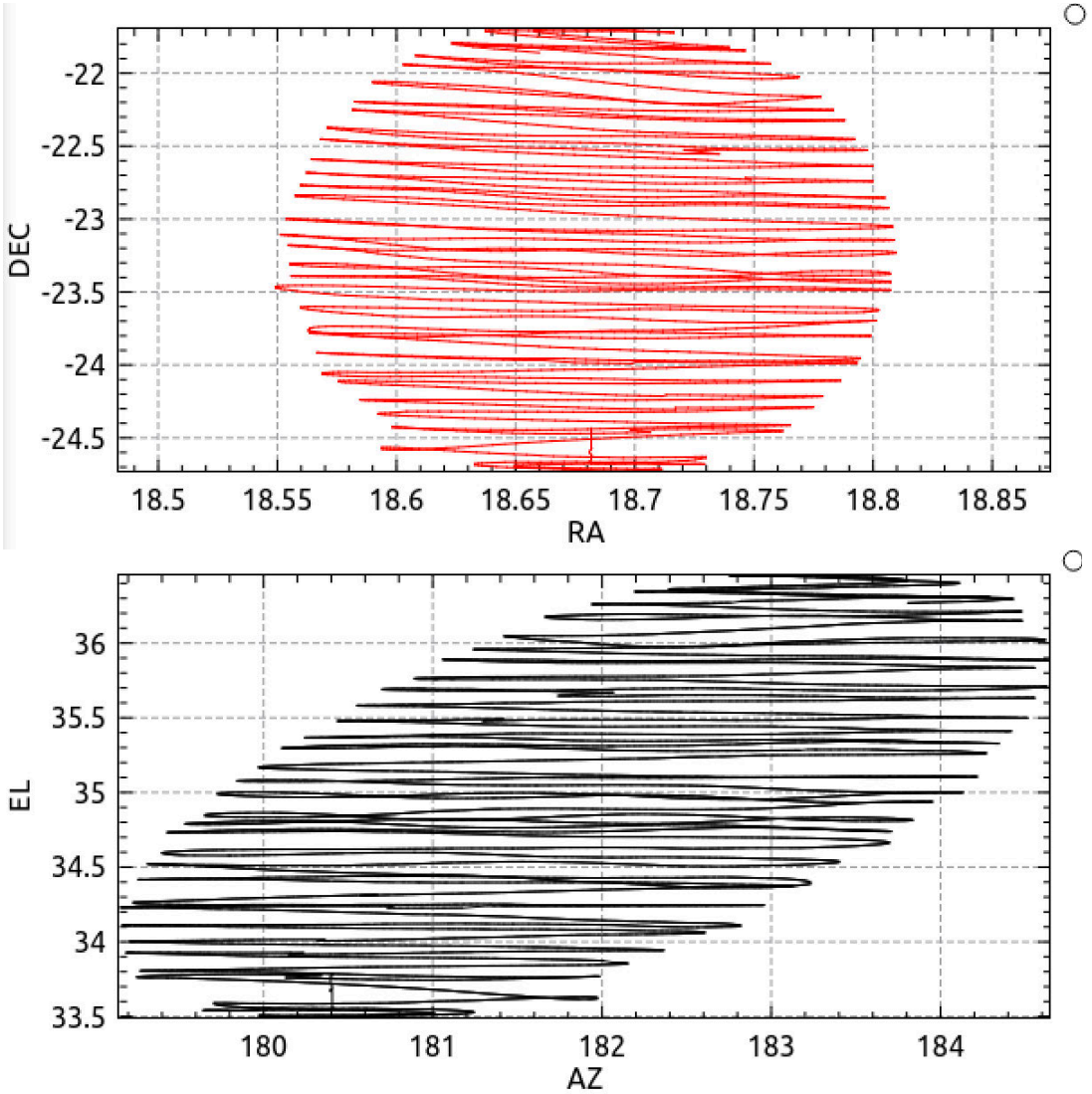
- Motors (all direct drive DC):
  - Azimuth:
    - Reaction wheel (short timescale control)
    - Pivot Motor (keep RW from saturating
  - IF driven with Elevation motor
- Primary Pointing Sensors:
  - Two boresight optical star cameras
  - Low noise gyros (DSP-1760s)
- Redundant Coarse Sensors:
  - Magnetometer (~3 deg precision)
  - Pinhole Sunsensors (~0.1 deg precision)
  - DGPS heading (from CSBF DGPS)
  - El motor encoder (0.2deg precision)
  - Tilt sensors (~1 deg precision)



BLAST-TNG at the Columbia Scientific Balloon Facility July 2018

BLAST-TNG Pointing System Current Status

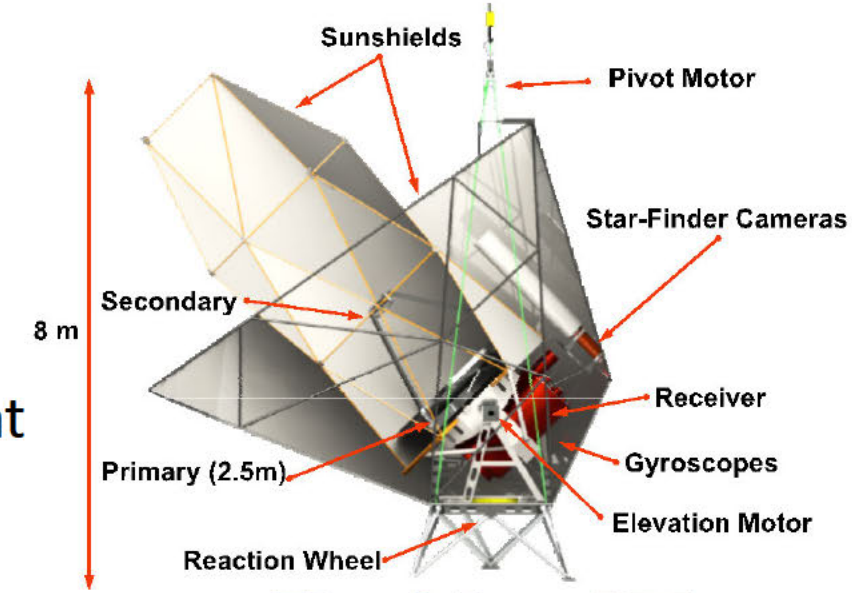
- Star Cameras + gyros fully integrated and tested with nighttime tests in Palestine, TX
- Extensive pointing control tests in both Palestine and the Antarctic LDB facility.
  - Pointing control precision <3’’
- Would like some additional time outside at LDB to test and calibrate coarse sensor offsets and zeropoints.

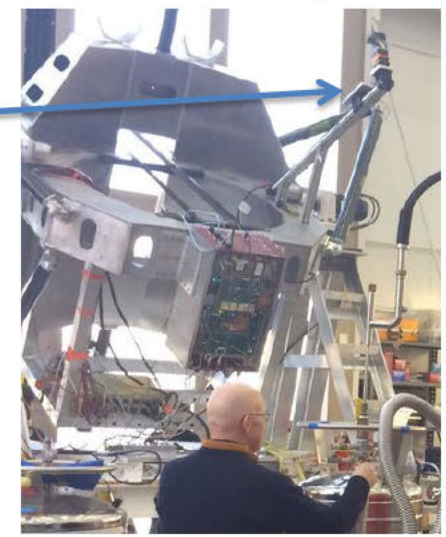


Test BLAST-TNG Scan in Palestine (July 20th 2018)

BLAST-TNG Motors

- Brushless DC Pointing motors:
  - Reaction wheel motor
  - Active Pivot motor
  - Elevation Drive
  - All driven with Accelnet+ Ethercat AEP-090-36 controllers
  - Flown previously in 2012
- Inner Frame Balance Control:
  - Replaces BLAST2012 liquid balance system.
  - 20 kg weight driven by an EZStepper motor to compensate for changes in inner frame balance due to cryogen boil off.





Power System

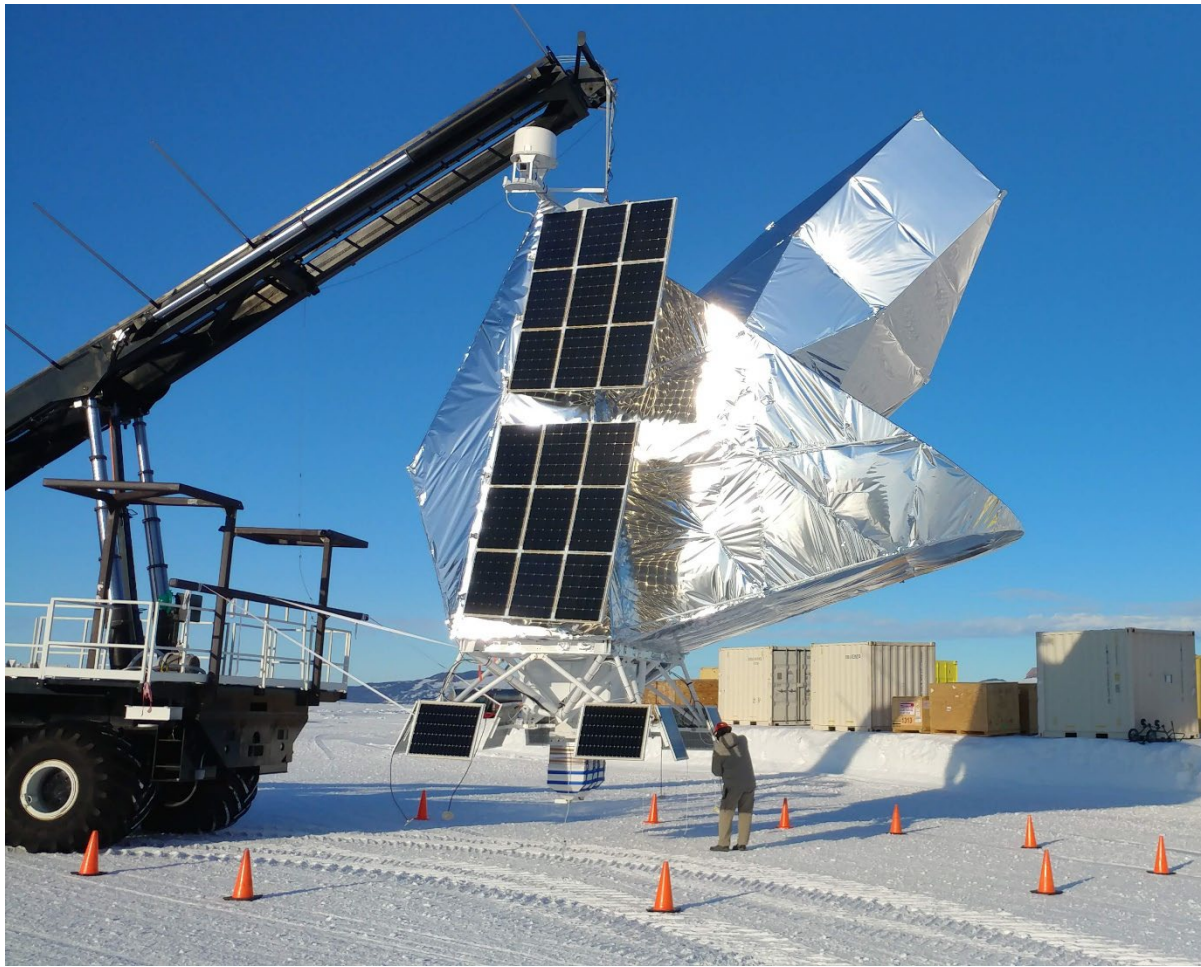
- Same power system as flown successfully on BLAST10/12

-18 solar panels each with 30 cells per panel.
- Manufactured in-house (same cells as CSBF uses).
- Grouped into sets of 3 panels in series.
- Should provide a voltage of up to 34.56 Volts for each 3 panel set.
- The current available from each panel is 6.83 A.
- 1400 Watts @ 28 V -> 700 Watts at a 60 degree angle.
- De-rate to 85% for high temperature -> 595 Watts
- Two separate systems one each for detectors and pointing.

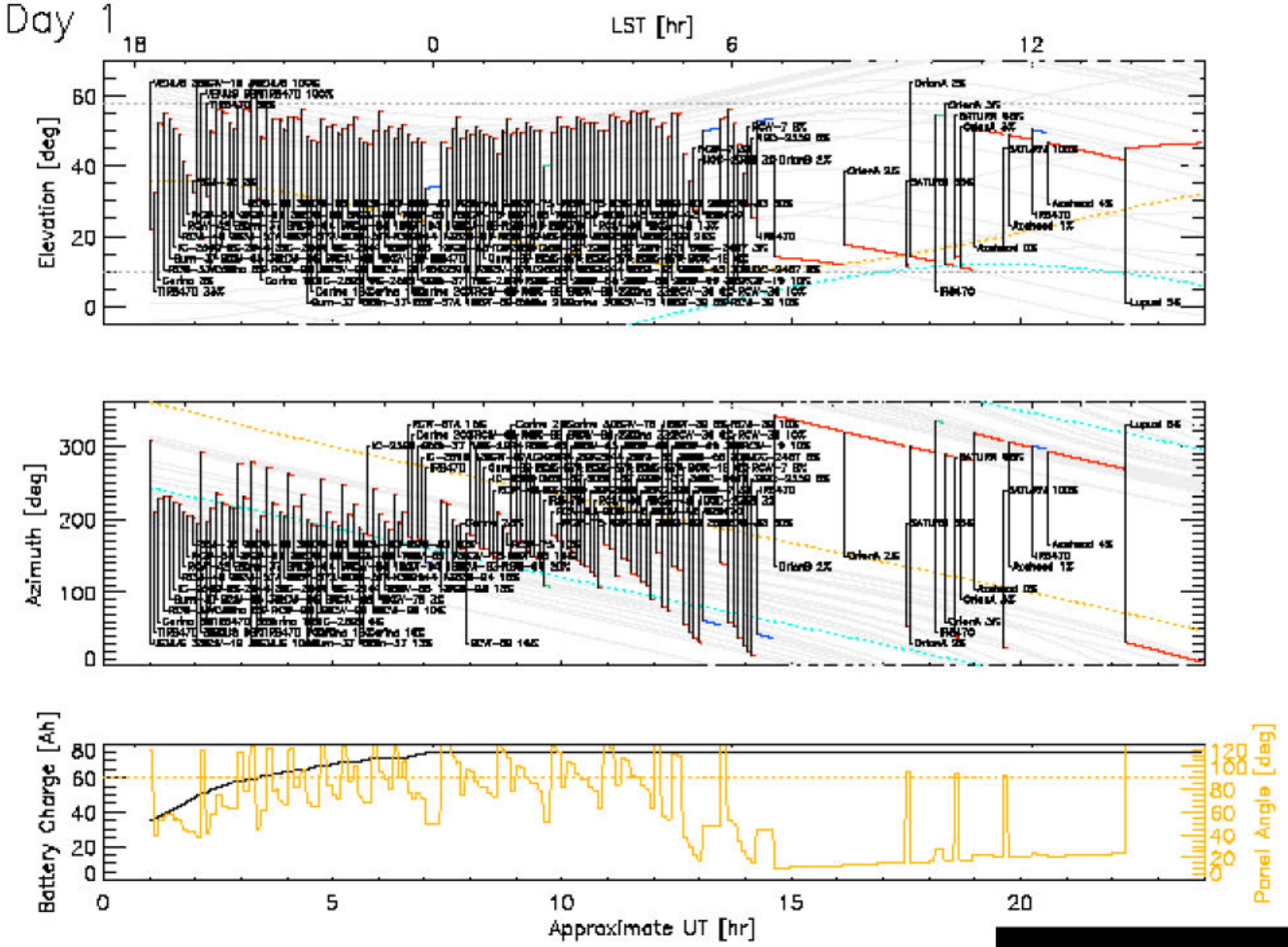
-BLAST Antarctica 2006 – 500 Watts
- BLAST10/12 - 300 Watts (new electronics – more capable, less power.)
- BLAST-TNG – 750 Watts (estimated).

- Lead acid batteries – Harsh environment – Same as CSBF

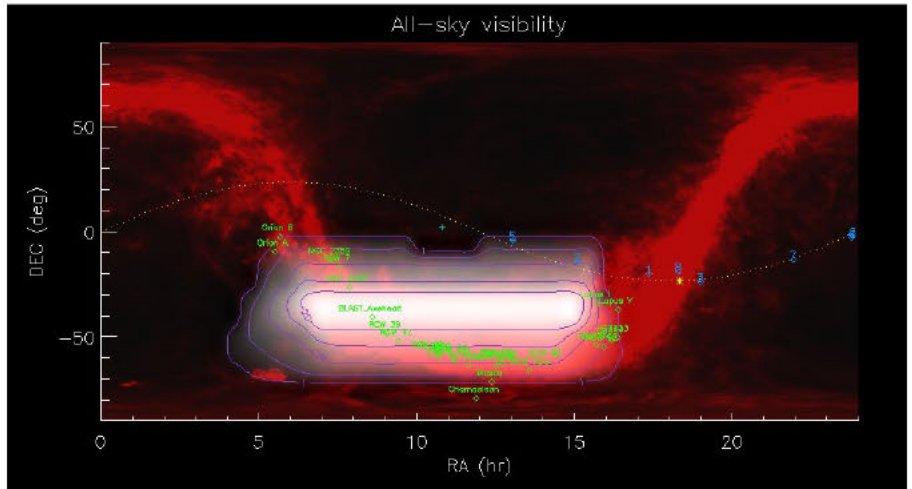
- Commercially available charge controller.
- TriStar MPPT-60 solar Charger from Morningstar Corp.

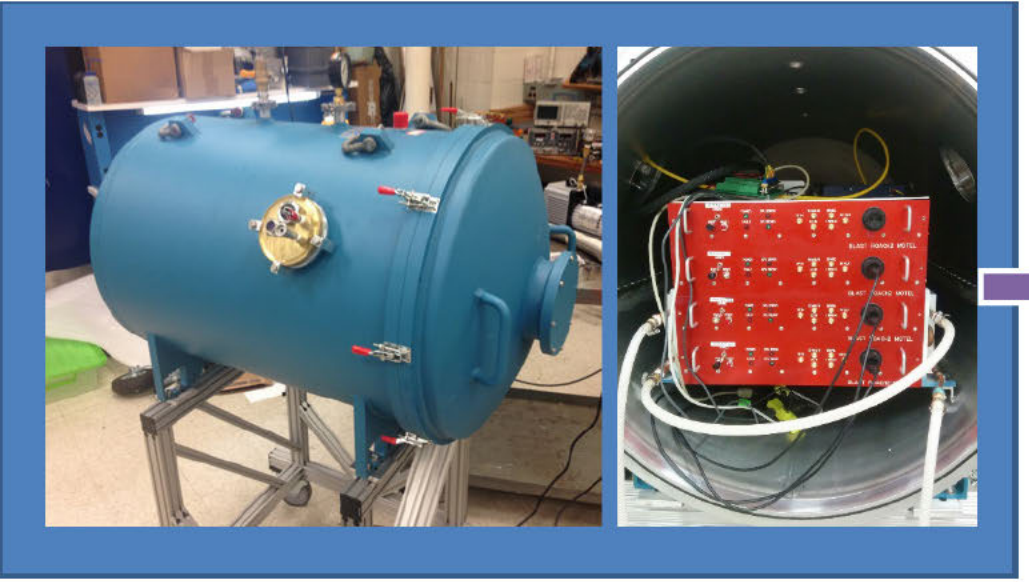


Flight Planning

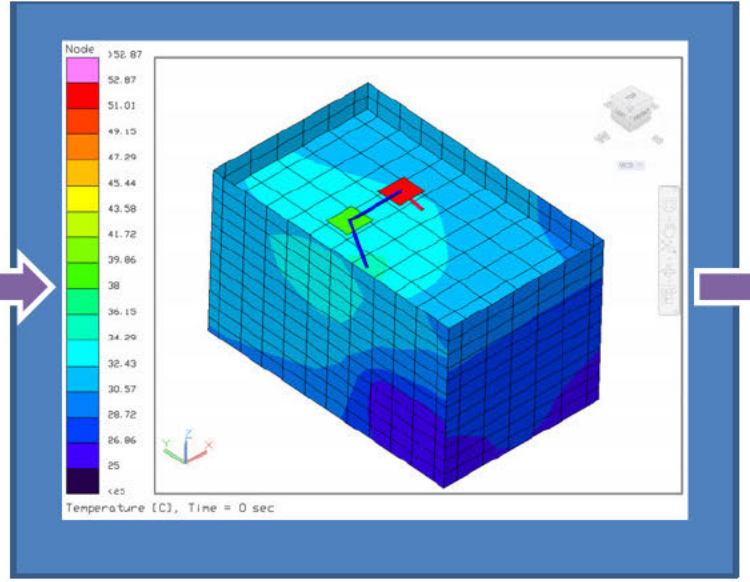


- Sophisticated flight planning software.
  - Tracks object visibility
  - Allocates time to reach science objectives
  - Plans calibration and cryogenic maintenance
  - Tracks battery charge

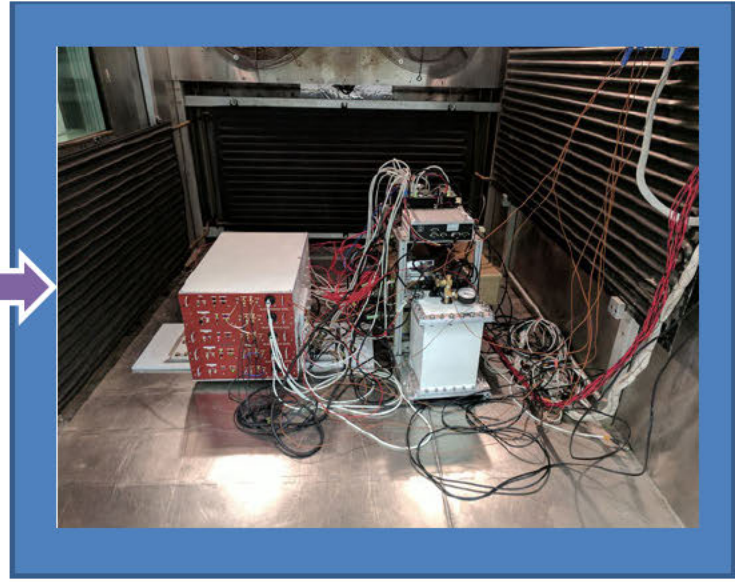




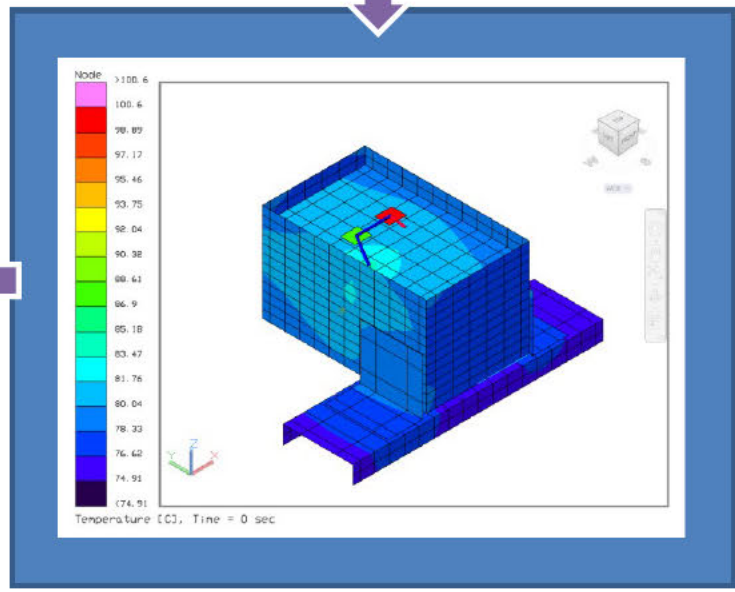
1. Vacuum Chamber Testing



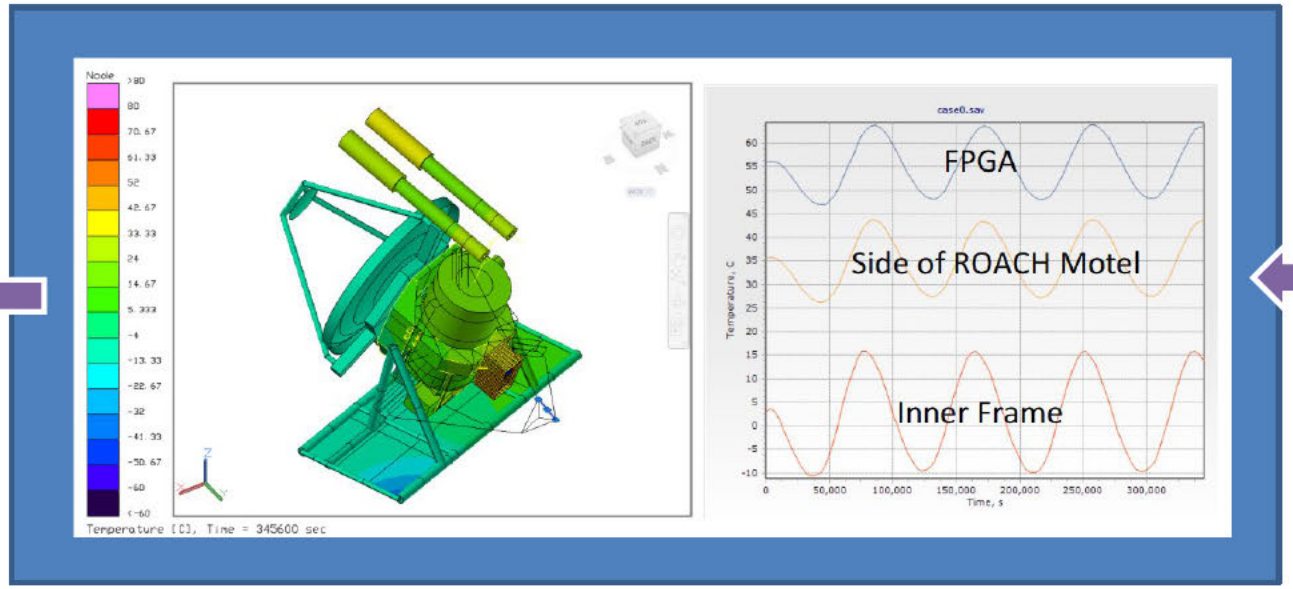
2. Build Model / Tune Thermal Links



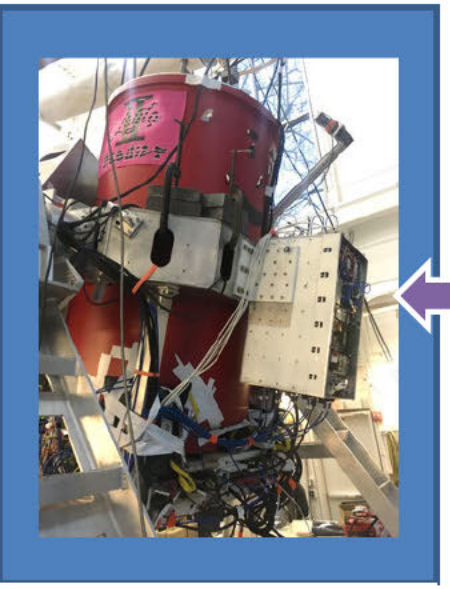
3. Thermal Vacuum Chamber Testin



4. Refine Model and Thermal Link



5. Update Full Assembly Model, Simulate Flight Temperatures

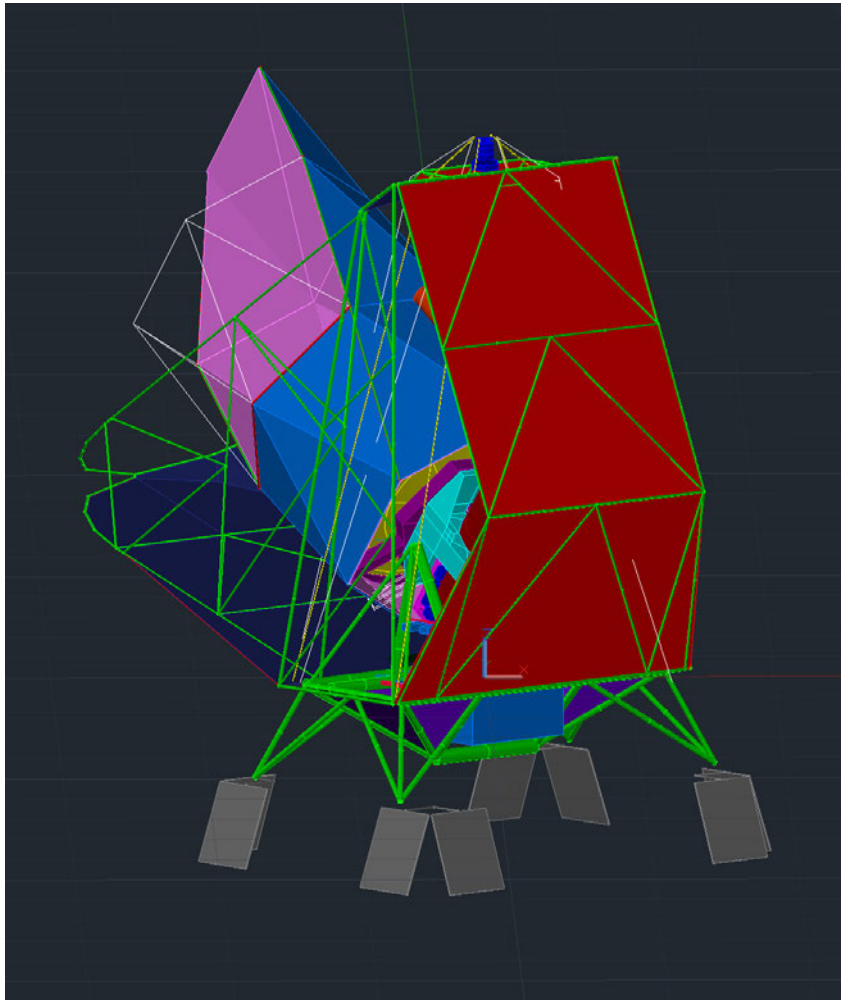


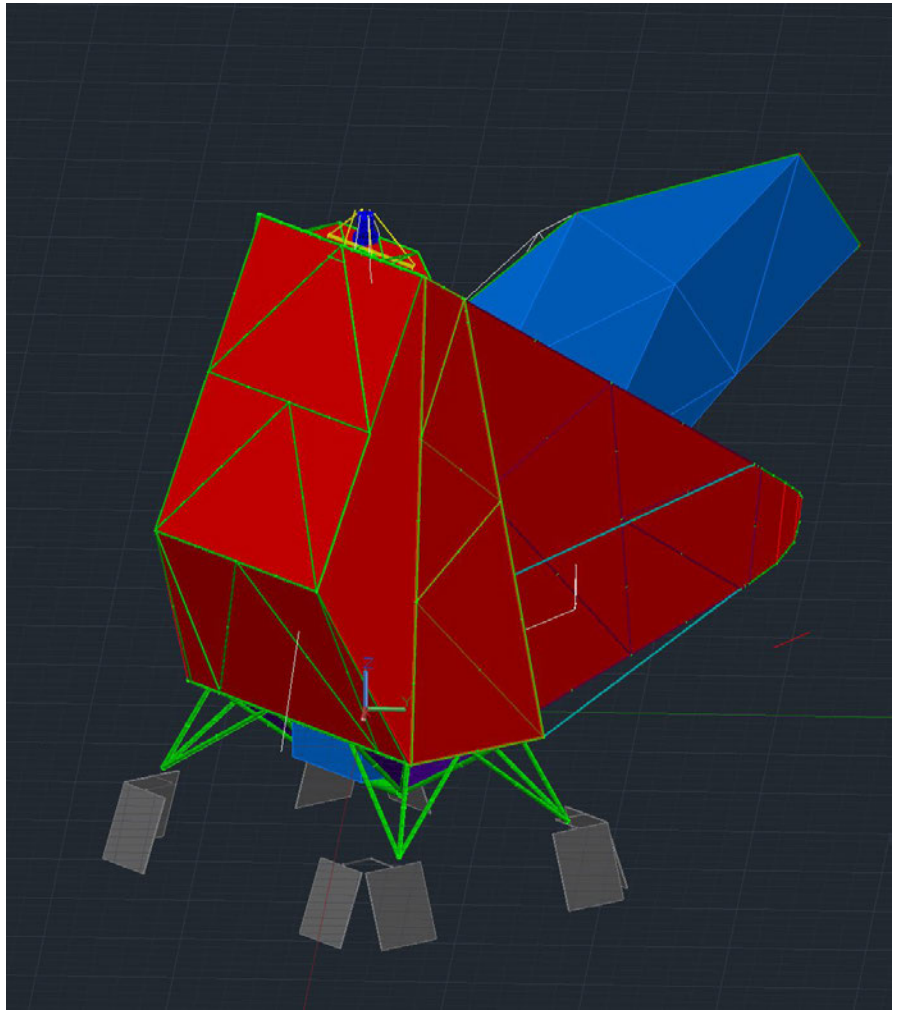
6. Install Hardware

Modeling Thermal Environment

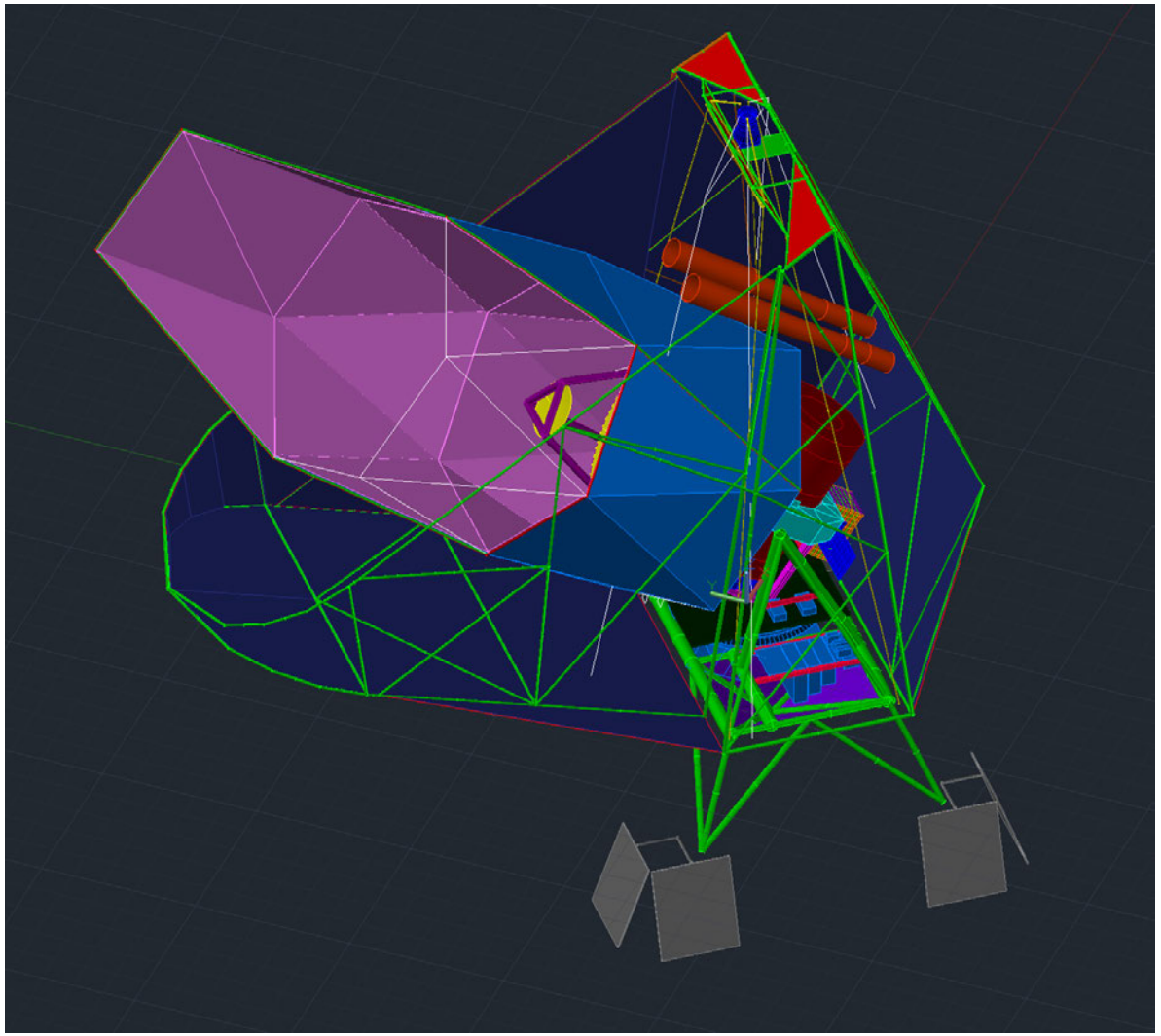
- Main Goals:
  - Keep Sun and Earth shine off optics
  - Define allowed pointing angles
  - Ensure electronics operate properly
    - Heat sinking
    - Surface Prep (Paints, MLI)
- Models must be verified, especially for critical components

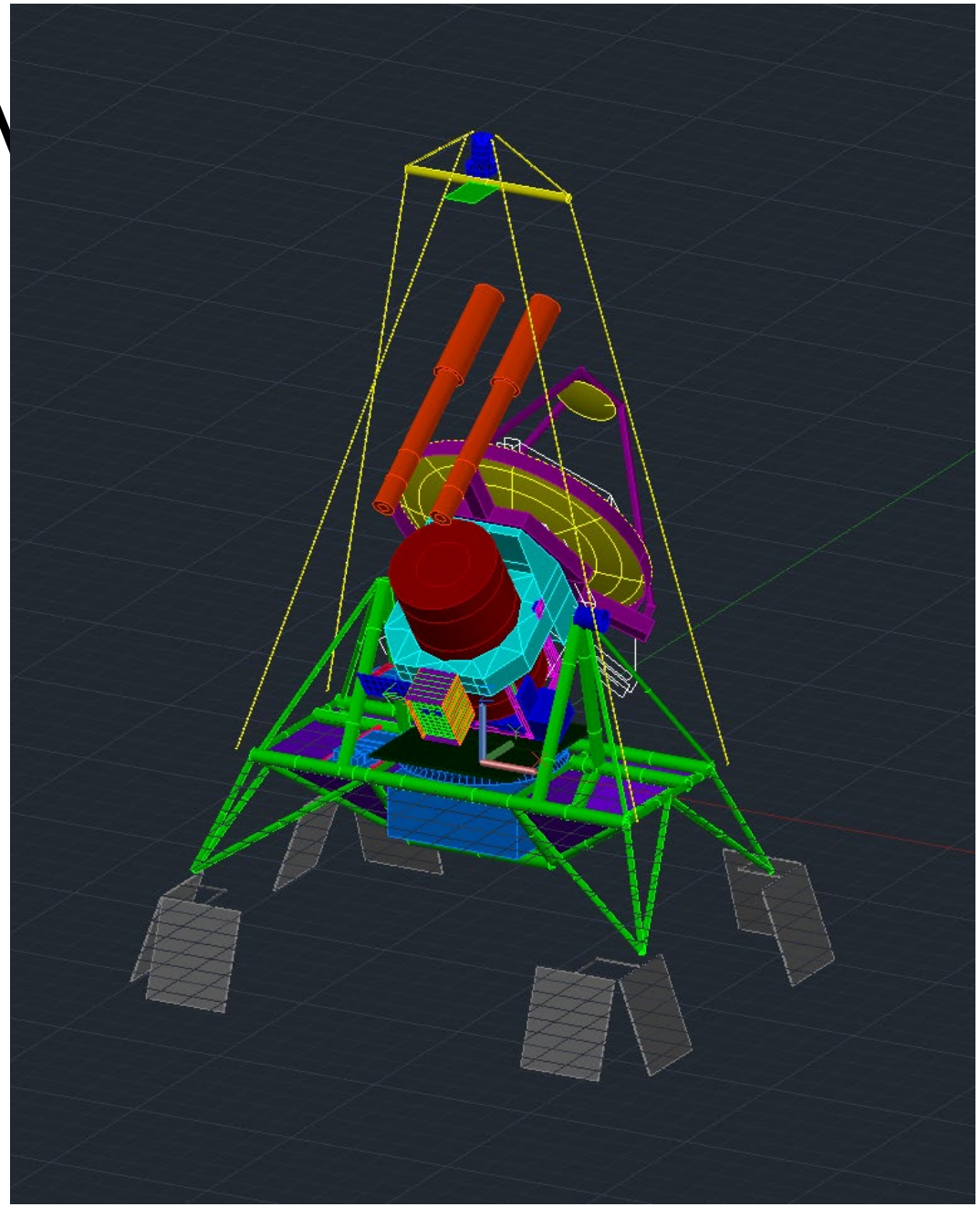
Thermal Model



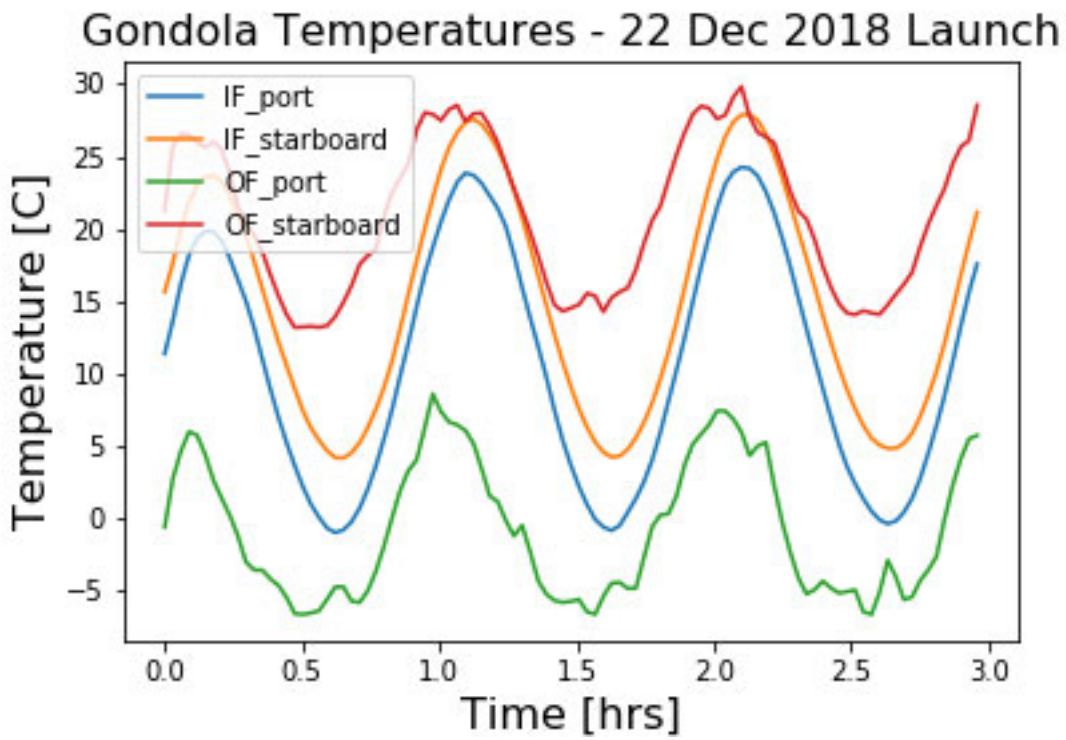


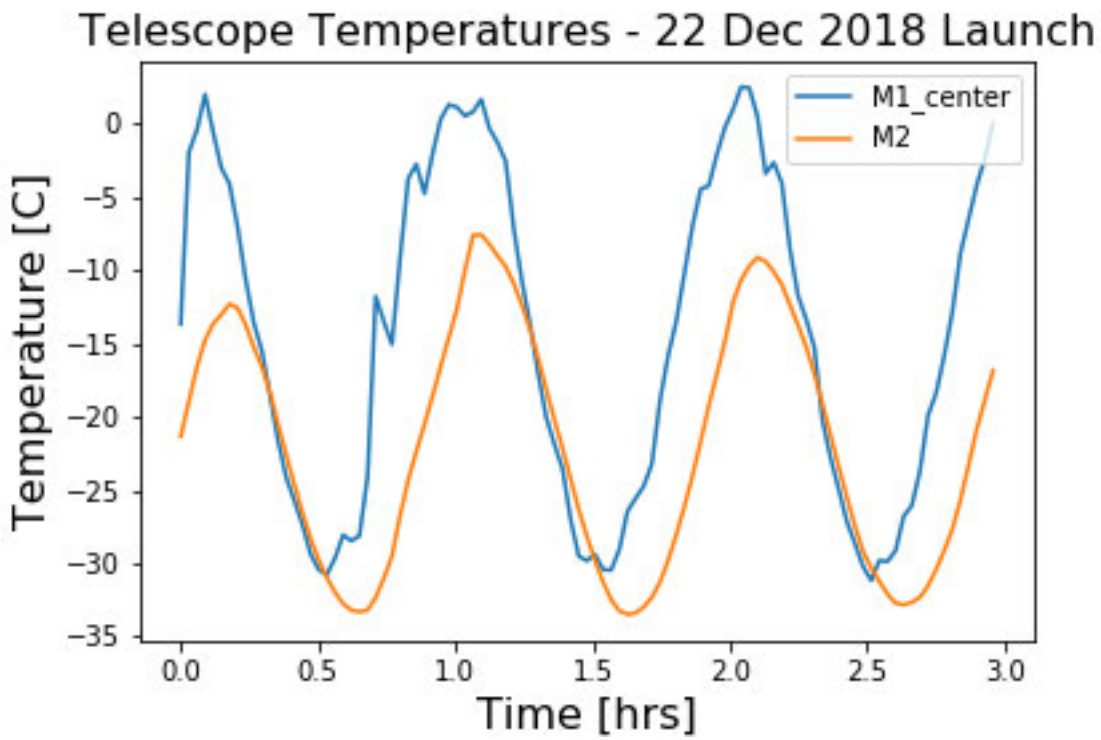
Thermal M



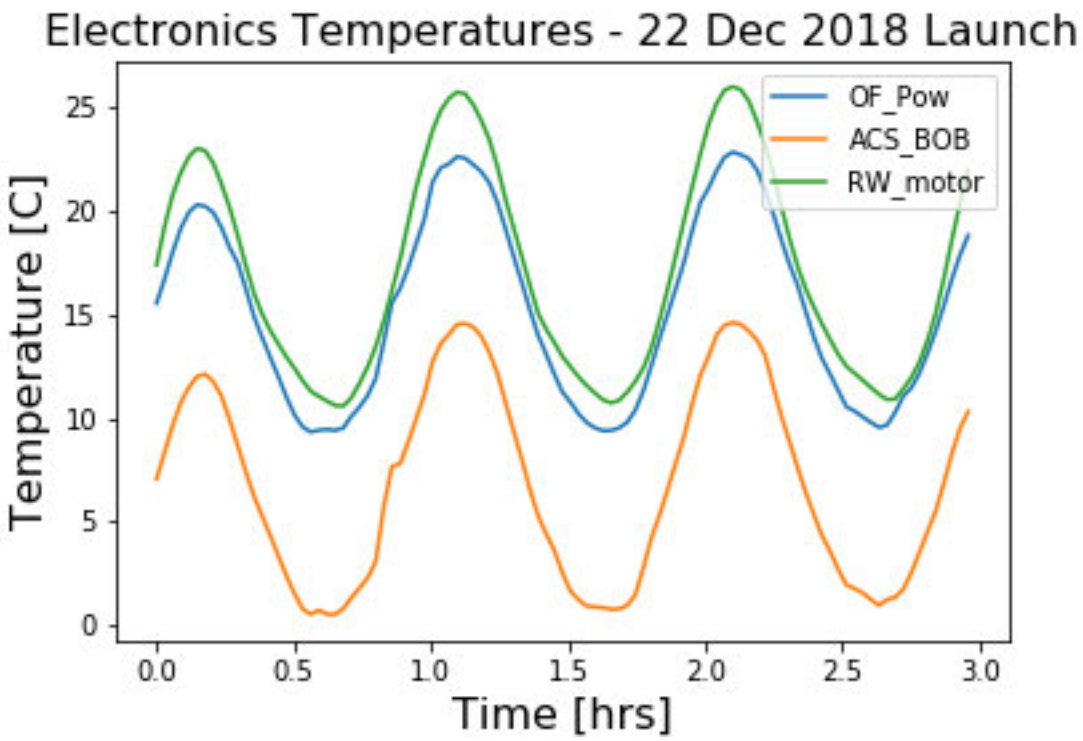


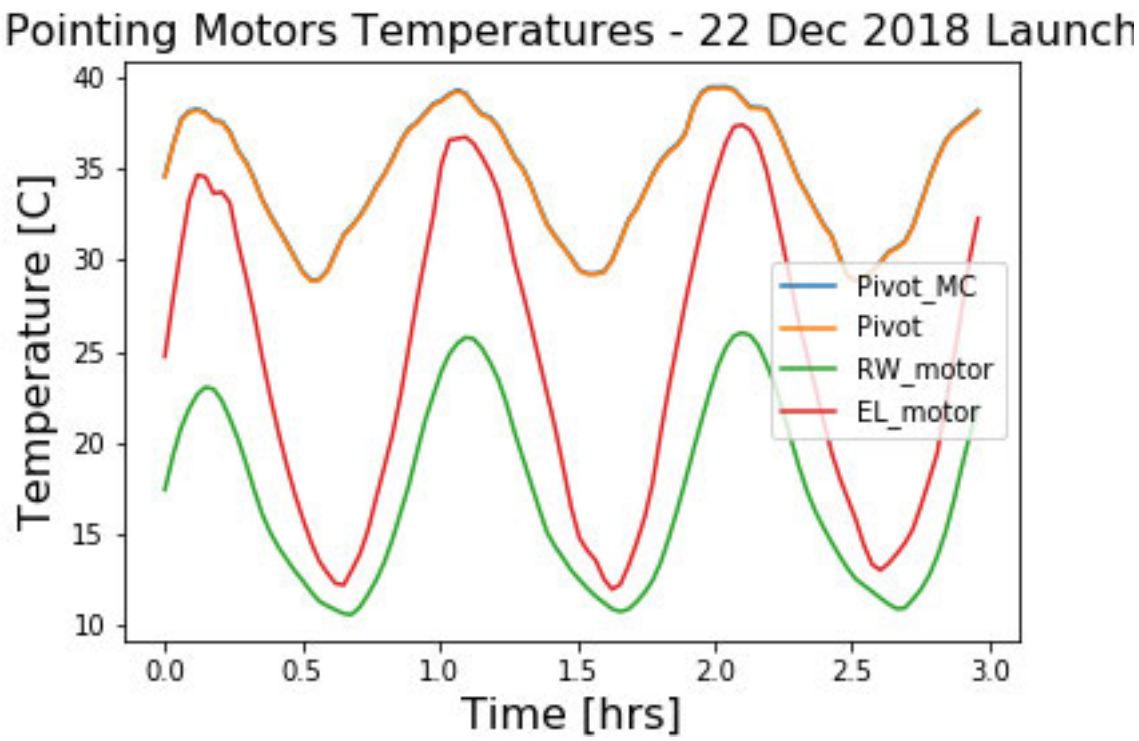
Thermal Simulations





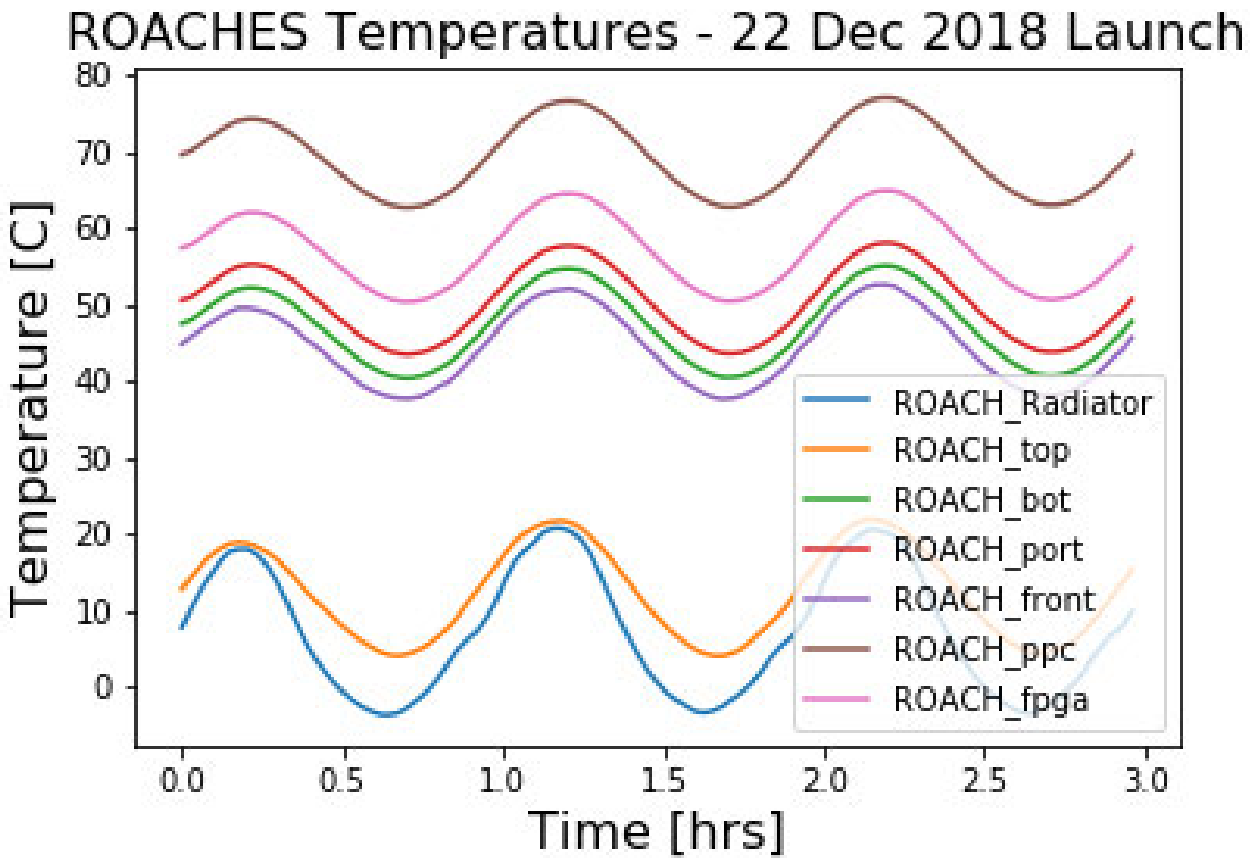
Thermal Simulations





ROACH Thermal Simulations

- ROACH thermal model validated during two Bemco tests
- Thermal link between ROACH enclosure and gondola calibrated in Bemco tests
- Large (12” x 24”) radiator increases radiation to sky
  - Model includes pessimistic estimate of conductive link to radiator



Logistical Requirements

- Shipping:
  - 3 5ft x 5ft x 5 ft pallets
    - Must arrive prior to personnel – no freeze issues
- Cryogens and Gasses
    - Must arrive by when team arrives – early November.
- LDB Facility transportation
    - Overcrowding at LDB and other issues may require significant off-hours work. Transportation may need to be arranged on a regular basis.

CSBF/NSF Support in McMurdo

- Standard pre-flight electronics and LDB support.

- Platform testing
  - Same as last time. Platform constructed away from high-bay for pointing sensor alignment

- Recovery
  - 2-3 BLAST team members on recovery – Hopefully with the Bassler.

BLAST McMurdo Requirements
Similar to BLAST 2006/2010

- Gas and Cryogens:
  - Nitrogen gas – normal – 3 cylinders
  - Helium gas – balloon – 3 cylinders
  - Helium gas – 0.99999 – 3 cylinders
  - Liquid helium - ~2000 liters
  - Liquid nitrogen - ~6x160 liter dewars

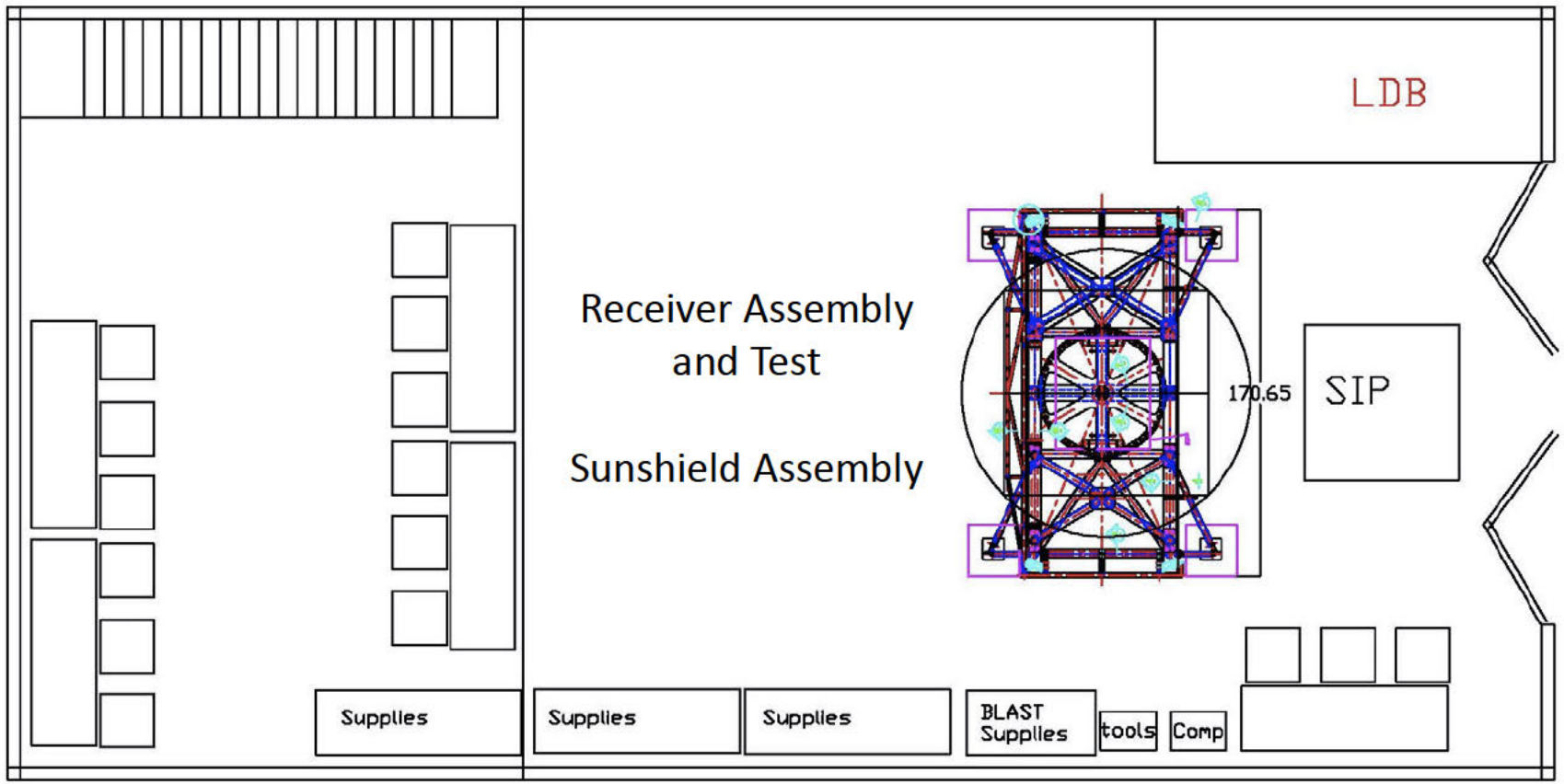
- High bay space to stage the instrument

- Internet connection

- 120 VAC, 220 VAC, 208 3-phase

- Shipping of payload to site

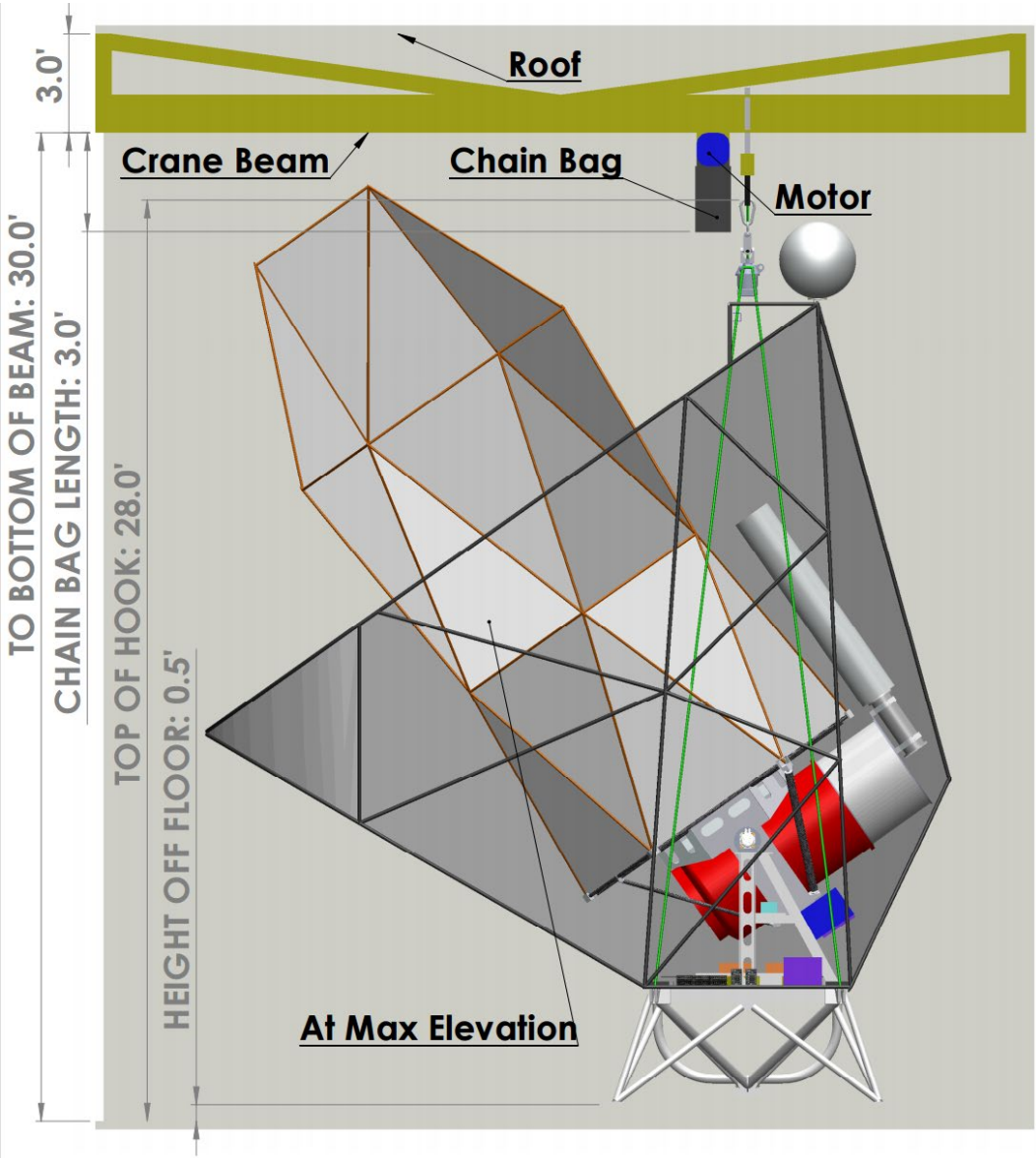
BLAST Highbay Layout



Gondola in High Bay

LDB High Bay Dimensions

- Rail Height: 28.5’
- Hook Height: 26.5’
- Door Height: 30’
- Door Width: 18’ (Bay 1), 20’ (Bay 2)



BLAST Hoist Usage

- Assemble Receiver
- Initial gondola assembly
- Sun shield assembly and installation
- Solar panel assembly and installation
- Assemble and install primary/secondary mirrors
- Install star cameras
- Pointing sensor calibration
- Pointing tests – every day
- Need access to man lift for assembling Sun Shields and Solar Arrays.

Internet Requirements

- During the flight:
  - 150 kilo-bits per second from North America to McMurdo
    - Relaying server on the Ice serves TDRSS/Iridium data to computers on the continent
  - 50 kbs from McMurdo to North America
  - Text and Audio Skype (or equiv.) continuously

- Normal operation
  - Normal internet usage
  - Webcam – 1 frame every 10 seconds served from North America
  - Occasional Text/Audio Skype
  - EP&O
    - Video Skype with classrooms
    - Photo blogs

- Require ONE static and externally accessible IP for the BLAST router.
  - All BLAST computers are behind the router/firewall
- PORTS open to our router from the outside
  - 22 (SSH), 41414, 41114, 14441, 14141
  - Ports for normal email operation
- Dorm drops for BLAST team – Especially during the flight!

Personnel

- We plan to have everyone that would have deployed by Nov 18th on the ice in the first wave
  - Gabriele Coppi, Ian Lowe, Laura Fissel, Sam Gordon, Federico Nati, Javier Romualdez, Adrian Sinclair, Caleb Wheeler, Paul Williams
  - Maybe Nathan Lourie?
  - With a significantly larger presence on the ice from day 1, we will be able to move more quickly through some tasks.
  - Certain tasks, however, saturate at 2-3 people and will take time

What needs to be done

- Lab unpacked and set up for monitoring and maintenance
- Cryostat removed from the inner frame, along with ROACHes
- Underside of the chin demylarized and scoop opened
- Mirror damage reassessed and mitigated where possible
- Cryostat opened and checked out, new amplifiers installed
- ROACH systems opened and checked out, new amplifiers installed
- New pivot motor installed
- Gondola reassembled

Schedule

- 11/18 – Unpacking the lab from the containers, assembling the landing zone for the cryostat, clearing the top of the IF, opening the OF escape hatch, vent the cryostat up to 1 atm
- 11/19 – This day begins with removing the star cameras, cryostat, and ROACH systems via the overhead crane. Maintenance begins on the ROACHes and cryostat.
- 11/20-23 – These days are slated to be all hands necessary on fixing the pivot, cryostat, and ROACHes.

Schedule

- 11/24 – Set aside time to open up the front of the gondola for mirror maintenance to begin, close up cryostat and rough it out
- 11/25 – Cryostat needs to be swapped to turbo pump and leak checked, if all goes well, continue turbo pumping. Gabriele and Ian can do a full assessment of the mirror situation and feasibility of access.
- 11/26 – First cryogenic transfer of the season, putting in LN2, best to put ~60-70L in (subject to review from Nate/Mark/books). ROACH maintenance must be finished or <24 h from completion. Mirror painting begins

Schedule

- 11/27 – LN2 burnoff day, ROACH amplifiers and loopback should begin being characterized. Mirror painting continues
- 11/28 – Liquid helium fill, ROACHes should be fully characterized and ready for cold detectors soon (1 day wiggle room). Post liquid helium fill, continue with any mirror tasks
- 11/29 – Finish up mirror fix, begin putting mylar back together
- 11/30 – looks like probably a short holiday day, refill liquid helium, button up the chin and scoop.

Schedule

- 12/1-5 – These days are all hands necessary on detector testing, everyone should be available to do whatever tasks the detector people need us to do. While not testing, we can continue gondola work/training people for flight on critical systems
- 12/6 – Post testing, we reinsert the cryostat into the gondola, reattach ROACHes, attach star cameras, put in flight tubing, etc
- 12/7 – Last touches on the gondola to ready it for preflight testing and flight. Leave helium fill hatch lightly taped in.

Schedule

- 12/8+
  - At this point, it really depends on CSBF, the weather, SUPERTIGER, etc. But we should be getting in as much in highbay pointing testing as Laura and Javier deem necessary in order to fully understand the gondola, as well as the stability of the commutation of the pivot.
  - Ideally we will be able to do coms tests, compatibility, and as much time on the dance floor as is required in order to fully understand and characterize the pointing systems, the data downlink, and our patience in rotating this beast of an experiment around in circles in the middle of an ice sheet while some poor soul waves an antenna at the telemetry building

Schedule, compressed

- 11/18 – Set up lab, prepare all of the maintenance areas, clear top of cryostat, open OF
- 11/19 – Remove cryo, roaches, XSCs, pivot, begin maintenance, opening cryostat
- 11/20-23 – Cryostat, pivot, ROACH maintenance days
- 11/24 – Cryostat closed and pumping, pivot may be back up by then
- 11/25 – Cryostat moved to turbo pump and leak checked, mirror mitigation begins
- 11/26 – LN2 required for cryostat, ROACH maintenance finished
- 11/28 – LHe added to cryostat, ROACH amplifiers recharacterized, mirror mitigation done
- 11/29 – Close up of the chin and scoop mylar
- 11/30 – Holiday(short day?) Refill of LHe in the tank, may have cold arrays late in day
- 12/1-5 – Detector recharacterization off the gondola
- 12/6 – Reinsertion of the cryostat, ROACHes, star cameras

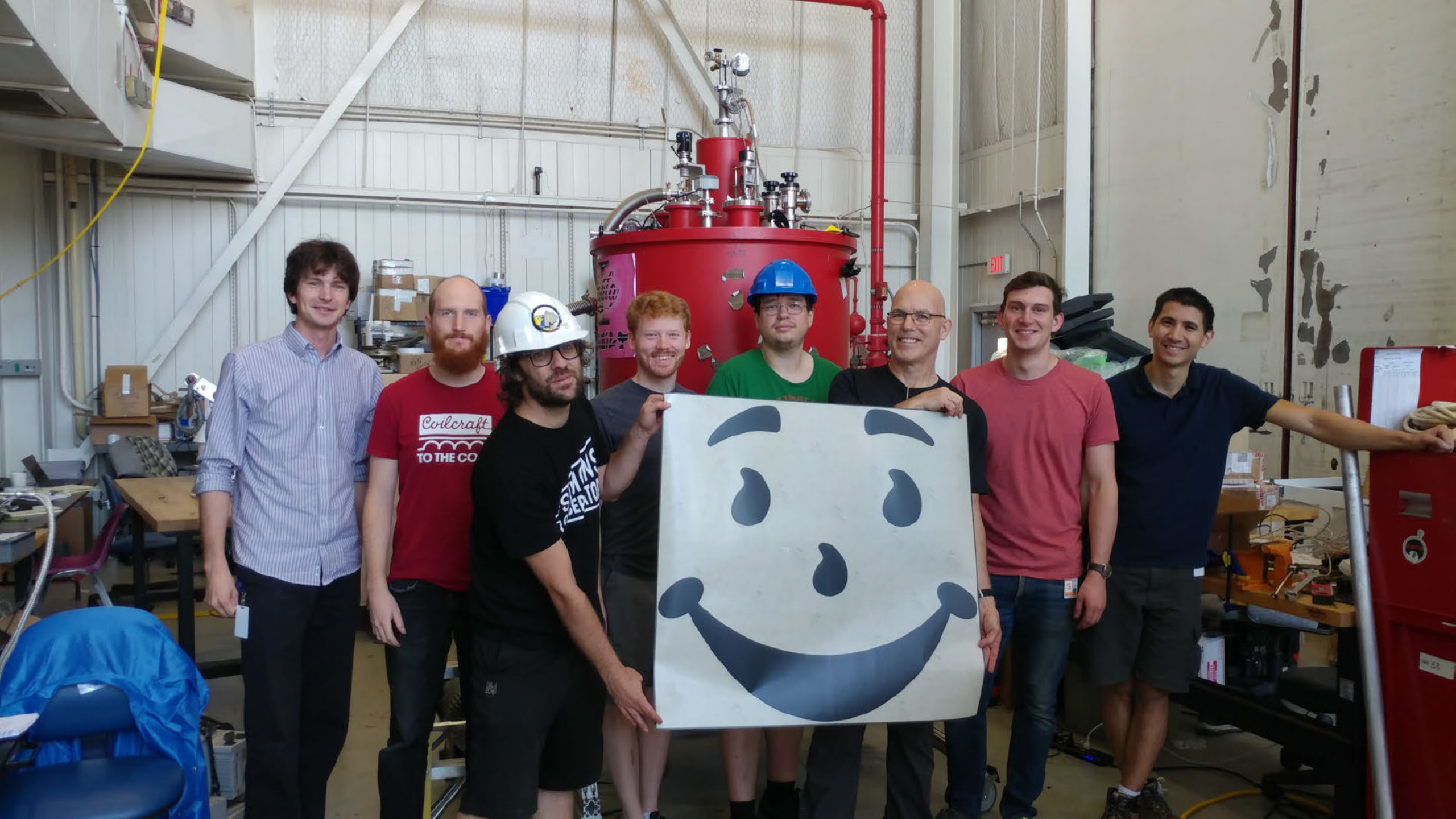
Schedule, compressed, cont.

- 12/7 – Final button-up of the gondola, minus refillings
- 12/8-??? – On gondola systems stress testing, pointing recalibration, coms tests, compatibility, dance floor for pointing system calibration and data rate/downlink testing, potential star camera testing outside if stars visible coincident with dance floor
- ~12/10 – LHE refill, depending on crew availability
- ~12/10 – Concurrent with helium fill
- 12/18+ – Flight ready, but this really depends on compatibility, outside availability. We *need* time outside to be ready to launch

BLAST McMurdo Requirements – Personnel

- Needs are similar to 2018 -
  - 3 person advance team arrives with the instrument
    - Unpack and set up lab
    - Assemble gondola
  - + 1-2 weeks – 2 more people - 6 TOTAL
    - Assemble receiver and begin tests
  - + 3 weeks – 4 more people - 9-11 TOTAL
    - Final flight preparation and planning
  - 3 days after launch – all but 6 people leave

Name	Middle Name	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3
Mark Devlin																		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Nathan Lourie	Patrick	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ian Lowe	Nicholas	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Federico Nati												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Gabriele Coppi		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laura Fissel	Marion											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Giles Novak	Anthony											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																			
Javier Romualdez	Luis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Paul Williams	Andrew	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Phillip Mauskopf	Daniel																	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Samuel Gordon	Bender											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
Adrian Sinclair	Kai											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
Nicholas Galitzki	Benjamin																	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																					
Bradley Dober	Jerald											1	1	1	1	1	1	1	1	1	1	1	1	1	1	P	P	P	P	P	P	P	P	P	P	P	P	P	P																							
Peter Ashton	Campbell																						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Total Daily		5	5	5	5	5	5	5	5	5	5	11	11	11	11	11	11	14	14	14	14	14	15	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13	12	12	12	12	12	12	12	12	12	12	12	12	12	10	6	6


Coilcraft
EXIT

THANKS!

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

The SuperTIGER-2 Experiment

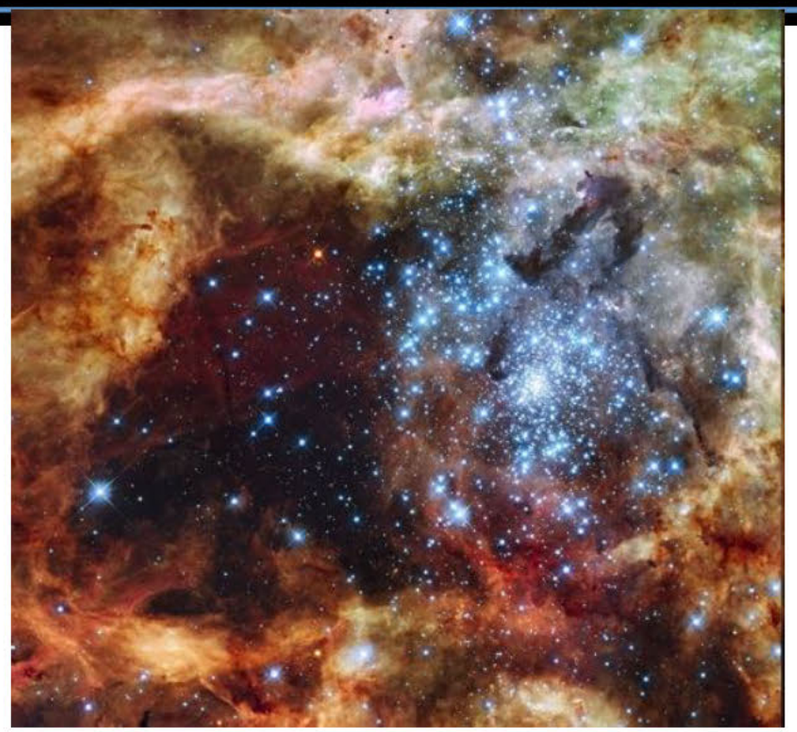
A-142-M
Brian Rauch

Y. AKAIKE[2], W.R. BINNS[1], T.J. BRANDT[2], D.L. BRAUN[1], J.H. BUCKLEY[1], R.M. CRABILL[3], T. HAMS[2], Z.D. HUGHES[1], M.H. ISRAEL[1], A.W. LABRADOR[3], J.T. LINK[2], R.A. MEWALDT[3], J.W. MITCHELL[2], B.F. RAUCH[1], K. SAKAI[2], M. SASAKI[2], G.E. SIMBURGER[1], E.C. STONE[3], C.J. WADDINGTON[5], N.E. WALSH[4], M.E. WIEDENBECK[4], A.T. WEST[1], AND W.V. ZOBER[1]

1. Washington University in St. Louis, St. Louis, MO 63130 USA
2. NASA/Goddard Space Flight Center, Greenbelt, MD 2077 USA
3. California Institute of Technology, Pasadena, CA 91125 USA
4. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
5. University of Minnesota, Minneapolis, MN 55455 USA

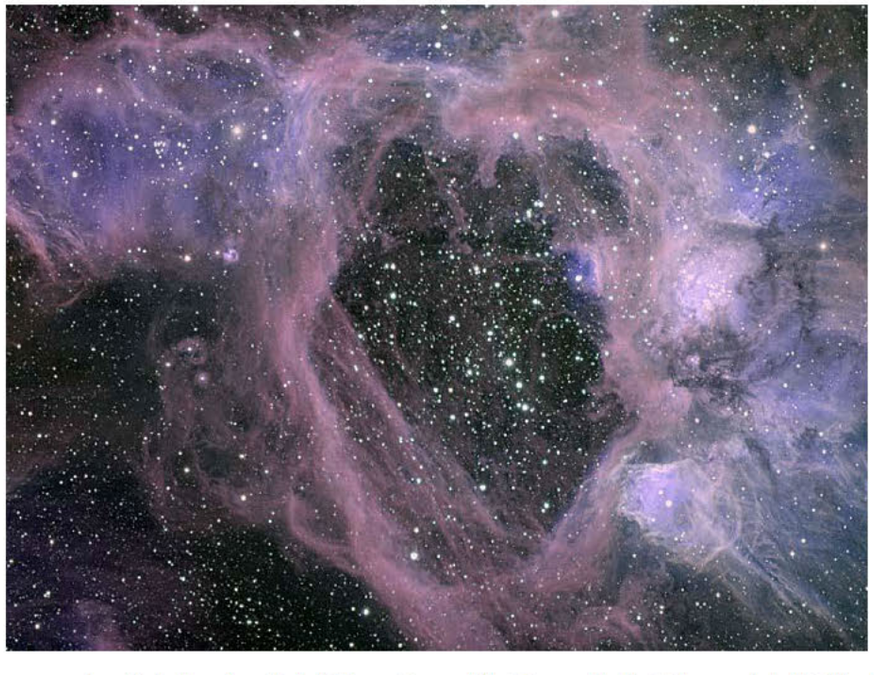
SuperTIGER-2 Science Objectives

- Primary objectives
  - Perform new tests of the origins of galactic cosmic rays
    - Strengthen evidence pointing to OB associations as a major source of cosmic rays
  - To do this
    - Measure composition of cosmic rays $26 \leq Z \leq 40$ with improved statistics and expand our measurements in the $40 \leq Z \leq 56$ range
  - Test mass dependence and refractory/volatile fractionation up to Z=56
- Extending our measurements up to Z=56 enables us to
  - begin to sample the charge range where r-process production resulting from binary neutron star mergers (BNSM) may become important
  - Test whether nuclei in the Z=50's charge range are produced and accelerated by the same sources as those in the $Z \leq 40$ range
  - BNSM with ejecta observed August 17, 2017



30 Doradus in LMC

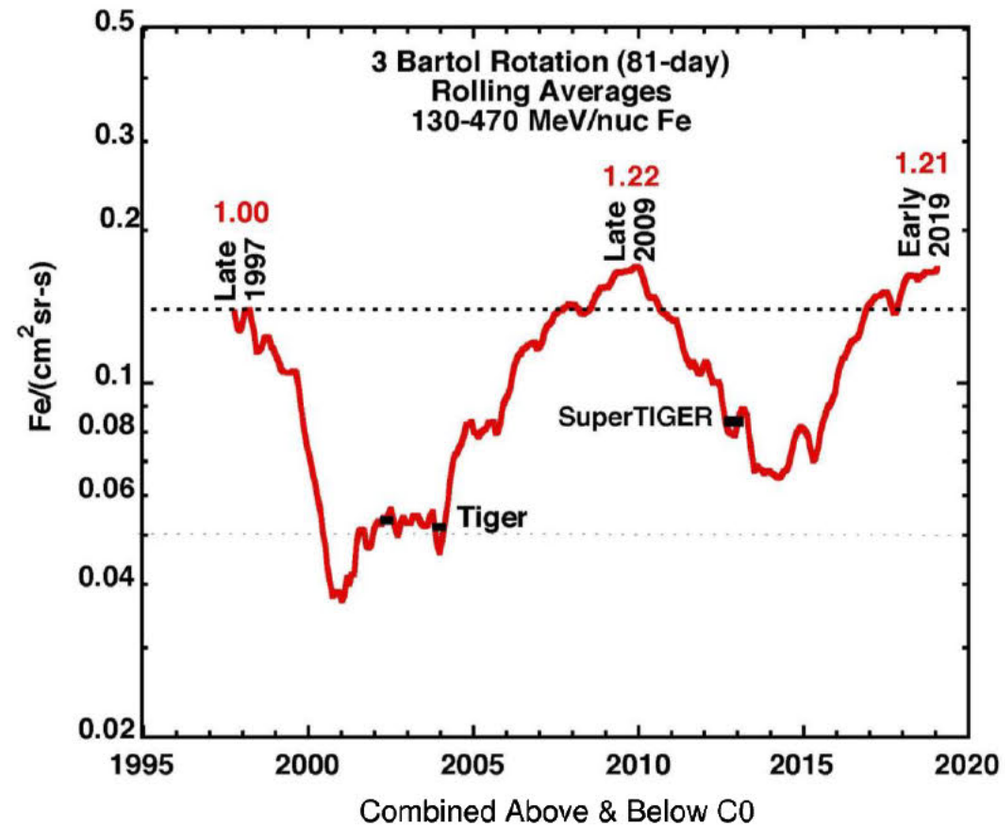
Credit: NASA, ESA,F. Paresce (INAF-IASF), R. O'Connell (U. Virginia), & the HST WFC3HST Science Oversight Com

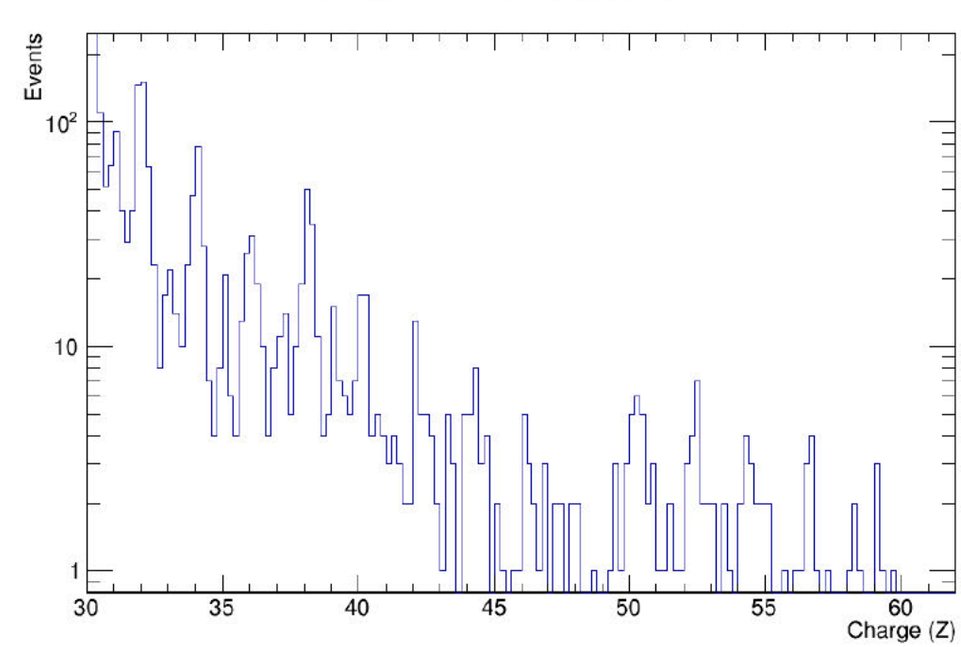


N44 Superbubble in LMC--Credit:Gemini Obs, AURA, NSF

Favorable Solar Modulation

- Recently we have seen the lowest levels of solar activity in the space age
- Reduced solar wind strength allows more of the cosmic ray flux through
- 60 days of ST2 now would be ~1.7x 55 days of ST1
- Cosmic-ray intensity is nearing its cycle maximum
- Now is a very good time to fly SuperTIGER





SuperTIGER-2.3 Ice Team

- Washington University
  - Brian Rauch (PI)—Management, science & recovery
  - Richard Bose—Electronics & software
  - Dana Braun—Mechanical
  - James Buckley—Integration with APT-Lite
  - Zachary Hughes —Grad Student—Integration with APT-Lite & software
  - Garry Simburger—Electronics
  - Andrew West—Grad Student—Integration & recovery backup
  - Wolfgang Zober—Grad Student—Integration, science & recovery

PQ Status:

- Complete
- Material submitted to UTMB
- Ongoing

- Goddard Space Flight Center
  - Yosui Akaike (Co-I)—Science & S-counters
  - Kenichi Sakai (Co-I)—Science & Cherenkov detectors
- California Institute of Technology
  - Marty Crabill—Recovery

Person Loading:

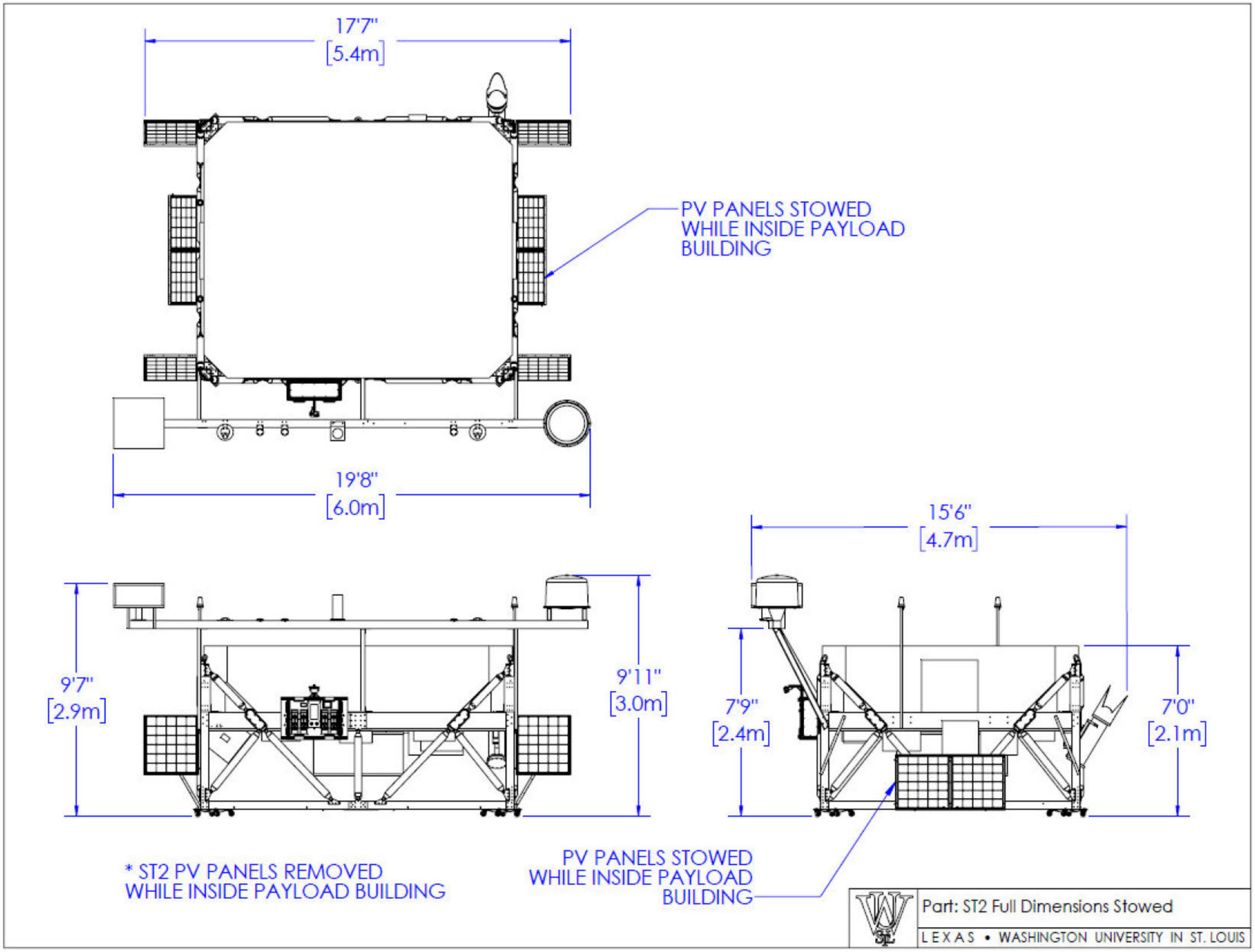
- Main group of 8 arrives on ice 13-Nov, 1 on 20-Nov, and 1 on 25-Nov
- 4-5 people for LOS monitoring, postlaunch packing
- After packing keep 2 people for data monitoring, possible recovery up to Feb
- Deploy up to 1 additional person for recovery in Jan
- Maximum team size 10 for launch preparations
- Launch ready as close to 01-Dec as possible

SuperTIGER-2.3 Schedule

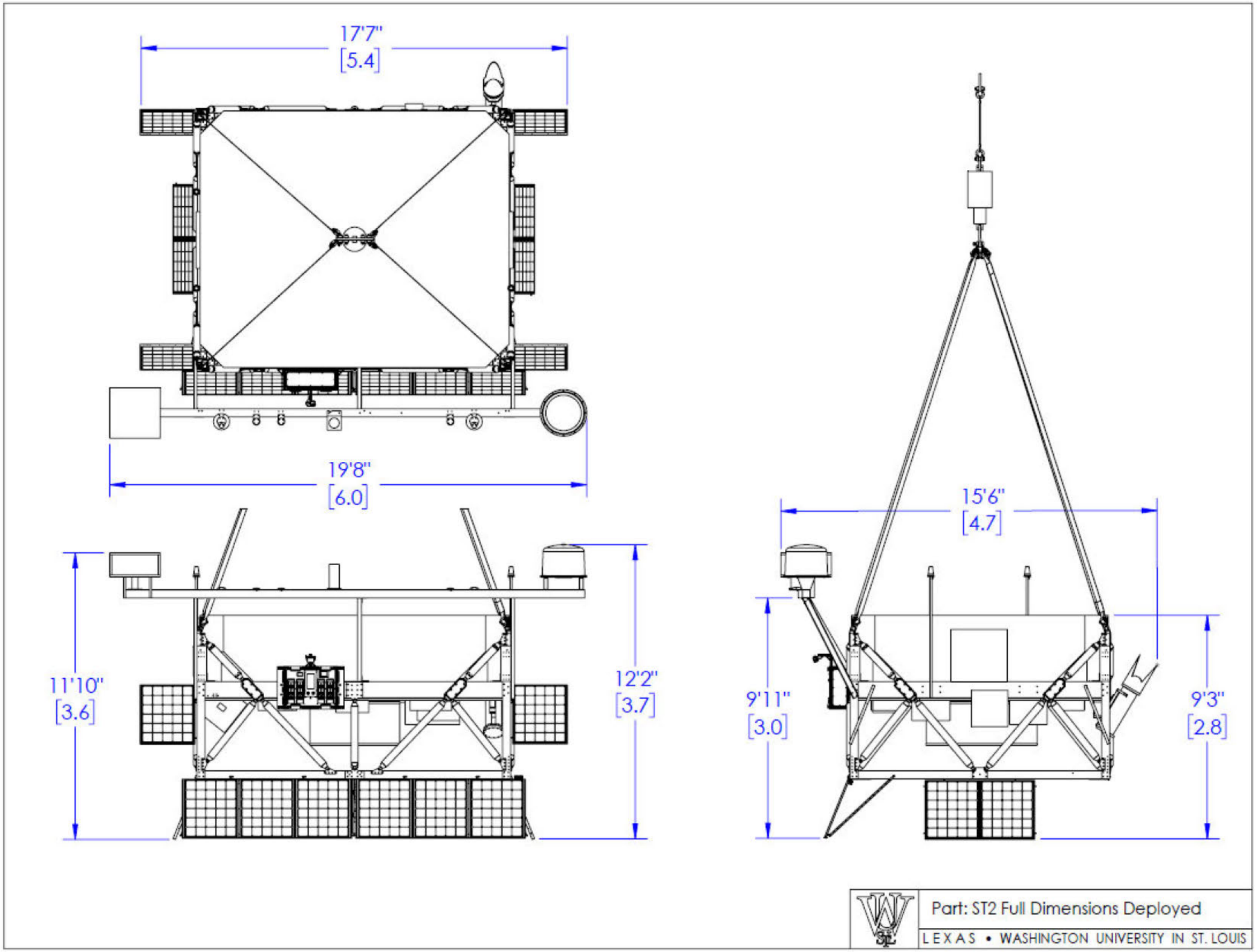
- Schedule assumes that CSBF will be able to support science groups starting November 18, requiring earliest possible LDB opening on November 14
- Delays in LDB opening will push back this schedule accordingly
- No explicit slack provided, but testing phases and insulation box construction time frames are conservative

November	18	19	20	21	22	23	24	25	26	27	28	29	30
I&T Antarctica Detail													
--Unpack/Set up	■	■											
--Assemble gondola	■	■											
--Test detector modules	■	■	■	■	■	■							
--Build thermal insulation box		■	■	■	■	■	■						
--Install modules on gondola						■							
--Install piggyback experiments						■							
--Install SIP						■							
--Test all systems						■	■	■	■	■			
--Install thermal insulation								■					
--Telemetry testing											■		
--FRR												■	
--Hang test													■

SuperTIGER-2.3 Schematics



Flight Configuration



Flight Requirements/Goals

- Requirements
  - Minimum altitude 115,000 ft
  - Minimum float time 8 days or one revolution
  - CSBF Rotator for solar panel pointing
- Goals
  - 50+ days at float and as many revolution.
  - Would like to be launched as early as possible. Plan to declare flight ready as early as possible.
  - Peak altitude of ≥120,000 ft
  - In short, we would like to fly as high as possible for as long as possible

CSBF Telemetry Support

- LOS data rate
  - Uncompressed data
  - Rate is fast enough so that all data comes down: 2 x 781 kbps transmitters
- HGA TDRSS data rate 90 kbps
  - Rate is fast enough so that all events come down in compressed format
- OpenPort data rate ~90 kbps
  - Rate is fast enough so that all events come down in compressed format
  - PMC-Turbo will take ~5 kbps of total rate
  - APT-Lite will take ~1 kbps of total rate
- Omni TDRSS data rate 10 kbps
  - Backup if HGA doesn't work
  - Get fewer events down
  - Have priority system so that most high priority events will be transmitted to ground

Hazardous Systems

- Cryogens
  - LN2 boiloff for slow continuous purge of Cherenkov counters
  - Personnel involved in operating the dewar have NASA training for handling and operating systems with compressed gas and cryogens
  - 160 L dewar of LN2 every ~2 weeks
- High Voltage
  - HVPS provides up to 1250 V to power photomultiplier tubes
  - All HV wires are coaxial and all HV contacts are potted
  - No hazard to those working on instrument
- Lift Operations
  - We will have a certified crane operator on-site

Field Support Requirements

- Require 160 liters of LN2 every ~2 weeks delivered to Willy Field from ~Nov. 18 until launch
  - Use boiloff to purge aerogel Cherenkov radiators, which are hygroscopic
  - It is not a problem if weather or any other circumstance delays the refill by 2-3 days
- Office/cubical space – Crary 111 listed in RSP
  - Space/seating for 3-4 people, telephone, 1 ethernet line for monitoring computer
- Payload Building 1
  - Tables and chairs for 10 people
  - Phone and internet connectivity
- Support for data transfer to/from the US
- Computer connectivity support for email and data in and out
- If we fly multiple revolutions, request LOS capability for each McMurdo bypass, if possible
- Air support for recovery (arranged by CSBF)
  - Basler strongly desired for full recovery

IT Support at McMurdo

- All computer systems and peripherals will be supplied by our team
- Each person will have a laptop and will need email access
- In addition we will have two desktop computers and one spare
- We will transfer data to/from McMurdo at various times
  - Low rate data from McM during pre-launch instrument tests
  - ≤ 100 kbps to McM during normal flight operations
  - ≤ 250 kbps from McM during LOS

Shipping/Integration Status

- 2 sea containers COMSUR
  - standard height 20’ sea container with partially assembled SuperTIGER gondola, precut insulation box pieces, assorted equipment, E-MIST, and PMC-Turbo
  - 10’ sea container with spare detectors and components, ground support equipment, foam insulation, supplies, BAS, and SAS
- 2 large wooden boxes COMAIR
  - Each box contains one of the two integrated SuperTIGER detector modules
- 2 small boxes with shirts COMAIR

Recovery Plan

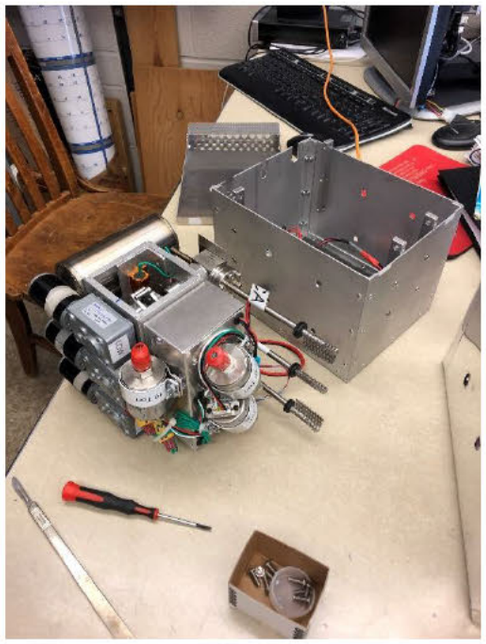
- Instrument is designed to be disassembled and handled in the field as was successfully done with ST-1 and ST-2.2
- Recovery with a single Basler flight, plus Twin Otter or helicopter flights to take people to the landing site
    - All detector components can be loaded and most reused
  - Recovery with Twin Otter flights only is possible, but:
    - Requires more on-ice disassembly time since we have to break the instrument further down to fit into plane
    - The fiber hodoscope has to be destroyed to fit in the DHC-6 (>1 FTE to rebuild)
- Plan to send 3 members of science team to recovery site to disassemble and recover instrument
- Science team members have past recovery experience
- Anticipate needing ~3-4 days of on-ground recovery time, depending upon the recovery conditions
- If limited recovery only this year—SuperTIGER data vault and piggybacks: BAS, E-MIST, APTLite and PMC-Turbo if possible

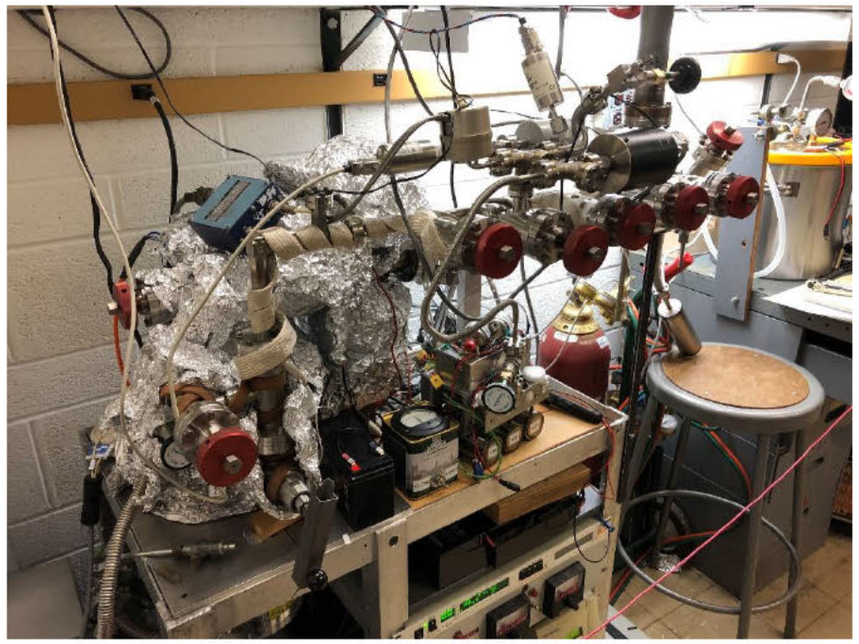
Piggyback Payloads

- E-MIST, PI David Smith — NASA/Ames
  - Study bacteria and fungi response to exposure in upper atmosphere
  - Refurbished after 2018-2019 season
  - Passed thermal-vacuum testing at NASA/CSBF in mid July
  - E-MIST shipped with SuperTIGER-2
  - Necessary permits have been issued
- PMC-Turbo, PI David Fritts
  - Upper atmosphere studies of polar mesospheric clouds and their turbulence
  - Recovered and in apparently good condition
  - PMC-Turbo shipped with SuperTIGER-2

More Piggyback Payloads

- Balloon Air Sampler (BAS), PI Alex Meshik, Washington University
  - Perform laboratory measurements of the atmospheric $_{2}He$, $_{36}Kr$, and $_{54}Xe$ (and other gases) content as a function of altitude.
  - Operated as designed, with 2 of 3 samples collected in 2018 flight for laboratory analysis
  - BAS refurbished and separate Surface Air Sampler (SAS) for 2019-2020 season
  - BAS shipped with SuperTIGER-2





- Advanced Particle-astrophysics Telescope-Lite (APT-Lite), PI James Buckley, Washington University
  - Demonstrator of a new type of imaging calorimeter aimed at a future gamma-ray/cosmic-ray mission
  - Mounted under a SuperTIGER-2 module to take data in coincidence using its trigger signal
  - Some components being prepared
  - APT-Lite, parts and supplies will be transported as excess baggage by Brian Rauch

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

TRAVALB
Trajectory Validation- Barrel Antarctica 2020 MRR

Robert Salter – CSBF Flight Project Manager

Robyn Millan – Barrel Mission of Opportunity PI

Outline

- CSBF Overview of Concept and Flight Plan
- Mission of Opportunity Science Overview
  - Science Objectives
  - Review of past BARREL campaigns (2013, 2014, 2015, 2016)
  - Review of 2018 693N Flight
  - Plans for TRAVALB 2019-2020
- Payload Overview and System Readiness
- Operations
  - Personnel
  - Launch Operations
  - Mission Operations Center
  - Schedule

Overview

- GUSTO Mission – Dec 2021
  - Explorer Mission, slated for launch in Antarctica 2021
  - First Explorers SPB +100 day Science Mission
  - Success criteria for payload is 60 days baseline, 100 day flight, with possibility of ocean landing (no recovery)
  - CSBF has provided multiple “trajectories” based on ECMWF reanalysis winds for previous years missions.
  - 693N provides the first snapshot of a flight trajectory.
- CSBF can provide further flights resolving SPB trajectory verification for a simulated GUSTO mission

Pathfinder Concept

Two Flights
Dec 1: GUSTO Nominal Trajectory
Jan 1: GUSTO OFF-Nominal Trajectory

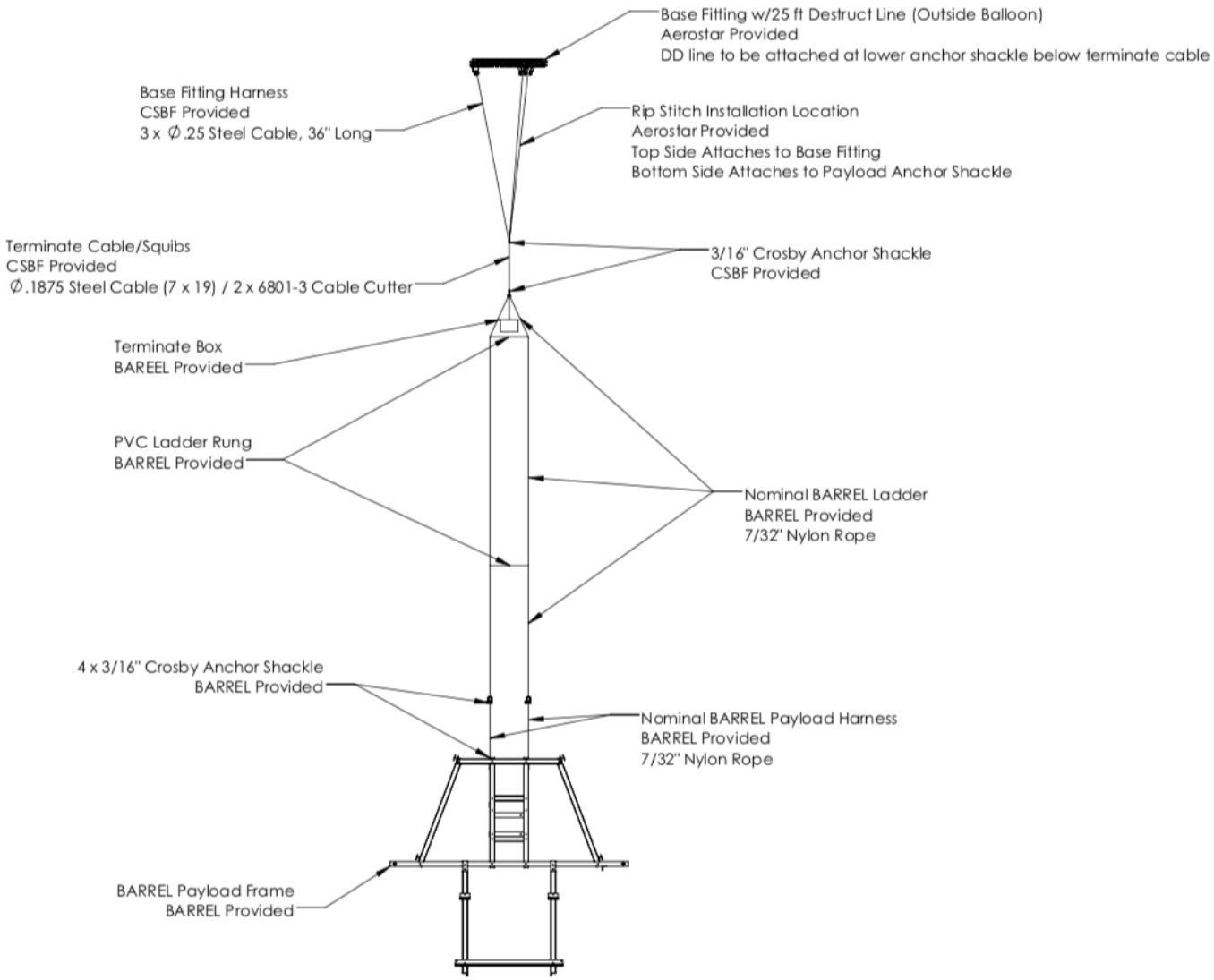
Aerostar provided SPB balloon to provide for ~75lbs @ 110Kft
- .6 MCF SPB
  - Based on Aerostar ThunderHead .4 designs
- SPB Balloon to mimic float altitude of the NASA 18MCF
- Aerostar provided flight proven Ripstitch,DP Gauges
- Aerostar health assessments of balloon health

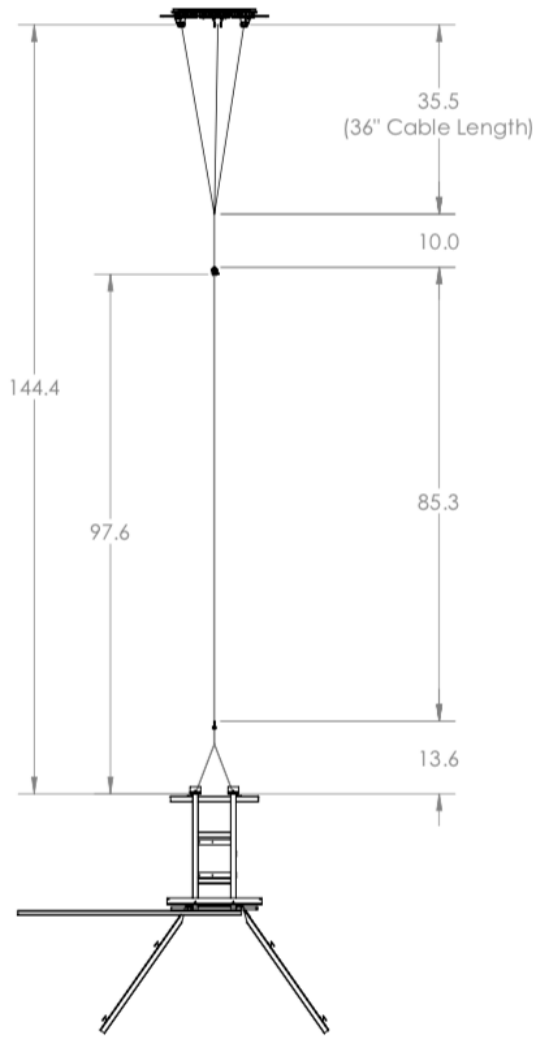
Barrel Mission of Opportunity
- Payload available (~65lbs estimated)
- includes science provided termination system (CSBF Heritage)
- CSBF provided iridium balloon tracker
-- CSBF provided Ordnance (two squibs for termination)
- No Helium valve
  - Balloon is filled via an inflation ‘port’

Pathfinder Flight Plan

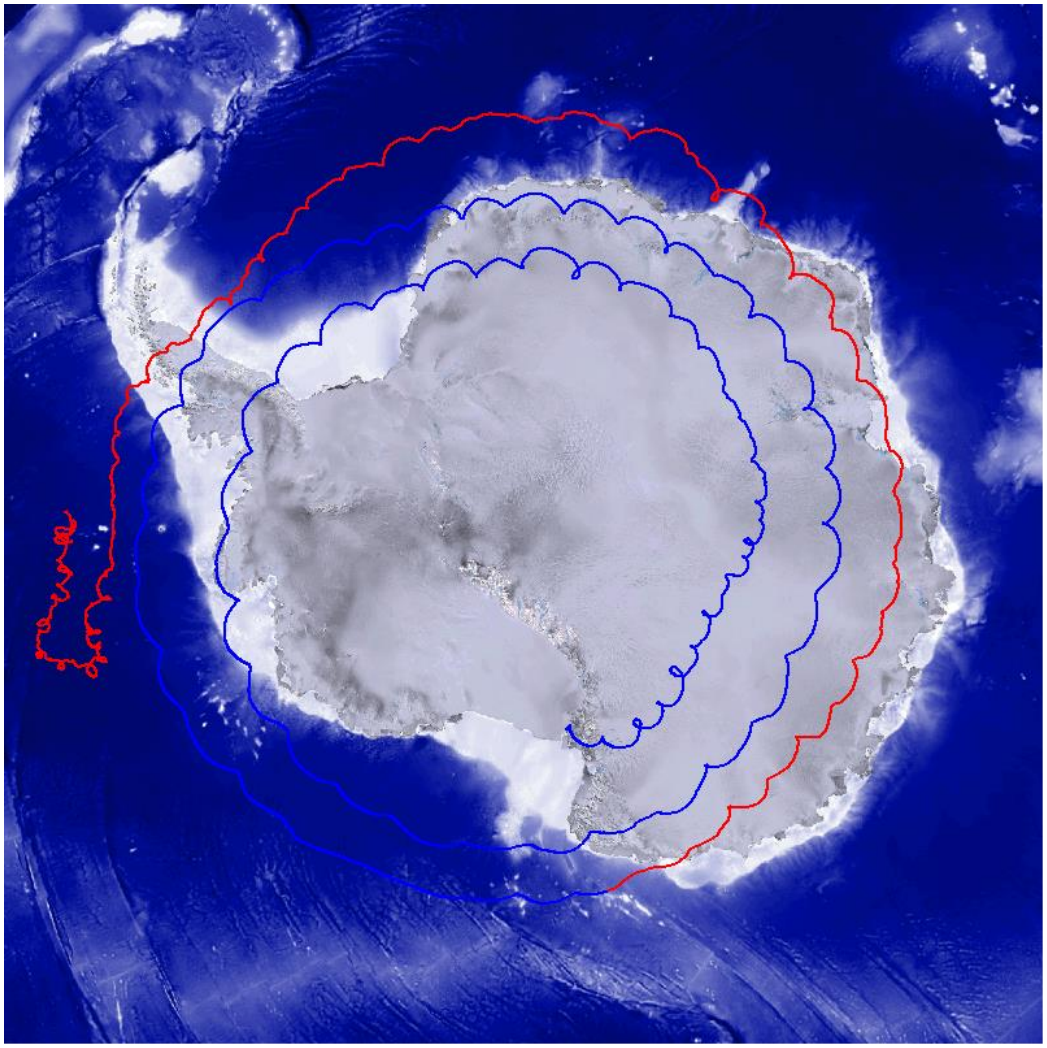
- Launch of First Payload “Nominal” GUSTO Dec 1-Dec 20
  - Gusto Flight Ready Date of Dec 10
- Launch of Second Payload “OffNominal” Jan 1-Jan 10
- Ascent – Float
  - Aerostar Health Assessment on initial float
  - OTH Monitoring via Barrel and CSBF Systems
- Float – Float +100
  - OTH Monitoring via Barrel and CSBF systems
  - Periodic Aerostar health assessment of balloon health
  - Flight allowed circumnavigation of Antarctica Continent without restriction
  - Flight will NOT be allowed overflight of ANY populated land mass
- Termination
  - Termination fires squibs
    - Tethered free fall of payload for nominal distance
    - Force provided to deploy RIP Panel
      - Balloon Destruction
      - NO Separation of flight gondola and balloon occurs
    - Both Payload and destroyed balloon fall as one unit
  - Meets environmental requirements for disposal in ocean (if necessary)

Flight Train Components



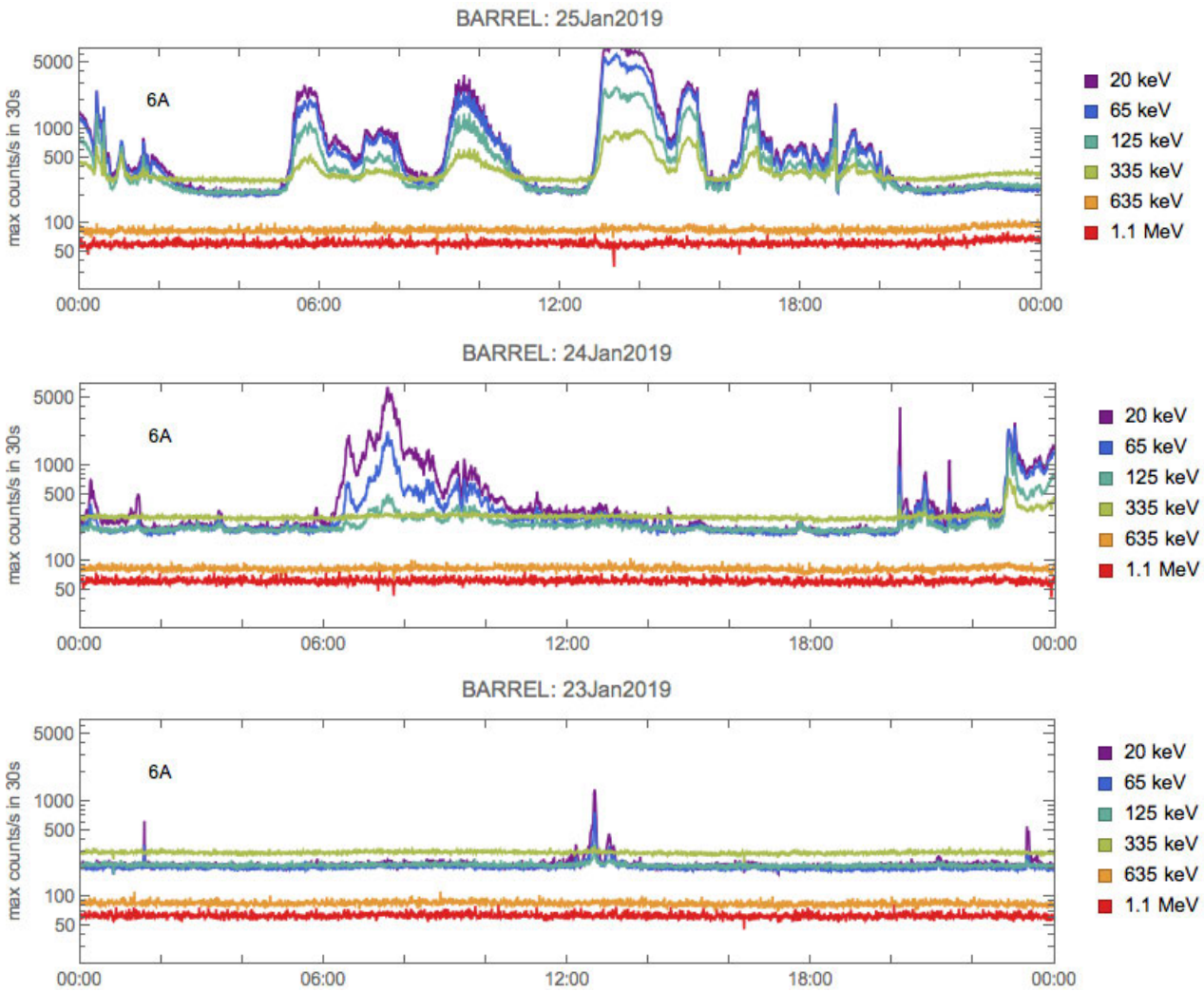


693N Flight Results



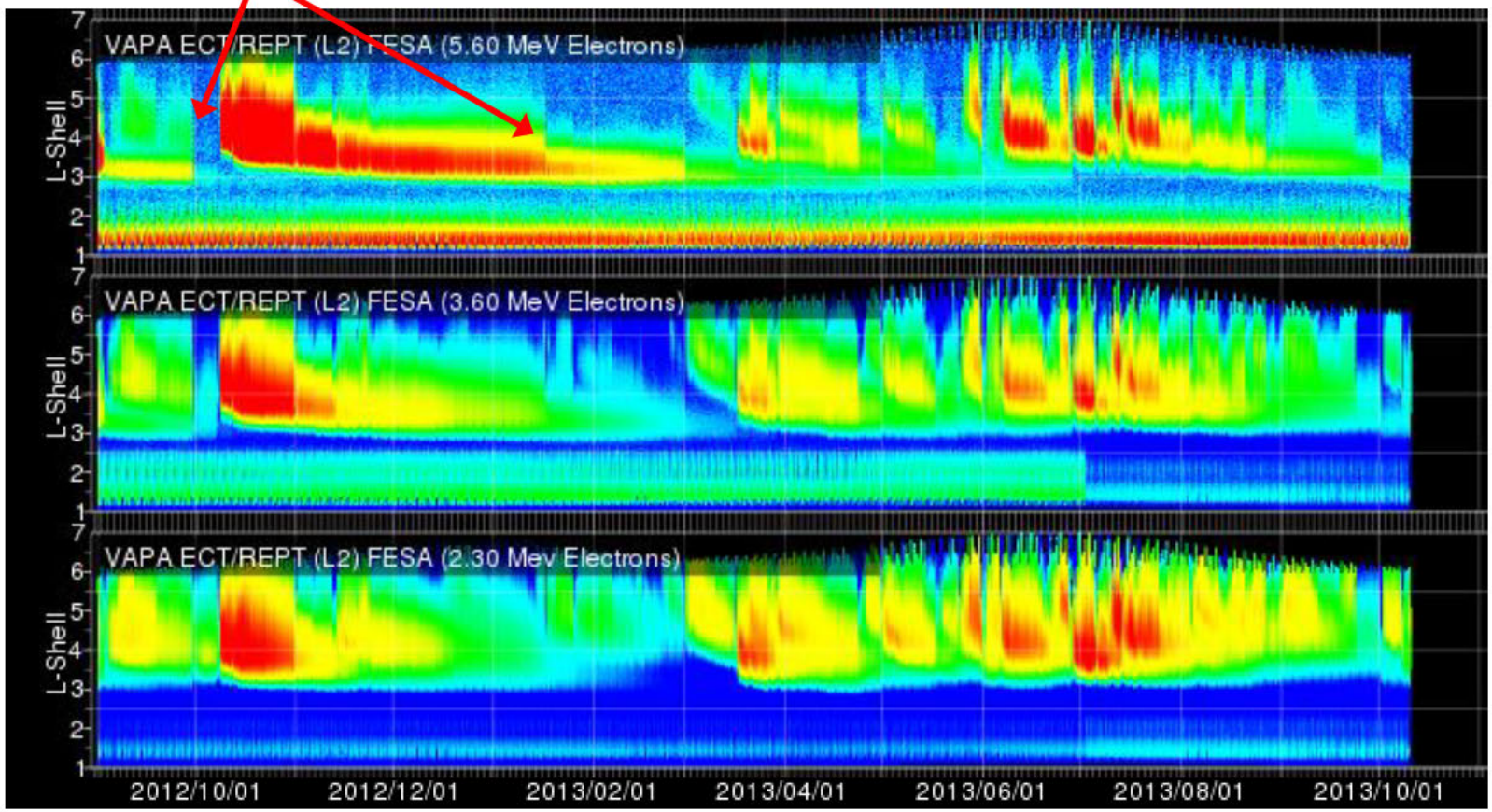
693N
Launched Dec 9, 2018
73 days at float
Balloon Anomaly
Terminated flight
Declared Mission Success
Multiple Science Events
Captured throughout the
Flight Duration
Nominal 2018 GUSTO
Launch would have been
a “Spiral OUT” year

693N Barrel MOO 24 HR Spectra



Science: Radiation Belt Electron Losses

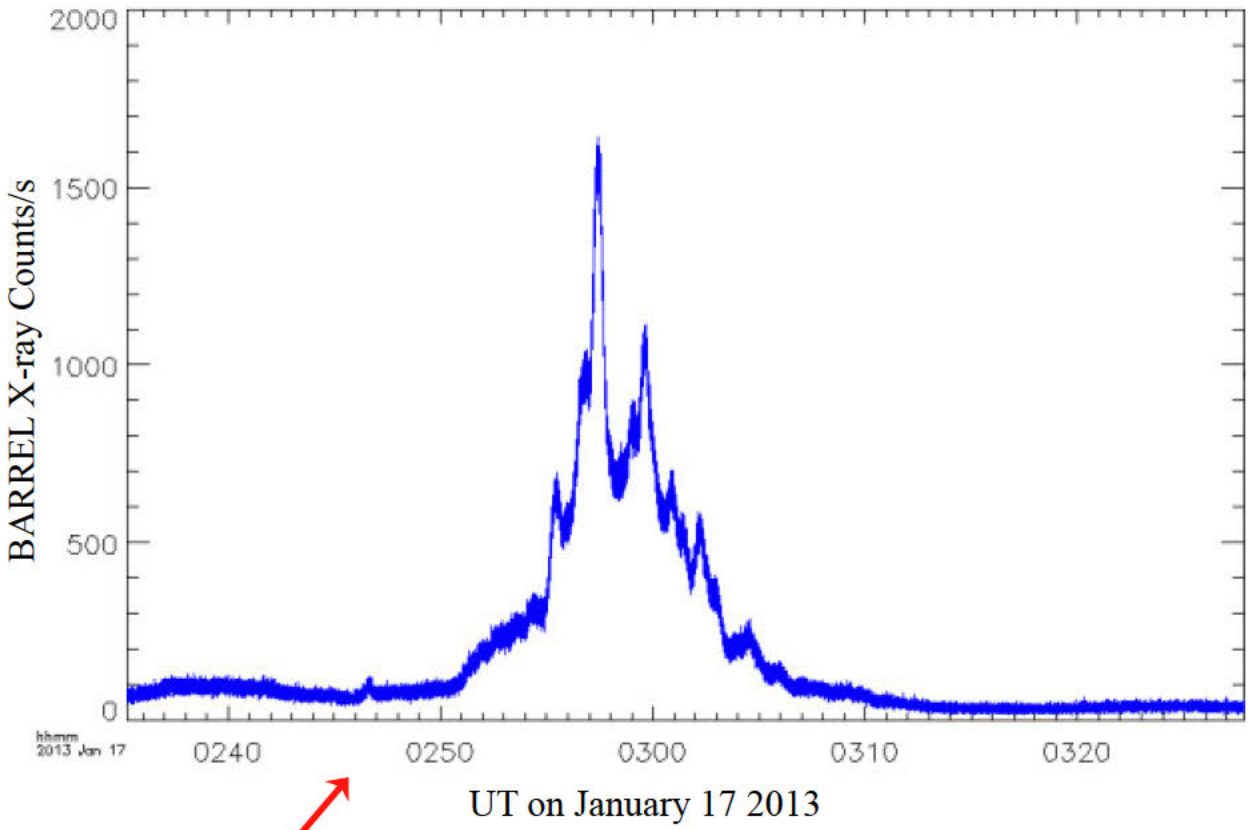
Quantify processes responsible for catastrophic losses of electrons from Earth's outer radiation belt



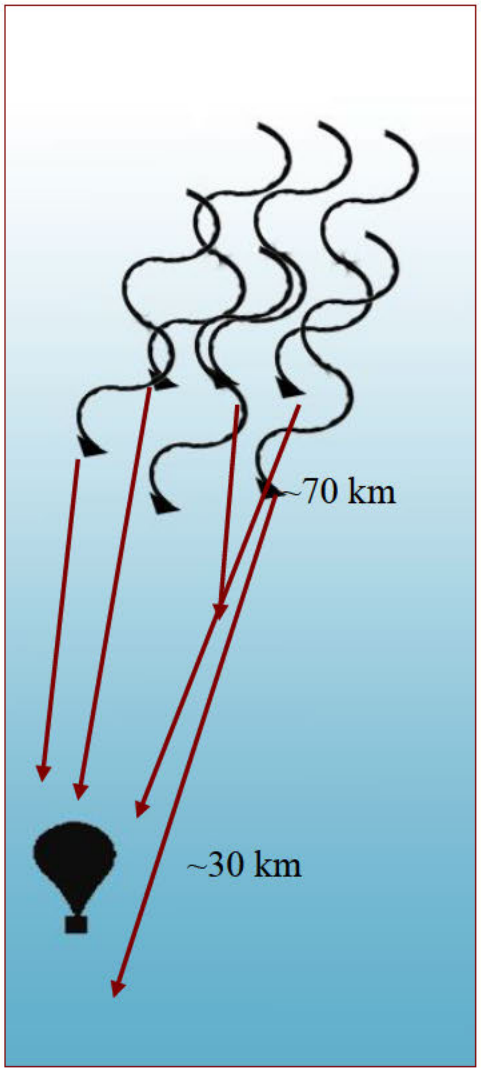
(Summary Plot from Van Allen Probes Science Gateway)

Science: Balloon observations of loss

Bremsstrahlung X-rays are produced as electrons collide with atmospheric neutrals



Relativistic precipitation event detected during 2013 BARREL campaign



BARREL Project Heritage

- Phase B test flights
  - ✓ Piggyback flight on 53 day SPB from McMurdo in December 2008
  - ✓ Test campaigns from McMurdo in December 2009, 2010
- Antarctic and Sweden Science Campaigns
  - ✓ 20 flights from Halley Bay and SANAE in Jan-Feb 2014
  - ✓ 20 flights from Halley Bay and SANAE in Jan-Feb 2013
  - ✓ 7 flights from Esrange in August 2015
  - ✓ 8 flights from Esrange in August 2016

* 6 payloads recovered from Sweden flights in 2016

BARREL 2013 - 2014 Campaign Summaries

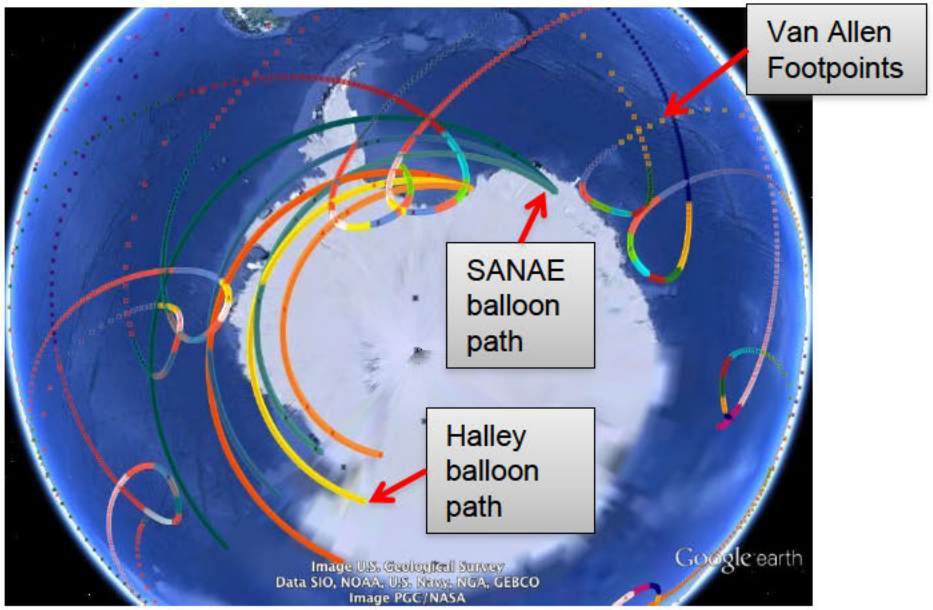
BARREL Campaign #1: January 1 – February 16, 2013

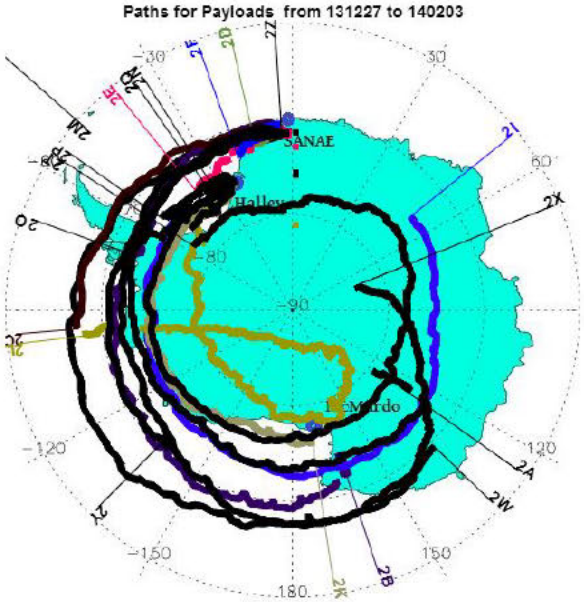
- Launched 20 payloads (13 from SANAE IV, 7 from Halley VI)
- Average Flight Duration: ~12 days

BARREL Campaign #2: December 28, 2013 – February 11, 2014

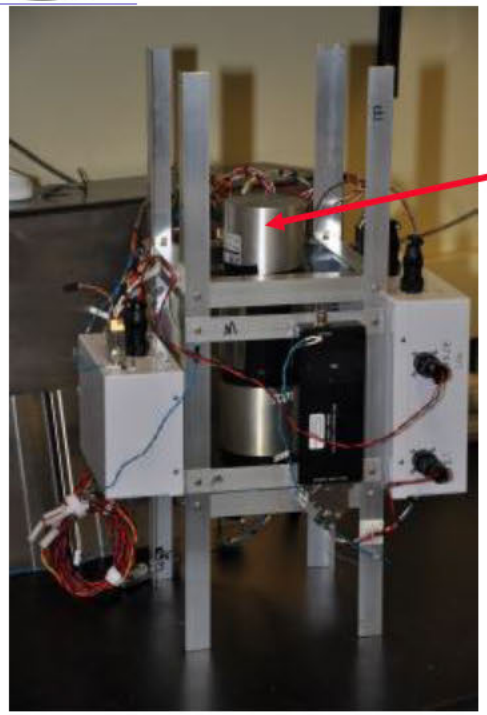
- Successfully launched 20 (10 from SANAE IV, 10 from Halley VI
- Average Flight Duration: ~10 days

Exceeded Desired Duration Requirements between L=3-7 of 1200 hours for both campaigns (> 1380 hrs).





Payload Overview



Science

NaI x-ray spectrometer

Supporting Subsystems

Real-time data acquisition system

GPS time and position

Trimble Lassen SQ

Telemetry

Iridium A3LA-X

Terminate

CSBF MIP Heritage

Secondary tracking

CSBF Iridium Balloon Tracker

Payload

Suspended mass:~ 70 lbs

Power: ~20W (includes 12W heaters, 2W transponder)

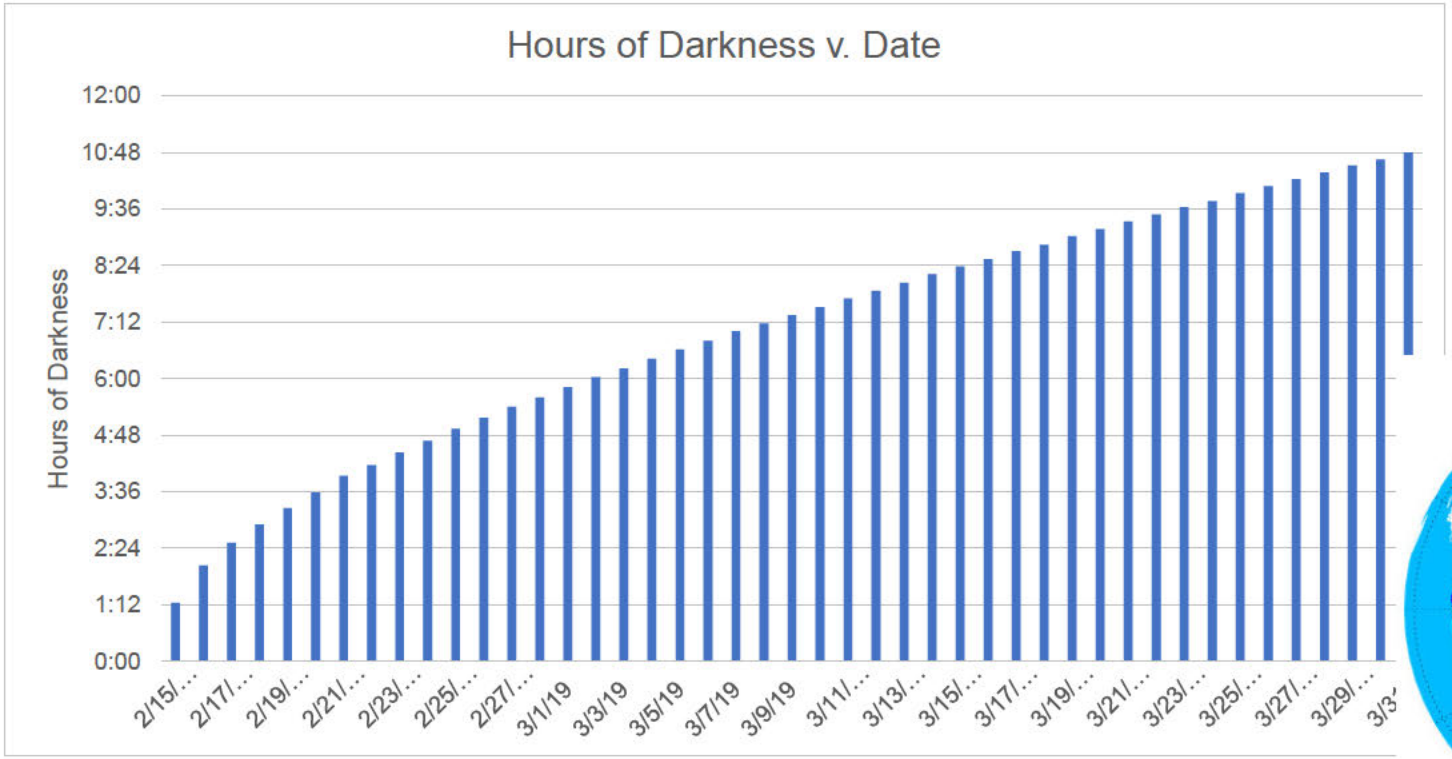
Float altitude ~33 km (110,000 ft)

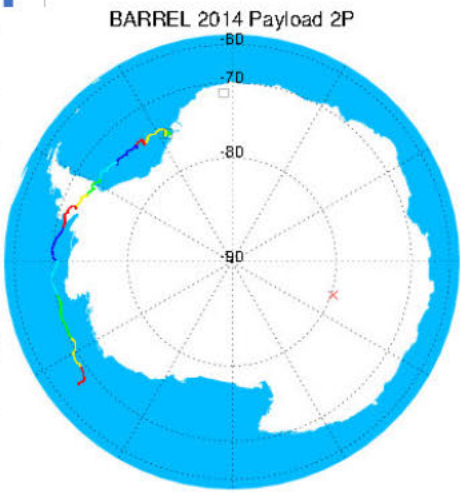
Modifications from BARREL Payload

- Payload
  - Add two additional NiMH batteries to support longer nights
  - Return to 4 PV panel configuration (used in 2013 campaign)
  - Fly additional heaters from flight proven baseline configuration
  - Minor change to flight software to accommodate Dp sensor data
  - Remove magnetometer and boom
- Terminate System and Flight train
  - Add 2” foam box for improved thermal insulation
  - Add 5 Watt heater (Li primary batteries housed in main payload)
  - Remove parachute, add decelerator ripstitch and CSBF provided cabling

- Similar configuration to be utilized for 2019/2020 Flights

Sunset Analysis at 68 deg. South





- Latitude chosen based on BARREL 2E and 2P on Feb. 11, 2014
- Altitude 30 km
- March 1: ~6 hours darkness
- March 15: ~ 8.5 hours darkness

Power Budget

L-DEEPS Power Budget			
Subystem	Voltage (V)	Current (mA)	Average Power
Scintillator	+5	15-18	100 mW
	-5	2	
DPU/EDI	+5	150	870 mW
	-5	15	
Iridium	14.5-17	300 mA Avg 2.5 A surge	4.4 W
Heater #1	14.5	550	8 W
Heater #2	14.5	140	2 W

- Power Requirement
  - ~1.05 A @14.5 V or 1.2 A @12 V
  - Three 9 A-h NiMH batteries – de-rate (50%) to total 13.5 A-h
  - Provides >9 hours of operation in total darkness

Thermal Model: Overview

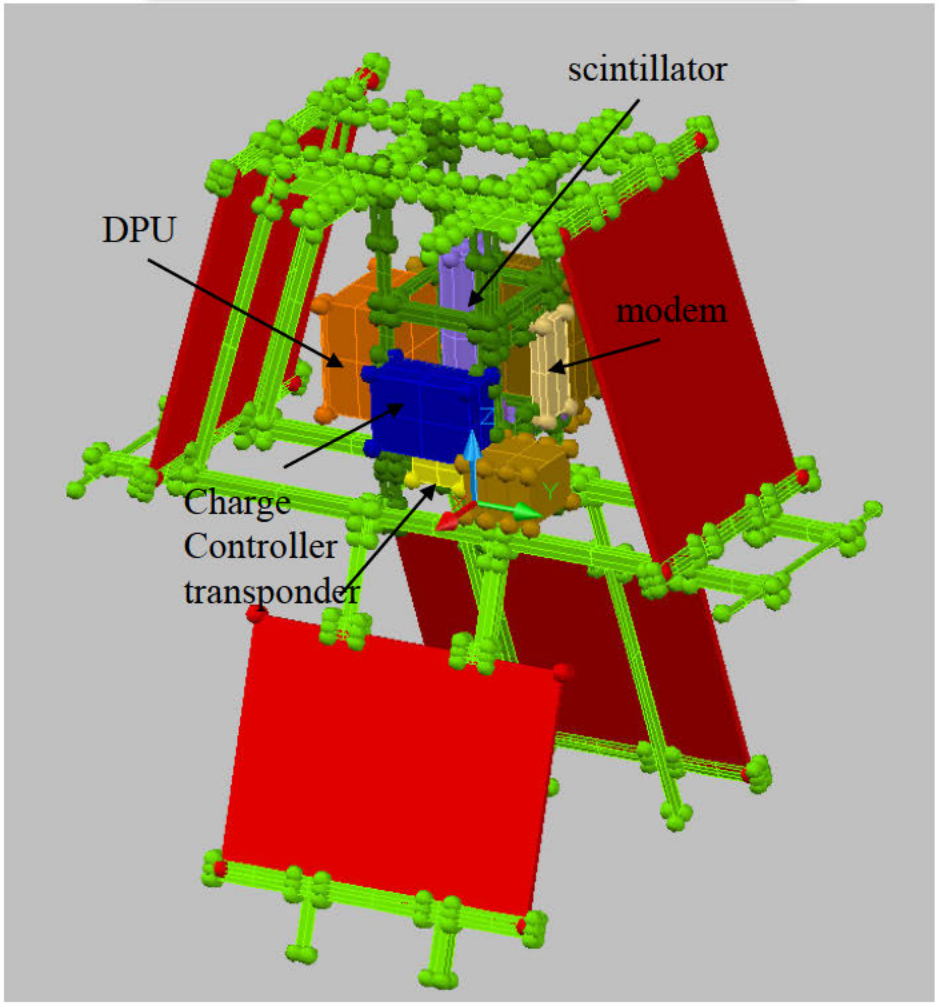
- **Thermal Control:** mechanical layout, component placement and passive and active thermal controls applied to ensure temperatures stay within limits.
- **Modeling Approach:**
  - Same software (Thermal Desktop) and modeling method used by CSBF and previously for BARREL.
  - Modeling carried out at Dartmouth with support from CSBF Thermal Analyst.
  - Model extreme hot and cold cases to bound expected temperatures, including 693N actual telemetry housekeeping

Hot and Cold Case Parameters

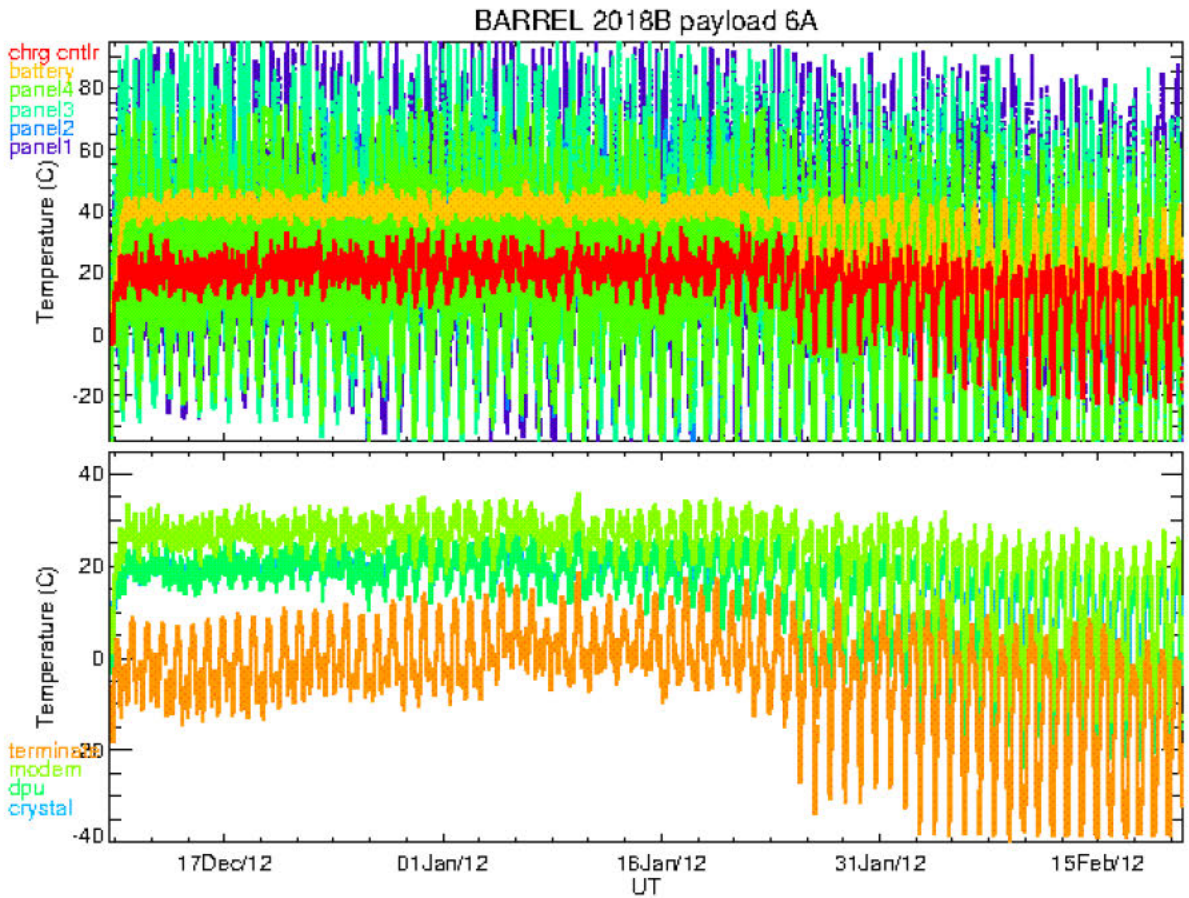
Cold Case Model Description	Hot Case Model Description
Start Date = March 17 (noon-noon)	Start Date: December 21(midnight-midnight)
Solar = 1392 W/m^2	Solar = 1397 W/m^2
Albedo = 0.63	Albedo = 0.95
IR Planetshine = 170W/m^2	IR Planetshine = 250 W/m^2
Latitude = -68°	Latitude = -70°

Thermal Model

Payload Interior View



693N Thermal Actual

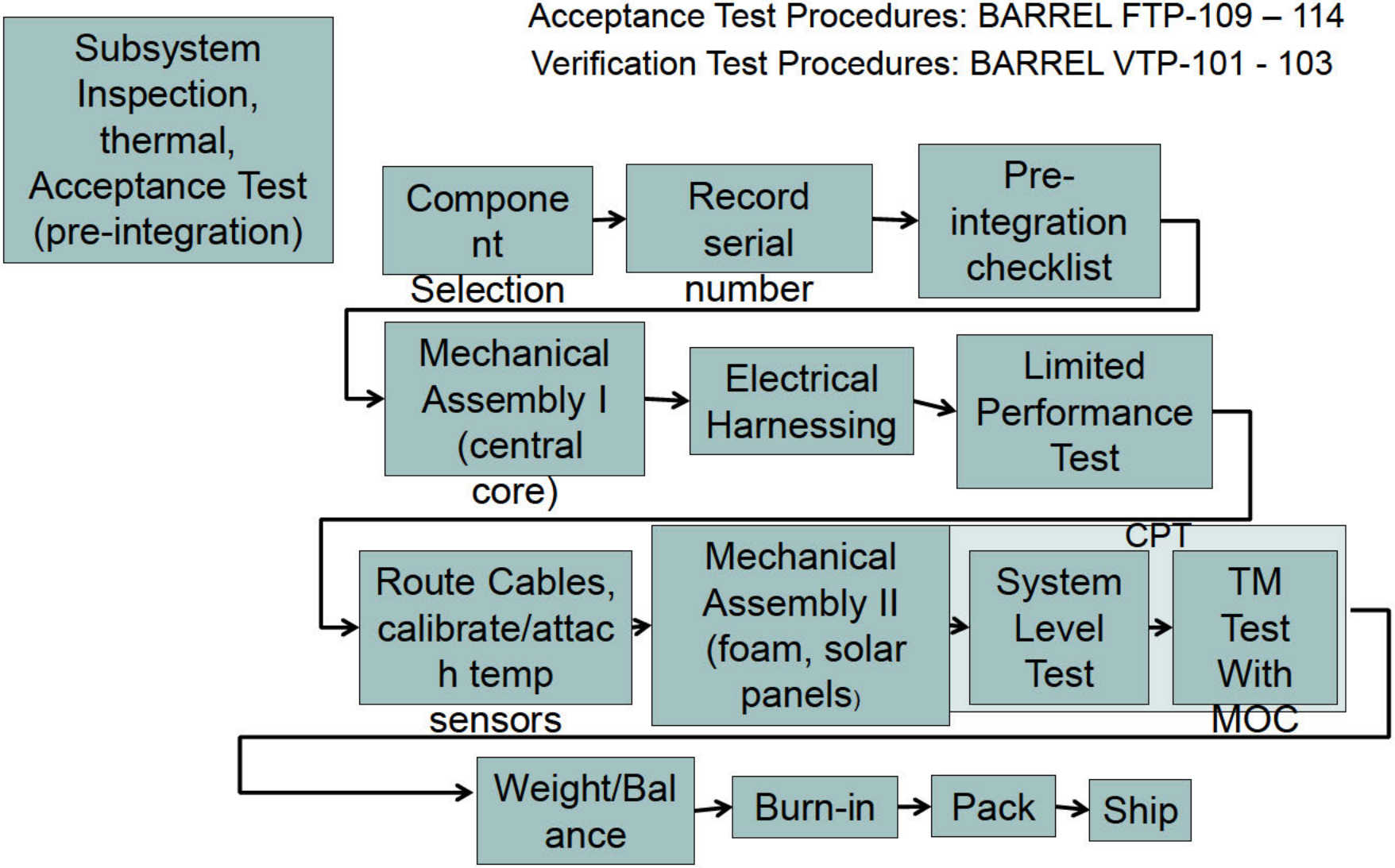


February 28 Cold Case

System/component		Cold Limit	Cold Model	Margin
Scinilator		-20	-10	10
DPU		-40	-30	10
Battery		-20	-14	6
DC-DC		-40	-29	11
Suncat PV Panel				
	Upper	N/A		N/A
	Lower	N/A		N/A
Iridium		-30	-22	8
Charge Controller		-40	-30	10
Terminate		-40	-40	0
Transponder		-45	-16	29

System Level I&T Flow

Acceptance Test Procedures: BARREL FTP-109 – 114
Verification Test Procedures: BARREL VTP-101 - 103



Status

- Return of Flight Spare from Mcmurdo 2018/2019
  - Arrives PSN late March 2019
  - Will become flight primary unit
- Refurb and configuration of Flight Backup unit
  - Two units onsite Mcmurdo 2019/2020.
  - No flight spare

Launch Operations – Payload Checkout

Visual Check

↓

Power On

↓

Instrument Checkout

↓

Test with Remote GSE

↓

Terminate Checkout

↓

Payload Ready!

BARREL Payload
Pre-Launch Checklist

Title | 3/5/10 2:43 PM Modified

Test Unit: _____
Test Date: _____
Tested By: _____

Pre-pickup: 1.5 hours prior to pickup

1. Move payload outside to deck
   - Record time here (UT): _____

2. Visual Check
   - Verify solar panel frame and panels are fully secured
   - Verify external temperature sensors are connected and secured
   - Tape down any loose seams in foam or loose foam pieces (center plug, CBSF plug)
   - Verify Iridium antenna cable is connected and secure
   - Verify GPS antenna is mounted and secure with white tape
   - Verify terminate cable mount is secured
   - Verify crush pad is attached

3. Power ON:
   - Verify that payload shorting plug is connected
   - Connect battery by connecting battery shorting plug
   - Connect all four solar panels
   - Secure battery, and solar panel connectors and cables to foam using tape

4. Instrument checkout
   - Place an Iridium call using local GSE
   - Record first filename here: _____
   - Record housekeeping values using data sheet
   - Verify all housekeeping is nominal

5. MOC Test
   - Notify UCSC MOC to place an Iridium call
   - Record first filename or time here: _____
   - Verify MOC has connected
   - Verify SOC display is updating with current data

6. Terminate Checkout
   - Connect terminate cable to payload
   - Connect test bulbs and shorting plug to terminate box
   - Send ARM command and verify on GSE display

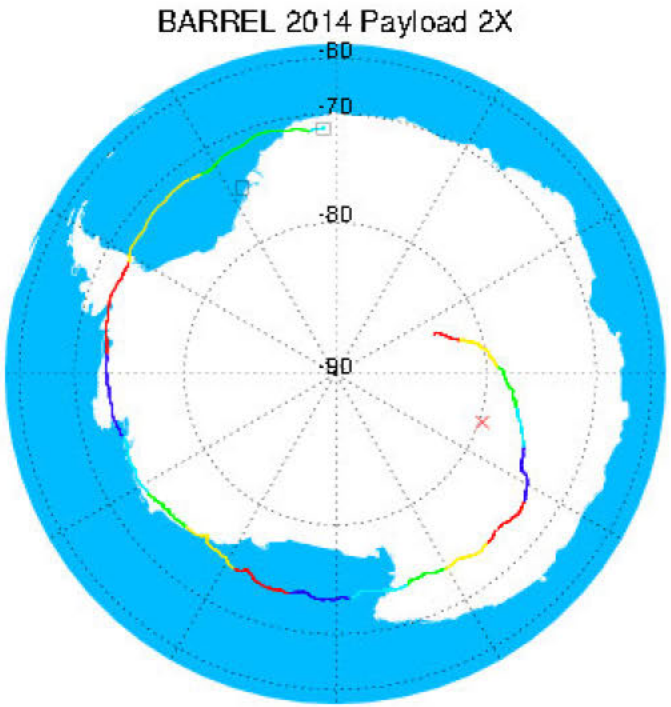
Launch Operations and Support Needed

- 1 team member will be present for launch
  - Performs payload checkout with Dartmouth ground station
  - Buttons up payload (attach lower solar panels, tape down cables, etc.)

- CSBF
  - Provide assistance to move payload to flight line
  - Assist with flight train attachment (second pair of eyes)
  - Ordnance connection
    - Utilize CSBF Ordnance Handlers, Existing approved hazop
    - Coordinate with BARREL for terminate system test prior
  - Verify Dp sensor data through Barrel telemetry
  - Inflation
  - Launch

Ground Stations

- Dartmouth Ground Station
  - Used during BARREL campaigns and I&T testing
  - Supports up to 4-payloads
  - Web interface for monitoring flight data: http://soc2.ucsc.edu
- McMurdo Ground station
  - Supports 2 payloads excluding web
  - Primarily used for payload testing



Schedule

Oct. 3, 2019: Mission Readiness Review

Nov. 18-20, 2019: Field team deployment (two personnel)

~Nov. 29, 2019: Flight Readiness Review

Dec. 1, 2019: Target First launch date

Jan. 1, 2020: Target Second launch date

~Mar. 1-15, 2020: Flight termination First Payload

~Apr. 1-15, 2020: Flight termination Second Payload

Thank You!

http://www.dartmouth.edu/~barrel

http://www.relativisticballoons.blogspot.com

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

E-MIST: Mission Of Opportunity Provided by Super TIGER-II Payload

2018/2019 Antarctic LDB Campaign, MRR September 2018

Project # A-454-M
Principal Investigator
Dr. David J. Smith
David.J.Smith-3@nasa.gov
NASA Ames Research Center
650-604-4819

E-MIST Payload

21” x 33” x 10”

80 lbs

15-30 W power draw

No telemetry

Exposing Microorganisms in the Stratosphere (E-MIST)

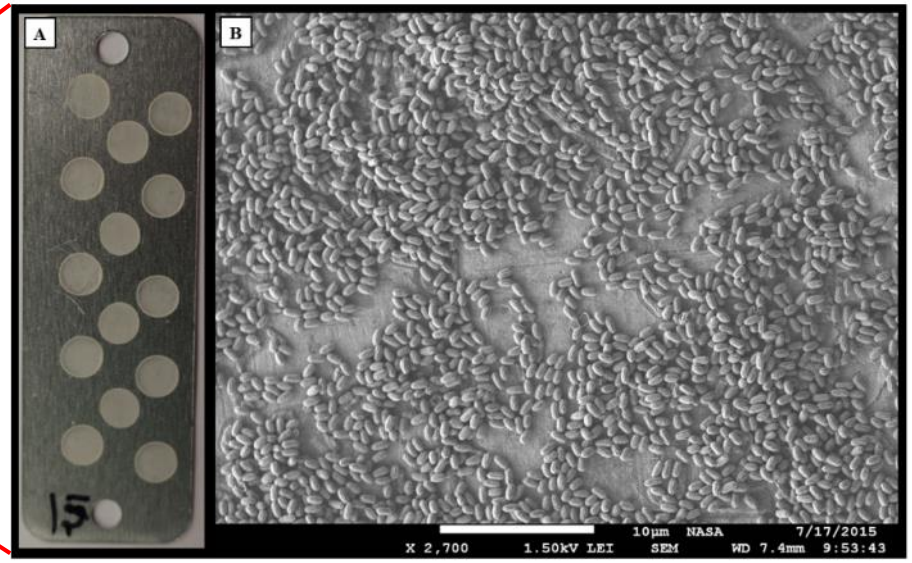
NASA Planetary Protection Office Grant (15-PPR15-0007) for FY17-FY19:

Survival and -Omics Outcomes from Exposing Microorganisms in the Stratosphere on Long Duration Balloon Flights around Antarctica

We know microbes will travel to Mars inside spacecraft.

Will they survive and how will they change when exposed to Mars-like conditions?

Earth's polar stratosphere allows us to examine these important questions.



http://www.nasa.gov/ames/research/space-biosciences/e-mist-2015

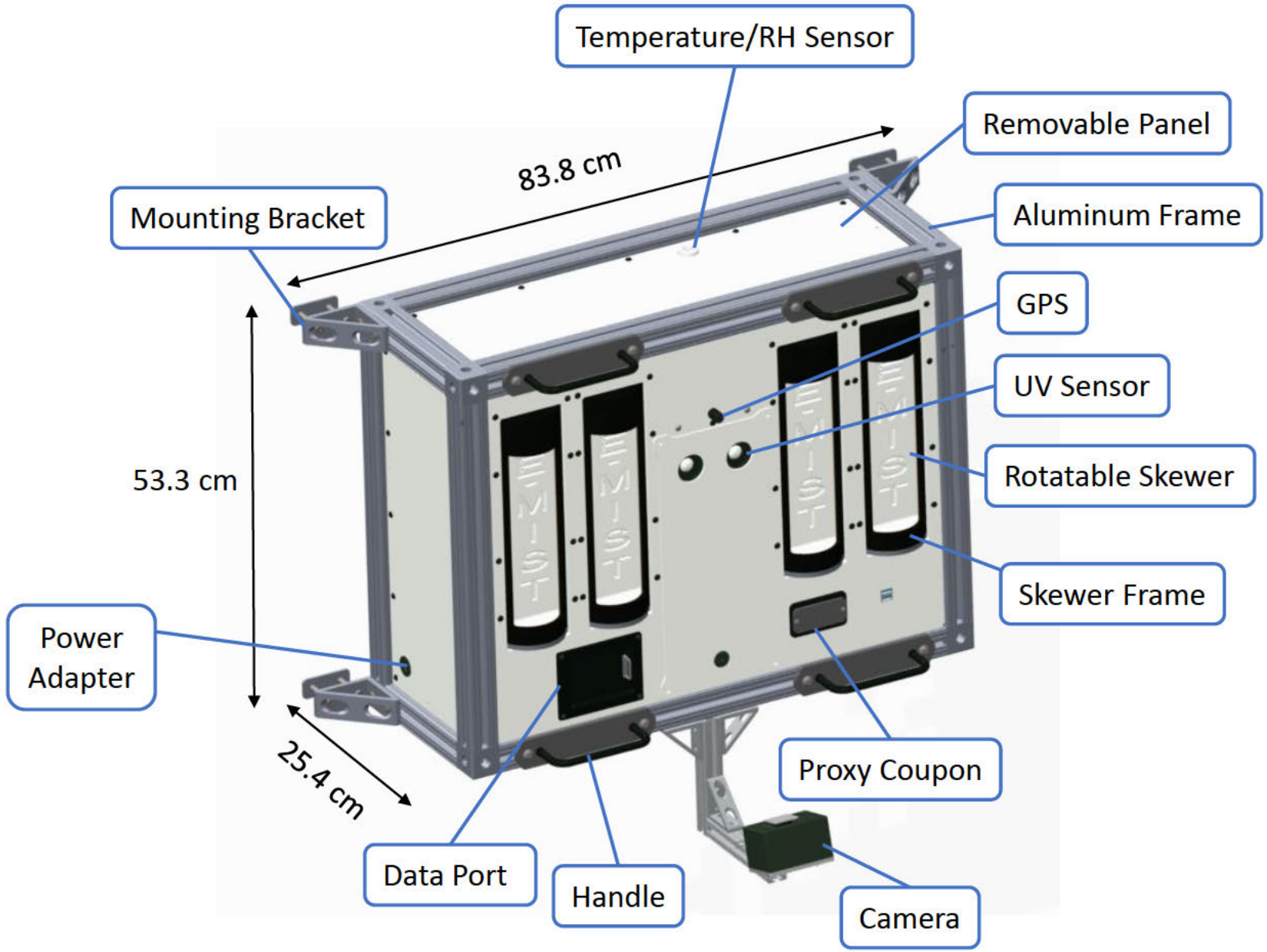
Position on Super TIGER-II Gondola

Launch:

- SOP to be reviewed with Super TIGER-II Team (October 3, 2018)

Recovery:

- Power off payload at earliest recovery opportunity.
- Nothing else required – place payload in shipping container and return to the US.


Temperature/RH Sensor
Removable Panel
83.8 cm
Mounting Bracket
Aluminum Frame
GPS
UV Sensor
53.3 cm
Rotatable Skewer
Skewer Frame
Power Adapter
25.4 cm
Proxy Coupon
Data Port
Handle
Camera

Environmental Permits: Ready

FORM APPROVED OMB NO. 3145-0034
Expires October 31, 2019

NATIONAL SCIENCE FOUNDATION ARLINGTON, VIRGINIA 22230	ANTARCTIC CONSERVATION ACT APPLICATION AND PERMIT FORM	PROPOSAL NO. A-454-M

1. TYPE OF PERMIT REQUESTED
- ☐ TAKE
- ☐ HARMFUL INTERFERENCE
- ☐ ENTER ANTARCTIC SPECIALLY PROTECTED AREA
- ☑ INTRODUCE NON-INDIGENOUS SPECIES INTO ANTARCTICA

☑ IMPORT INTO USA—PORT OF ENTRY Port Hueneme, CA
☑ EXPORT FROM USA Port Hueneme, CA

2. NAME, ADDRESS, PHONE/FAX NO. AND E-MAIL ADDRESS OF APPLICANT (IF APPLICANT IS A CORPORATION, FIRM, PARTNERSHIP, INSTITUTION, OR AGENCY, EITHER PUBLIC OR PRIVATE, COMPLETE NO. 4).
David J. Smith, NASA Ames Research Center, M/S SCR-261-3, Moffett Field, CA 94035 (650) 604-4819 david.j.smith-3@nasa.gov

3. IF APPLICANT IS AN INDIVIDUAL, INCLUDE BUSINESS OR INSTITUTIONAL AFFILIATION (IF DIFFERENT THAN NO. 2)

4. NAME AND ADDRESS OF PRESIDENT OR PRINCIPAL OFFICER

5. NAME OF PERMIT HOLDER'S AGENTS (FIELD PARTY MEMBERS), IF ANY (USE "TBA" AND INDICATE NUMBER, IF NAMES UNKNOWN)
Scott Battaion Gabriel Garde, Sean Fitzsimmons

6. DESIRED EFFECTIVE DATES
Sept. 1, 2017 – March 1, 2018

7. LOCATION(S)—INCLUDE DESCRIPTION, TIME PERIOD, AND PROPOSED ACCESS TO THE LOCATION
E-MIST payload will travel to/from McMurdo Station along with the Super TIGER-II LDB payload.

8. SPECIMEN INFORMATION

	(a) SPECIMEN/SPECIES (scientific name, if applicable)	(b) NUMBER PER ANNUM	(c) DESCRIPTION OF SPECIMEN(S) (life stage, sex, sample type & size, etc.)	(d) MANNER OF TAKE OR INTERFERENCE	(e) IMPORT (Y/N)	(f) ULTIMATE DISPOSITION
1	Bacillus pumilus SAFR-032 (wt)	8×10^6 endospores	dormant – in stasis, glued onto holders in containment	Not applicable – nothing is capable of dispersal	Y	Returns to NASA Ames
2	Bacillus pumilus SAFR-032 (ΔSS)	" endospores	"	"	"	"
3	Acinetobacter pittii	" cells	"	"	"	"
4	Paenibacillus xerothermodurans	" endospores	"	"	"	"
5	Saccharomyces cerevisiae	" cell	"	"	"	"

CERTIFICATION

I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. Any false statement will subject me to the criminal penalties of 18 U.S.C. 1001.

SIGNATURE [signature] DATE 08/11/2017

FOR NSF USE ONLY

This application for a permit under the Antarctic Conservation Act, P.L. 95-541, as amended, and NSF regulations contained in Title 45 Part 670 of the Code of Federal Regulations is approved subject to the following conditions:

Please refer to the conditions on page 1 of this permit.

THIS PERMIT EXPIRES ON: March 31, 2020 (Date)

TYPED NAME AND TITLE AND SIGNATURE OF NSF AUTHORIZING OFFICIAL
Polly A. Penhale, Environmental Officer [signature] DATE October 16, 2017

NSF Form 1078 CONTINUE ON REVERSE SIDE

McGinn, Nature A <nmcginn@nsf.gov> Smith, David J. (ARC-SCR) 4/16/2018
Re: ACA permit annual report due now

Hi David,
Thank you for providing this information. I will add it to your permit file. I hope the payload launches next year.
Kind regards,
Nature

From: "Smith, David J. (ARC-SCR)" <david.j.smith-3@nasa.gov>
Date: Monday, April 16, 2018 at 12:26 PM
To: Nature McGinn <nmcginn@nsf.gov>
Subject: RE: ACA permit annual report due now

Hi Nature,
We transported our EMIST samples to Antarctica for a launch attempt on the SuperTIGER-II mission but the balloon was not flown due to unfavorable weather conditions. Therefore, our samples remain securely inside the EMIST payload at McMurdo and are overwintering until next summer's SuperTIGER-II launch attempt.
Sincerely,

David J. Smith, Ph.D.
NASA Ames Research Center
Space Biosciences Research Branch
650-604-4819

ACA Permits <acapermits@nsf.gov> Smith, David J. (ARC-SCR); Ouda, Samina (Contractor); + 7 1 10/16/2017
Re: NSF Form 1078 for E-MIST (A-454-M) - approved and issued
You replied to this message on 10/16/2017 6:00 PM.

20171016_Permit_Permit_Smith 2018-010.pdf
4 MB

Dear David,
Your ACA permit for introduction of non-indigenous species into Antarctica has been approved by NSF and issued. Please review the permit conditions and be sure that your agents keep a copy of the permit with them while conducting the permitted activities.

A notice will be placed in the Federal Register regarding the issuance within the next 10 days.

Please let me know if there are any changes/updates to the agents list on your permit application for this season. Also, let me know if you have any further questions or if you have any issues with the attached file.

Best wishes for a very successful flight and recovery.
Kindest regards,
Nature

Nature McGinn, Ph.D.
Environmental Policy Specialist

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

BAS = Balloon Air Sampling (a SuperTIGER piggyback)

Scientific goal: To achieve a better understanding of the evolution of volatiles in terrestrial atmosphere.

To reach this goal we plan to capture air samples at different altitudes over Antarctica and to analyze returned captured noble gas isotopes by high precision isotope mass-spectrometry at Washington University.

This will allow us to set the limit on possible altitude dependence of elemental and isotopic mass-fractionation caused by low ionization potential of xenon and low escape velocity of ^{3}He.

BAS team:

R. Binns, R. Bose, D. Braun, P. Dowkontt, A. Meshik (BAS PI), O. Pravdivtseva, B. Rauch (SuperTIGER PI). All from Physics Dept., Washington Univ., St. Louis

BAS consists of three ~ 200 ml stainless steel vacuum cylinders with all-metal ultra-high vacuum valves actuated by gear motors at altitudes 4,800’, 18,000’ and 94,000’.

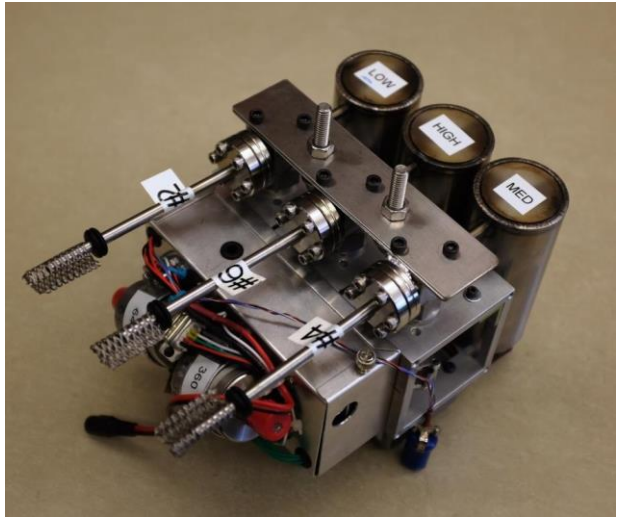
BAS : weight ~ 15 lbs, size < 1’ x 1’ x 1’

Power: < 1W during balloon ascend (to run processor and pressure sensors)

< 30W during air sampling (4 minutes for each sample)

no power is needed for the rest of the flight.

BAS is electromagnetically passive, does not requite telemetry and is self-contained.



“naked” BAS

BAS in the box

BAS mounted on the frame

BAS – the maiden flight (Jan-2019):

During the short Jan-2019 flight BAS successfully collected air samples at 4,800' and 18,000'. The 94,000' altitude has not been reached and the third cylinder (to our relief) was found to be still under vacuum (~ 3×10^{-9} Torr) a half year after the flight.

BAS is now field-tested and ready for the next flight. The only modification will be an adjustment of sampling altitudes. The low altitude air sample (a reference) will be taken manually on the ground. Instead, one high-elevation sample will be added. This will increase the scientific outcome of the BAS experiment. The weight, dimensions and power consumption of modified BAS are the same as in January 2019.

BAS experiment will be presented at centennial AGU meeting:
https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/507162

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

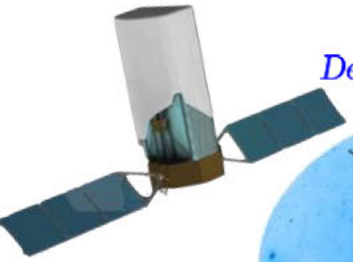
Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

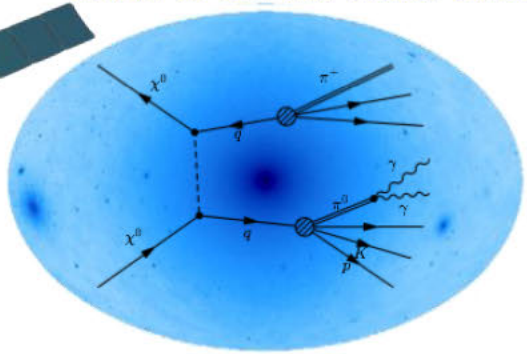
APT-Lite: SuperTIGER CsI Calorimeter Prototype PI: James Buckley

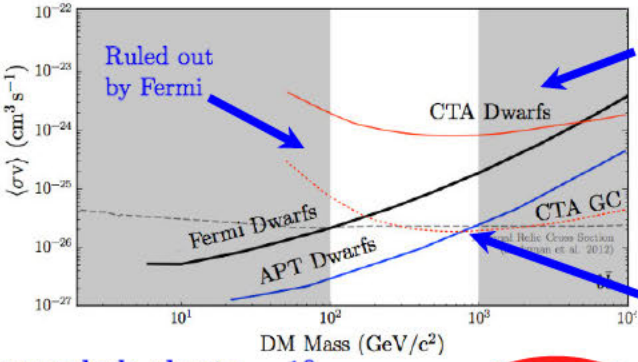
Washington University: W. Robert Binns, James Buckley, Zachary Hughes, Martin Israel, Brian Rauch, Wolfgang Zober
Goddard Space Flight Center: Jason Link, John Mitchell, Georgia De Nolfo
Louisiana State University: Michael Cherry
University of Hawaii: Garry Varner
Erlangen Center for Astroparticle Physics: Stefan Funk, Adrian Zink

Science with APT



Detect or rule out WIMP dark matter over entire natural parameter space

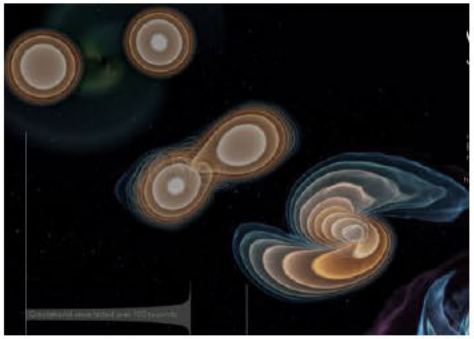


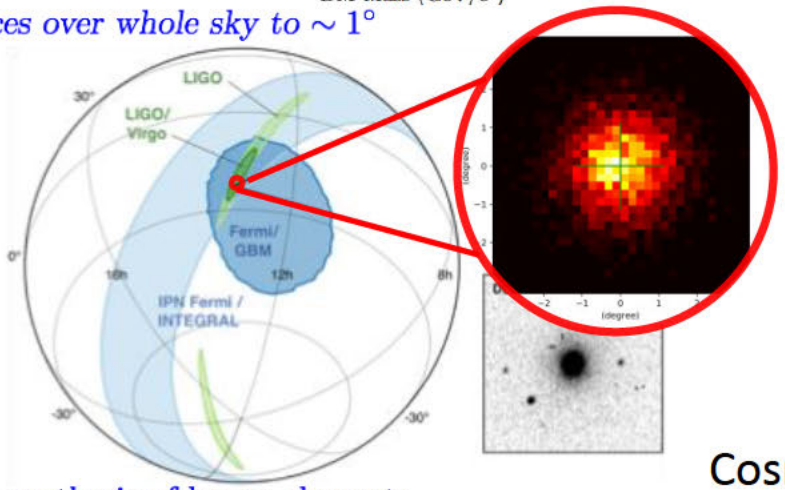


These masses above natural range motivated by hierarchy problem!

Ground-based (CTA) GC constraints are better

Localize n-star mergers/GW sources over whole sky to $\sim 1°$



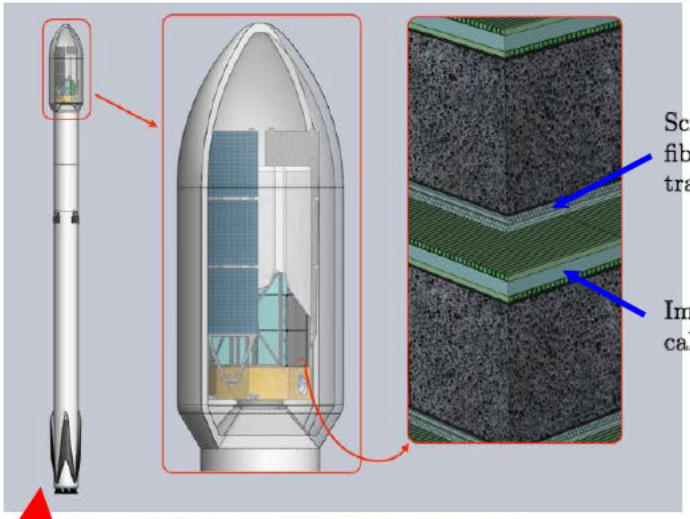


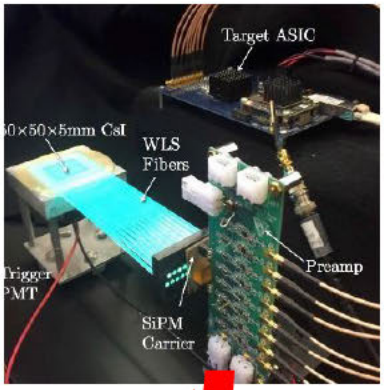
Descriminate n-star and r-process synthesis of heavy elements

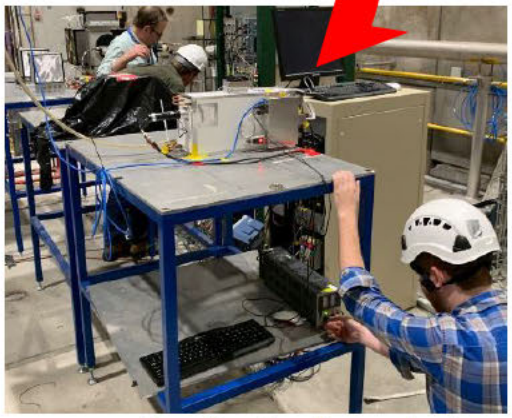
Cosmic rays too.

APT Research & Development

APRA - Detector and electronics development



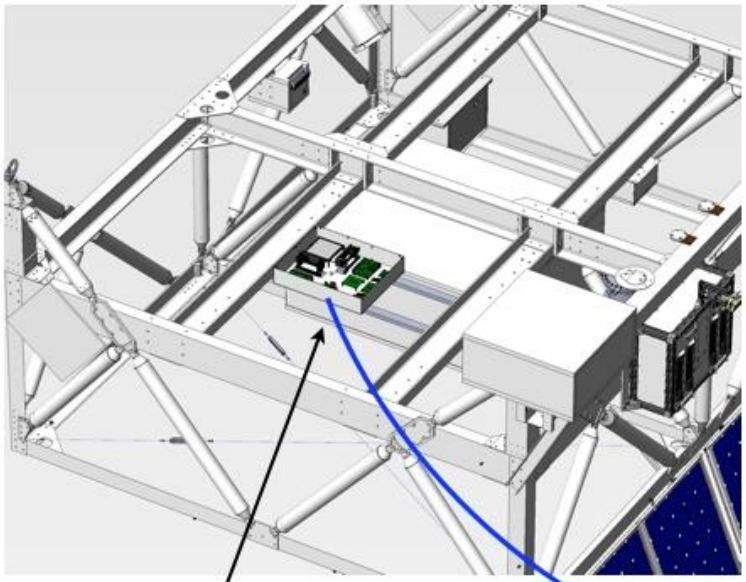




Accelerator beam tests

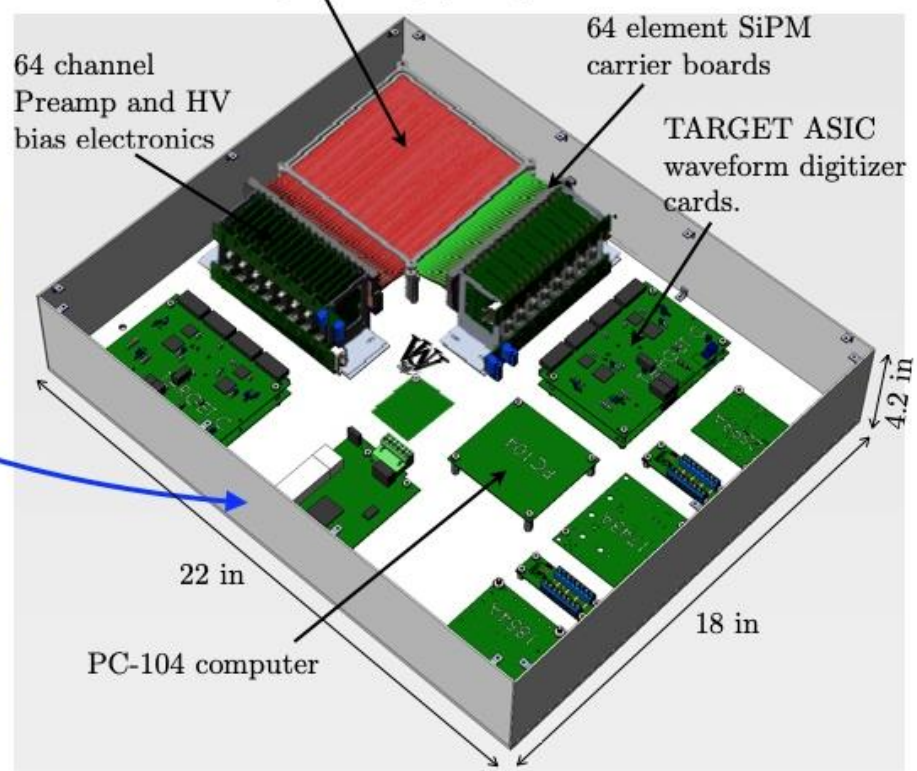
Piggy-back flight on SuperTiger

APT-Lite Schematics



APTLite mounting position under Super-TIGER truss

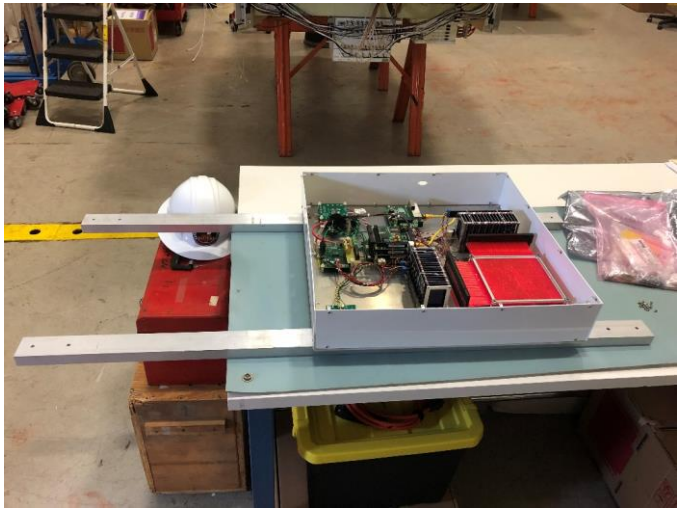
Weight ~25 lbs

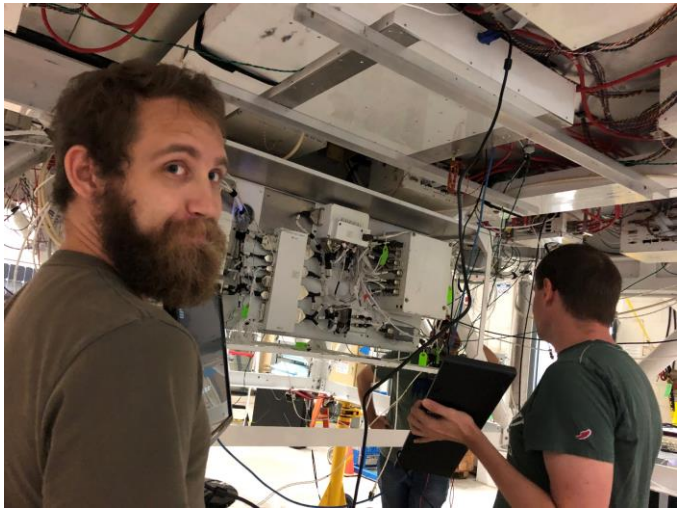


- APT-Lite receives trigger signal from SuperTIGER model
- Utilizes ~1 kbps OpenPort
- Expect ~1,500 Iron group cosmic rays with SuperTIGER
- Will validate charge resolution and suitability for a balloon flight payload

APT-Lite Integration & Support

- Part of compatibility testing at NASA/CSBF
- Undergoing intensive testing at WUSTL to resolve issues that might delay SuperTIGER integration on the ice
- Will be transported with spare parts and supplies as excess baggage by Brian Rauch on November 6
- No support requirements beyond those listed for SuperTIGER
- No permits required
- Request same-season recovery if possible





Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

Mission Readiness Review
Antarctica Campaign 2019

Safety

Lauren Morgan
(Range Safety Officer)

Documentation

- Ground Safety Plan – In Work
- Flight Safety Risk Analysis – In Work
- Flight Safety Plan – In Work

Ground Safety

Ground Safety – Balloon Hazardous Systems

BALLOON VEHICLE SYSTEM HAZARD

ITEM	TYPE	HAZARD
Collar Release	Guillotine Cutter	Moderate Fire/No Blast
Balloon Termination Fitting	Guillotine Cutter	Moderate Fire/No Blast
Rip Stitch Release Line	Delay Cutter	Moderate Fire/No Blast
Payload/Parachute Separation	Guillotine Cutter	Moderate Fire/No Blast
Helium Tanks/Hoses	Pressure System	Rupture/Mass Projection
Balloon Restraining Spool	Stored Energy	Impact/Crushing
Launch Vehicle	Mobile Crane	Impact/Crushing
Balloon Rip/Destruct Line Guillotine	Delay Cutter	Moderate Fire/No Blast

Ground Safety – Payload Hazardous Systems

SuperTIGER II

Hazard	TYPE	Payload
Liquid Nitrogen	Cryogen	SuperTIGER II
Gaseous Nitrogen	Pressure	SuperTIGER II
Photomultiplier Tubes	Voltage	SuperTIGER II
Lead Acid	Batteries	SuperTIGER II
RF Transmitter(s)	Radio Frequency	SuperTIGER II

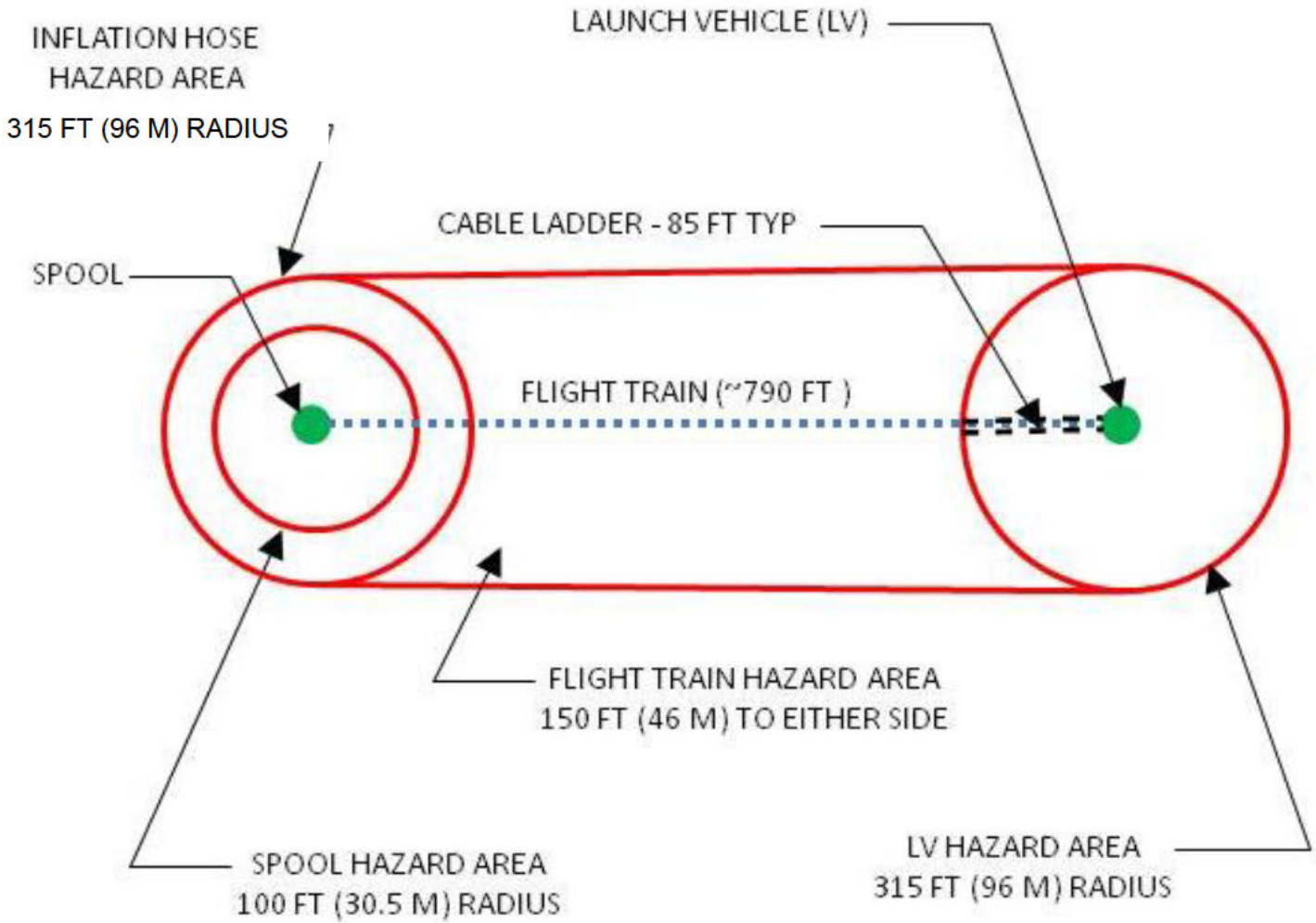
BLAST

Hazard	TYPE	Payload
Liquid Nitrogen	Cryogen	BLAST
Gaseous Helium	Pressure	BLAST
Lead Acid	Batteries	BLAST
RF Transmitter(s)	Radio Frequency	BLAST

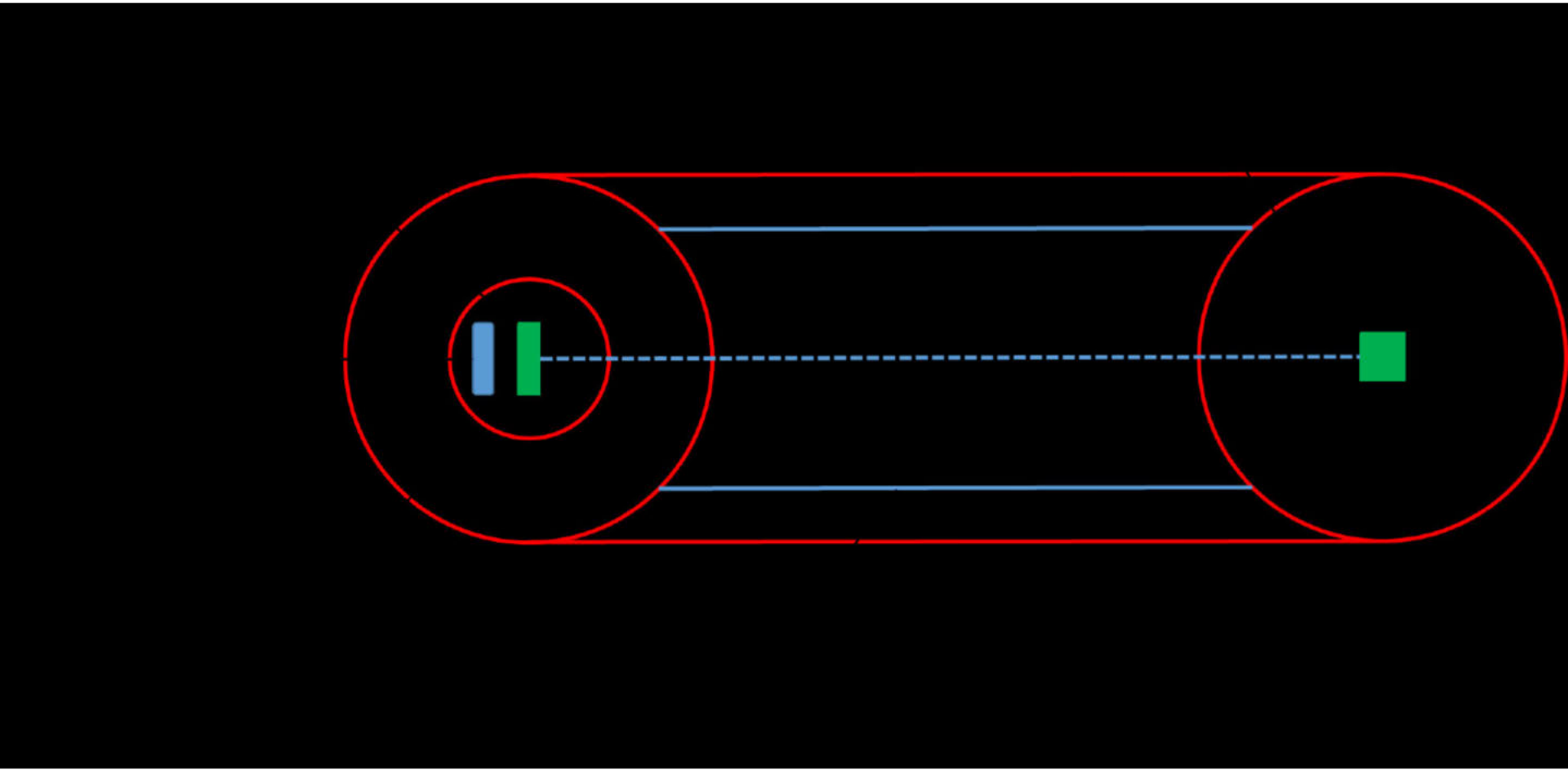
TravalB Handheld

Hazard	TYPE	Payload
NiMH and Lithium Ion	Batteries	TravalB Handheld
X-Ray Detector Component	Voltage	TravalB Handheld
RF Transmitter(s)	Radio Frequency	TravalB Handheld

Zero Pressure Balloon Prelaunch Danger Area

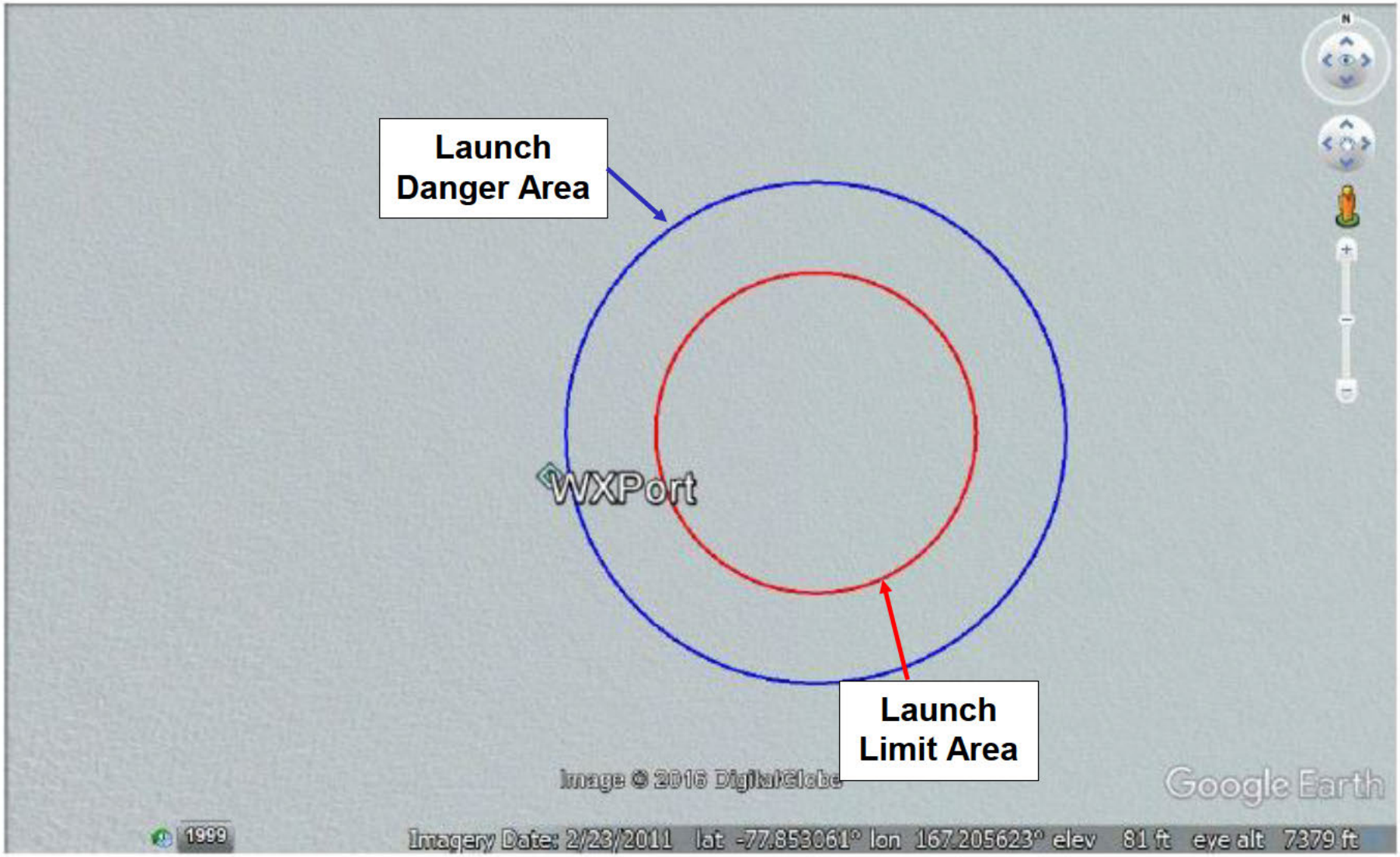


Hand Launch Prelaunch Danger Area (TBD)



Flight Safety

Launch Limit Area and Launch Hazard Area



Science Viewing Locations

WFF Safety Office approved Viewing Locations

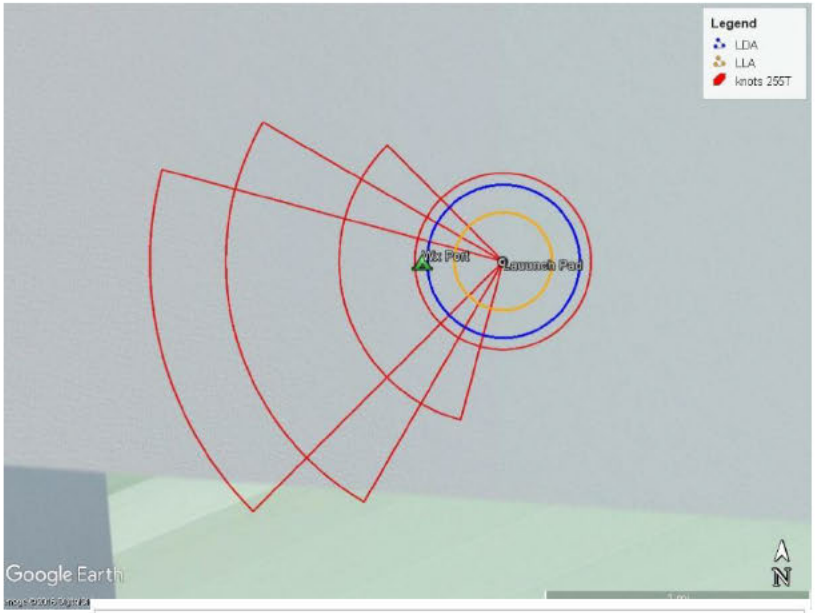
- WFF Safety Office approved an Equivalent Level of Safety for an alternate viewing site
- **MM/MRSO** and **Camp Manager** shall coordinate implementation based on direction of Launch Hazard Area (LHA).
- Sheltering required if LHA encompasses any part of the LDB camp.

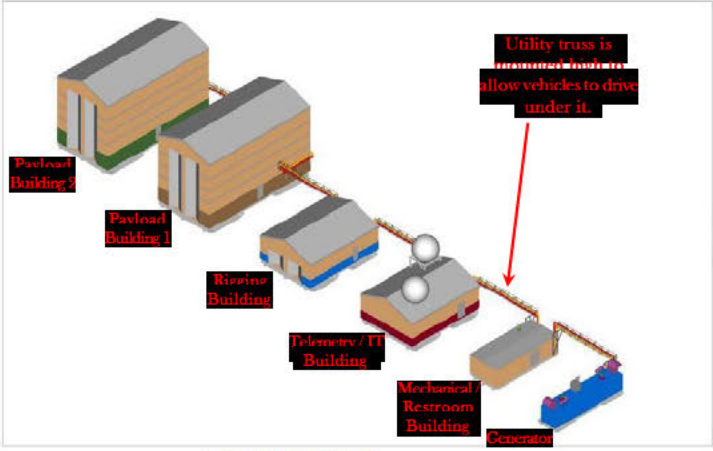
For layout directions that do **NOT** require sheltering

- Viewing will be open to all personnel
- Viewing location is between Payload #2 and the long drop (**A**)

For layout directions that **DO** require sheltering

- Viewing is restricted to current mission personnel only
- Viewing location is between Payload #1 and Rigging (**B**)
- Ingress into Payload #1 will immediately follow launch until cleared by MRSO





Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

FY2020 Antarctica Campaign

Mission Readiness Review

5 October 2019

Operations/Campaign Manager

Completed Tasks

Date	Task
2019	
April 4	Project Initiation Conference
May 13	CSBF Support Information Package submitted to ASC
May 21	Support Planning Meeting with ASC
July 15	SUPER TIGER group began arriving in Palestine
July 24	Support Planning Meeting with ASC
August 15	SUPER TIGER Compatibility testing completed
Aug 30	First sea shipment departed Palestine
Sept 13	Second sea shipment departed Palestine

Projected Tasks

Date	Task
2019	
Nov 6	CSBF Campaign Manager and initial setup crew arrive on site
Nov 13	CSBF Electronics and second wave Rigging arrive
Nov 13	Super Tiger and BLAST personnel arrive
Nov 18	CSBF payload engineers Super Tiger and BLAST arrive
Nov 18	Anticipated Science Support
Nov 18-20	BARREL Group arrives (Millan and Johnson)
Nov 20	BPO Mission Manager and NASA Safety RSO arrive
Dec 1	GUSTO pathfinder Flight Ready
Dec 9	CSBF, SUPER TIGER Ready Date (Assuming CSBF Support Nov 18)
Dec 23	BLAST Ready Date (Assuming CSBF Support Nov 18)
Jan 10	Nominal launch window ends (conditional launches after)
Jan 31	Close out of campaign begins

LDB Facility Safety Briefings

- The CSBF Antarctic Safety Briefing is broken down into three parts.
  - Facility Safety Briefing for Antarctica QS-210-AA-B
  - LDB Facility In-Briefing QA-210-AA-B1
  - LDB Travel Procedures QA-210-AA-B2
- The Antarctic Support Contractor (ASC) will give a safety and in-briefing also. These are in addition to the CSBF Safety Briefings.

SUPER TIGER Instrument Weight Estimates

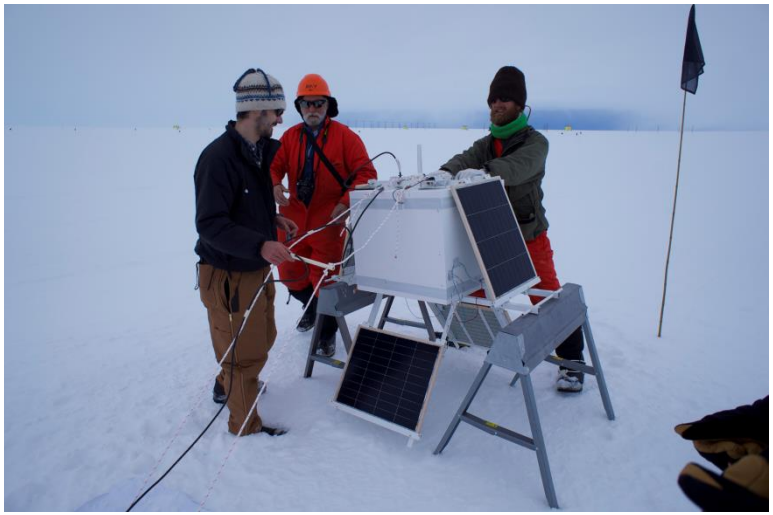
- Principle Investigator: Prof. Walter Robert Binns
- Organization: University of Washington
- Launch Date: December 2019
- Balloon Allocation: CSBF# 1254 W39.57-2-118
- Backup: CSBF# 1243 W39.57-2-113
- Science weight: 4693 lbs.
- CSBF Weight: 1,173 lbs.
- Ballast: 190 lbs.
- Suspended Weight: 6,056 lbs.
- Balloon Weight: 4153 lbs.
- Gross Load: 10,209 lbs.
- Free Lift (10%): 1020 lbs.
- Gross Inflation: 11,229 lbs.
- Altitude with ballast: 126,000 ft.
- Altitude without ballast: 127,000 ft.

BLAST- Instrument Weight Estimates

- Principle Investigator: Dr. Mark Devlin
- Organization: University of Pennsylvania
- Launch Date: December 2019
- Balloon Allocation: CSBF# 1156 W34.43-3H-11
- Backup: CSBF#1038 W34.43-3H-04
- Science weight: 5724 lbs.
- CSBF Weight: 1,217 lbs.
- Ballast: 800 lbs.
- Suspended Weight: 7741 lbs.
- Balloon Weight: 5,218 lbs.
- Gross Load: 12,959 lbs.
- Free Lift (10%): 1295 lbs.
- Gross Inflation: 14,254 lbs.
- Altitude with ballast: 118,000 ft.
- Altitude without ballast: 120,000 ft.

TRAVAL-B
Instrument Weight Estimates

- Principle Investigator: Robert Salter/Robyn Millan
- Organization: CSBF / Univ of Dartmouth
- Launch Date: December 2019 and January 2020
- Balloon Allocation: CSBF# 1313 .6MCF SPB
- Backup: No Backup
- Science weight: 70 lbs.
- CSBF Weight: 5 lbs.
- Ballast: n/a
- Suspended Weight: 75 lbs.
- Balloon Weight: 273
- Gross Load: 348
- Altitude without ballast: 110,000 ft.



General Facilities and Equipment

- Facility Opening
  - November 23 facility turnover to science
  - December 1 Launch Pad Ready
- Balloons
  - Primary and backup for BLAST and SUPER TIGER
  - TRAVEL-B 2 SPB balloons
- Helium
  - Enough helium on site for all inflations
- Proposed Space Assignments
  - Payload building #1: CSBF / TRAVAL-B / SUPER TIGER
  - Payload building #2: CSBF / BLAST / BARREL
  - CSBF Support split between both buildings

NSF/ASC Support

- Camp Manager and One General Assistant
- Galley
  - Cook and assistant for the season
  - Galley operational from November 23 (or camp open date) until closeout of project
- Cryogens and Gases
  - Ln2 and gases per science SIP
  - Lhe per delivery schedule supplied by CSBF
  - High purity gases (He) for BLAST
- Accommodation in McMurdo
  - TBD
- Office Space in McMurdo
  - Office space in Crary Lab for CSBF, Science Teams

Transport

- Shuttle
  - Base transport timetable
    - 07:30 depart McMurdo
    - 17:30 depart LDB Facility
  - Shuttle service per schedule
  - On call shuttle (procedure to be determined)
  - No personal transport

NSF/ ASC Support cont.

- Preparation of Launch Pad
  - Condition of launch pad and road to launch pad dictated by weather
    - Cold weather = good condition
    - Storms = more work required to bring pad back to launch condition
    - Warm weather = poor condition
  - After storms the airfields and roads are cleared before the LDB facility and launch pad

- Assistance on the Launches
  - Fleet ops personnel provided to assist on launch
  - Fleet ops equipment required, 2 x Quad tracks to haul helium racks, 1x challenger to tow balloon on layout, 1 x track loader (Kathy)

- Recovery
  - DH6 Twin Otter
  - Bassler (requires a groomed strip: 1 week preparation required)
  - Helicopter if required

- Cargo Handling
  - Shipments on site prior to arrival
  - Retro cargo due on dock January 17

FY2020 Antarctica Campaign

Mission Readiness Review

October 4, 2019

Electrical Engineer

Antarctica MRR 2019-2020
Topics of Discussion

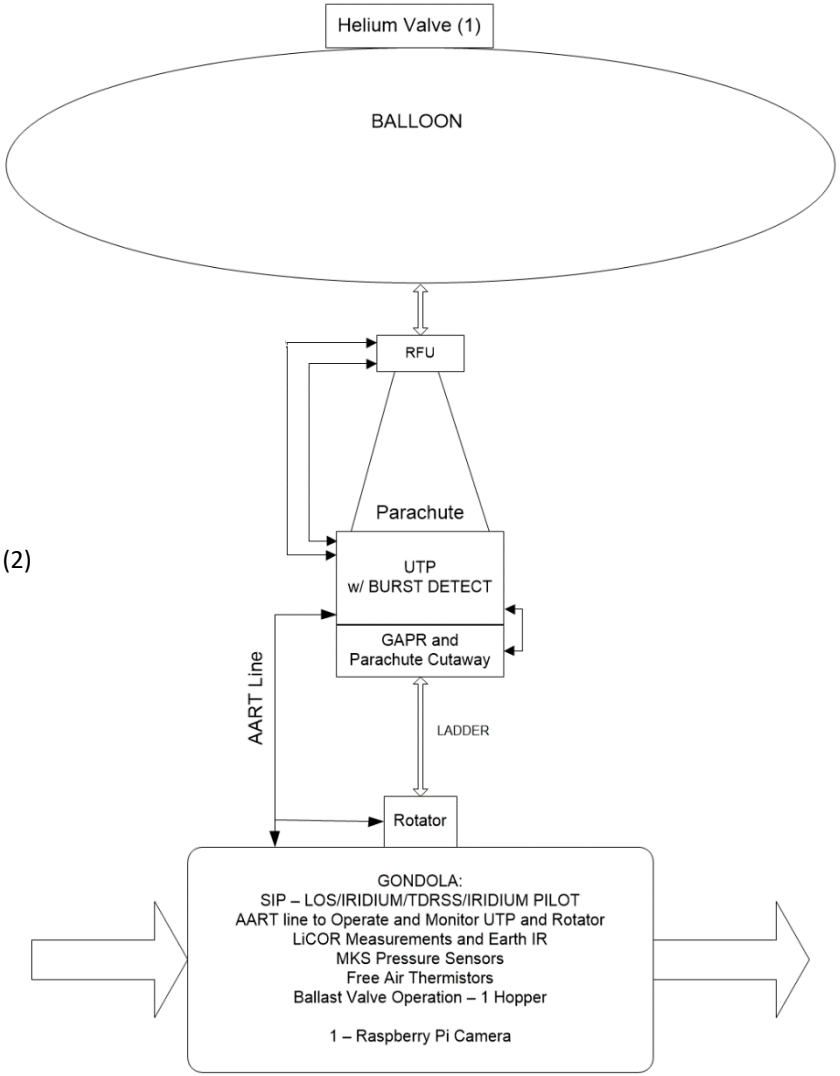
LDB Support Overview

- Flight System Configuration (Overview)
- SIP System Configuration
- Ground Support Equipment (ROCC/OCC)
- LDB Systems
- List Of Spares

LDB Final Payload Integration

- SuperTIGER Integration Review
- BLAST-TNG Integration Review

Antarctica MRR 2019-2020
Flight System Configuration (Overview)



RETRANSMIT:
- UHF COMMAND RETRANSMITTERS (2)

UPLINKS:
- SIP LOS UHF COMMAND (2)
- UTP LOS UHF COMMAND (2)
- TDRSS COMMAND
- IRIDIUM COMMAND (2)
- IRIDIUM PILOT

DOWNLINKS:
- SIP LOS DATA (2)
- UTP LOS DATA (2)
- SCIENCE LOS DATA
- IRIDIUM DATA (2)
- TDRSS DATA (OMNI & HGA)
- IRIDIUM DATA (BACKUP NAVIGATION)
- IRIDIUM PILOT

Antarctica MRR 2019-2020
SIP System Configuration

TDRSS/IRIDIUM SIP:

- RTD Computer COMM1 & COMM2
- TRIMBLE GPS Receiver used on COMM1 & COMM2 COMM links
- TDRSS Transceiver
- IRIDIUM Satellite Data Modem (Dial-up & Short Burst Data) COMM1 & COMM2
- Line-of-Site (LOS) UHF Command Uplink
- UHF Command Retransmitter to UTP (via OTH link only)
- L-Band LOS Data Downlink
- IRIDIUM SBD Modem, Backup Nav (MIP Based): Data Downlink for Critical Parameters
- Charge Controllers (SunSaver MPPT)
- Iridium Pilot

Antarctica MRR 2019-2020
SIP System Configuration

COMM1 and COMM2 Science Options:

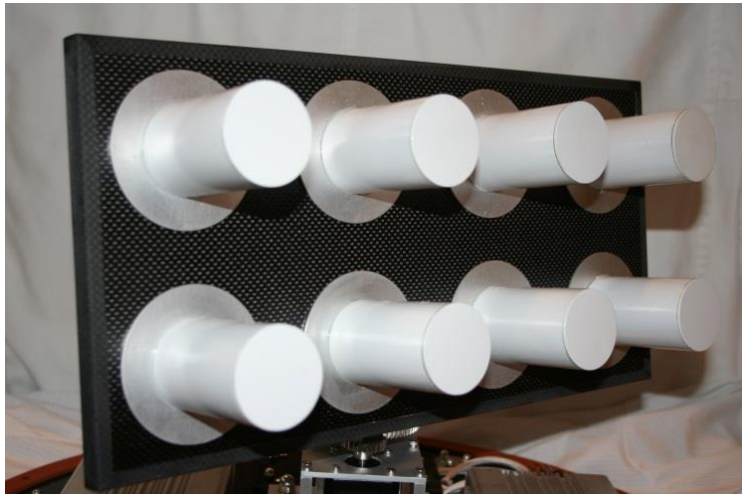
- Commanding
  - Iridium (primary) and TDRSS (backup) : OCC
  - LOS: ROCC
  - TDRSS command windows are scheduled upon science request
- Return TM via TDRSS While in View of Satellite
  - Real time high-rate science data:
    - 6 kbps with omni-directional antenna
    - 92 kbps with High Gain antenna
  - Receive TDRSS data at MOC in Palestine
- Return TM Via Iridium
  - Real time high-rate science data: up to 2-kbps while in dial-up mode
  - Receive Iridium data at OCC in Palestine

Antarctica MRR 2019-2020
Iridium OpenPort (Pilot)

- ADE (Above Deck Equipment):
  - Contains the RF equipment
  - Approximate weight 25 lbs
- BDE (Below Deck Equipment):
  - Router and power
- Highest achievable throughput: 134 kbps
- Observed average throughput (Sweden 2013): ~80-100 kbps
- Data throughput is characterized as “bursty”
- Access: Static IP (accessible anywhere), uses port forwarding for internal access
- TCP and UDP packet format available
- Science controls packet sizing and TCP intervals
- Global coverage, essentially Ethernet in the sky
- CSBF will power the IOP equipment, science simply provides the Ethernet cable

Antarctica MRR 2019-2020
TDRSS High Gain Antenna

- DeVries Scientific HGA
  - Polar unit has azimuth positioning only
  - Gain = 17dB
  - Weight = 25 lbs
  - Utilizes Trimble BX982 GPS compass
  - Has successfully been tested at gondola rotation of 3 degrees per second



Antarctica MRR 2019-2020
Ground Support Equipment

GSE:

- Standard Windows 10/Lab View (v2013) based OCC computers and ground station software.
- All command uplink, data downlink, and science interfaces tested during full up compatibility test with Science groups.
- Software Changes or Enhancements (GSE):
  - Aquila

Antarctica MRR 2019-2020
LDB Systems

UTP:

- Universal Terminate Package (UTP) will be flown as the termination system
- Chute cutaway operation (SAPR/GAPR Capability)
- Party line and retransmit capabilities were tested and integrated in flight configuration

Power System Configuration:

- Solar panel tilt angle set at 22 degrees
- 84 (1/3 cut) cell laminated panels on each side, Suncat Solar (8 total)
- Charge controllers, MorningStar SunSaver MPPT
- Lead-acid batteries (20 A-H)
- Lithium backup batteries (90 A-H)

Antarctica MRR 2019-2020
List Of Spares

GSE Spares:

- 1 ROCC System
- 1 LOS DECOM System

Flight Hardware Spares:

- LDB TDRSS Transceiver
- IRIDIUM LBT
- System Stack
- Flight Computer
- Hard Drives
- L-Band Transmitter
- LOS Receiver
- UTP and RFU
- Iridium PILOT
- DeVries TDRSS HGA
- Solar Pointing System (Rotator)

Antarctica MRR 2019-2020
Battery Analysis

BATTERY CAPACITY ANALYSIS "ANTARCTICA - FY2020"

Battery Systems	Nominal Operating Period (Room Temp @ 25°C)	Predicted Temp Range (EC)	Battery Capacity Reduction	Temp Corrected Operating Period (Days)	Anticipated Use (Days)	Safety Factor
UTP (Telemetry)	98.48	-21C to 41C	10%	88.64	60	1.48
UTP (Command)	83.33	-21C to 41C	10%	75.00	60	1.25
B/U Nav System (2)	6.82	-20C to 33C	10%	6.14	0 hrs	N/A

BATTERY CAPACITY/DEPLETION RATE ANALYSIS

Battery System	Battery Pack Specs	Power Consumption A-H / day	Maximum Duration (Room Temp) See Note 1 below	Predicted Temp Range (EC)	Predicted Temp % Reduction	Temp Corrected Operating Period DAYS
UTP (Telemetry)	parallel 10 cell packs (30AH) 26.4V(55 ma)	1.32	98.48	-21C to 41C	10%	88.64
Number of packs	5					
Total Capacity (Ah)	130					
Quiescent Current Consumption (A)	0.055					
	(+20 amp-hrs for 20 hrs LOS)					
UTP (Command)	parallel 6 cell packs (30 AH) 16V(75 ma)	1.8	83.33	-21C to 41C	10%	75.00
Number of packs	5					
Total Capacity (Ah)	150					
Quiescent Current Consumption (A)	0.075					
B/U Nav System	parallel 8 cell packs (30 AH) 21V(550 ma)	13.2	6.82	-20C to 33C	10%	6.14
Number of packs	3					
Total Capacity (Ah)	90					
Quiescent Current Consumption (A)	0.55					

1. Based on Measured Power Consumption.
2. On only if entire solar power system fails.

*** Manufacturer's rate batteries as good for 35 amp-hrs each, we use 30 amp-hrs for analysis**

Antarctica MRR 2019-2020
Schedule of Events

Schedule of Events:

- July 30 (2018) – BLAST-TNG OTH communication test
- July 31 (2018) – BLAST-TNG compatibility test
- December 26 (2018) – BLAST-TNG Antarctica compatibility test
- August 13 – SuperTIGER OTH communication test
- August 15 – SuperTIGER compatibility test
- November/December – Reintegration, Antarctica
- December 09 – SuperTIGER flight ready
- December 24 – BLAST-TNG flight ready

SuperTIGER Integration Review

Antarctica MRR 2019-2020
SuperTIGER Integration

Antarctica MRR 2019-2020
SuperTIGER Integration

SuperTIGER Configuration:

- Low and High Rate Science ports on COMM1 and COMM2 systems providing:
  - Downlink telemetry (6 kbps via OMNI)
  - Downlink telemetry (150 kbps via HGA – 92 kbps effective)
  - Downlink telemetry (2 kbps via Iridium Dialup)
  - Uplink commanding (including LOS)
  - Polled SIP data – GPS position and time, MKS (calibrated) pressure
- Iridium Pilot
  - Up to 134 kbps bidirectional data transfer
- Science LOS Upper-L-Band return link
  - Two LOS data transmitters
- Science Stack providing:
  - 24 open collector command outputs

Antarctica MRR 2019-2020
SuperTIGER Integration

Environmental Testing:

- BEMCO test of SIP 14 and all associated flight hardware performed 7/06/2019
- All components/hardware functioned nominally through predicted thermal analysis range

LOS Transmitters:

- LDB: L-Band (1444.5 MHz)
- Science TX1: Upper-L-Band (1780.0 MHz)
- Science TX2: Upper-L-Band (1784.0 MHz)

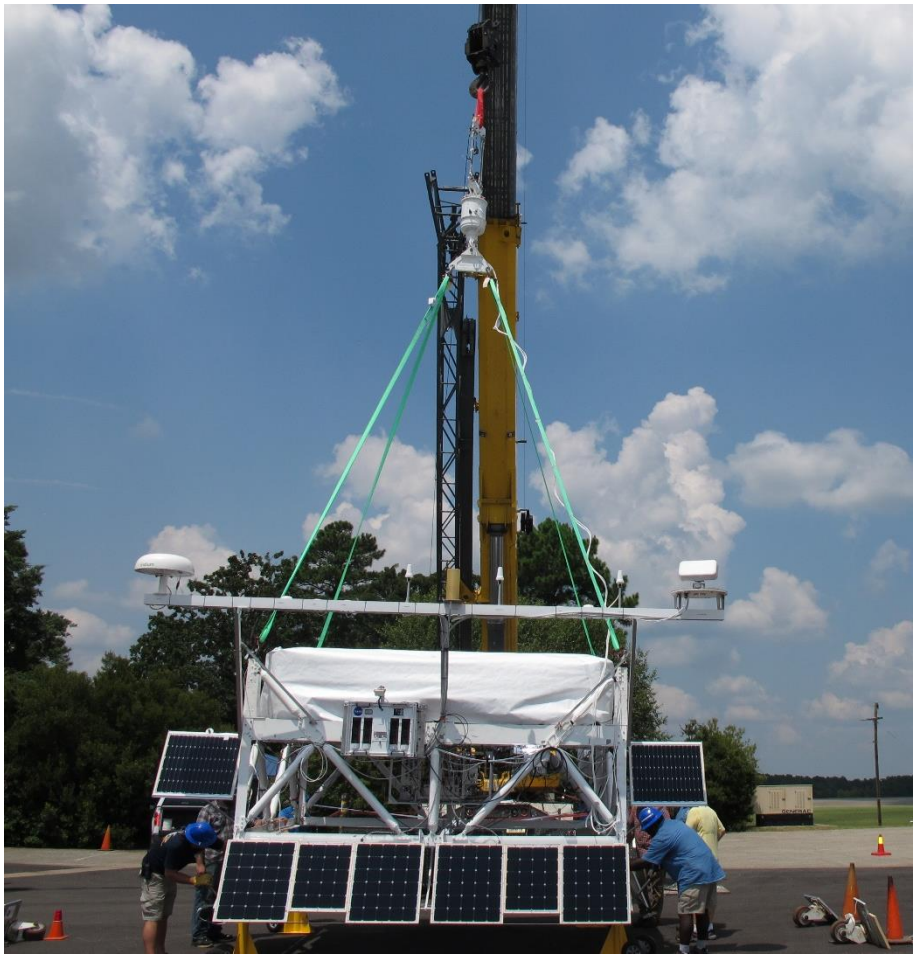
Additional Sytem:

- Iridium Pilot
- TDRSS HGA

Antarctica MRR 2019-2020
SuperTIGER Integration

Compatibility Testing

- A full integration of all LDB systems including SuperTIGER instrument, science subsystems, science GSE at the OCC with end to end TDRSS uplink/downlink test and UTP – August 15, 2019.
- All CSBF command/data interfaces verified with no anomalies noted.



BLAST-TNG Integration Review

Antarctica MRR 2019-2020
BLAST-TNG Integration

Antarctica MRR 2019-2020
BLAST-TNG Integration

BLAST-TNG Configuration:

- Low and High Rate Science ports on COMM1 and COMM2 systems providing:
  - Science downlink TM (6 kbps via TDRSS Omni, 75 kbps via TDRSS HGA)
  - Science downlink TM (2 kbps via Iridium Dialup)
  - Science uplink commanding
  - Polled SIP data – GPS position and time, MKS (calibrated) pressure
- HGA PCM Encoder providing:
  - Science downlink TM (115.2 kbps via TDRSS HGA)
- Science Stack providing:
  - 28 open collector command outputs

Antarctica MRR 2019-2020
BLAST-TNG Integration

- LOS Transmitters:
  - LDB TX: L-Band (1491.5 MHz)
  - BLAST-TNG 999 kbps Data TX: L-Band (1515.5 MHz)
  - BLAST-TNG Video TX: Upper-L-Band (1831 MHz)

- Additional Systems:
  - Iridium OpenPort
  - High Gain Antenna (DeVries sn: 004) for TDRSS transceiver

Antarctica MRR 2019-2020
BLAST-TNG Integration

Compatibility Testing

- A full integration of all CSBF LDB systems, BLAST-TNG systems, LDB and BLAST-TNG GSEs at the OCC with end to end TDRSS, Iridium, and LOS uplink/downlink test, and UTP July 31, 2018.
- Reintegration of CSBF and BLAST-TNG systems completed during FY2019 Antarctica
- All CSBF command/data interfaces confirmed operational with BLAST-TNG team
- BEMCO thermal testing of SIP6 and other associated CSBF flight equipment was completed successfully August 16, 2019. All components and hardware requalified through predicted thermal analysis range

Balloon Program Office
Wallops Flight Facility

2019/2020 Antarctic LDB Campaign

FY20 Mission Readiness Review

4 October 2019

NASA Goddard Space Flight Center
Wallops Flight Facility
Bldg. E-107, Rm. 305
Wallops Island, VA

Introduction and Campaign Overview

9:00	ASC Onsite Report	NSF/ASC

FY20 Science Status Review

(Schedule, Support, Integration, System/Sub-system status, Open Issues)

9:10	BLAST	Mark Devlin
9:25	SuperTIGER	Brian Rauch
9:40	GUSTO Pathfinder / BARREL	Robert Salter / Robyn Millan

FY20 Science Piggyback Science Status Review

9:55	E-MIST	David Smith
10:05	PMC Turbo	David Fritts
10:15	BAS	Alex Meshik
10:25	APTLITE	James Buckley

Campaign Support Overview

10:35	Campaign Safety Overview	WFF Safety Office
11:05	CSBF Campaign Planning and Electronics Support Overview	Hugo Franco / CSBF
11:35	Campaign Planning	Andy Hynous

Close Out

11:45	Open Discussion, Wrap-up & Adjourn	NASA

All times Eastern Daylight Time

Meeting Call-in Information

WebEx Meeting Link:	https://nasaenterprise.webex.com/
Meeting Number:	908 177 146
Meeting Password:	HhEJJt4$
Audio Connection:	(844) 467-4685
Audio Passcode:	381049

FY20 Candidate Presentation Guidelines:

Primary Missions 10 slides; Piggyback 5 slides.

Description:

- Provide a brief overview of the science, science team, institutions, and roles.
- Show schematics of the payload. Provide brief status of all major components.

Requirements and needs:

- Specify Level 1 requirements in balloon terms: altitude, duration, number of orbits over Antarctica.
- Describe where you are in the integration process (pictures are helpful). Highlight any issues, anomalies, recovery plans that may affect schedule.
- Describe CSBF component requirements for thermal, pointing, telemetry.
- Describe any special needs of payload: gases, cryogens, special shipping, etc.
- Describe the On-Ice support required. Provide general integration schedule on the Ice, duration, and payload dimensions.
- Describe in the field support requirements: quantity of tables/chairs, phone, internet, etc.
- Describe the recovery plan (at a high level). How the payload will be dismantled on the ice and aircraft requirements.

Schedule:

- Show your summary schedule & key milestones.
- List your team, by institution, role, with Crew arrival dates on/off Ice. Flight ready dates. Recovery support requirements.

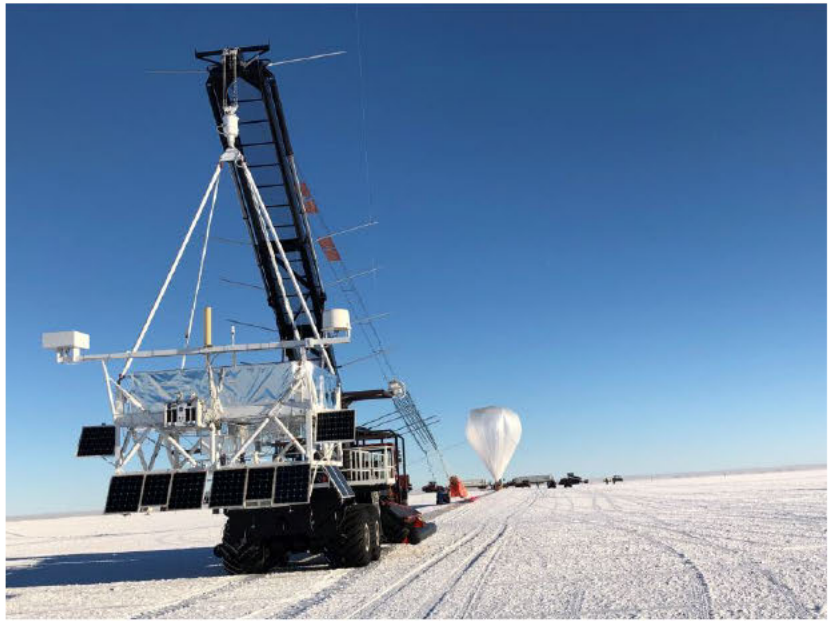
Mission Readiness Review FY20 Antarctic Long Duration Balloon Campaign

Andrew Hynous

Balloon Program Office

Mission Operations Manager

4 October 2019



FY19/20 BPO Manifest

Principal Investigator (PI) / Institution / Instrument	Discipline	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Fort Sumner, New Mexico	**Fall 19**												
Kogut / GSFC / BOBCAT	IR-Submillimeter		◆		*2nd Flight, Cancelled by PI*								
Fields / CSBF / LDB test	Test Flight			◆									
Gopalswamy / GSFC / BITSE	Solar and Heliophysics			◆									
Guzik / LSU / HASP	Student Flight Project			◆									
Salter / GSFC / 11 MCF PiggyBack	Test Flight			◆									
Fischer / GSFC / Big 60 Qual	Test Flight			*Cancelled out by PI*									
Chakrabarti / UMass / PICTURE-C	UV / Visible			◆									
Toon/JPL/Remote/Bailey / VATech / GLO	Upper Atmosphere				◇								
Kogut / GSFC / PIPER	IR-Submillimeter				◇								
Young / SwRI / THAI-SPICE (Hand Launch	UV / Visible				◇								
Tang/JPL/RECKTANGLE (Hand Launch)	IR-Submillimeter				◇								
Livesey / JPL / SWITCH (Hand Launch)	IIP / Upper Atmosphere				◇								
Kerber/UMB/MATTADOR (Valve Down)	Upper Atmosphere			*Cancelled out by PI*									
McMurdo, Antarctica	**Winter 19**												
Salter / CSBF / TRAVALA	Test Flight						◇ ◇						
Binns / WUSTL / SuperTIGER	Cosmic Ray/Particle						◇						
Devlin / UPENN / BLAST	IR-Submillimeter						◇						
Wanaka, New Zealand	**Spring 20**												
SPB Test Flight / Boggs / UCSD / COSI-2	Test Flight / COSI MoO									◇			
Salter / CSBF / TRAVALB	Test Flight									◇ ◇			
Palestine, Texas	**Summer 20**												
Kogut / GSFC / PIPER	IR-Submillimeter												◇
Kogut / GSFC / BOBCAT	IR-Submillimeter												◇

FY19 Antarctic LDB Campaign

Critical Milestones	Location	Date
Science Pre-Shipment Integration	CSBF, Palestine, TC	July 2019. Complete
Mission Readiness Review	NASA WFF, Wallops Isl., VA	4 October 2019
Mission and Safety Documentation	NASA WFF, Wallops Isl., VA	End of October / Beginning of November
CSBF Deployment on ICE	McMurdo, Antarctica	Early November 2019
Tentative Science Deployment	McMurdo, Antarctica	Middle November 2019
NASA Deployment	McMurdo, Antarctica	20 November
Science Flight Readiness	McMurdo, Antarctica	Beginning December 2019
Campaign Flight Readiness Review and ATP	McMurdo, Antarctica / NASA WFF, Wallops Isl., VA	Beginning December 2019