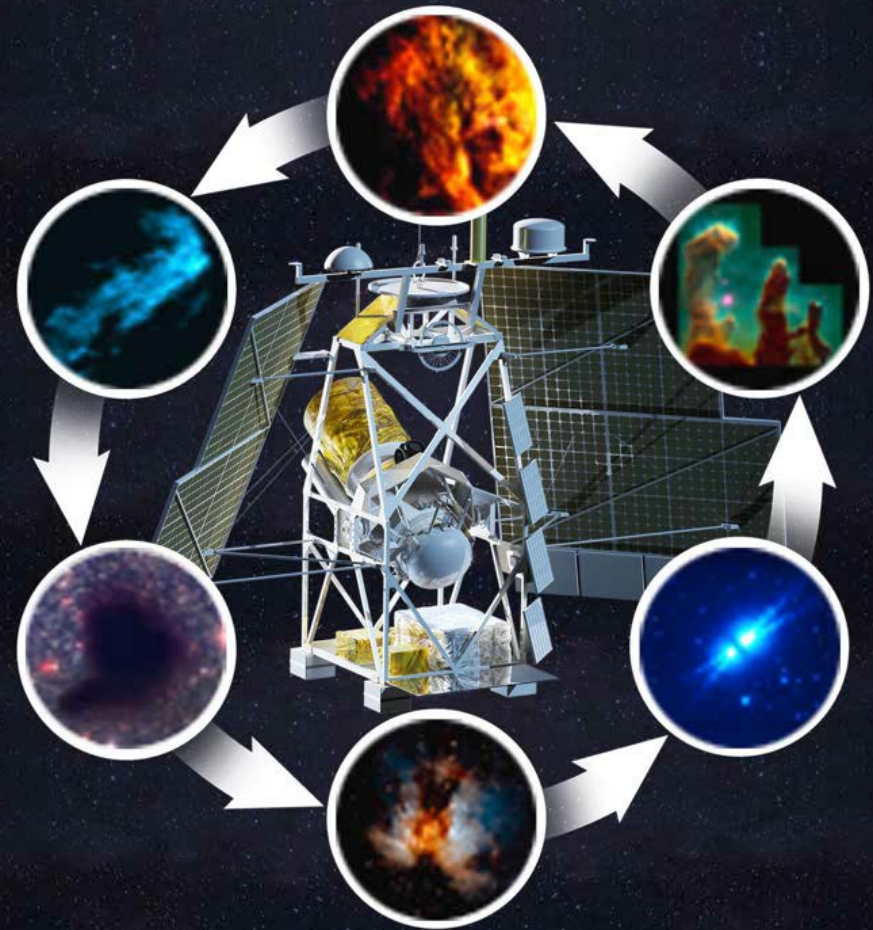


Galactic/Extragalactic ULDB Spectroscopic-Stratospheric Terahertz Observatory (GUSTO)

Project Update

Principle Investigator
Deputy PI
Project Manager
Deputy Project Manager
Payload Manager
Deputy Payload Manager

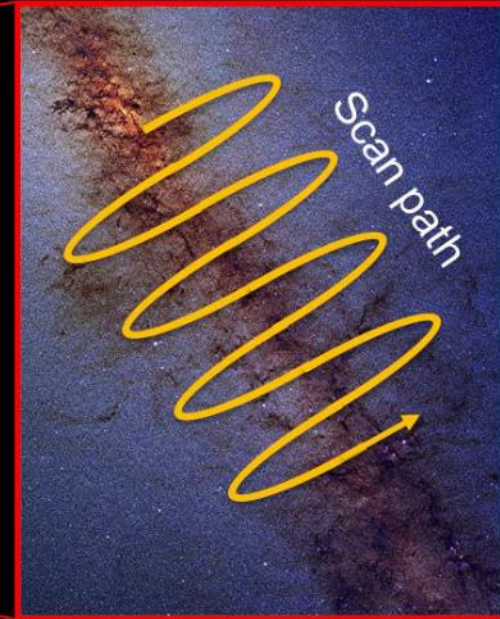
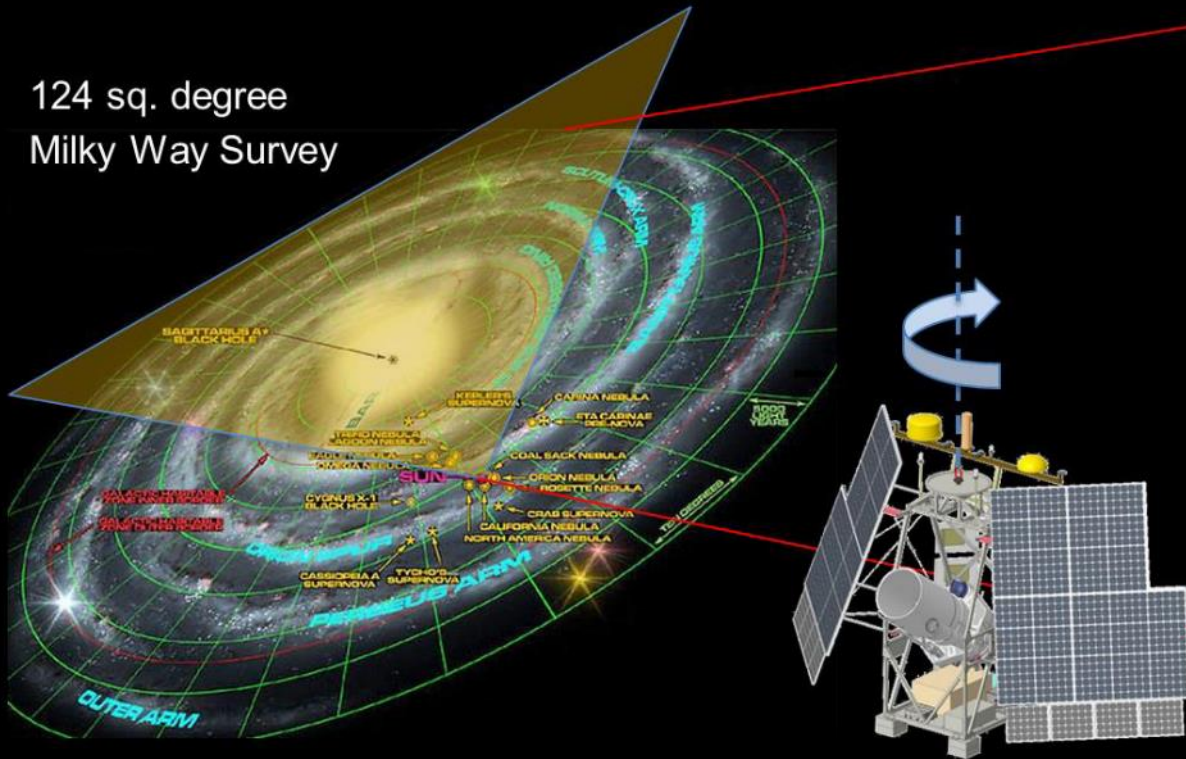
Dr. Christopher Walker
Dr. Craig Kulesa
Matthew Reinhart
Richard Fitzgerald
Hop Bailey
David Dolana





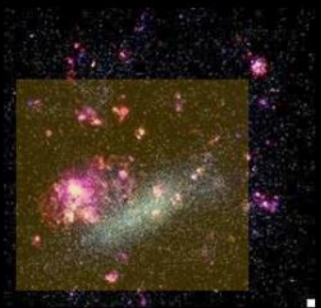
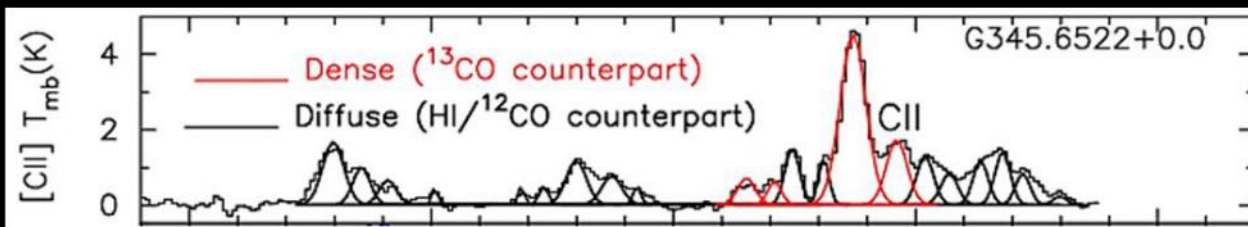
GUSTO Observational Objectives: [CII], [OI], & [NII] Surveys of MW and LMC

124 sq. degree
Milky Way Survey



On-the-Fly Mapping

Herschel CII line of sight (LOS): GUSTO will observe 540,000 LOS's



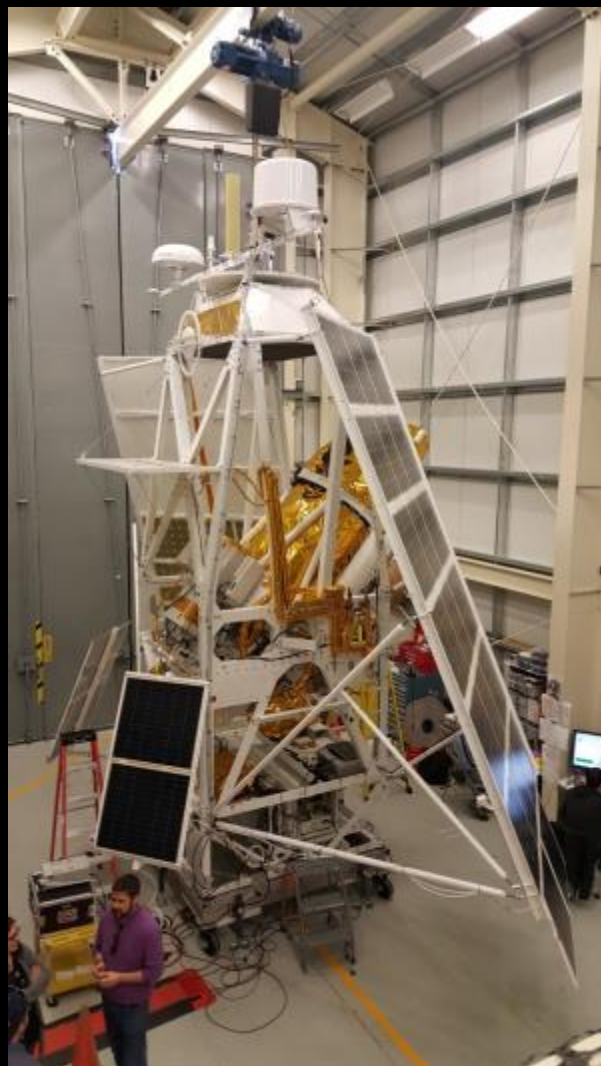
25 sq. degree
LMC Survey

Spectral Resolution is Key to Disentangling Complex Lines of Sight





Stratospheric Terahertz Observatory (STO): *Pathfinder* for GUSTO



STO provides GUSTO experience:

- Teaming arrangements
- Gondola and instrument architecture
- Observing profile and mission plan
- Data product management



Dec. 9, 2016



Balloon

Parachute

STO-2

STO-2 in Flight

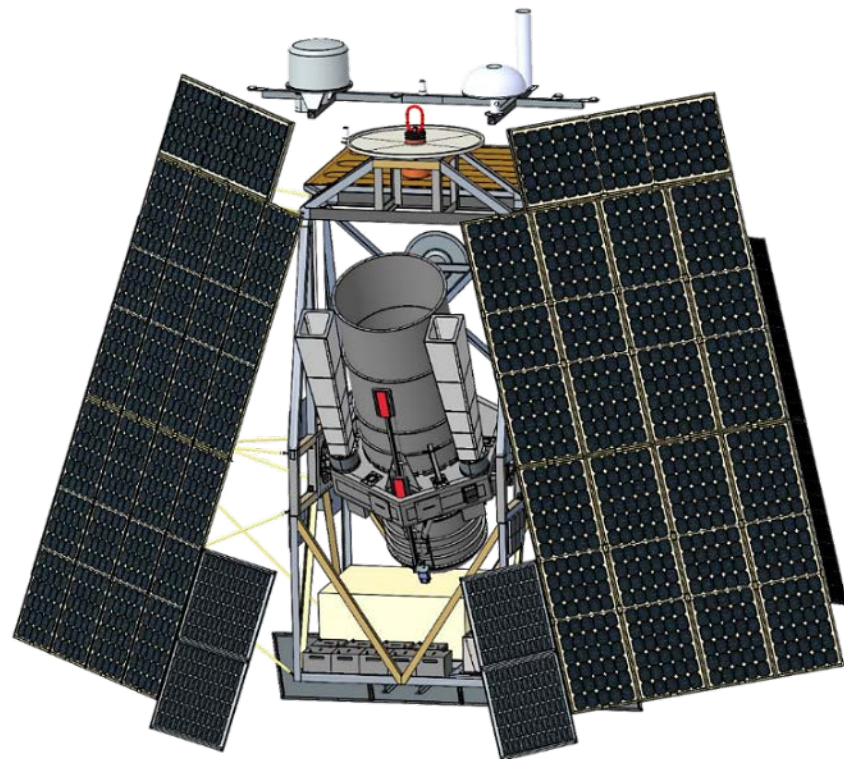


STO-2 Mission Operations Center: McMurdo, Antarctica



Mission Overview

- **NASA's First Balloon Class D Explorer Mission**
 - Designated as a Category 3, Class D Mission
 - First Balloon Explorer Mission of Opportunity selected for Phases B-F.
- **Project Management**
 - UA: PI, Payload
 - APL: PjM, MSE, Gondola, MOPS
 - NASA BPO: Balloon hardware, launch services
- **Mission Profile**
 - **First full balloon science** mission that will :
 - Use the NASA developed Super Pressure Balloon system
 - Fly for 75 days or more at 110 kft (33.5 km) altitude
 - Launch from Antarctica in December 2021
 - Mapping mission:
 - Slow scans across Milky Way and Large Magellanic Cloud
 - ~100% duty cycle science observations
- **Science Payload:**
 - 0.9-m F/10 Cassegrain telescope optimized for THz frequencies
 - 3x8 pixel array of cryogenically cooled heterodyne detectors
 - 150 liter LHe cryostat maintains detectors at 4K for 100+ days
- **Gondola (Observing Platform):**
 - 2.5 axis stabilized gravity gradient attitude control system
 - Power system with solar arrays and Li-Ion rechargeable batteries
 - Liquid cooling system to support payload heat dissipation requirements
 - Telecomm & balloon control via NASA provided SIP electronics

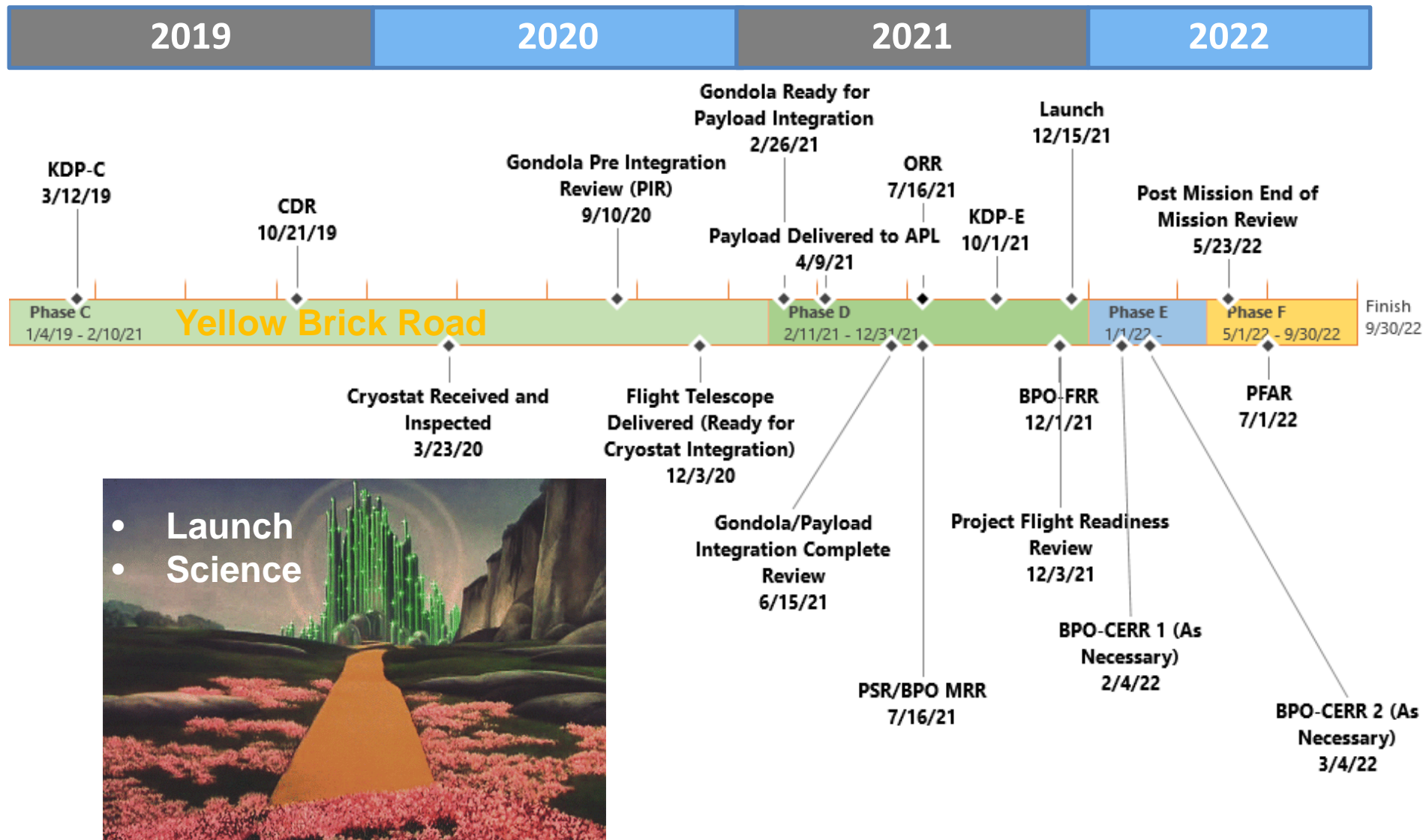


GUSTO Gondola Stats

Dimensions (W x D x H)	24.5 x 15.5 x 21.5 ft
Observatory CBE mass	1459 kg
Average power usage	1000 W
Average power generation	1700 W

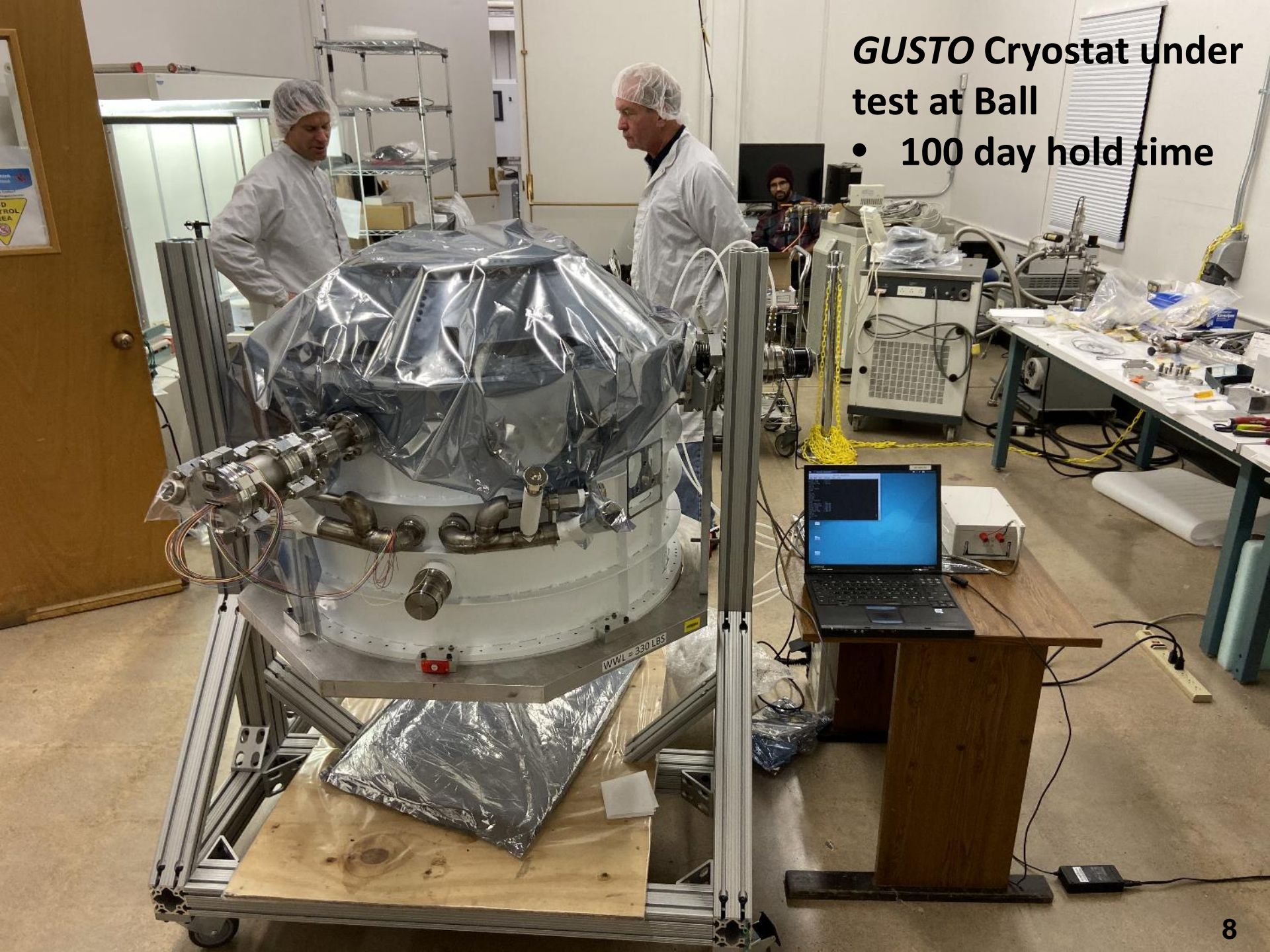
GUSTO is the pathfinder for future bold balloon programs

Project Timeline



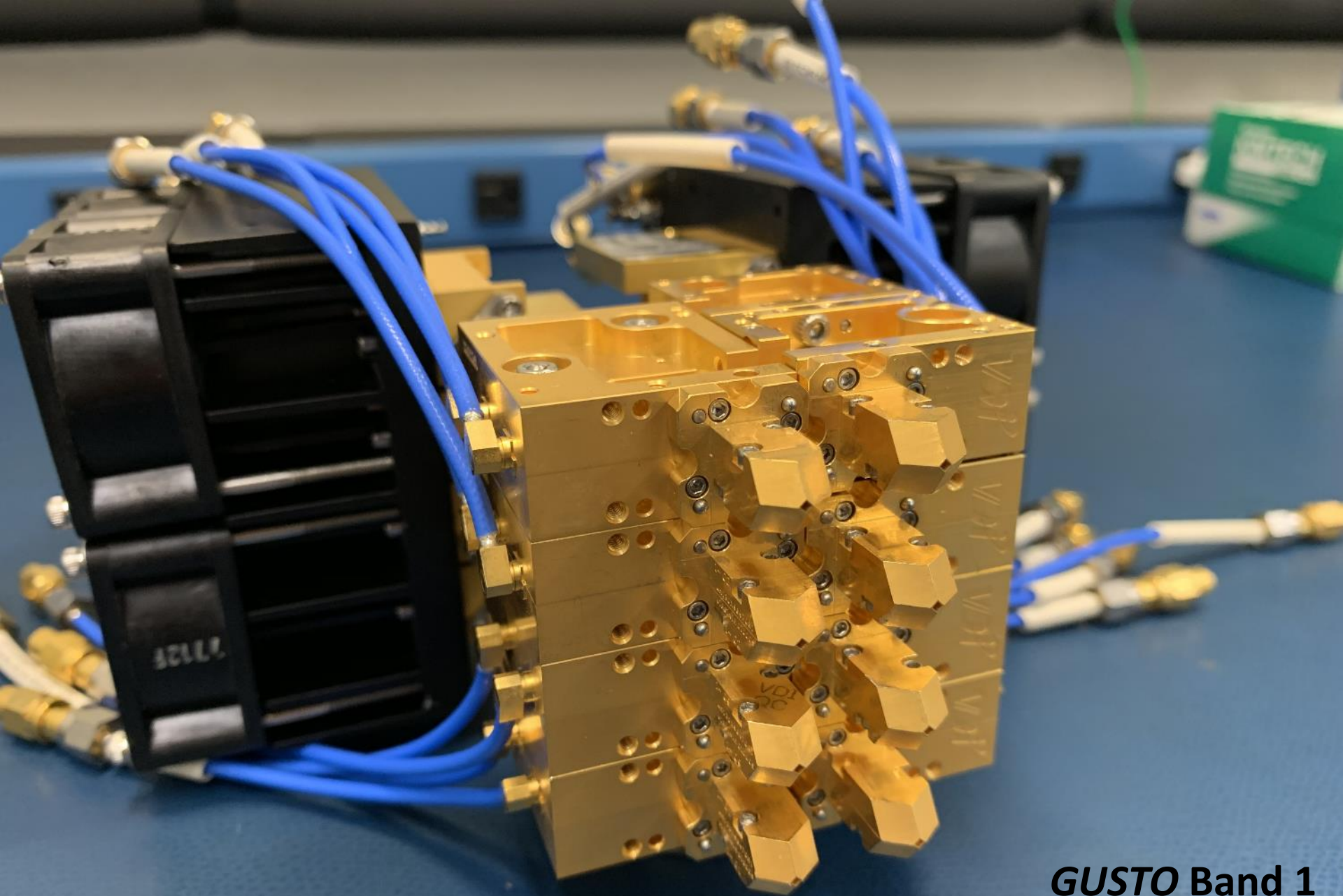
***GUSTO* Cryostat under test at Ball**

- 100 day hold time



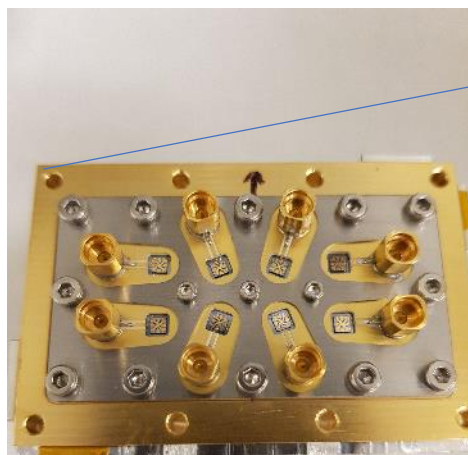
***GUSTO* Cryostat in flight lab at UofA**



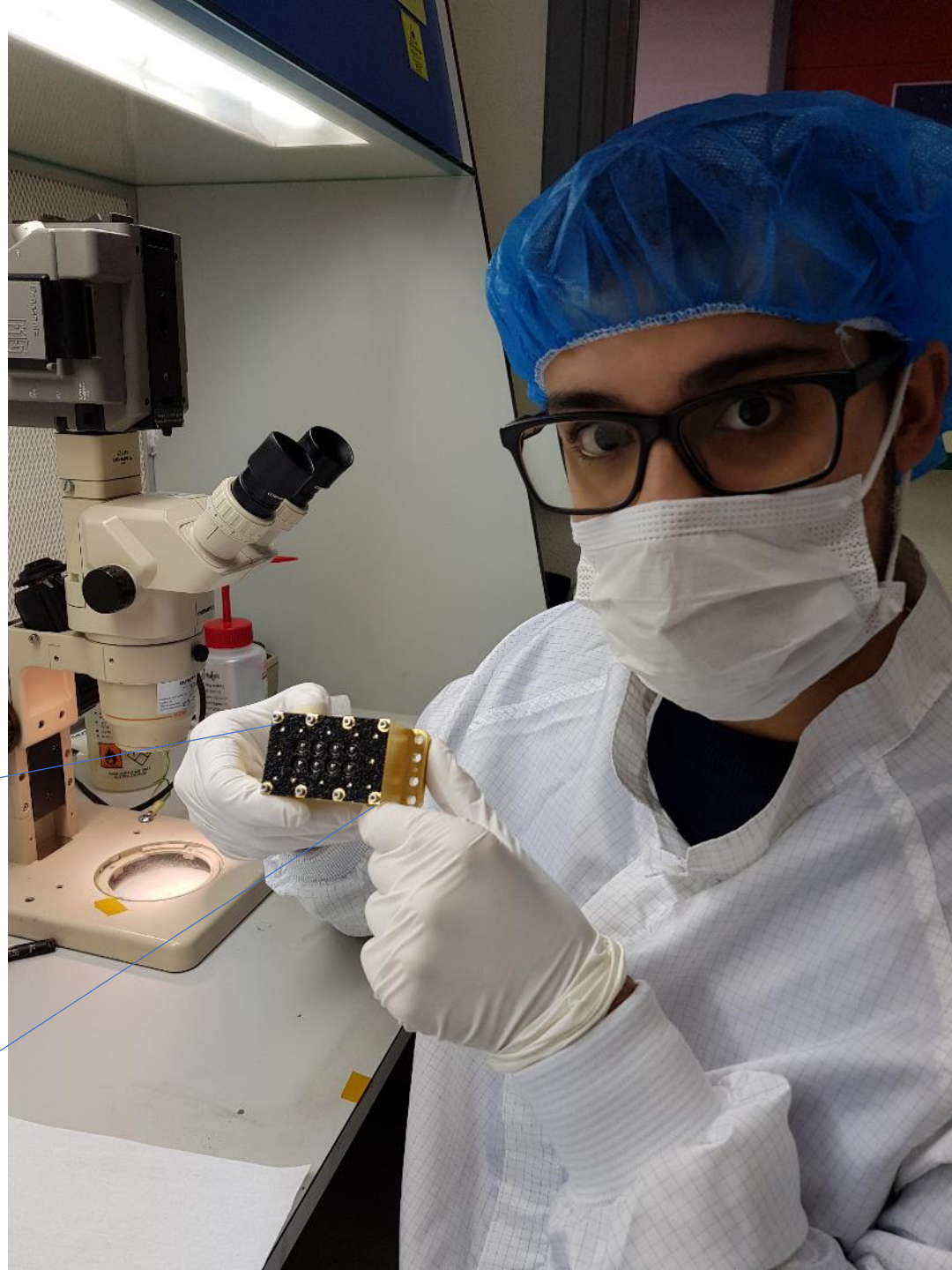


***GUSTO* Band 1
LO Array**

Band 3 HEB Array Assembly at SRON



Back of Array



Crystal Ball: Risk Management

Likelihood of Occurrence

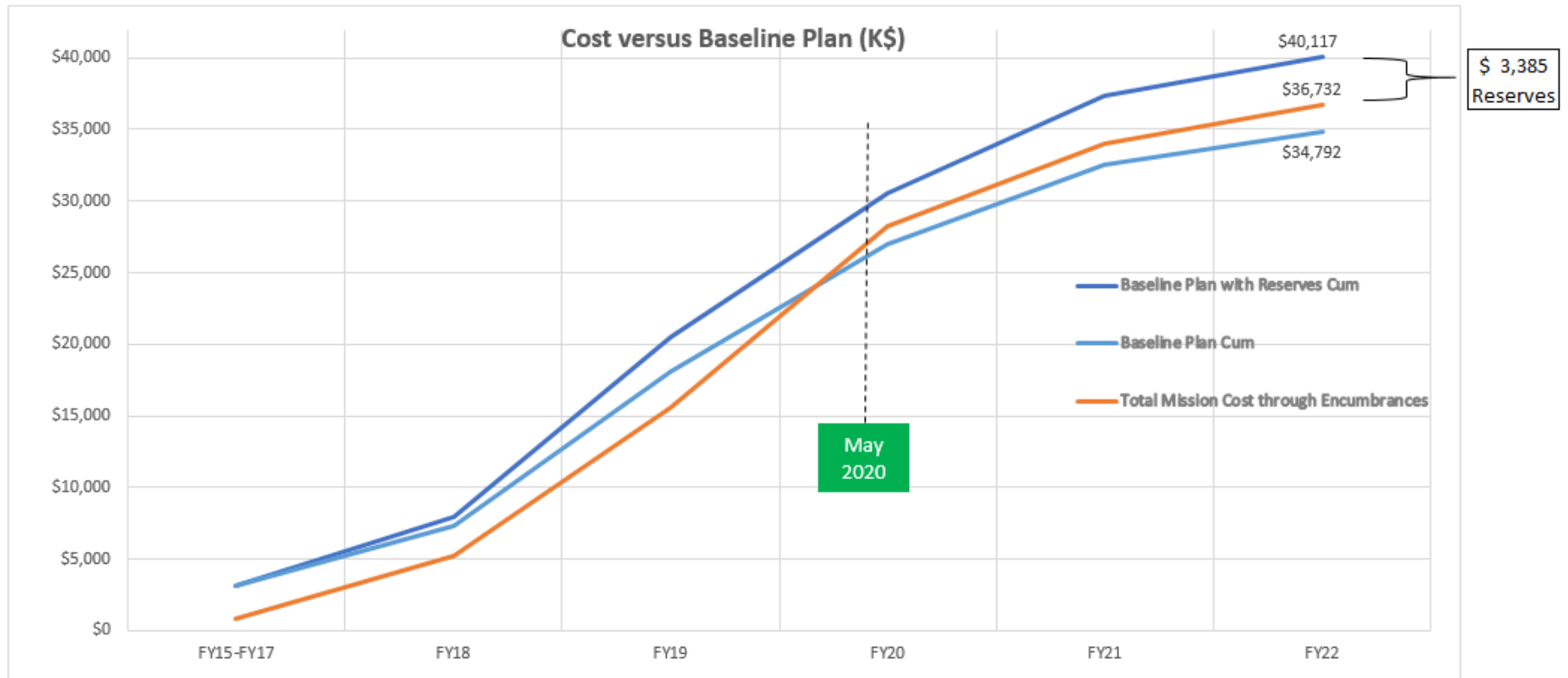
5- Very High					
4- High	GUSTO-R-073 GUSTO-R-074	GUSTO-R-028			
3- Moderate			GUSTO-R-008		
2- Low			GUSTO-R-045 GUSTO-R-070	GUSTO-R-010 GUSTO-R-025	
1- Very Low				GUSTO-R-006 GUSTO-R-066	
	1 - Very Low	2 - Low	3 - Moderate	4 - High	5 - Very High

Consequence of Occurrence

Top Ten	Code	Motion	Title	Approach
1	008	↑	Band 3 QCL LO meeting all requirements on schedule	Mitigate
2	028	↑	Super Pressure Balloon Lifetime	Watch
3	010	=	Band 3 Receiver Performance	Watch
4	025	=	IF standing waves in spectra	Mitigate
5	070	=	Gondola CG positioning	Mitigate
6	045	↓	Late Start of I&T in Antarctica Causing 1 Year Launch Delay	Watch
7	073	=	Cost Growth in APL Estimate at Complete	Mitigate



Total Mission Budget vs. Baseline



GUSTO is a Team Effort



Knowledge
Leadership
Passion
Grit

Explorer Program Office

- Your extended project Family
- Advocates within the NASA system
- Deep knowledge of how to run a mission
- Access to unique resources
- Always ready to help

SMA

- Helps keep bad things from happening
- When they do, provides a path forward

Project Management

- Keeps project on schedule and cost
- Risk Management

Science Team

- Sets Science Objectives & Requirements
- Keeps “eyes on the prize”

Instrument Team

- Turns ppts into reality
- Works to achieve the requirements necessary for mission success

Light at End of the Tunnel



Phase E/F