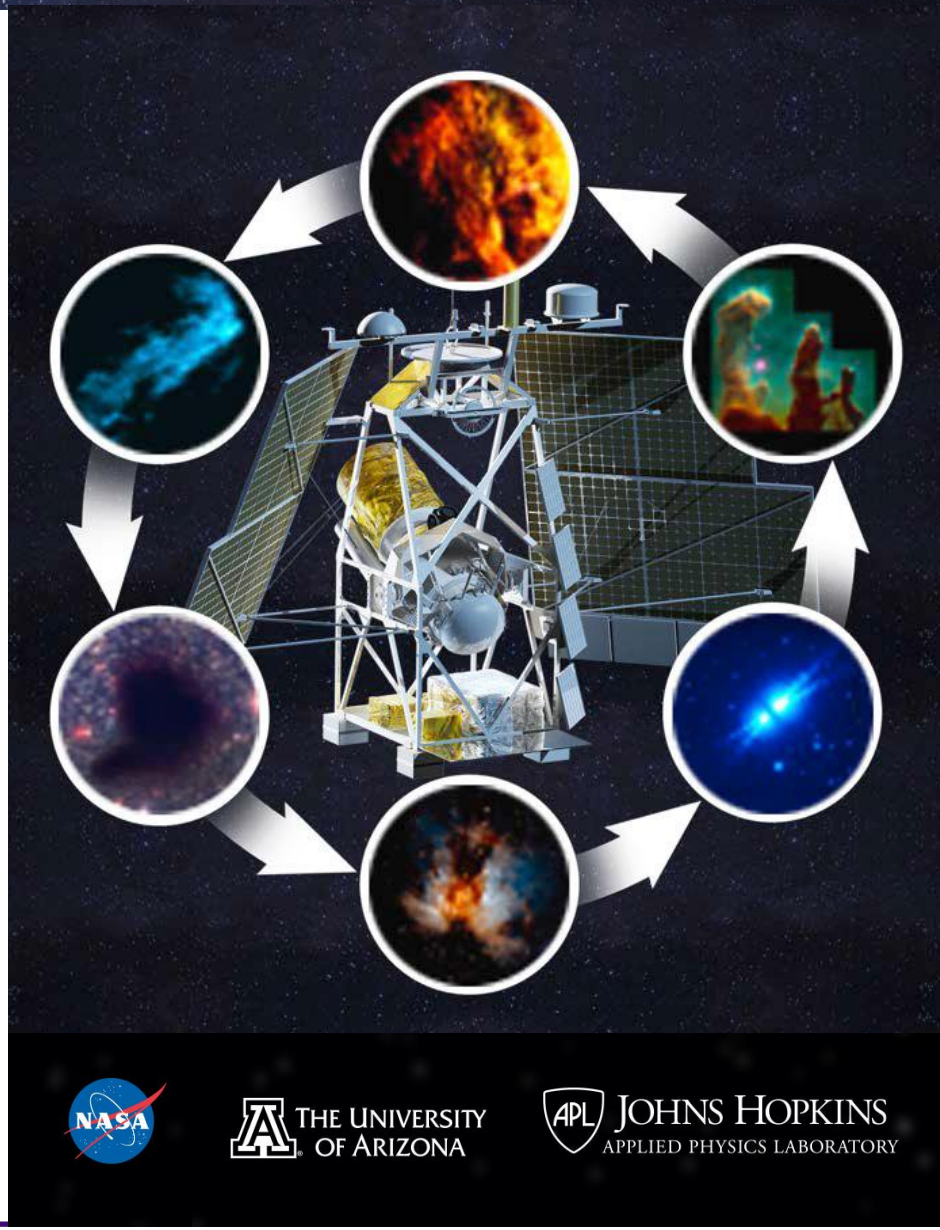
Galactic/Extragalactic ULDB Spectroscopic-Stratospheric Terahertz Observatory (GUSTO)

Project Update



Principle Investigator	Christopher Walker
Deputy PI	Craig Kulesa
Project Manager	Kieran Hegarty
Payload Manager	Doug Kelly
Project Scientist	Paul Goldsmith
Mission Systems Engineer	Pietro Bernasconi

Project Description Quad-Chart

Science Objectives

1. Determine the constituents and the life cycle of interstellar gas in the Milky Way
2. Witness the formation and destruction of star-forming clouds
3. Understand the dynamics and gas flow into and within the Galactic Center
4. Understand the interplay among star formation, stellar winds and radiation, and the structure of the interstellar medium in the Large Magellanic Cloud (LMC)
5. Construct Milky Way and LMC templates for comparison to distant galaxies.

GUSTO Highlights

Instrument

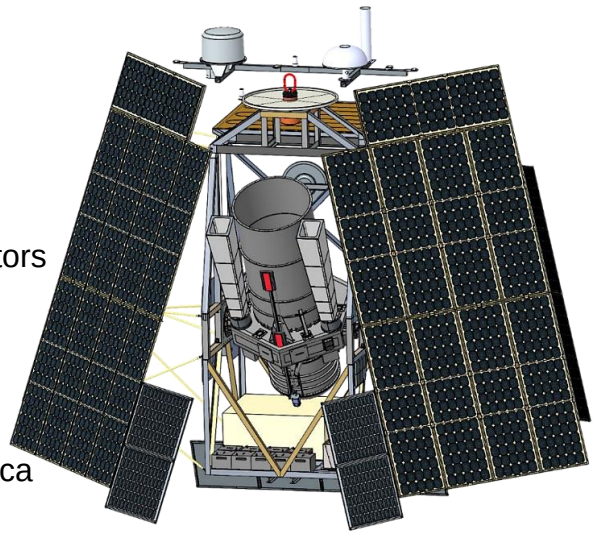
- 0.90-m telescope
- Terahertz heterodyne array receivers
- Cryostat cooled detectors

Gondola

- 2.5 axis stabilized

Launch site

- McMurdo Stn. Antarctica



Key Mission Requirements

Mission Design Life	**75 day Baseline, 55 day Threshold**
Altitude	**Sub-orbital, nominal 33.2 km**
Launch Vehicle	**Zero Pressure Balloon (ZPB)**
Observatory Mass	**1,600 kg maximum**
Power Usage	**850 W minimum average**
Data Downlink	**300 kbps minimum average**
Storage	**1.6 Tb**

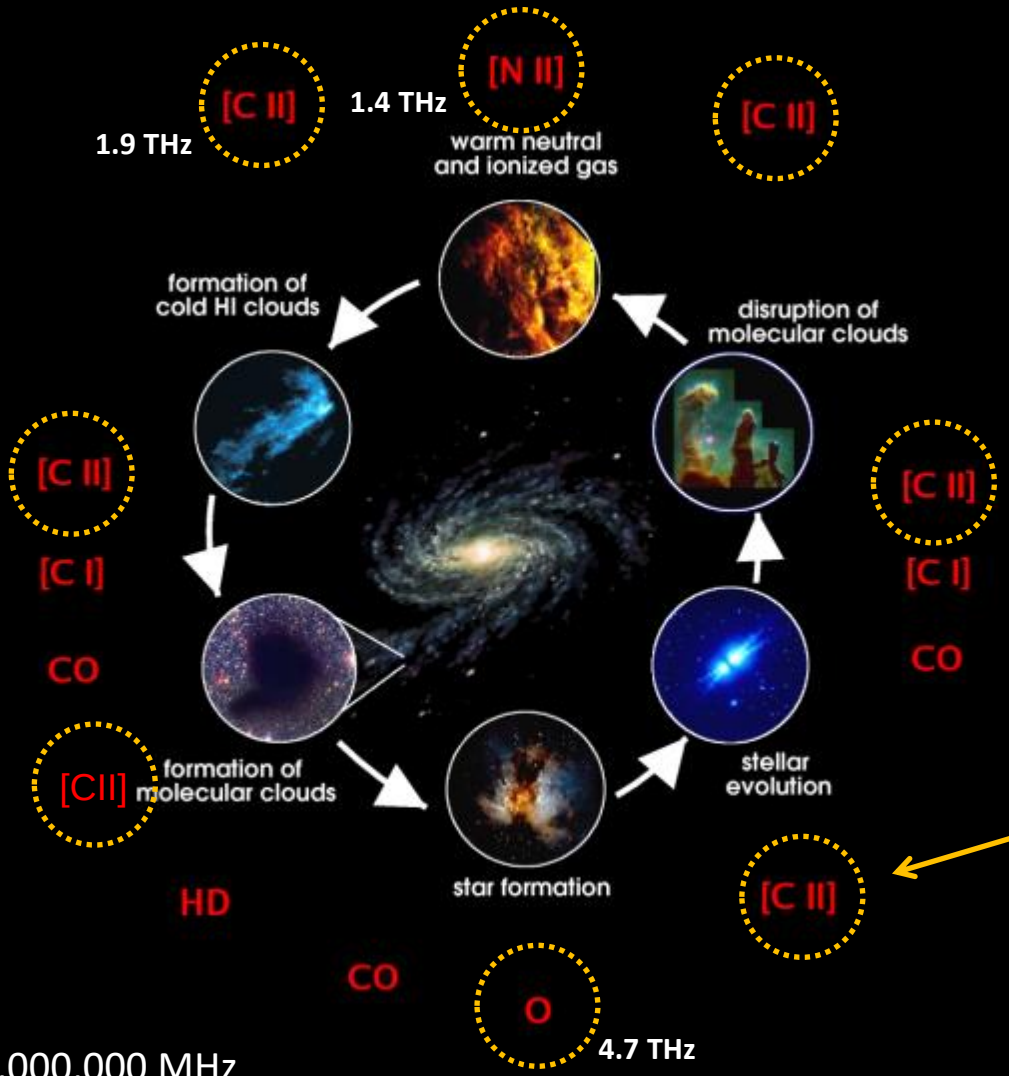
Mission Programmatics

$47.167M Cost Cap
Project Category 3, Risk Class D streamlined
December 2023 launch readiness date
Sponsored by NASA-GSFC Explorers Program Office

Instrument:	University of Arizona (UA)
Gondola:	Johns Hopkins Applied Physics Lab (APL)
Mission Operations:	APL
Science Operations:	UA

Principal Investigator:	Christopher Walker, UA
Project Manager:	Kieran Hegarty, APL
Mission System Engr.:	Pietro Bernasconi, APL

Life Cycle of ISM



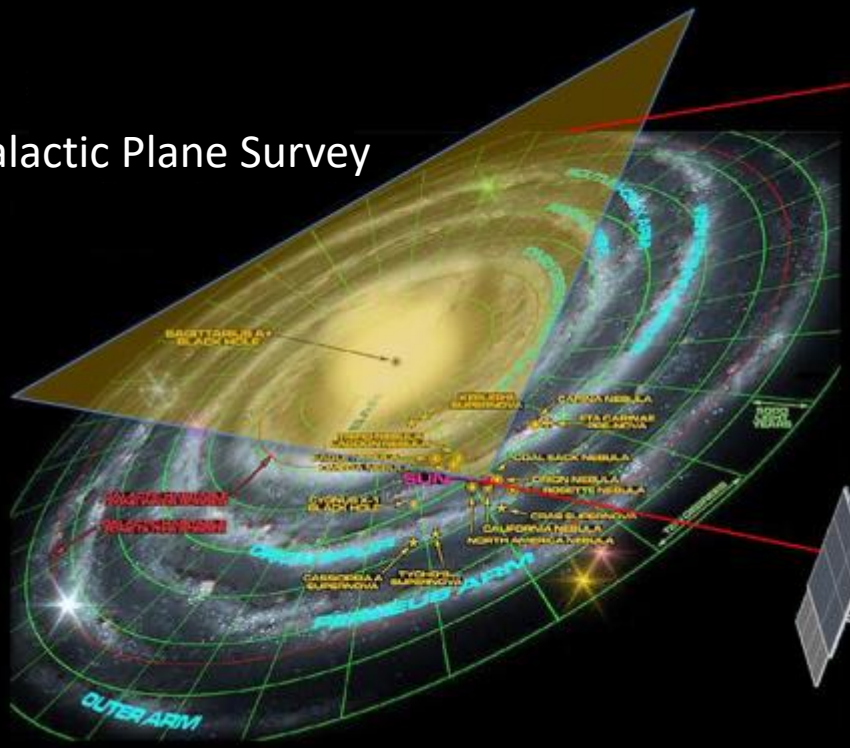
Brightest Line in *the FIR over cosmic time*

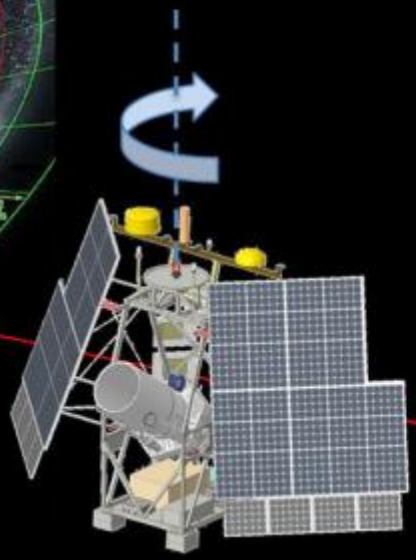
1 THz = 1,000,000 MHz

Atmospheric Absorption makes it difficult or impossible to see…

GUSTO Observational Objectives: Far-IR Line Surveys of MW and LMC

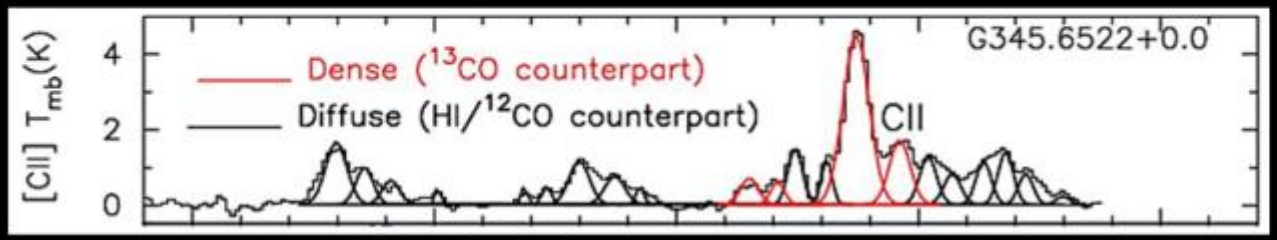
Galactic Plane Survey





On-the-Fly Mapping

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

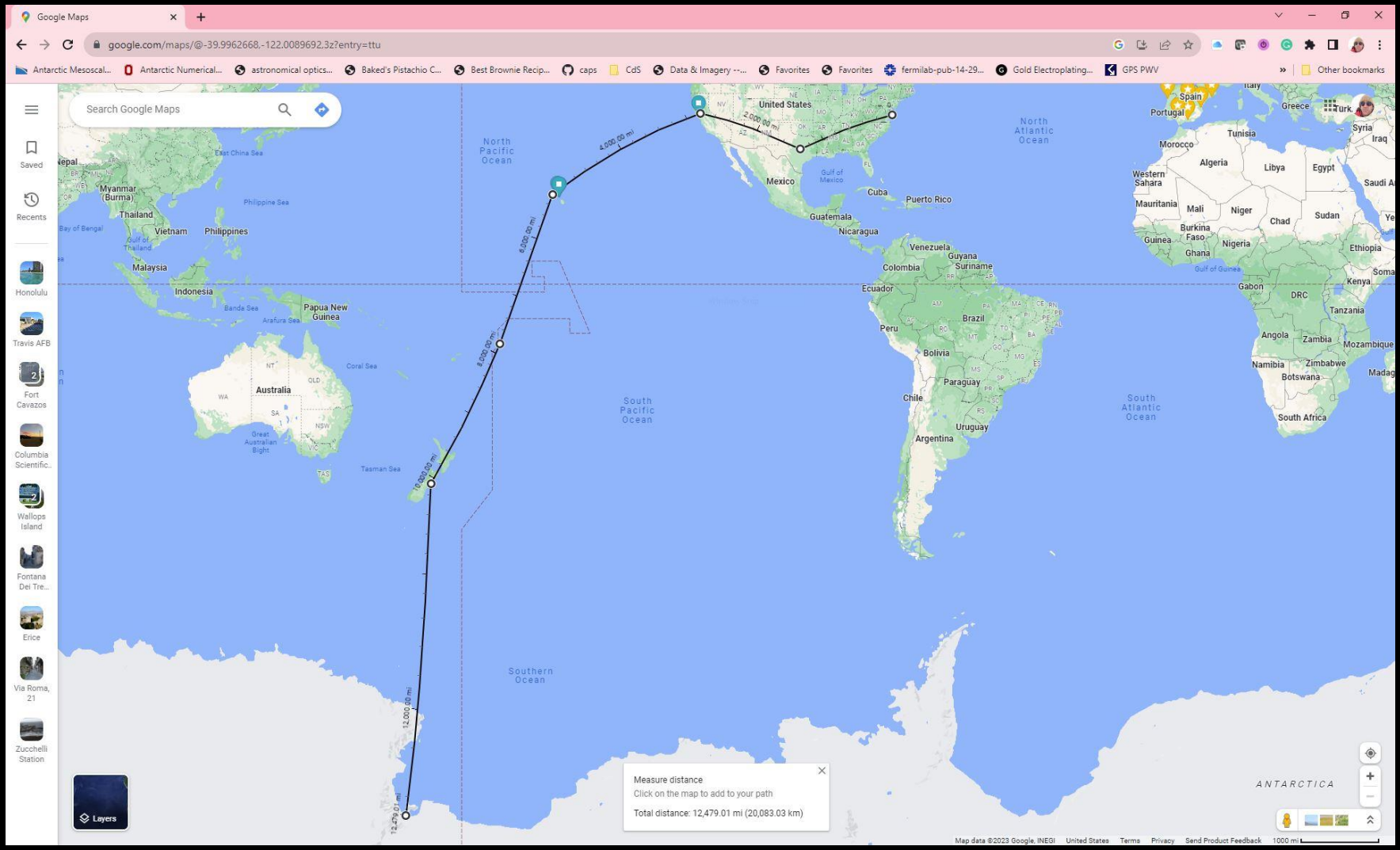


LMC Survey
Dist: 158,000 ly

GUSTO Hang-test

CSBF in Palestine, TX: August 2023

GUSTO Flight to Antarctica



Christchurch, NZ

Time to Go….

Inside C-130

Only 7.5 hours… if you are lucky.

- Free sack lunch
- Toilet… don’t ask.

GUSTO Integration & Test: Antarctica

About a month or so later….

Long Duration Balloon (LDB) Hangar#2, Antarctica

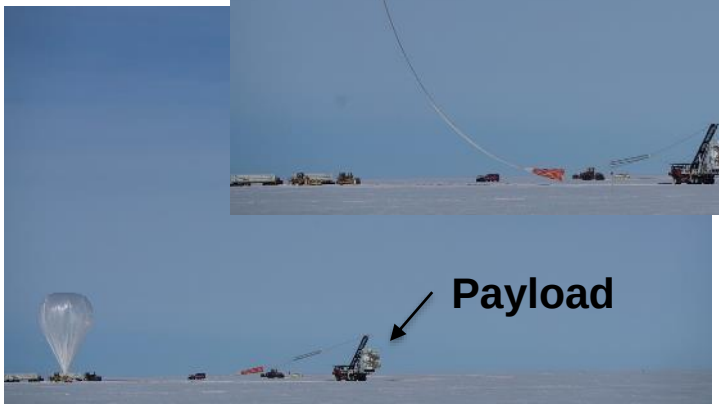
Pre-Flight Checkouts: *Hang Test*

Pre-Flight Checkouts

Launch!

Payload Release

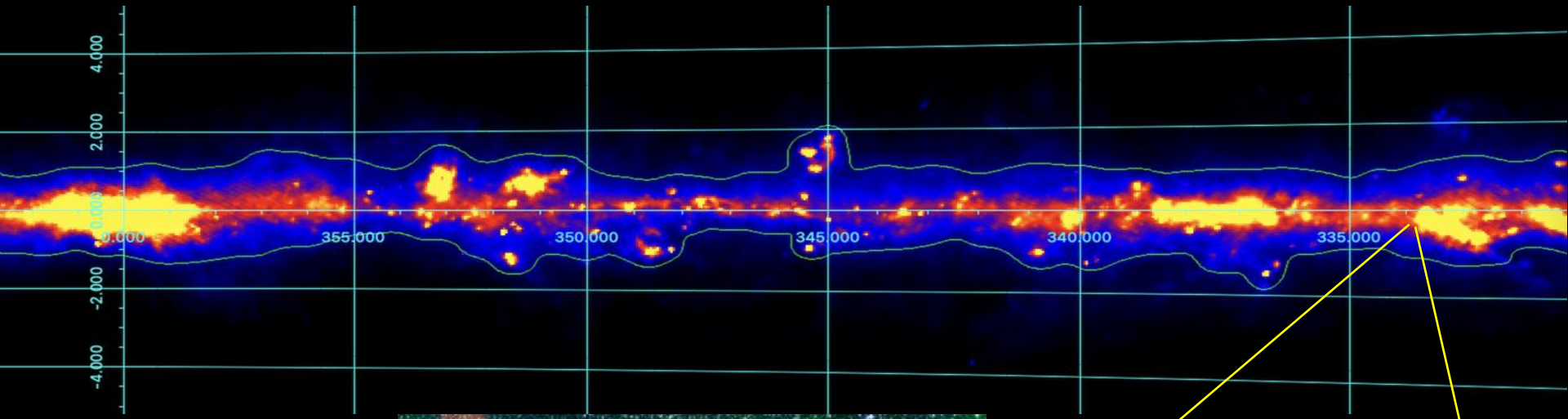
Balloon Release



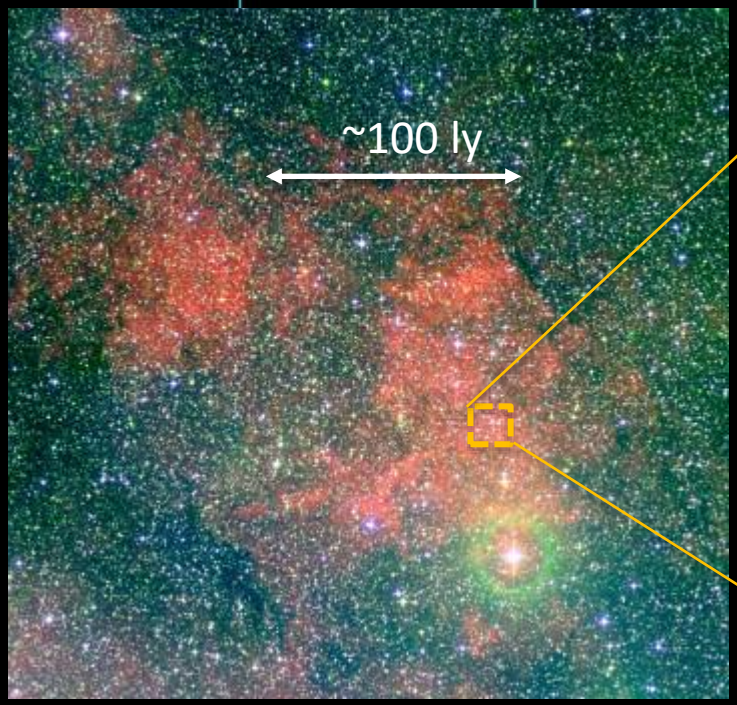
Balloon Inflation

GUSTO Science Operations Center (SOC)

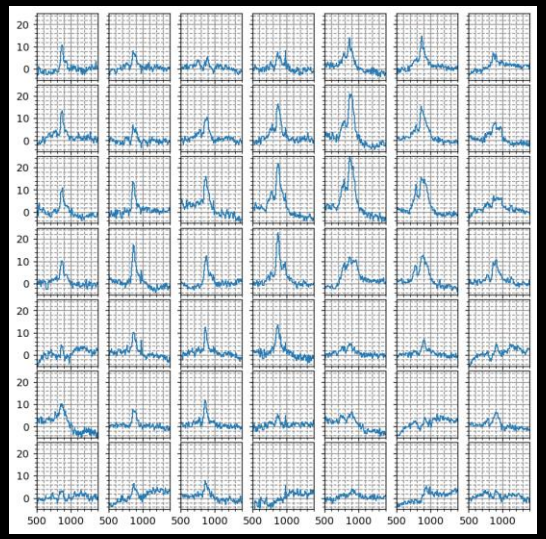
Survey Status



GC



[CII] (PS Map)



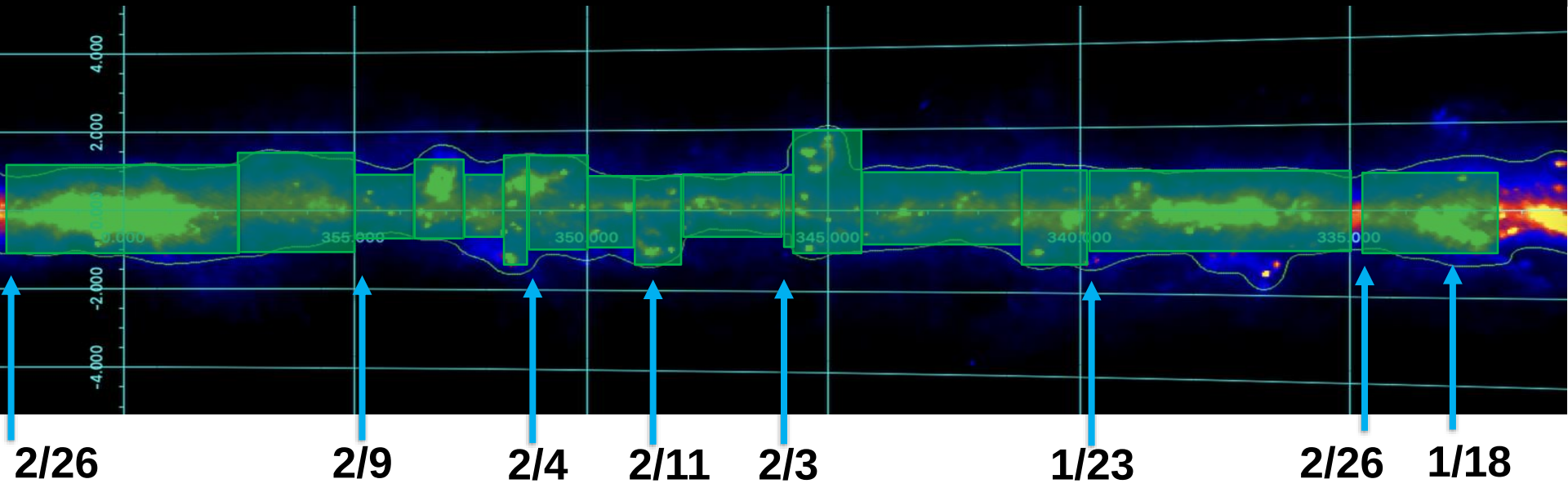
~10 ly

Massive Star Forming Region

Dist: ~20,000 ly
Mass: ~10^5 M_{sun}
Luminosity: ~10^6 M_{sun}

G333.6-.2

Galactic Plane Survey status



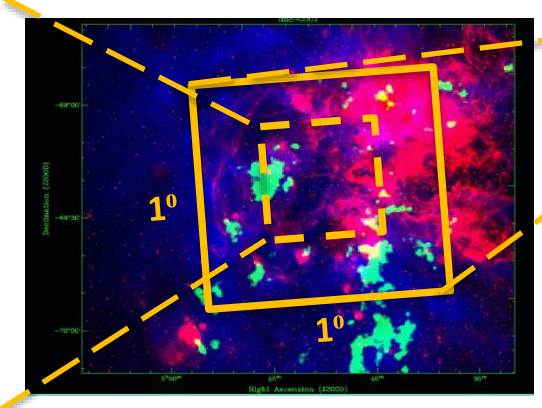
- Data products on track to meet or exceed Threshold Requirements
  - Angular resolution & coverage, spectral resolution & coverage, sensitivity
- 62 square degrees of Galactic Plane mapped in Bands 1 and 2
  - Easily exceeds mission success criteria, and 100% of Threshold mission!
  - ***> 1 Million Lines of Sight through the Milky Way!***
  - *Data processing ongoing*

LMC Survey: 30 Doradus & N11

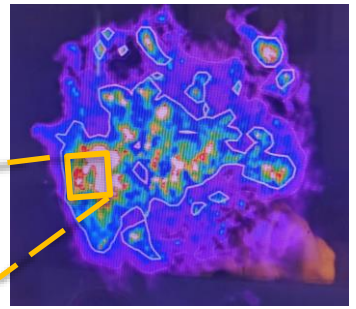
JWST NIRCam Image

Fully Surveyed in [CII] & [NII]

LMC Survey

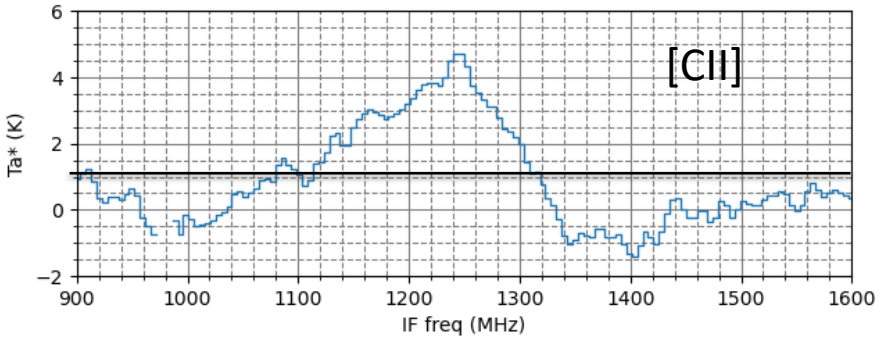


(Red Hα, Blue HI, and Green CO)



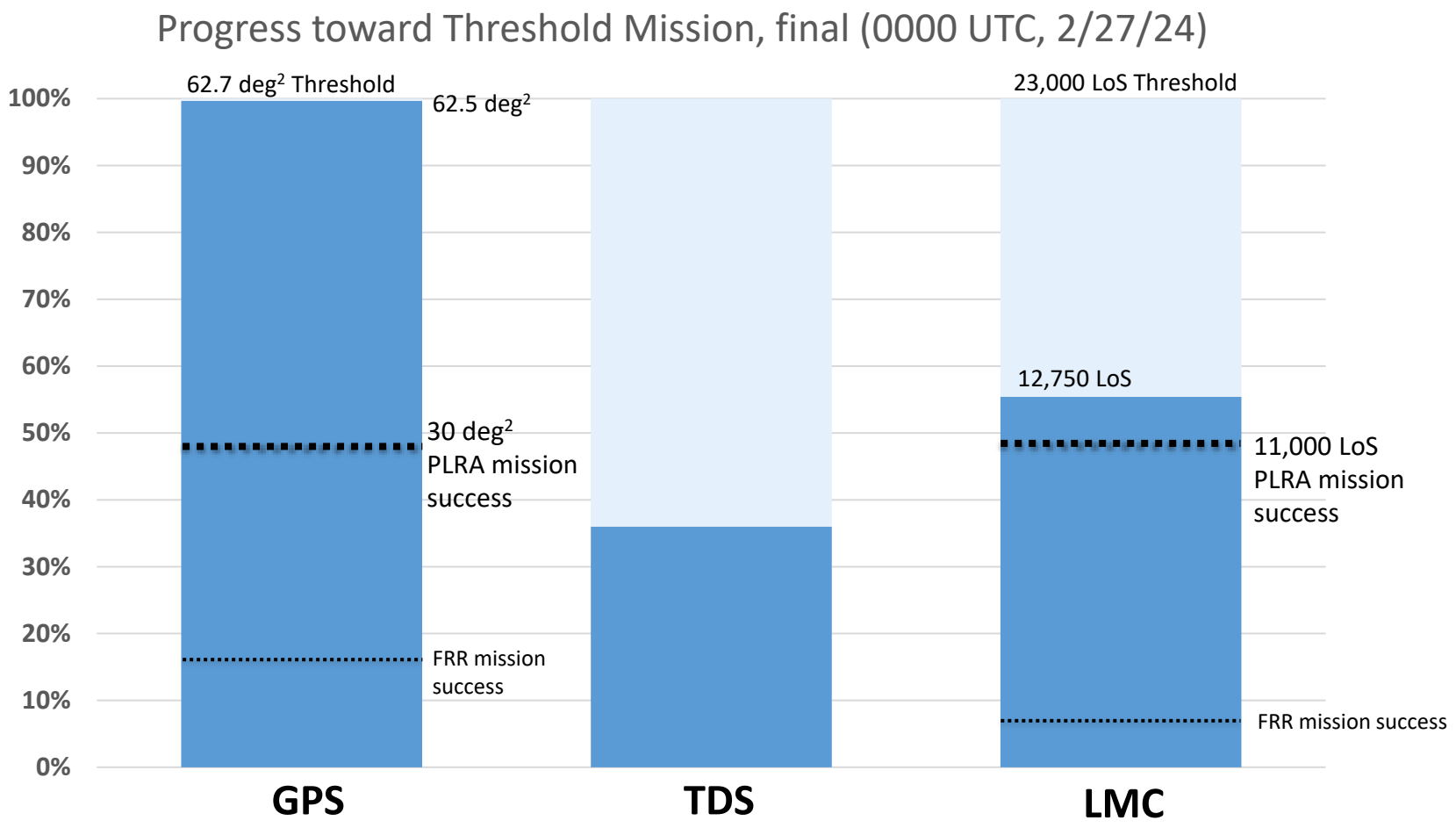
LMC Survey in Bands 1 and 2

- 1.1 deg^2 map of 30 Dor region (100% complete)
- 0.6°x0.5° map around N11 (100% complete)
- 0.9 deg^2 map, molecular ridge south of 30 Dor



First Extragalactic GUSTO spectrum (30 Dor in LMC)

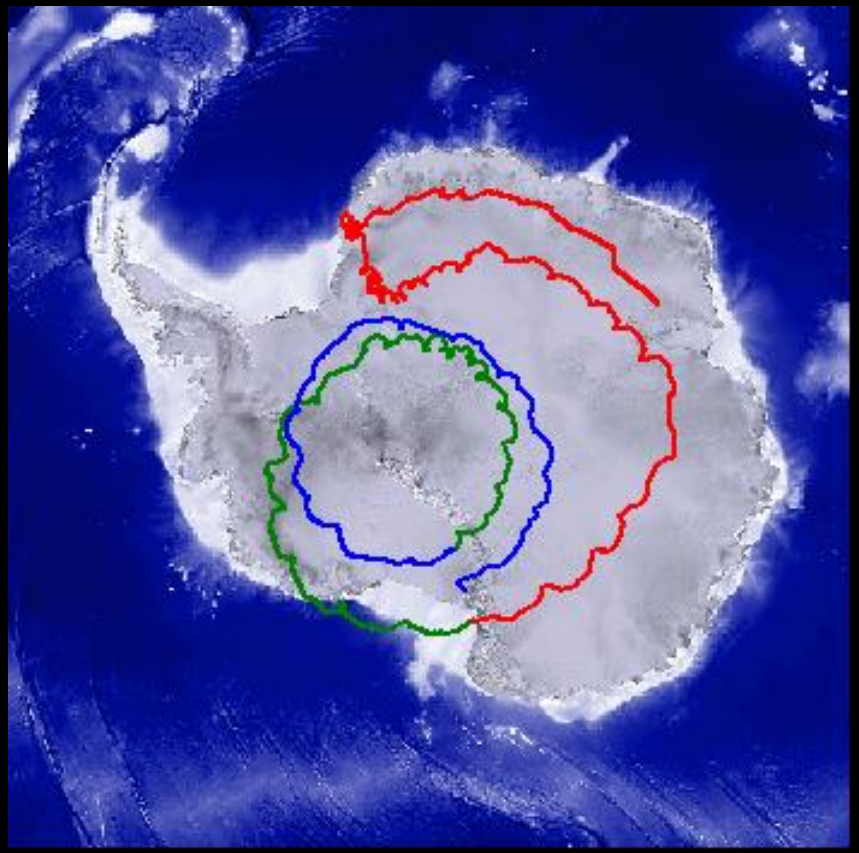
GUSTO Survey Progress



GUSTO Trajectory

Payload position as of:
20:31:07Z 02/27/24

Latitude: 71°12.54 S
Longitude: 61°59.47 E



https://www.csbf.nasa.gov/map/balloon8/flight736N

GUSTO Recovery Site

Payload position as of:
20:31:07Z 02/27/24

Latitude: 71°12.54 S
Longitude: 61°59.47 E