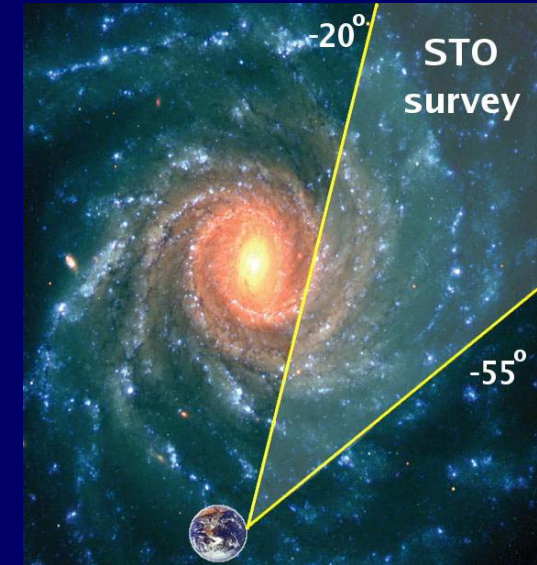


Stratospheric THz Observatory (STO)

Finder's Scope for SOFIA

UAz, JHU/APL, CIT/JPL, KOSMA, Ames, SAO, Oberlin, U.Maryland

- 0.8-meter telescope with two 4-pixel THz arrays
- platform for THz surveys



- LDB Platform
- ~14 day flights

2009 – First Engr. Flight

2010-11 - First Science Flight : C+, N+ Survey



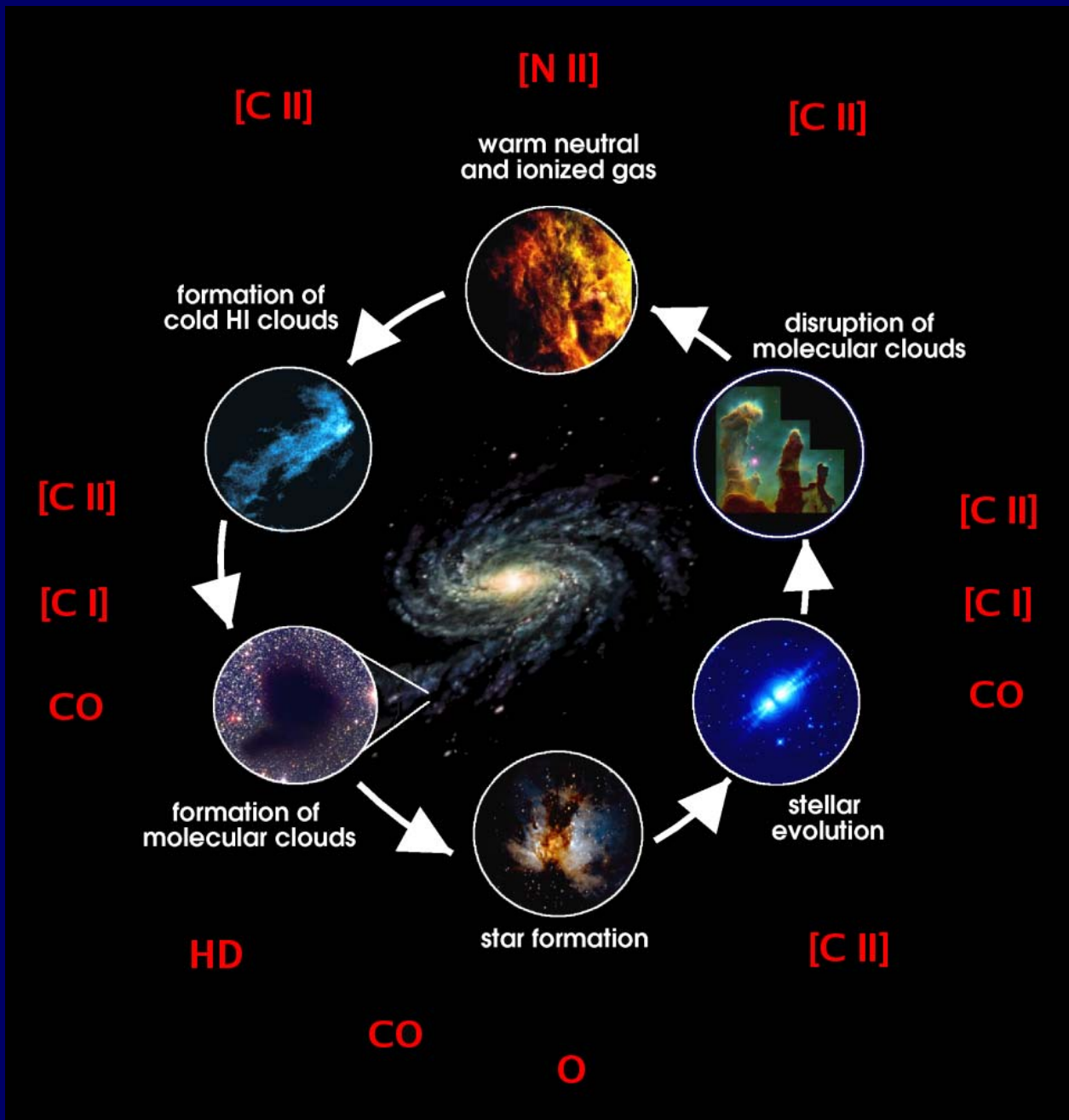
**We live in a
Galaxy
comprised of
stars, dust,
gas, planets,
and people.**

**Where did it
all come
from?**

Long Standing Questions



- How and where are interstellar clouds made, and how long do they live?
- Under what conditions do clouds form stars?
- How do stars return enriched material back to the Galaxy?
- How do these processes sculpt the evolution of galaxies?

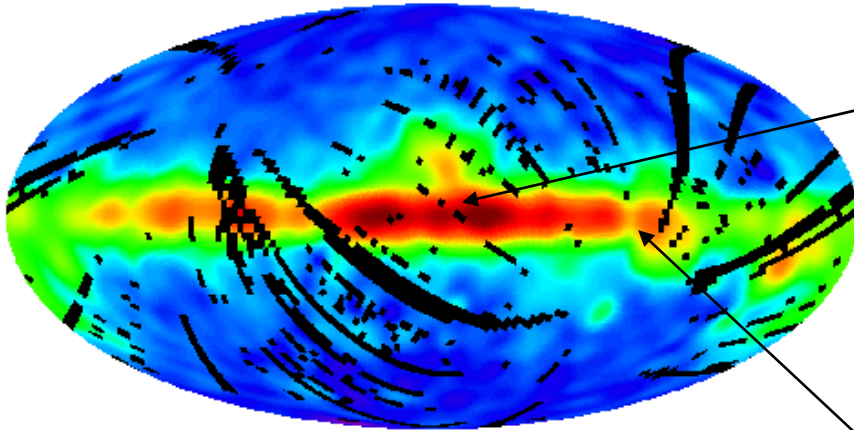


Spectral diagnostics of the interstellar life cycle define a new, pressing need for large-scale, high resolution, **THz** spectroscopic surveys!

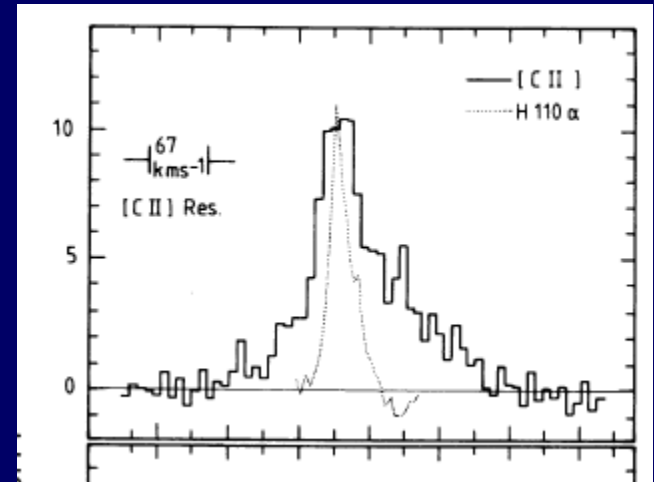
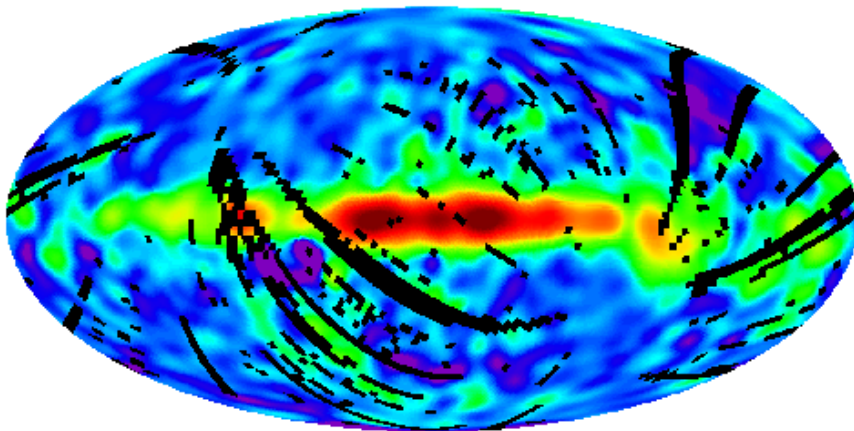
[CII]/[NII] Emission is Widespread

Bulge-KAO:

COBE FIRAS 158 μm C⁺ Line Intensity

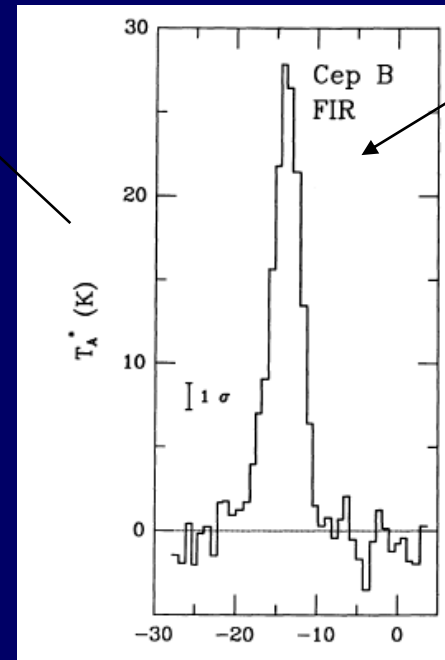


COBE FIRAS 205 μm N⁺ Line Intensity



(Genzel, et al. 1990)

Disk-KAO:

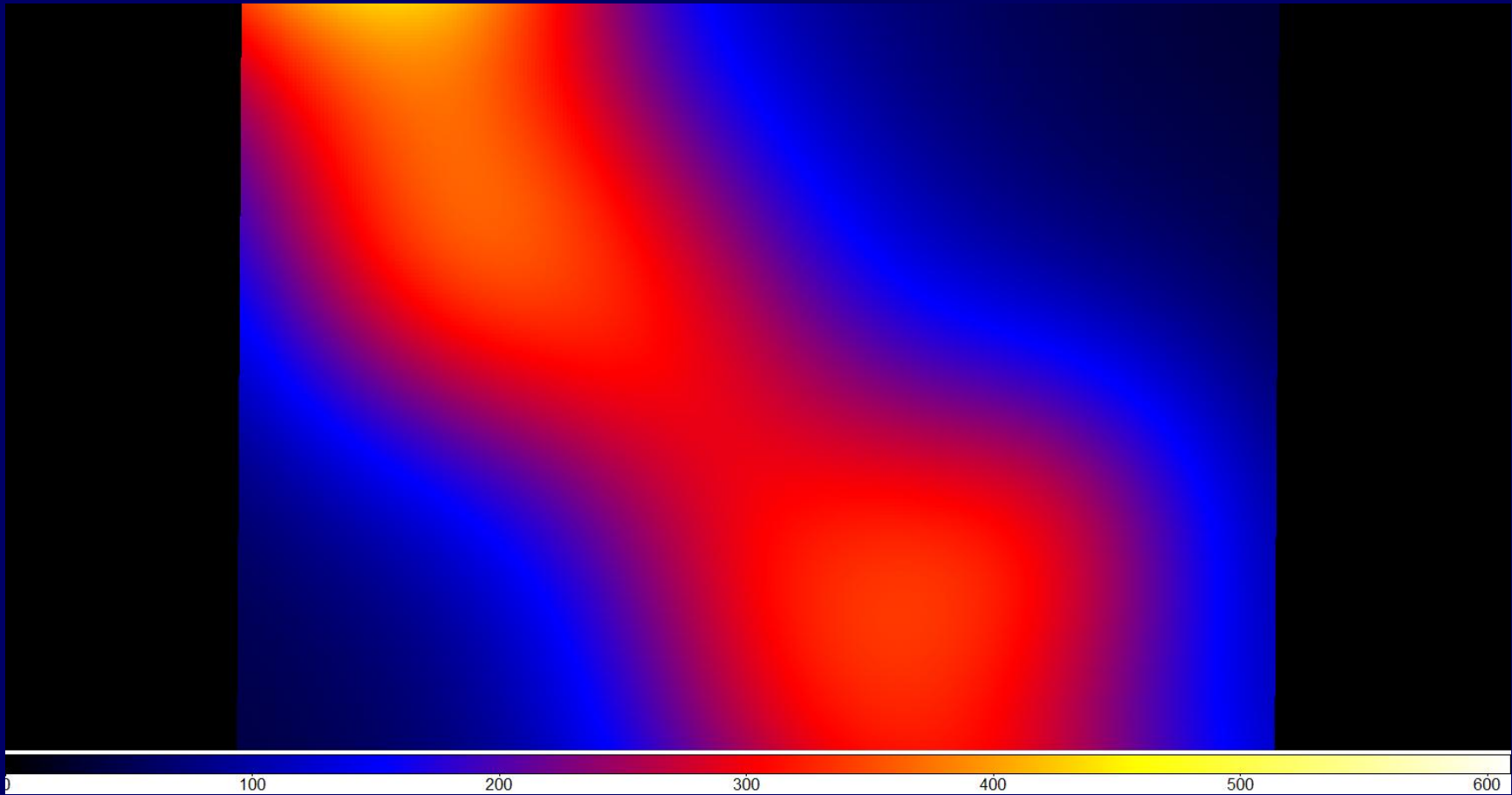


(Borieko, et al. 1990)

High Velocity
(Heterodyne)
Resolution is
essential!

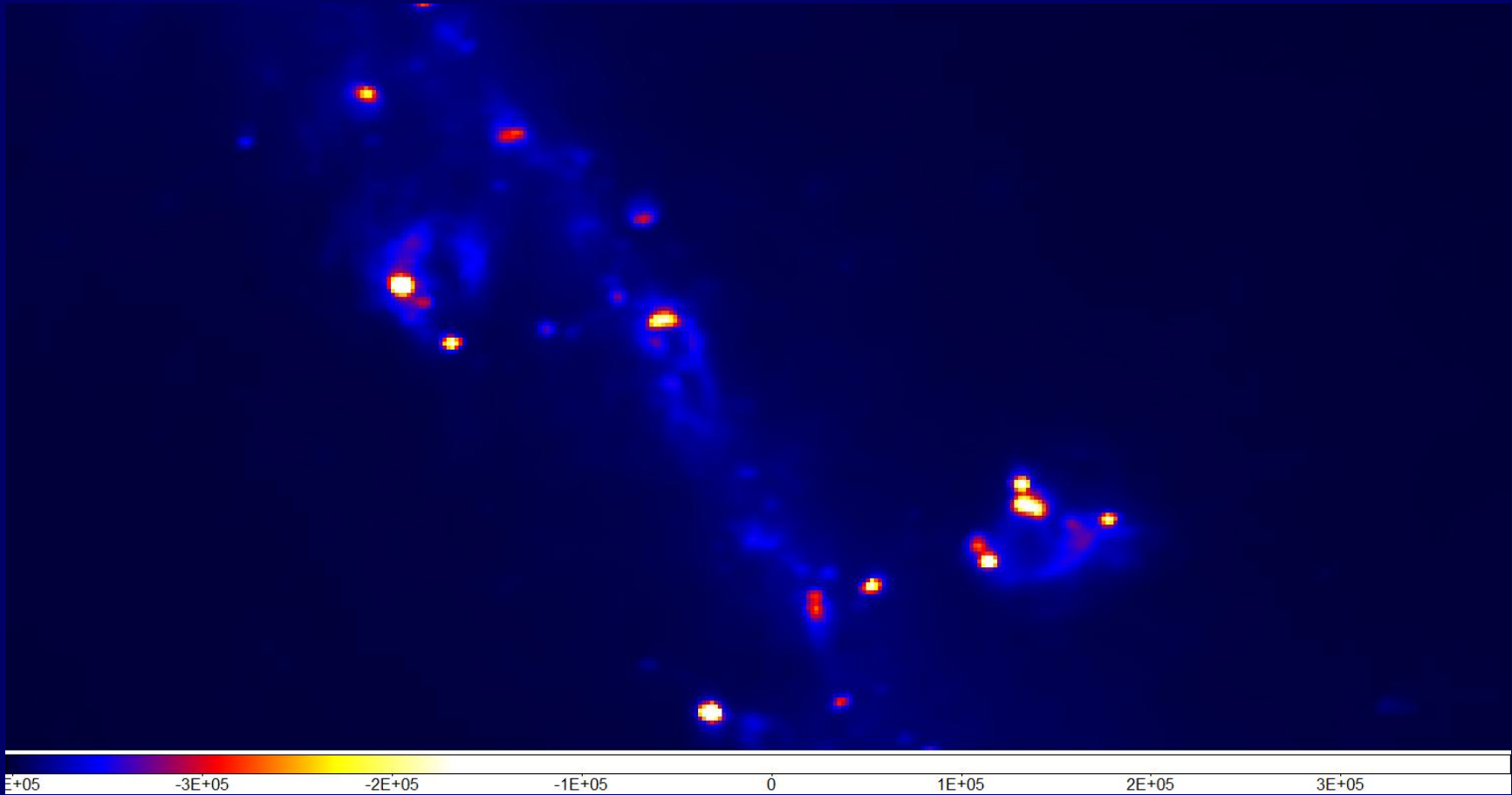
STO maps
 $\sim 10^5 \times$
angular
 $\sim 10^3 \times$
velocity
resolution
of COBE.

STO Vastly Improves Available Angular Resolution



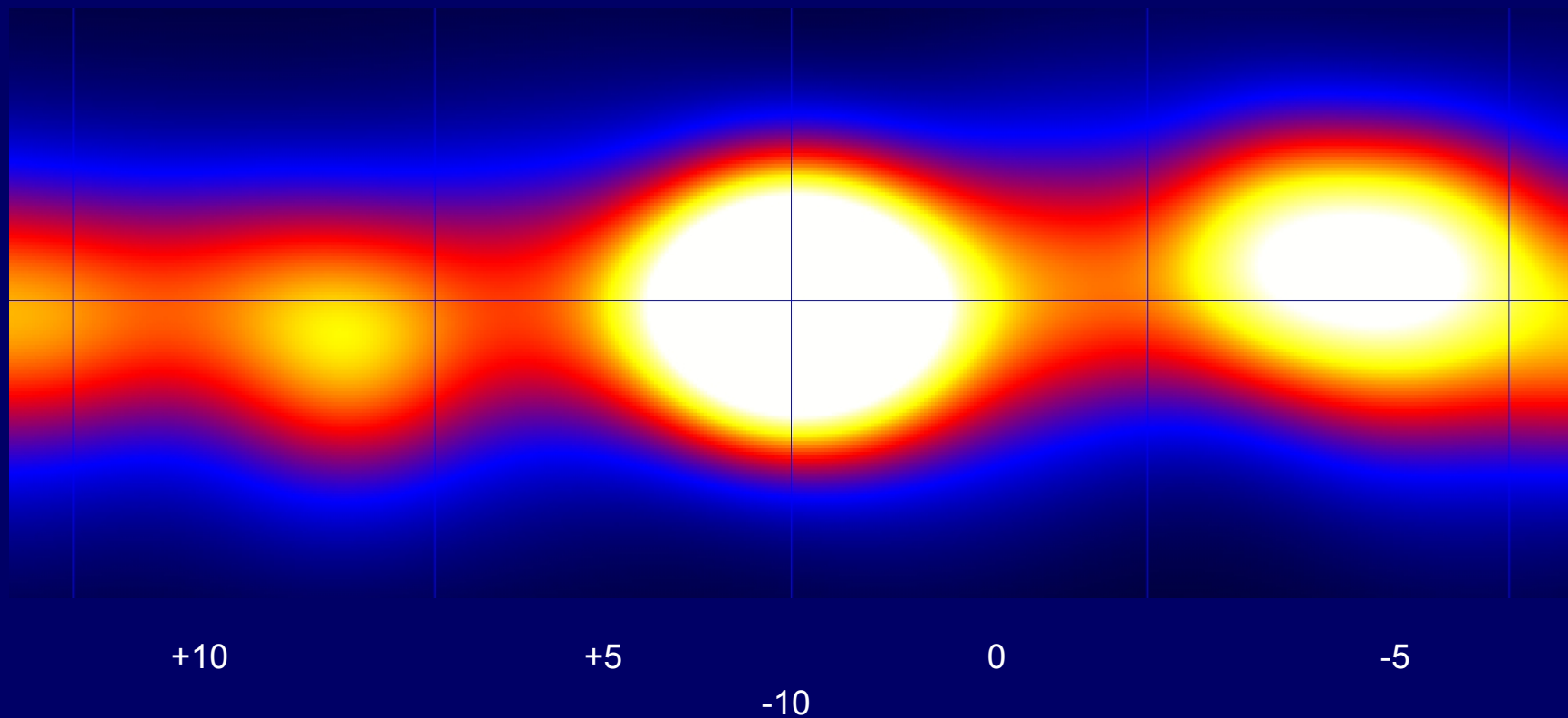
Galactic Plane Region Near $l = 340$ IRAS $60 \mu\text{m}$ Smoothed to 3°

STO Vastly Improves Available Angular Resolution



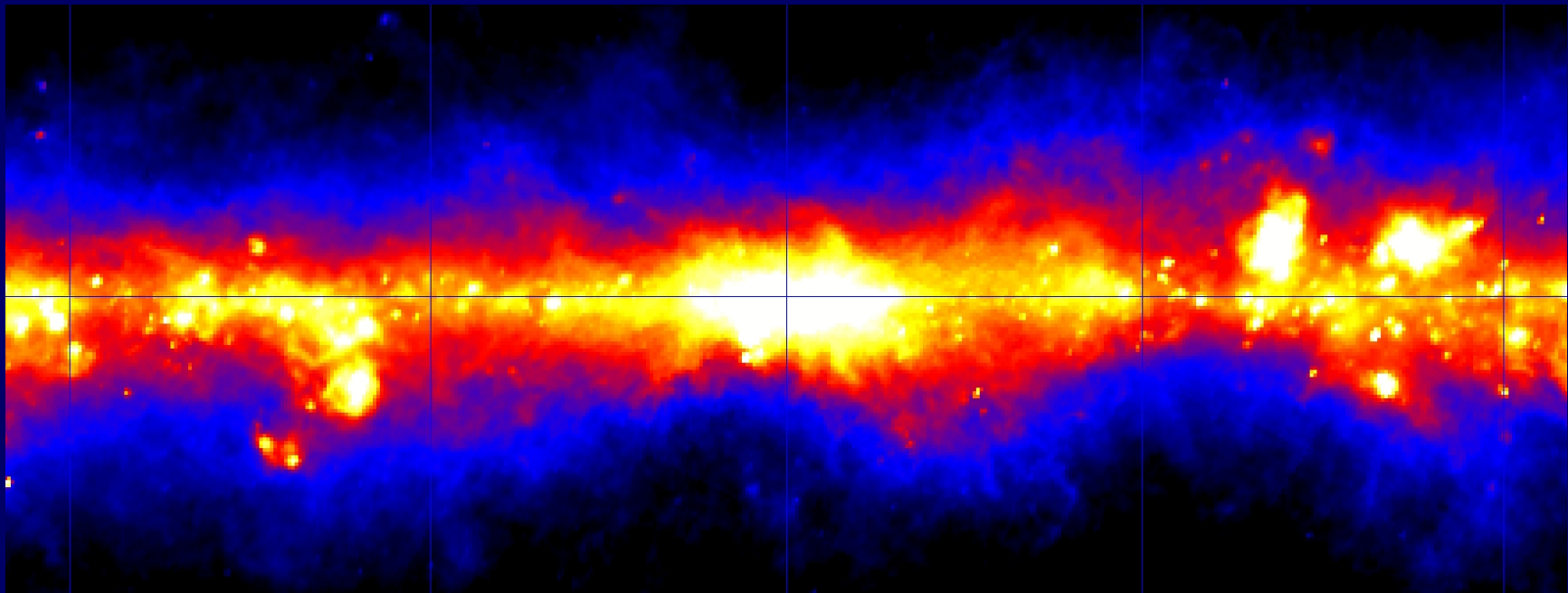
Galactic Plane Region Near $l = 340$ IRAS $60 \mu\text{m}$ $2'$ Resolution

STO Vastly Improves Available Angular Resolution



Galactic Center Region IRAS 60 μm Smoothed to 7°

STO Vastly Improves Available Angular Resolution



+10

+5

-10

0

-5

Galactic Longitude (degrees)

Galactic Center Region IRAS 60 μm 3' Resolution

STO Galactic Plane and Deep Survey

GPS: Galactic Plane Survey:

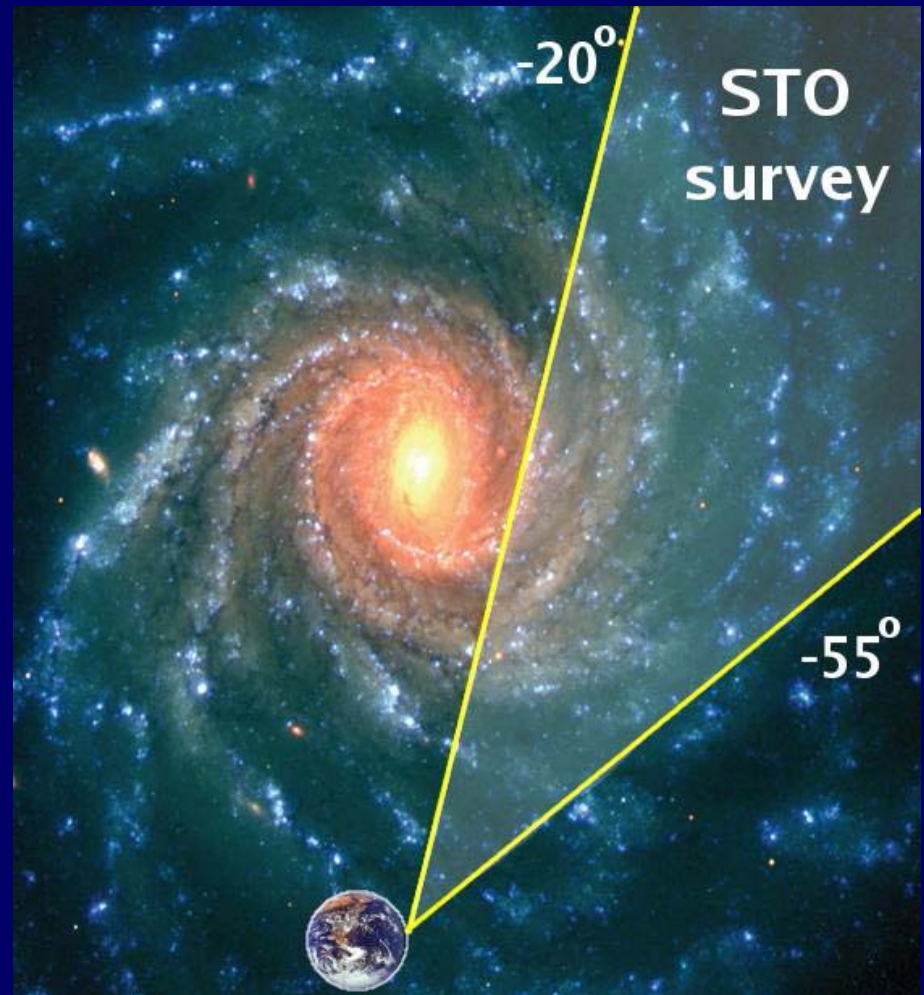
$$-20^\circ > l > -55^\circ;$$

$$0^\circ < b < 1^\circ$$

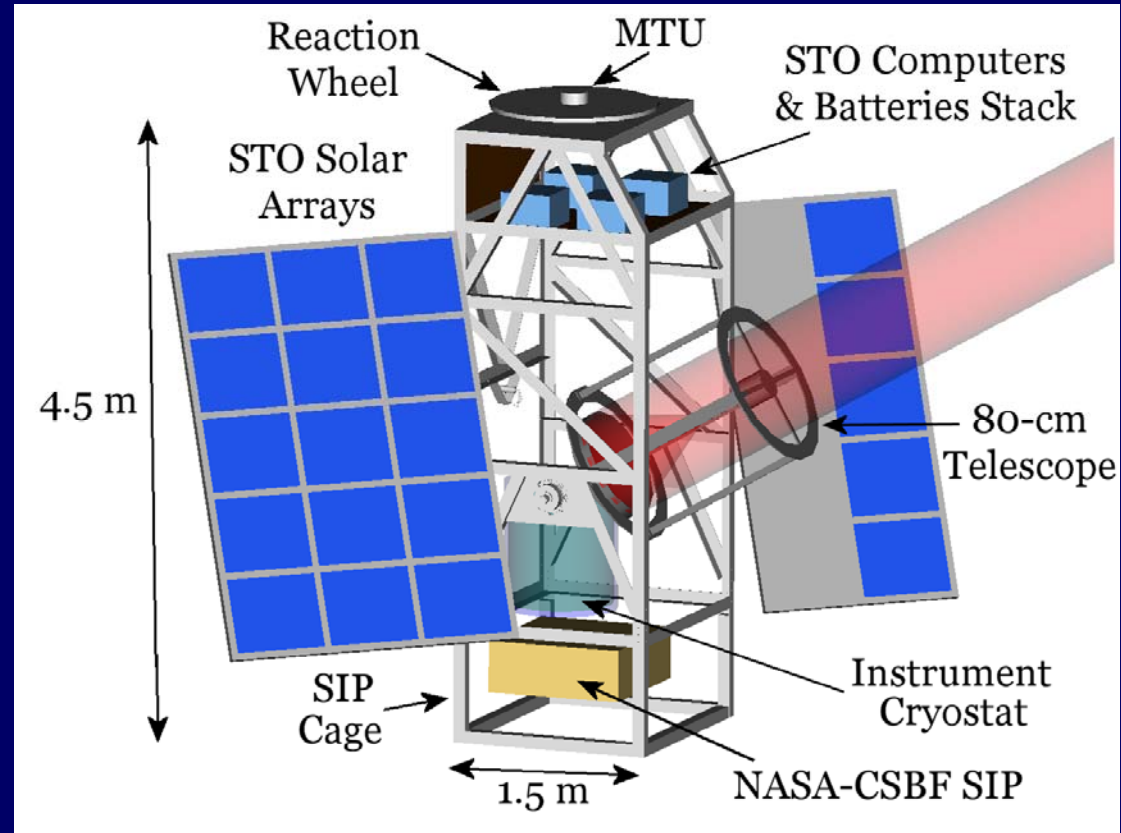
**DS: Deep Survey of arm
and interarm regions:**

$$l \sim -50^\circ \text{ and } l \sim -40^\circ$$

$$-0.5 - 0.7 \text{ in } b.$$



STO Payload



Telescope:

Aperture : 0.8m optical

Type : on-axis Cassegrain

Spectral Range : 60 to 210 μm

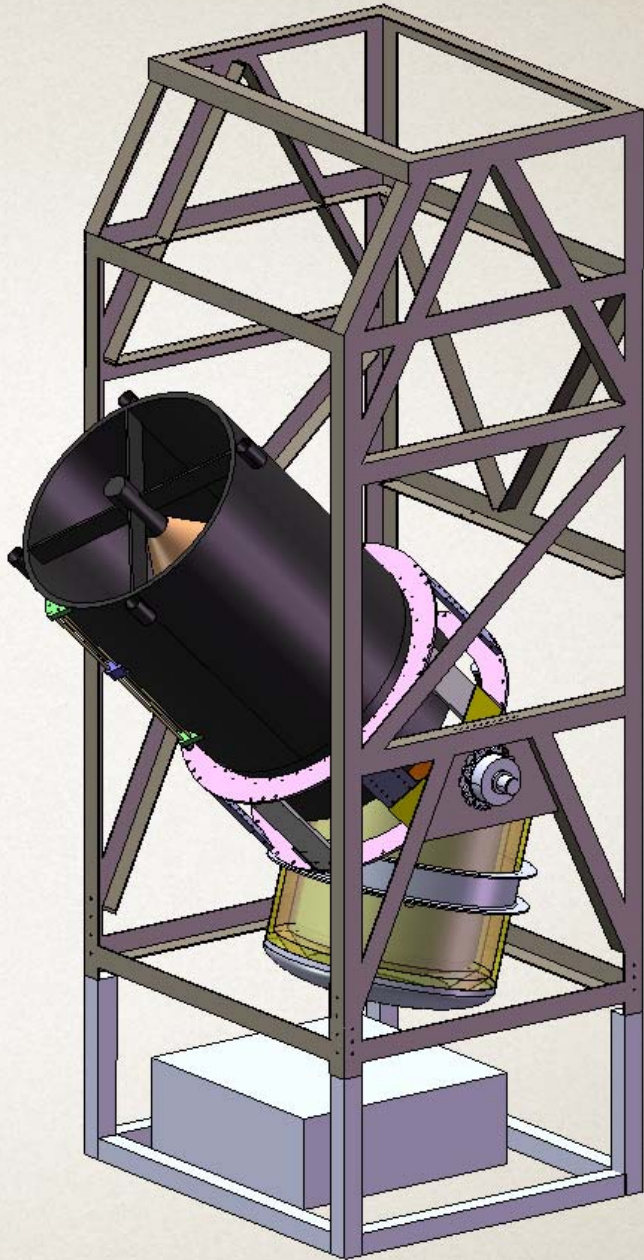
Pointing Knowledge : 15''

Detectors: Coherent Receivers

Flight time: ~14 days

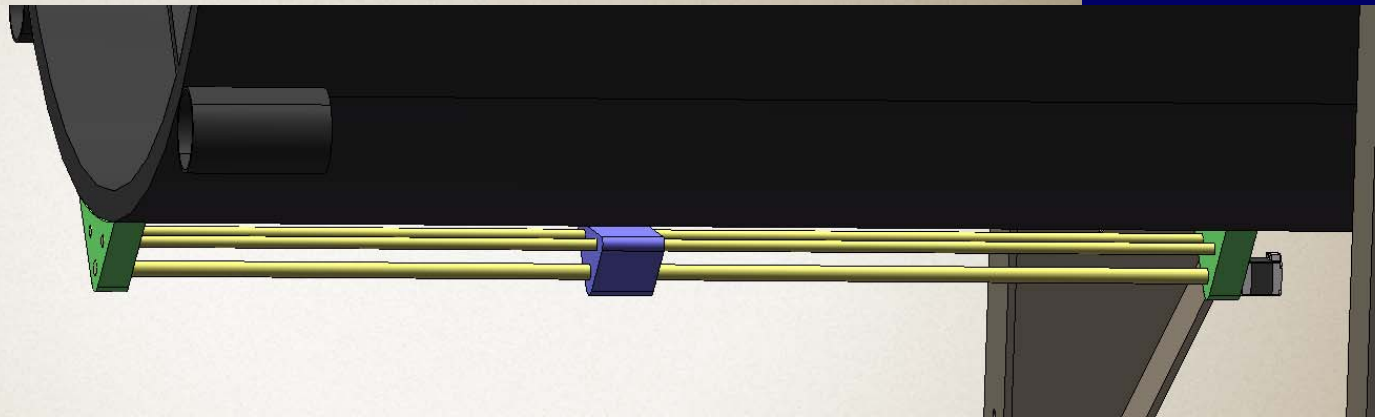
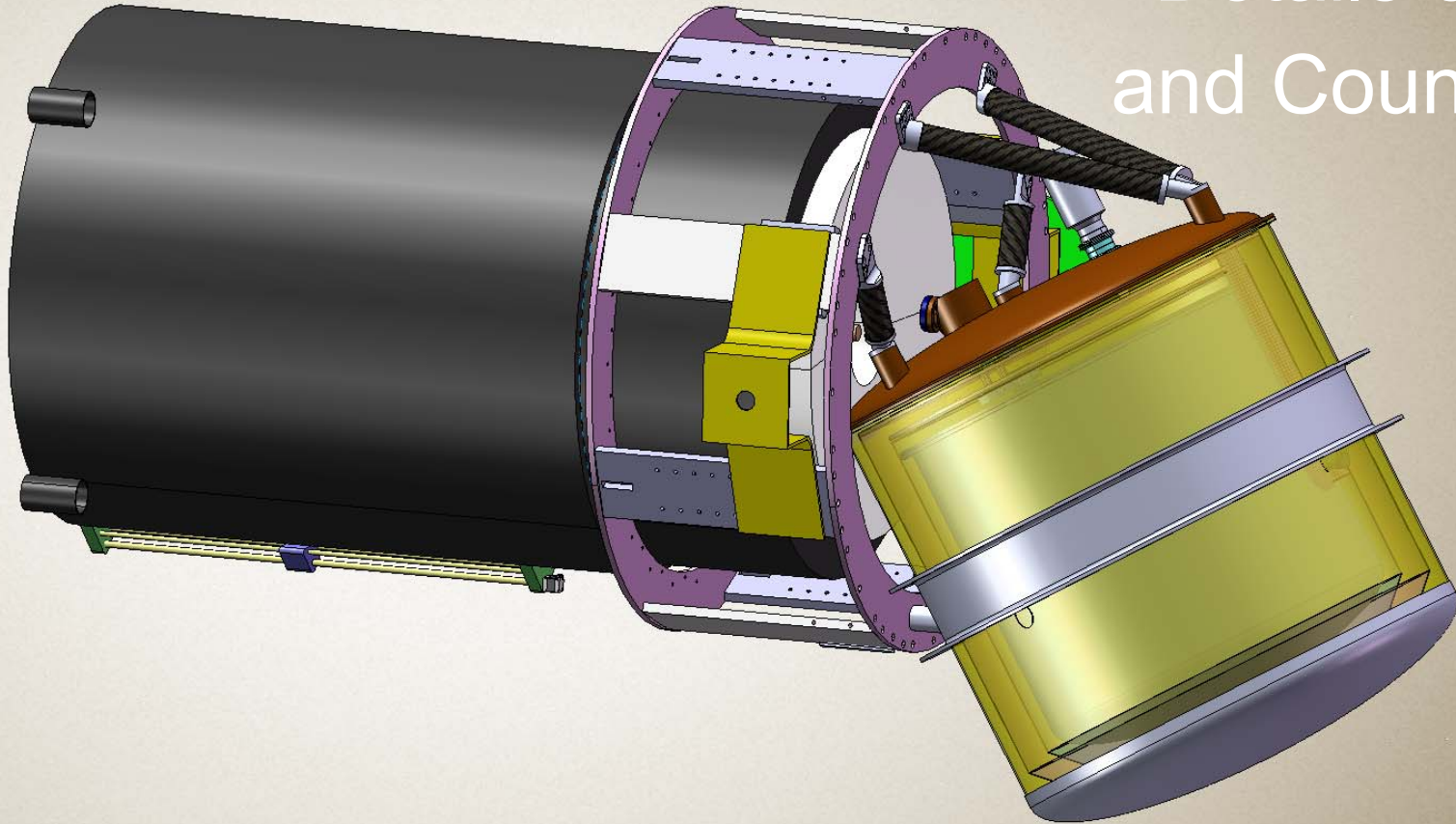
Altitude: ~35km (116,000 ft)

STO Antarctic Flight Cryogenics

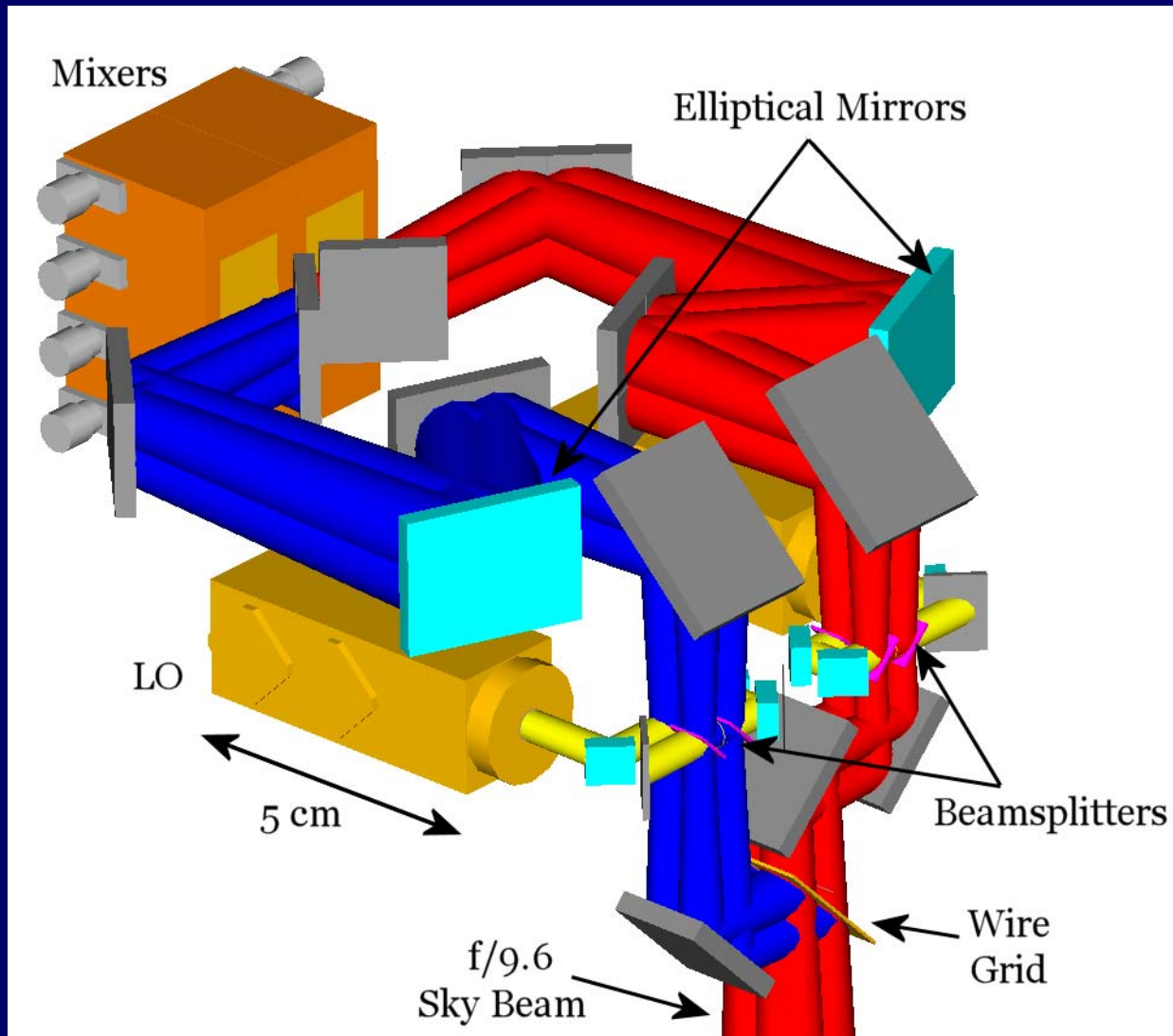


Weight List	(kg)
Inner Tank Top Plate	2.73
Inner Tank Body	10.05
Inner Shield Top Plate	2.27
Inner Shield	3.64
Outer Shield Top Plate	3.18
Outer Shield	4.55
Outer Shell Top Head	8.64
Outer Shell Bottom Head	7.27
Outer Shell Cylinder	16.36
Inner Supports	3.41
Outer Support Structure	9.50
Plumbing, Wiring, MLI	1.96
Misc. + Fasteners	6.82
Liquid Helium	15.91
Total:	96.29
plus 15% contingency:	14.44
Working Total:	110.73

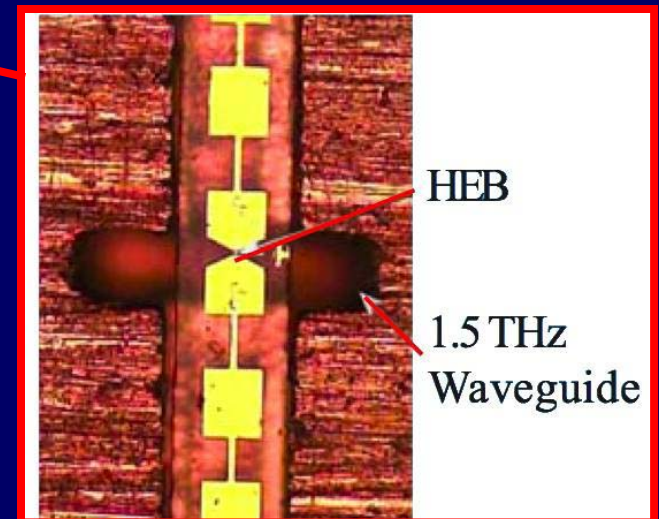
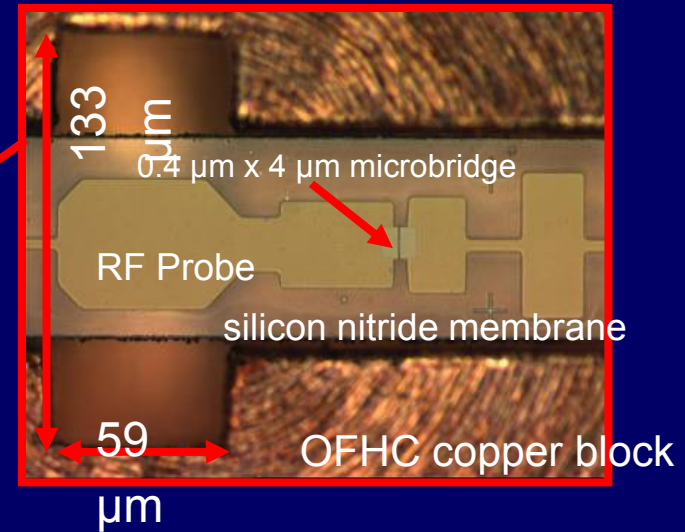
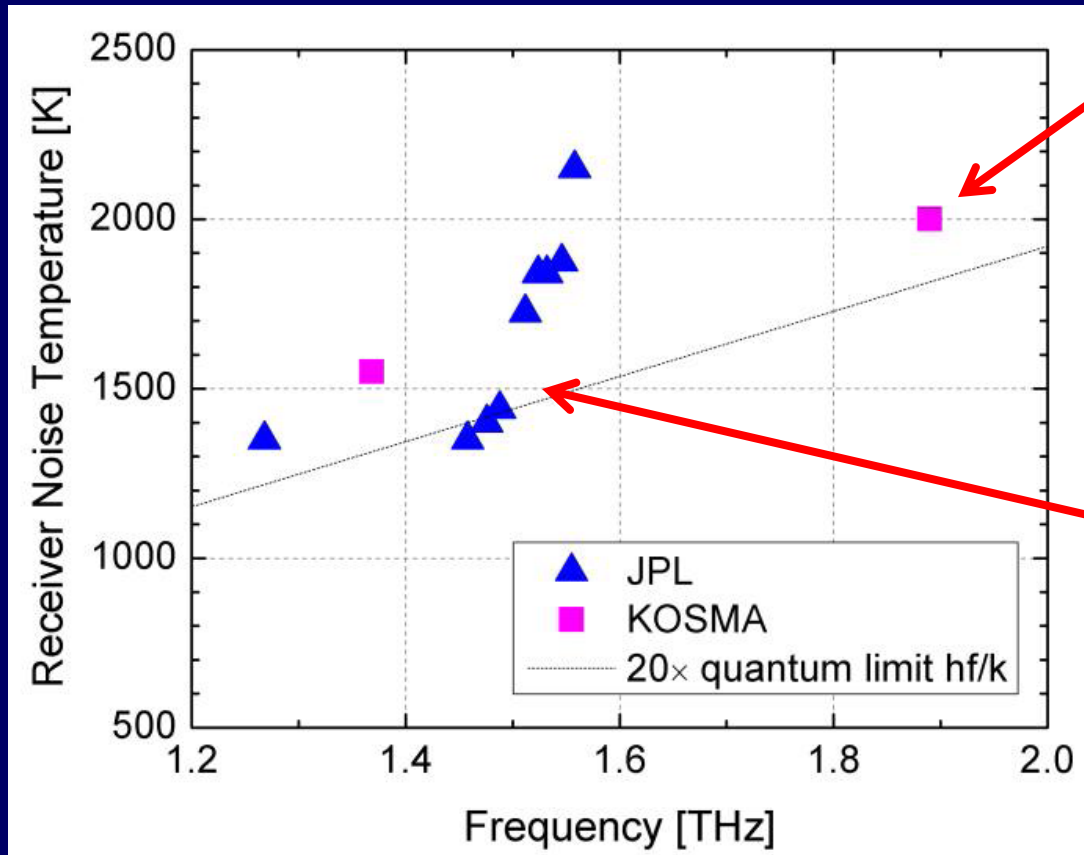
Details of Dewar and Counterweight



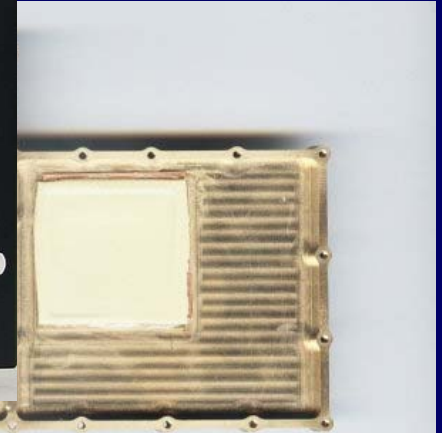
STO FPU



STO HEB Mixers

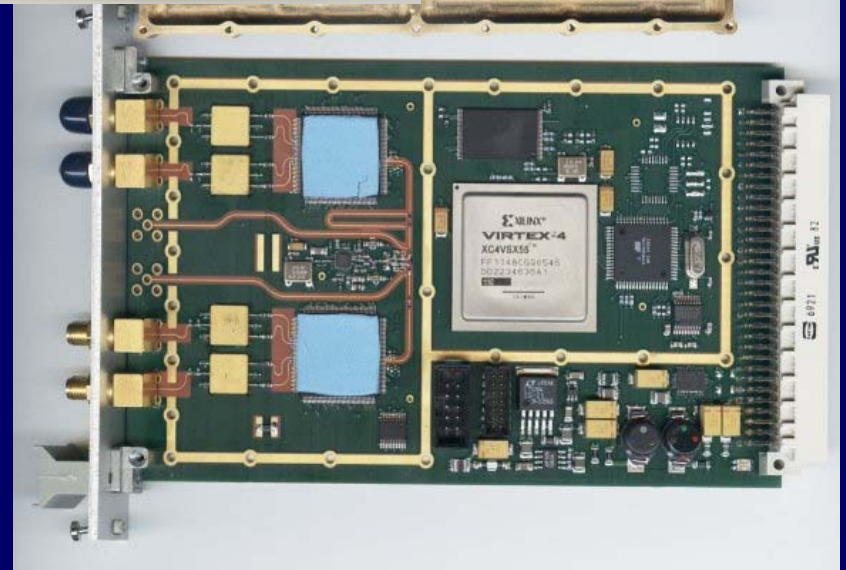


Omnisys AB FPGA-Based Spectrometer



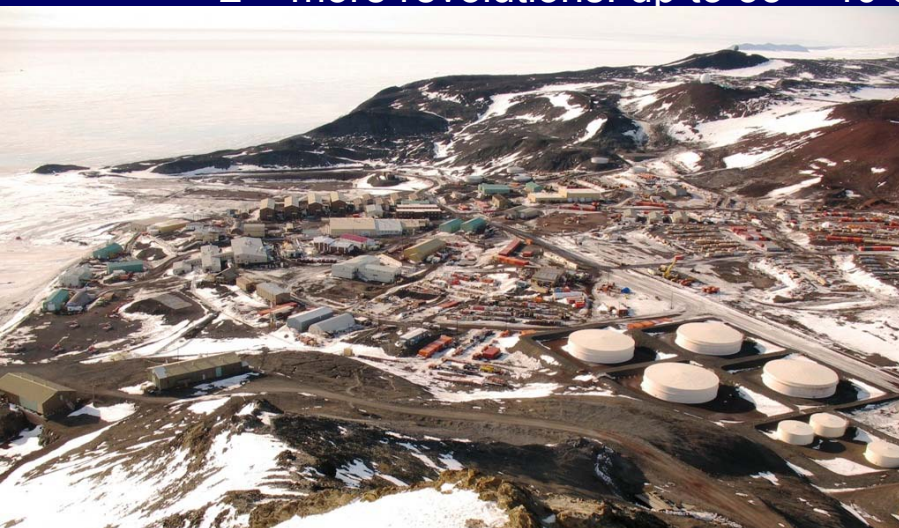
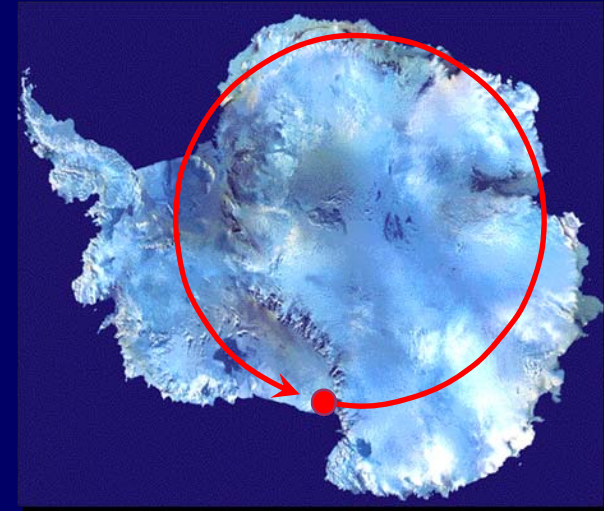
A large FPGA (Xilinx Virtex 4) performs a real time FFT on the data and integrates.

One board processes 4 500 MHz bandwidth signals, with 2048 channels per spectrum (resolution of 250 kHz)



Antarctica LDB Campaigns

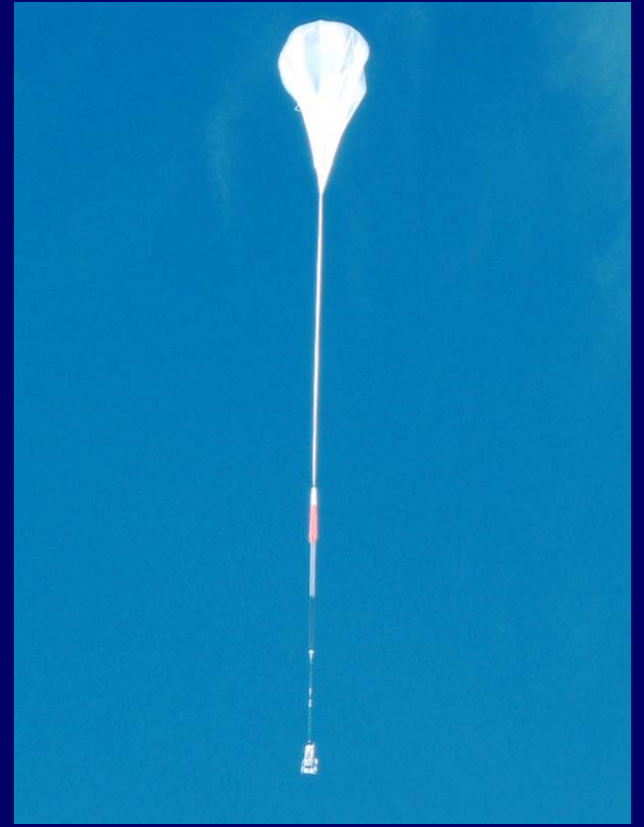
- Summer season: October-February
- Base of operations: McMurdo
- Reachable via Christchurch (NZ)
- CSBF Long Duration Balloon Facility located at Williams Field
 - ~ 7 mi from McMurdo (~ 20-60 min drive)
 - Lodging in McMurdo
- 2-3 payloads can be launched
- Launch period: mid – end December
- Flight duration:
 - 1 revolution: 10 – 15 days
 - 2 – more revolutions: up to 35 – 40 days



Williams Field



Launch



The FGE Flight Path

January 10-27, 2000

Launch site:
Ross Ice Shelf
near McMurdo Station

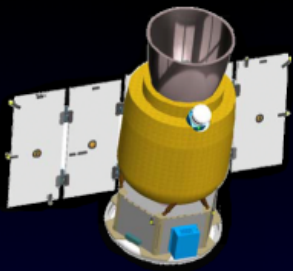
Landing site:
Ross Ice Shelf
340 km from McMurdo
17 days later

Flight trajectory at an
average altitude of 35 km.



Recovery





Space THz Interstellar Mapper

0.5m, 1-2 THz

[CII], [NII]

THz Observing Platforms

GRASI / SOFIA

2.5m, 4.7 THz

[OI]



Stratospheric THz Obs.

0.8m, 1 - 3 THz

[CII], [NII]

Test Flight: 09/09

LDB Flight: 12/10



Supercam / HHT

10m, 0.3-0.4 THz

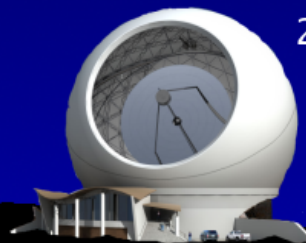
CO



Supercam / Atacama

25m, 0.6-0.8 THz

CO, [CI]

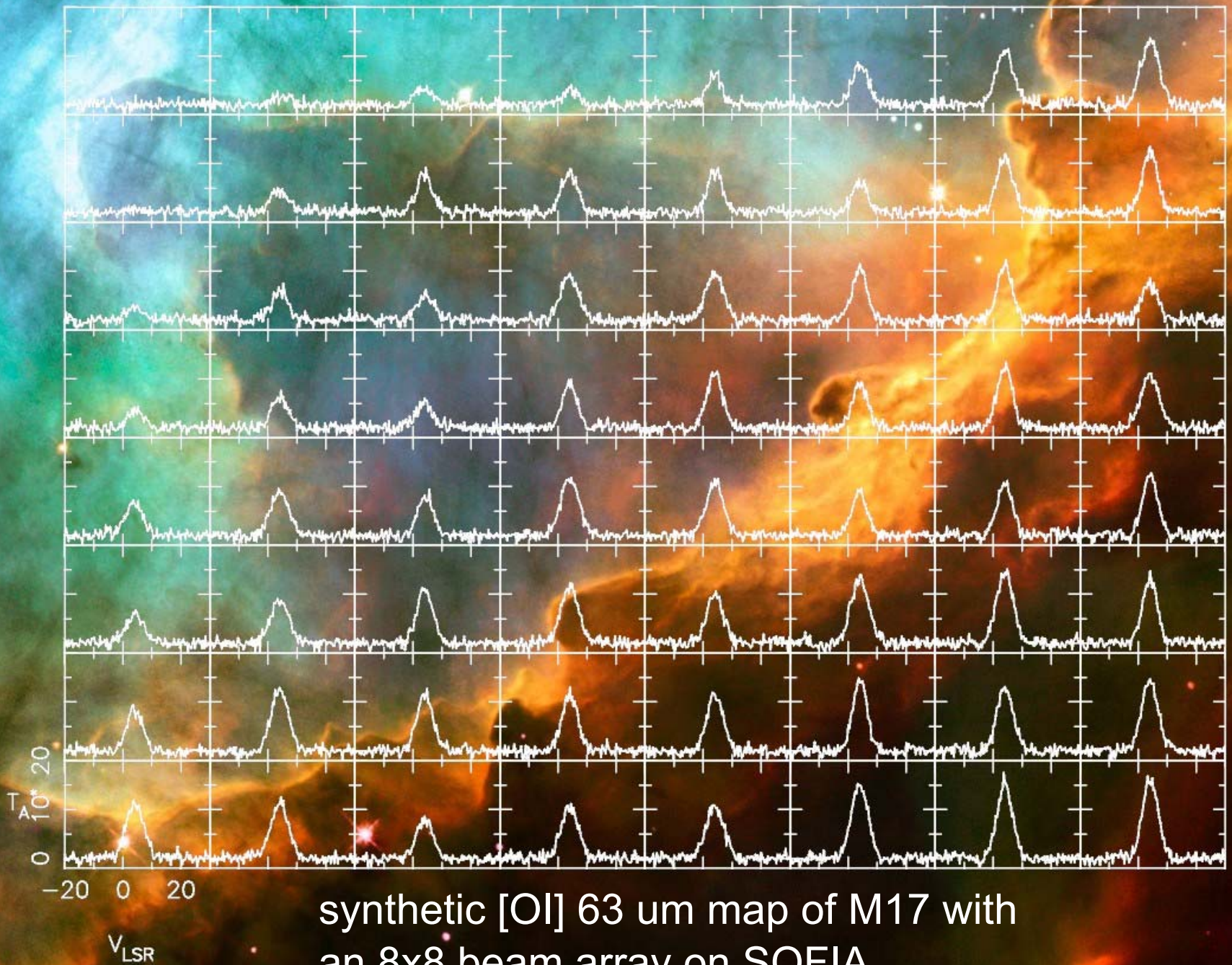


HEAT / Dome A

0.5m, 0.8 - 2 THz

CO, [CI], [CII], [NII]

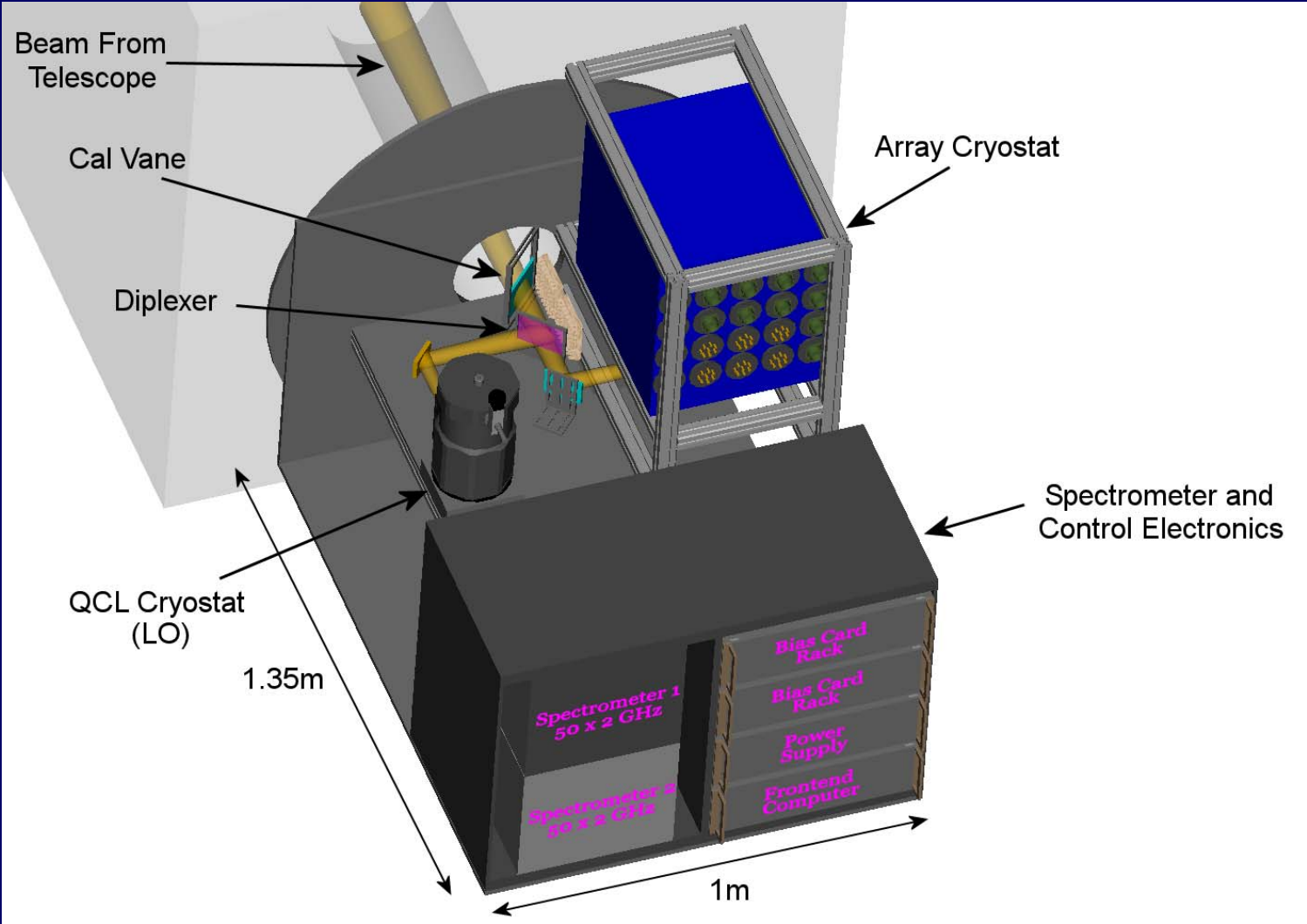




synthetic [OI] 63 μm map of M17 with
an 8x8 beam array on SOFIA

SOFIA Large Heterodyne Array (LHA) Concept

UAz, KOSMA, DLR



Thank You!