



Results from GISMO, a 2 Millimeter TES Bolometer Camera used at the IRAM 30 m Telescope

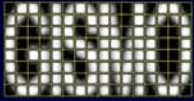
Johannes Staguhn

*Observational Cosmology Laboratory, NASA Goddard Space Flight Center
& University of Maryland, College Park*

GISMO Team

**Christine Allen¹, Dominic Benford¹, S. Harvey Moseley¹, Elmer Sharp¹,
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Catherine Marx¹, Tim Miller¹, Santiago Navarro³, Eva Schinnerer⁴, Albrecht Sievers⁴,
George Voellmer¹, Fabian Walter⁴, Edward Wollack¹**

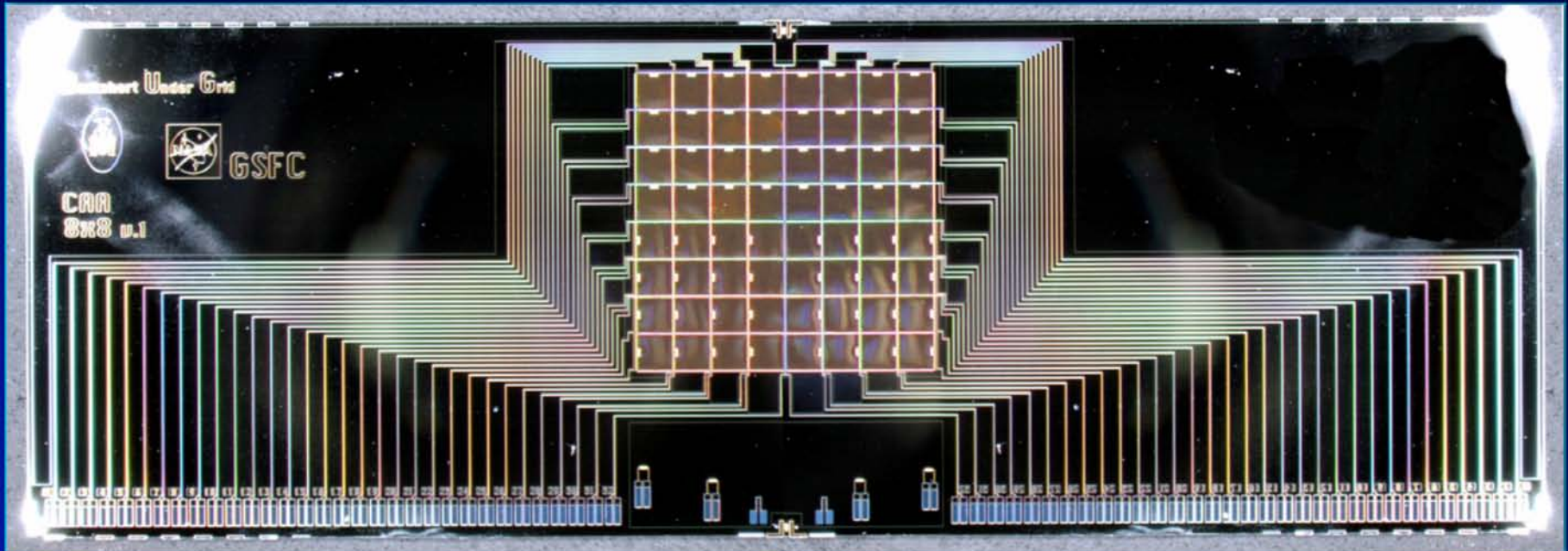
¹NASA's GSFC, ²University of Maryland,, ³IRAM, Spain, ⁴MPIA Heidelberg, Germany



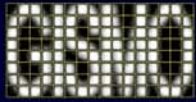
Goddard
Space
Flight
Center



Superconducting Bolometer Arrays



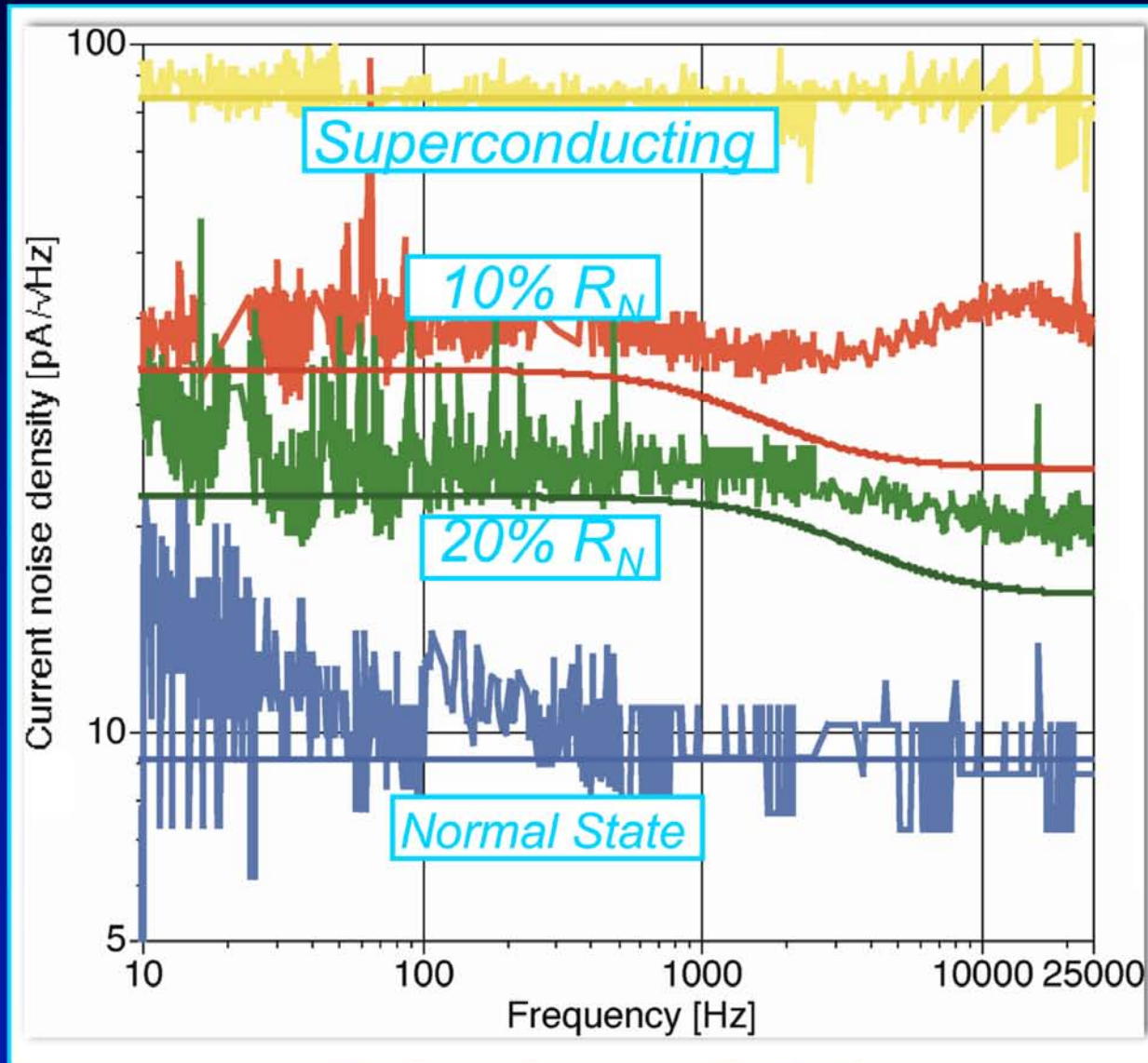
J. Staguhn, CCAT, UC-Boulder, May 13, 2008



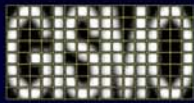
Goddard
Space
Flight
Center



Detector Noise



**Noise
Near
Thermo-
dynamic
Limit
(straight
lines)**



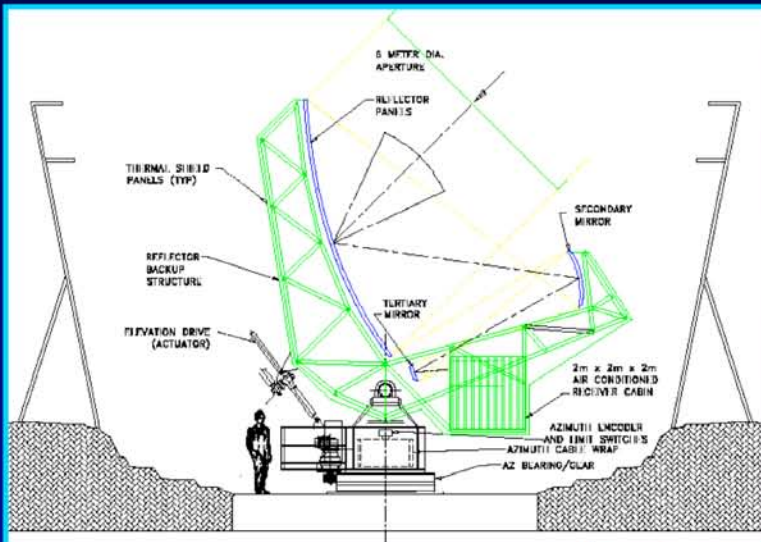
Goddard Space Flight Center



ACT - Atacama Cosmology Telescope



U. Wales - Cardiff, U. Colorado, Columbia, CUNY, Haverford, NASA/GSFC, U. Penn. Princeton, Rutgers, UBC, Univ. de Catolica, U. Mass. - Amherst, Univ. Toronto



Observations:

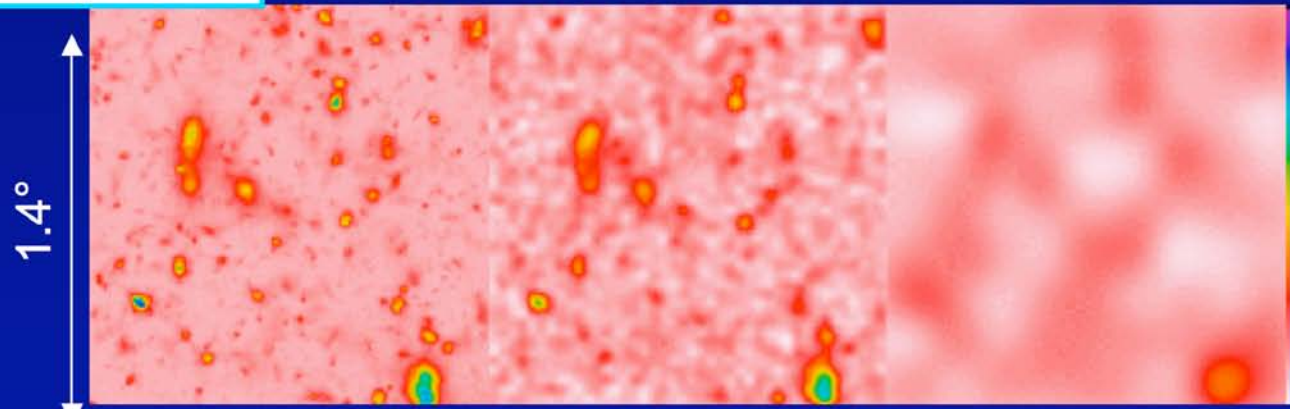
- CMB: $l > 1000$
- Cluster (SZ, KSZ)
- X-rays, & optical)
- Diffuse SZ
- OV
- Lensing



ACT camera will consist of 3 1024-element arrays from GSFC

Science:

- Growth of structure
- Eqn. of state
- Neutrino mass
- Ionization history
- Power spectrum



SZ Simulation

MBAC on ACT

PLANCK

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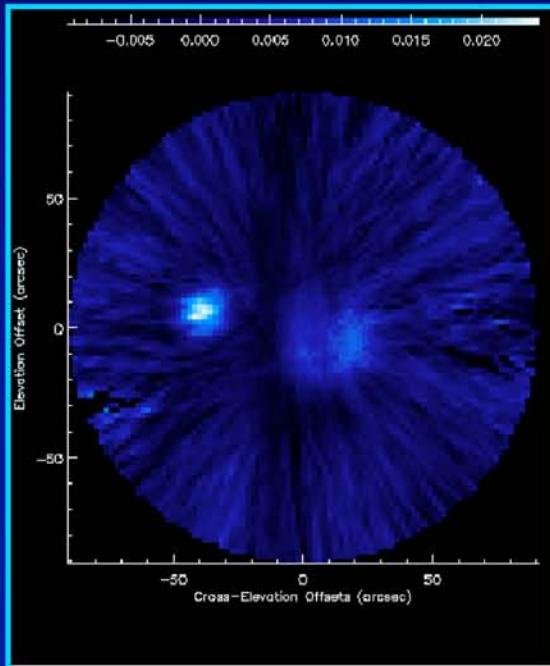
Goddard
Space
Flight
Centre

GBT 3mm Camera

U. Pennsylvania, NASA/GSFC, NIST, NRAO,
U. Wales - Cardiff

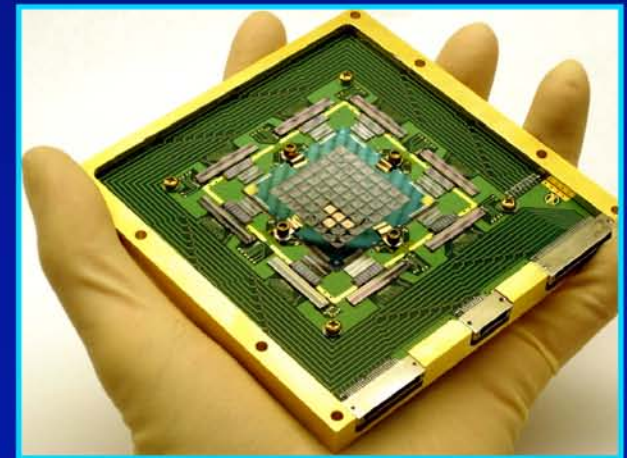


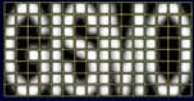
- First NRAO bolometer camera
- Sensitivity $\sim 500\mu\text{Jy}$ in 1 s
- Great for extragalactic followup - very sensitive



W3OH

- 3.3mm wavelength, 8x8 array
- Features 64 pixels = 32" x 32" FOV, with 8" resolution

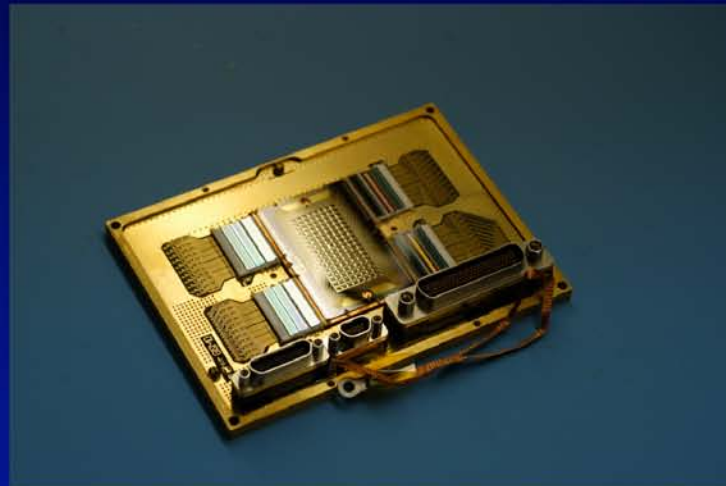
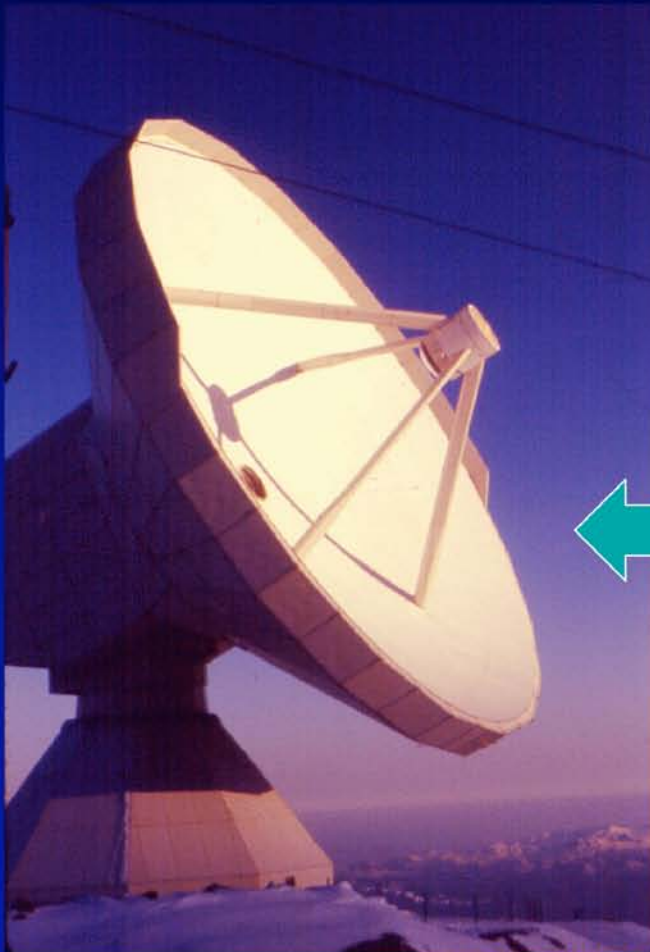




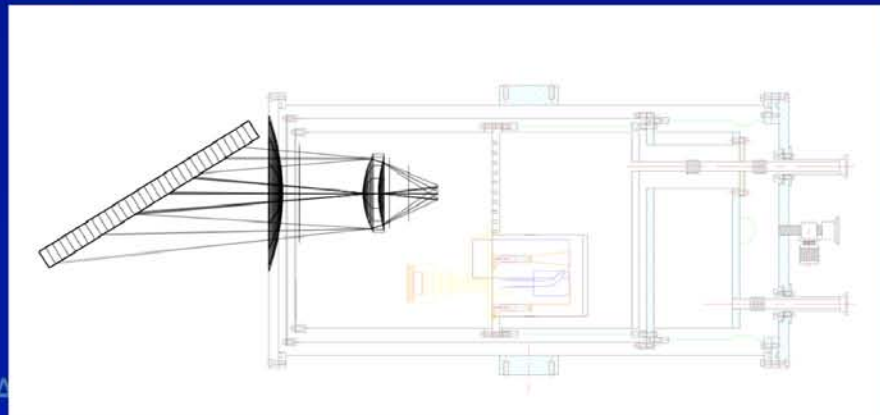
Goddard
Space
Flight
Center



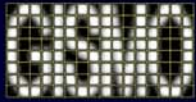
Goddard-Iram Superconducting 2-Millimeter Observer (GISMO)



Backshort
under Grid
(BUG)
TES detector
array

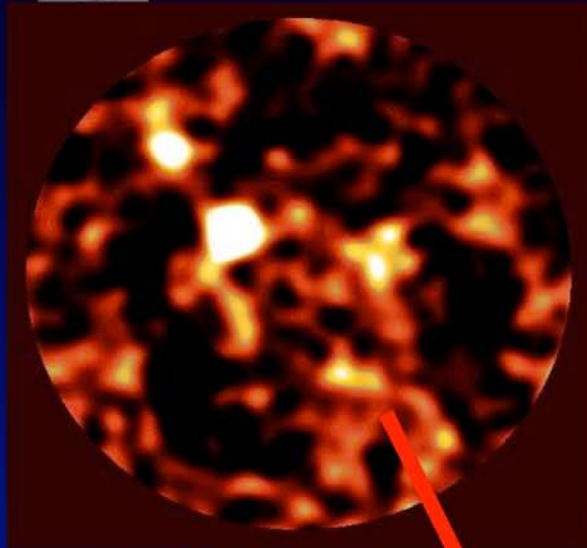


J. Staguhn, CCA



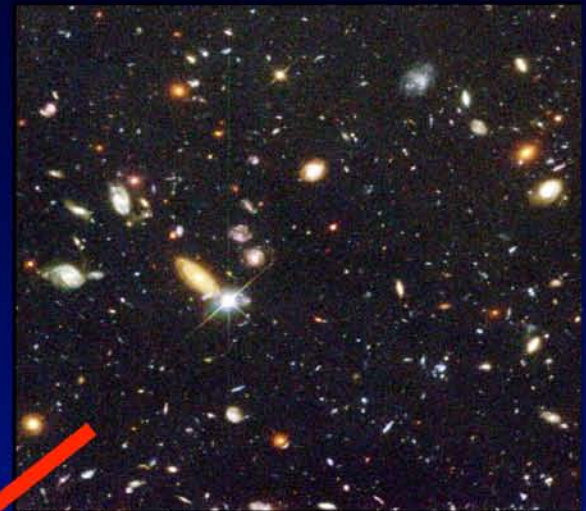
Goddard Space Flight Center

SCUBA Deep Field



Hughes, 1998

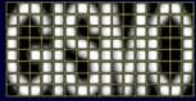
Hubble Deep Field



Hubble Deep Field HST - WFPC2
PRC96-01a - ST ScI OPO - January 15, 1996 - R. Williams (ST ScI), NASA

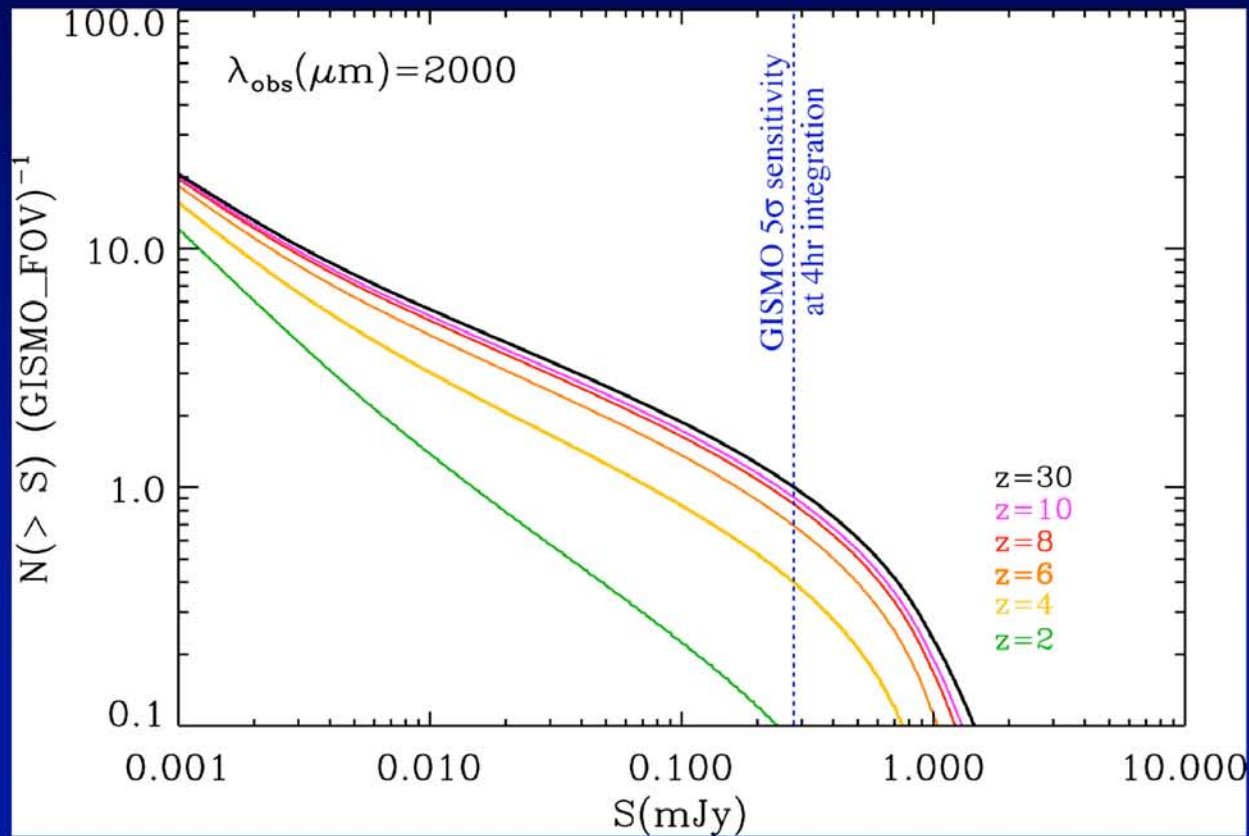


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Goddard
Space
Flight
Center

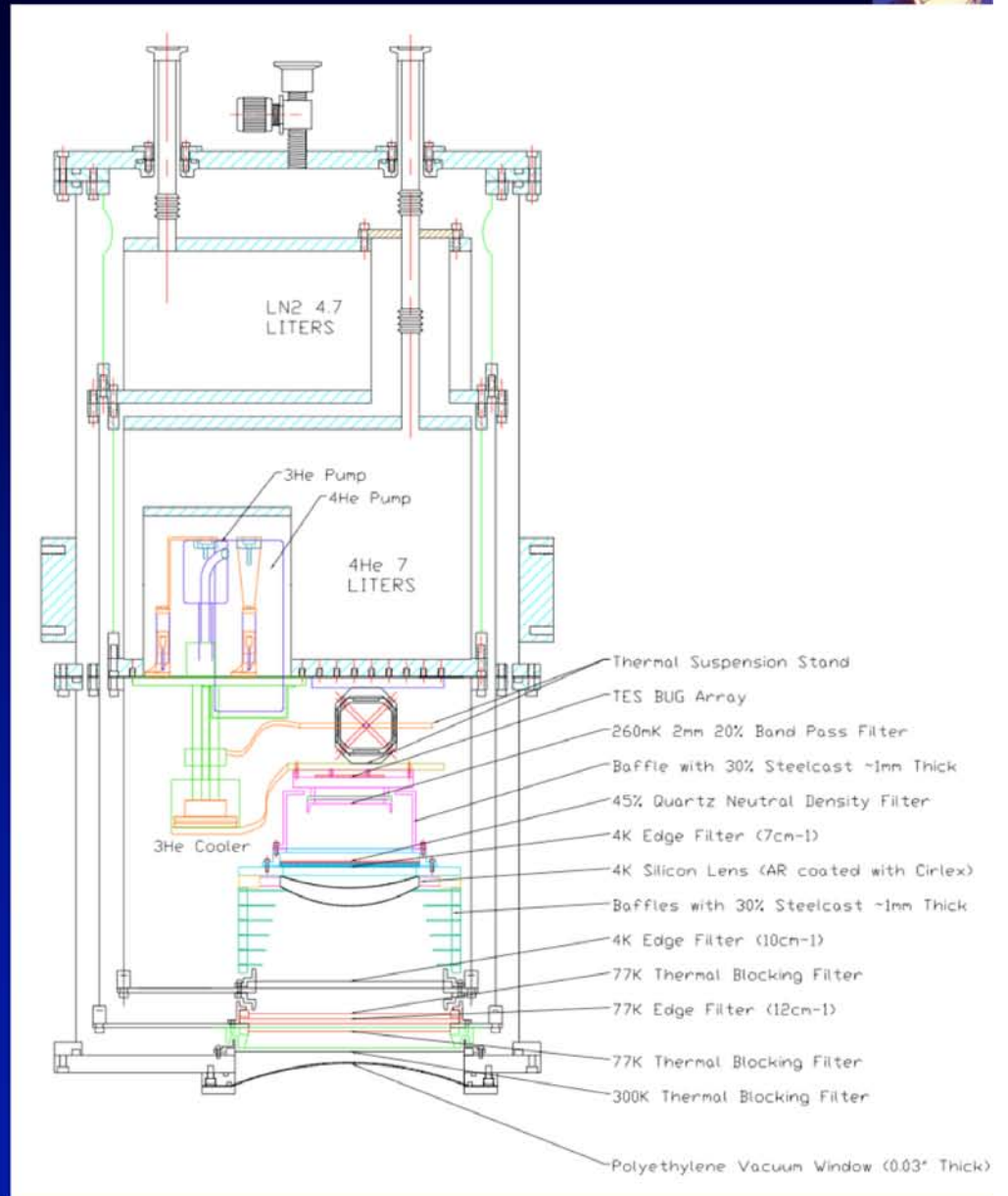
GISMO 2mm Camera Science



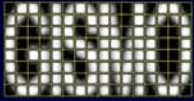
$N(>S)$ @ 2 mm for
GISMO instantaneous
sky coverage versus
flux



Goddard
Space
Flight
Center



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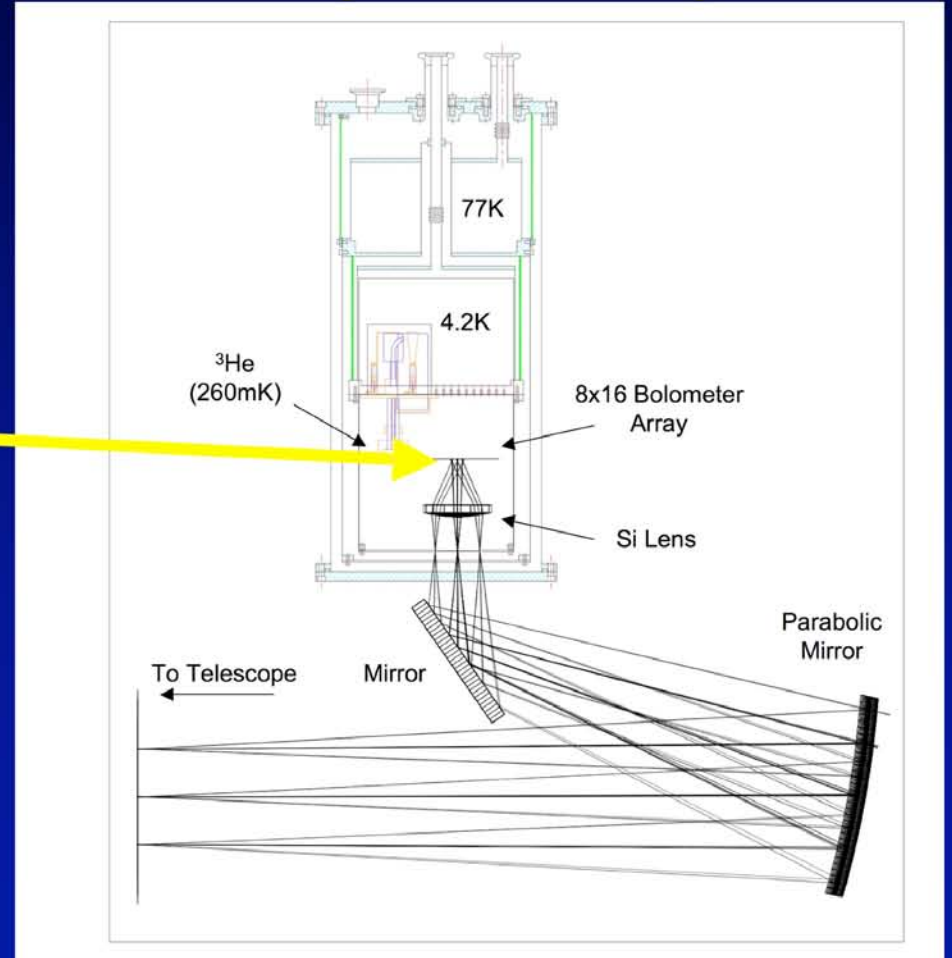
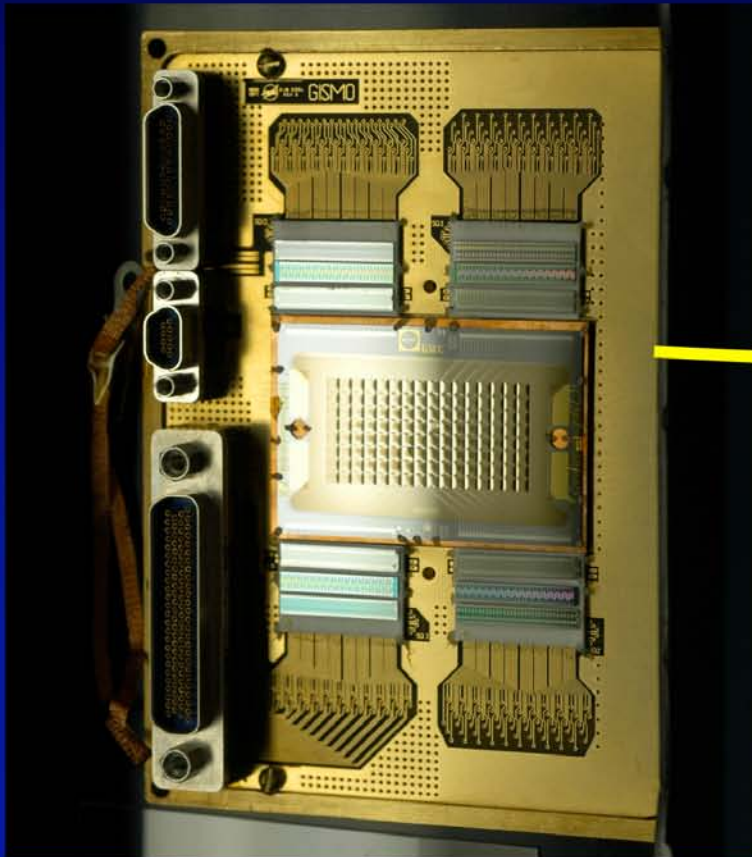
Goddard
Space
Flight
Center



Goddard-Iram Superconducting Millimeter Observer (GISMO)



NEP $\sim 3 \times 10^{-17} \text{ W Hz}^{-0.5}$



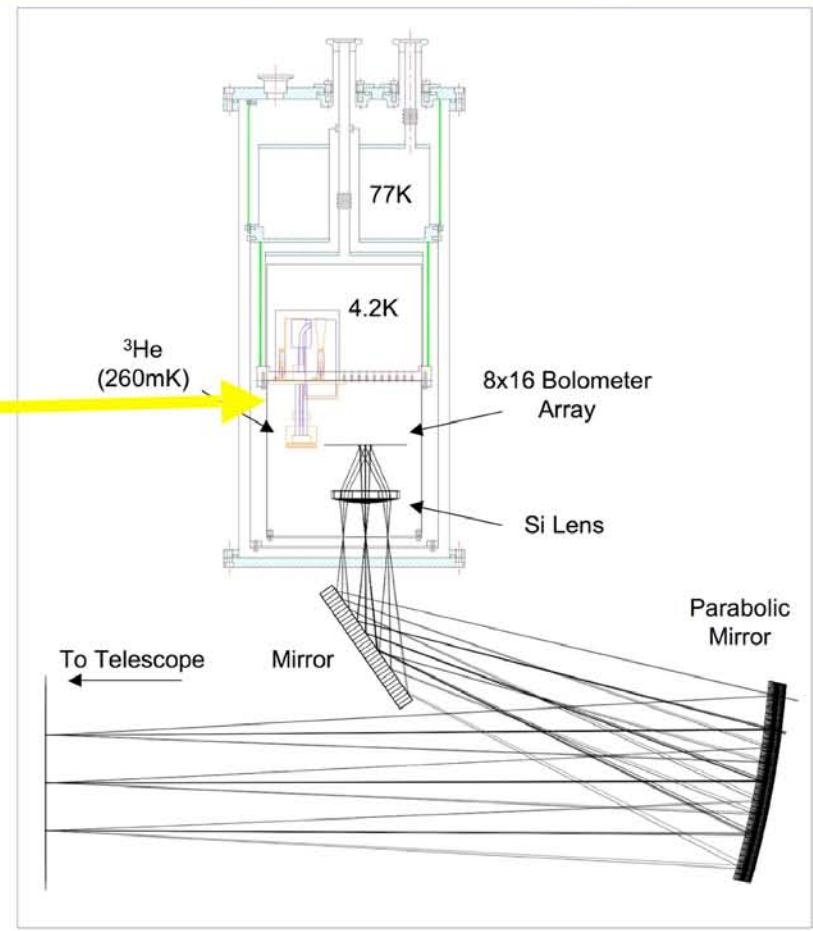
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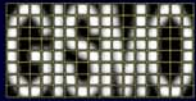


Goddard
Space
Flight
Center



Goddard-Iram Superconducting Millimeter Observer (GISMO)

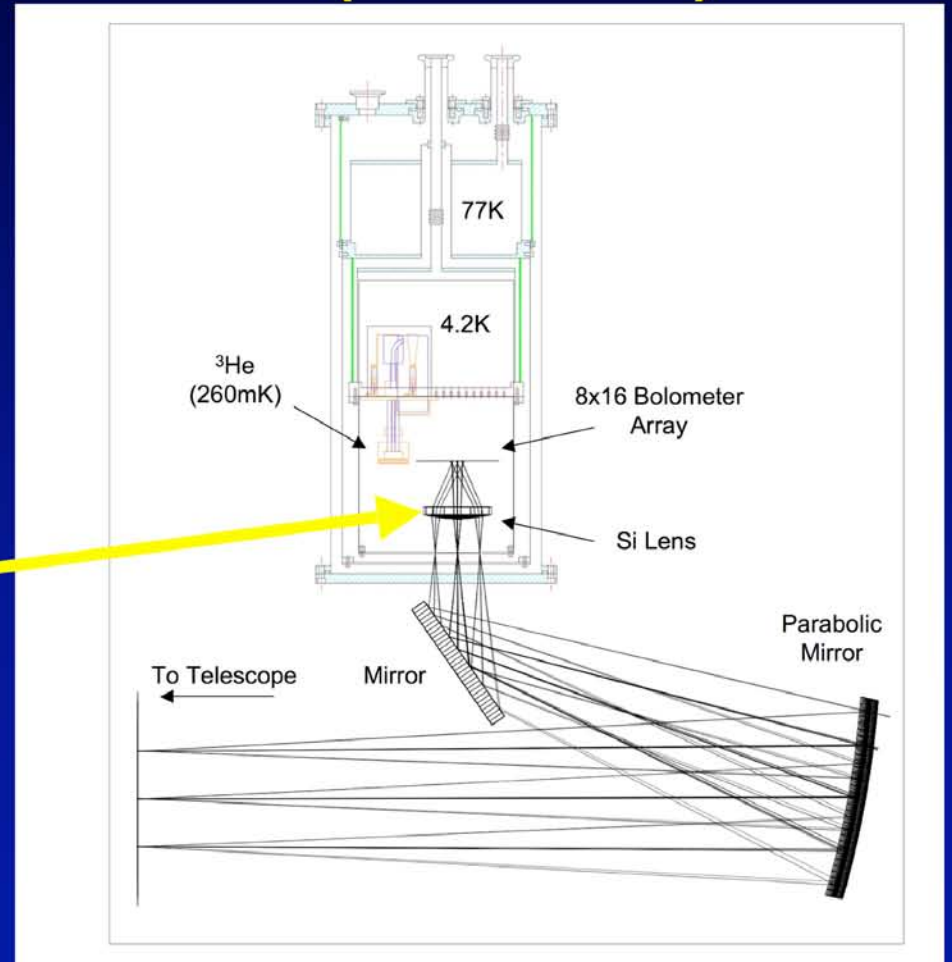
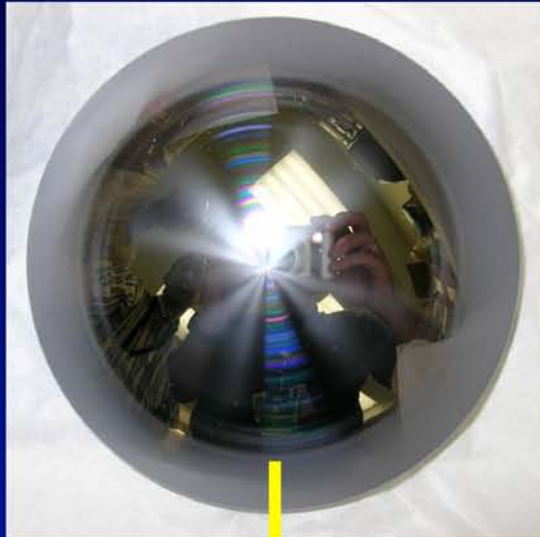




Goddard
Space
Flight
Center



Goddard-Iram Superconducting Millimeter Observer (GISMO)



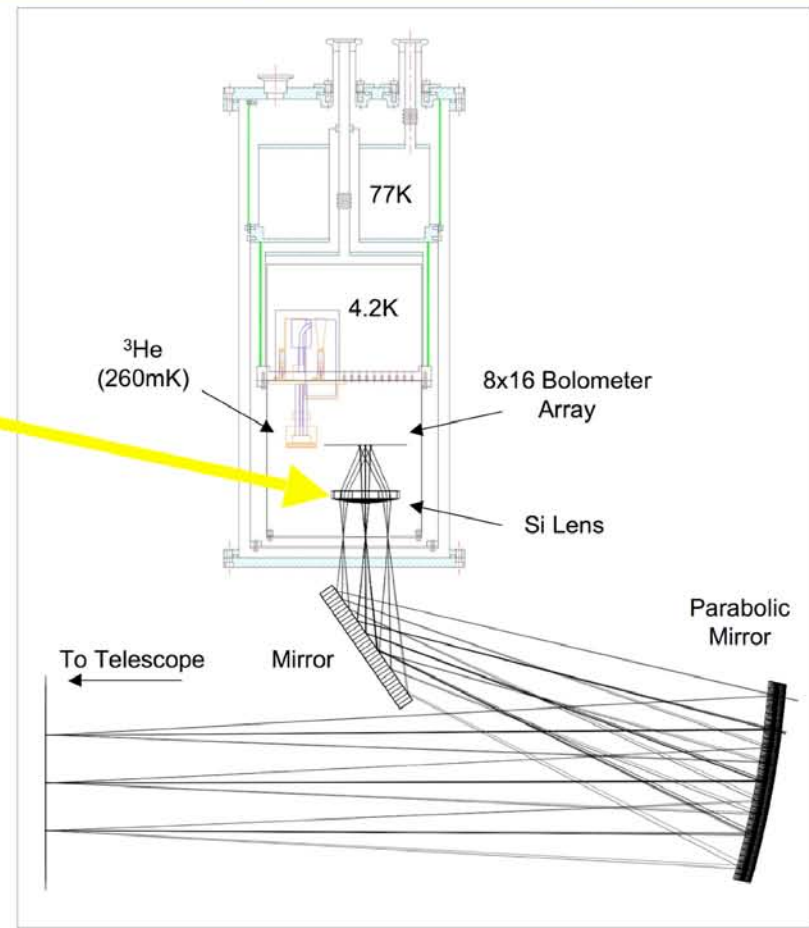
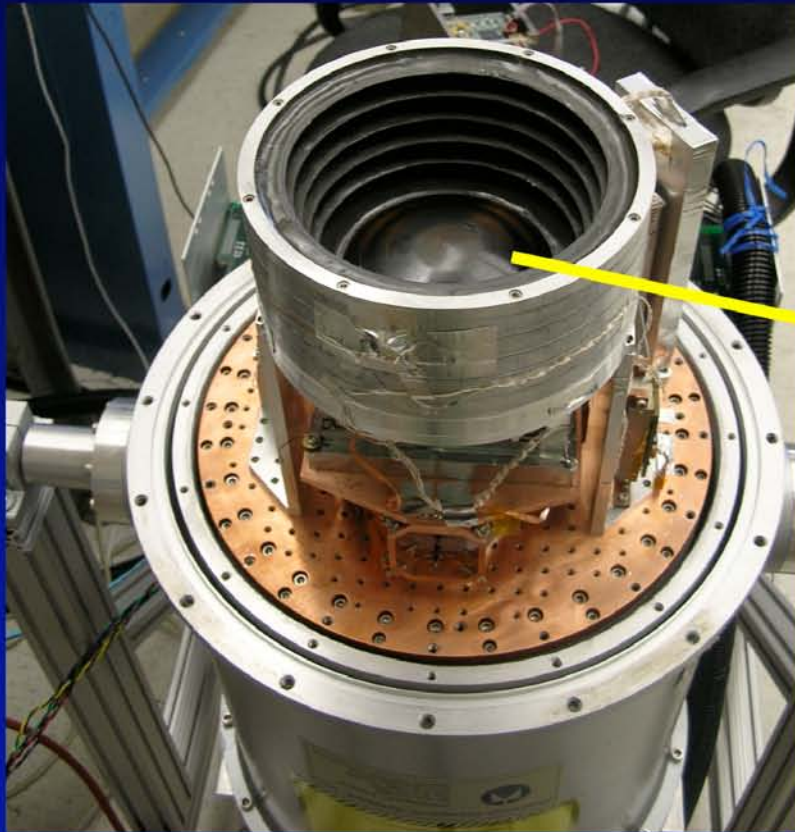
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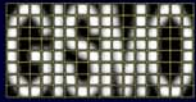
Goddard
Space
Flight
Center



Goddard-Iram Superconducting Millimeter Observer (GISMO)



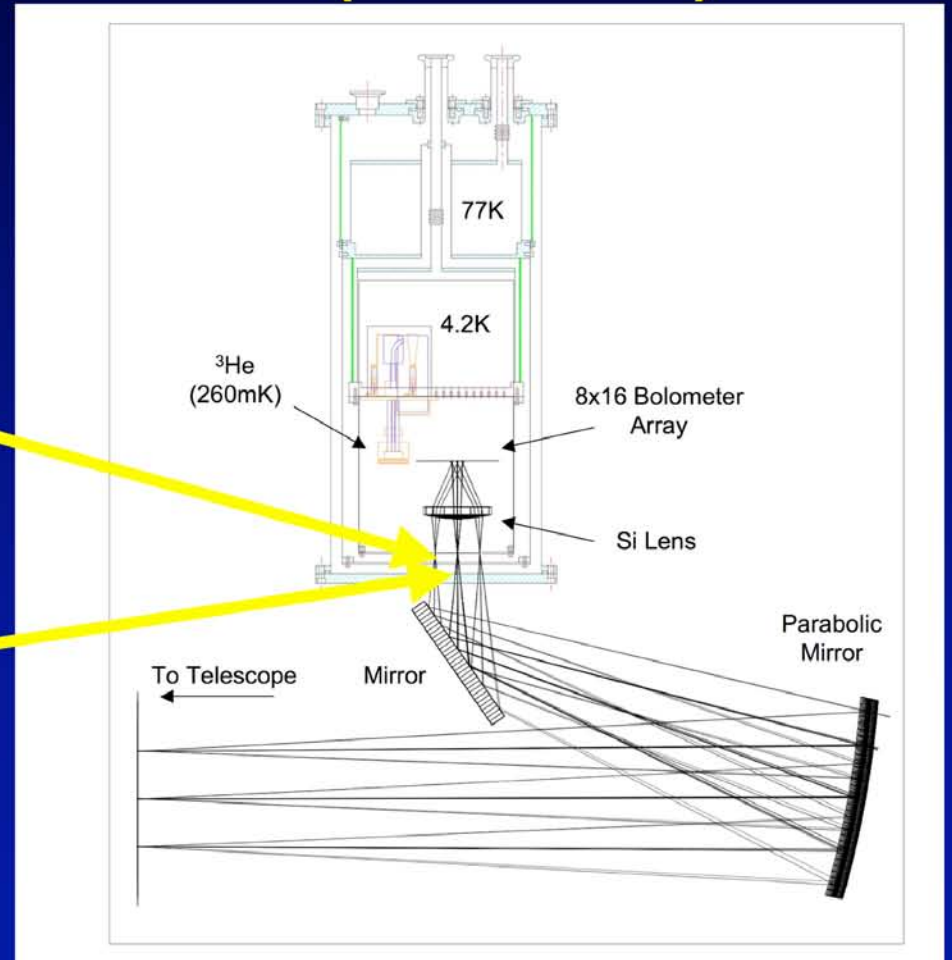
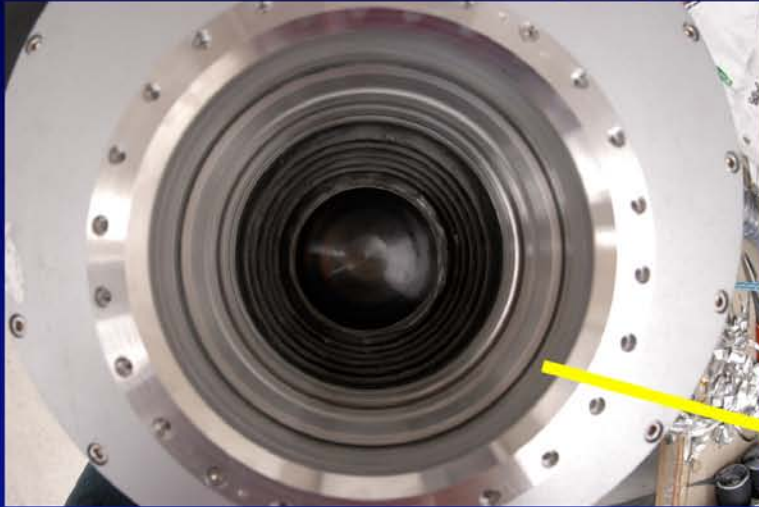
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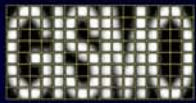


Goddard
Space
Flight
Center



Goddard-Iram Superconducting Millimeter Observer (GISMO)





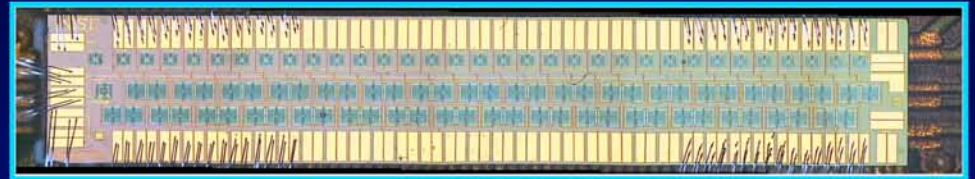
Goddard
Space
Flight
Center



Electronics Photos



Below: Mark III Tower prepared for operation.



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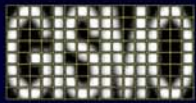
Goddard
Space
Flight
Center



GISMO Run



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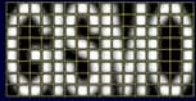


Goddard
Space
Flight
Center

GISMO Run

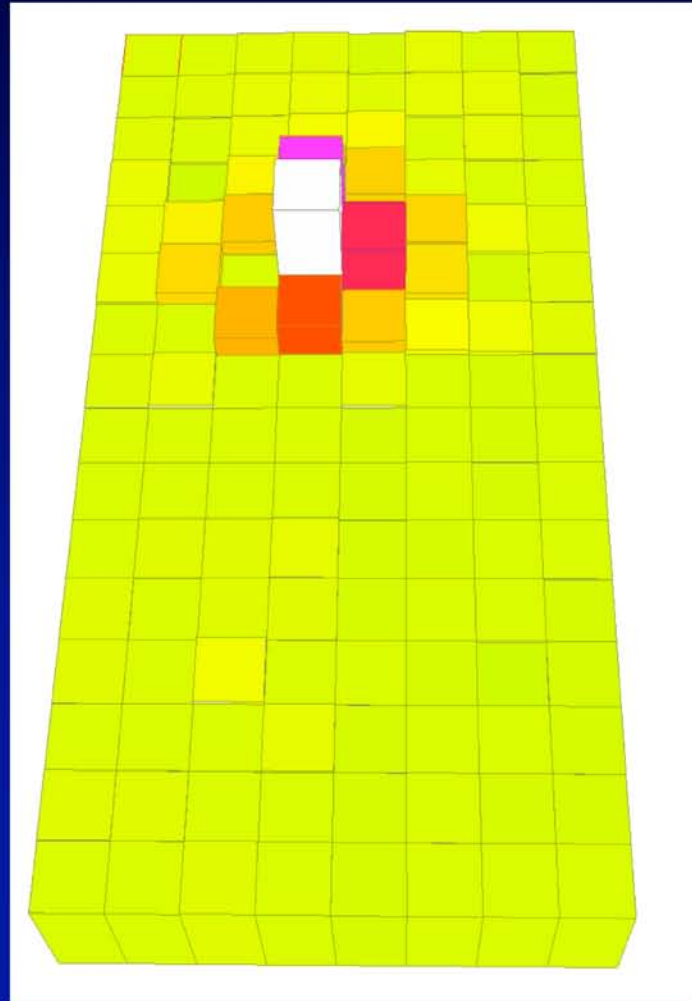


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Goddard
Space
Flight
Center

GISMO Run



Realtime Mars
observations,
 $T_{\text{int}}/\text{frame} = 0.5\text{ms}$

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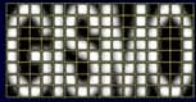


Goddard
Space
Flight
Center

GISMO Run

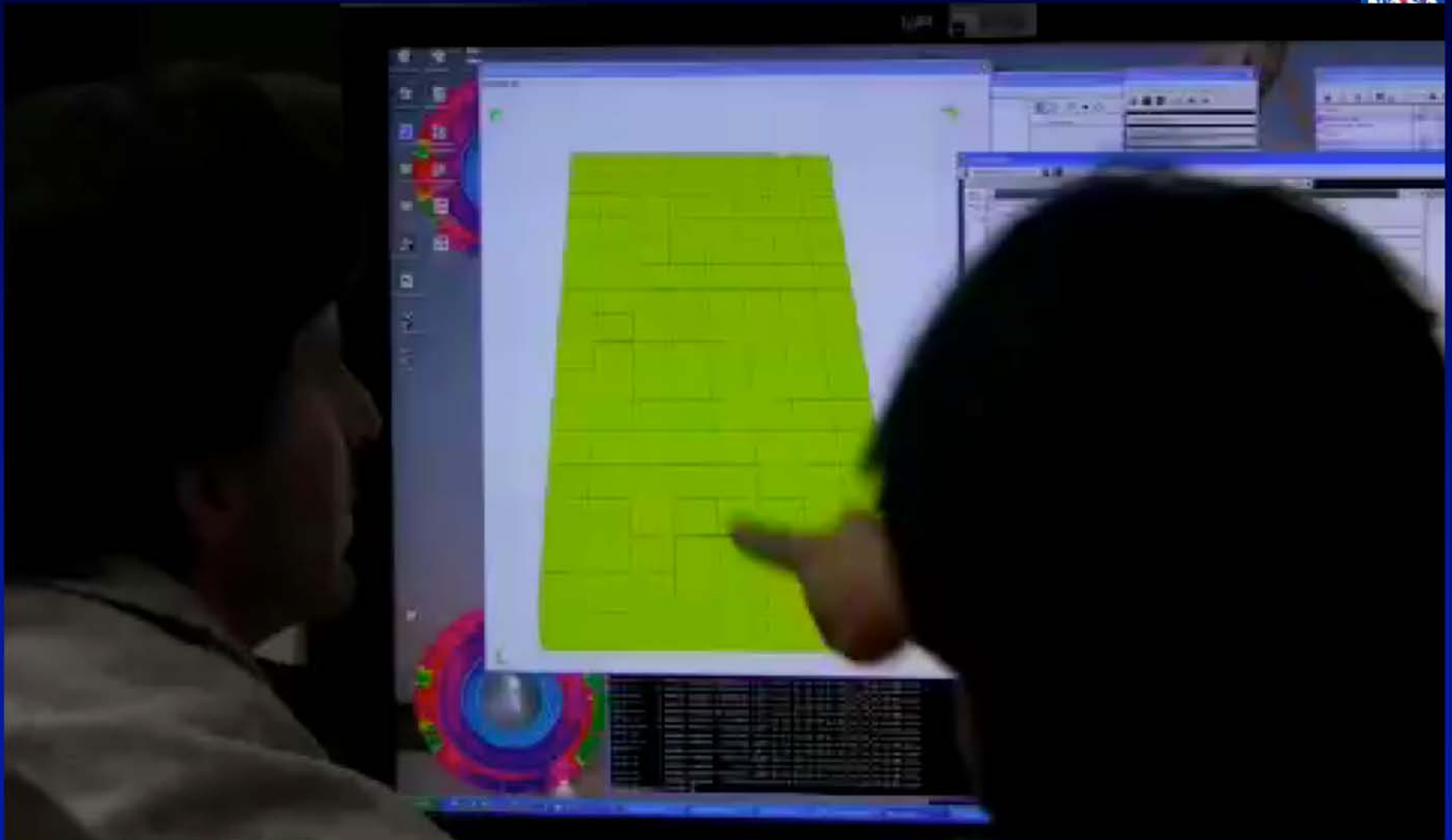


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Goddard
Space
Flight
Center

GISMO Run



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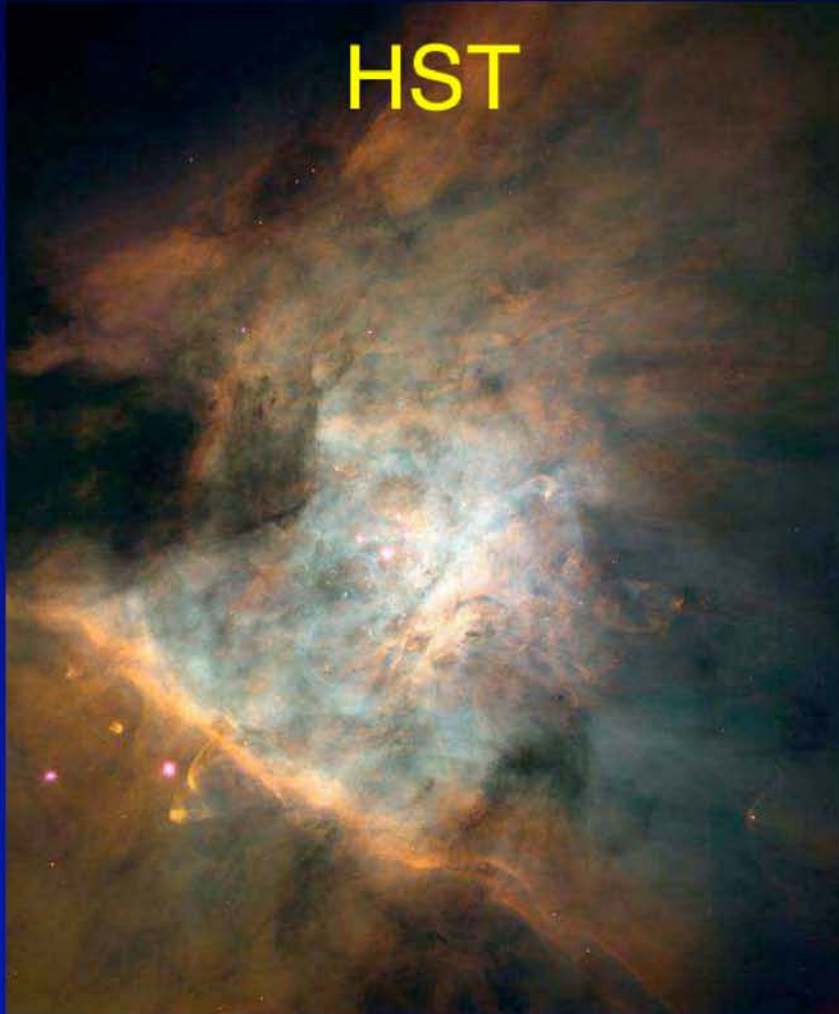


Goddard
Space
Flight
Center

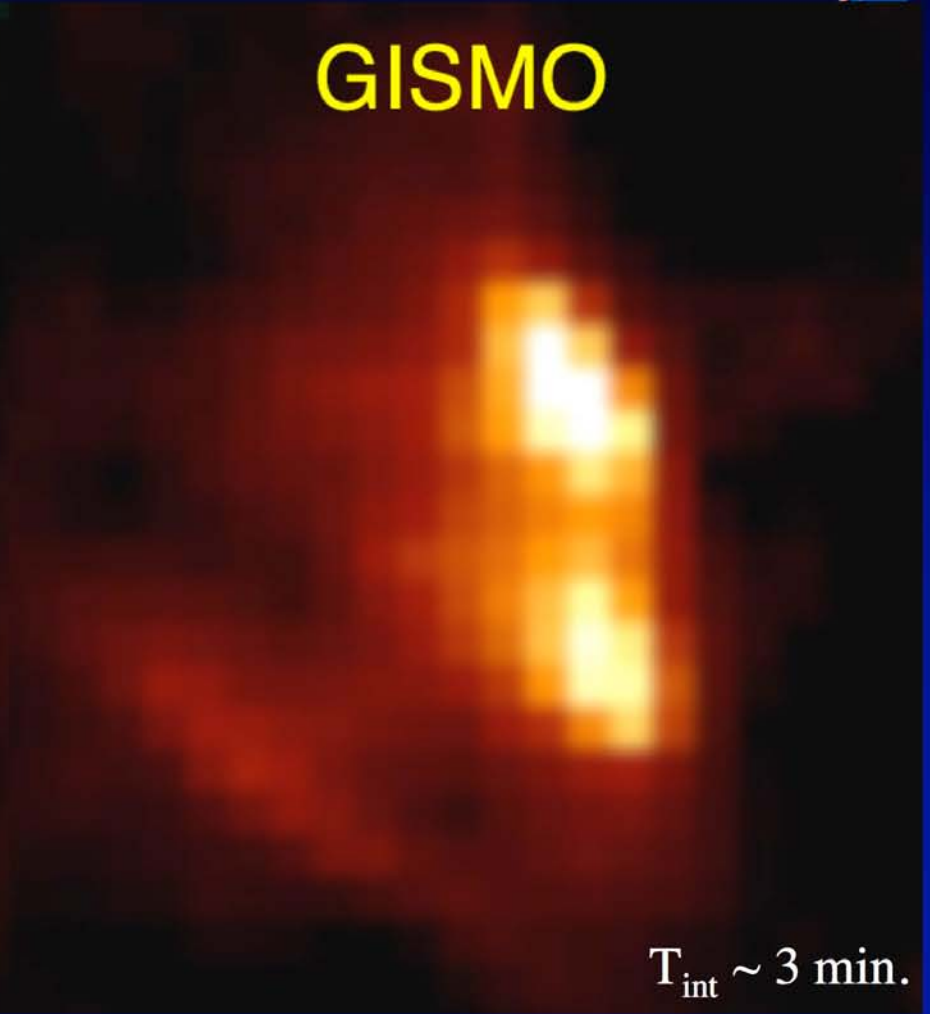
GISMO Run



HST

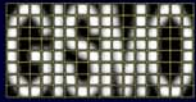


GISMO



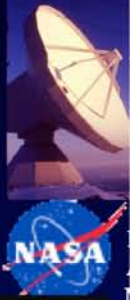
$T_{\text{int}} \sim 3 \text{ min.}$

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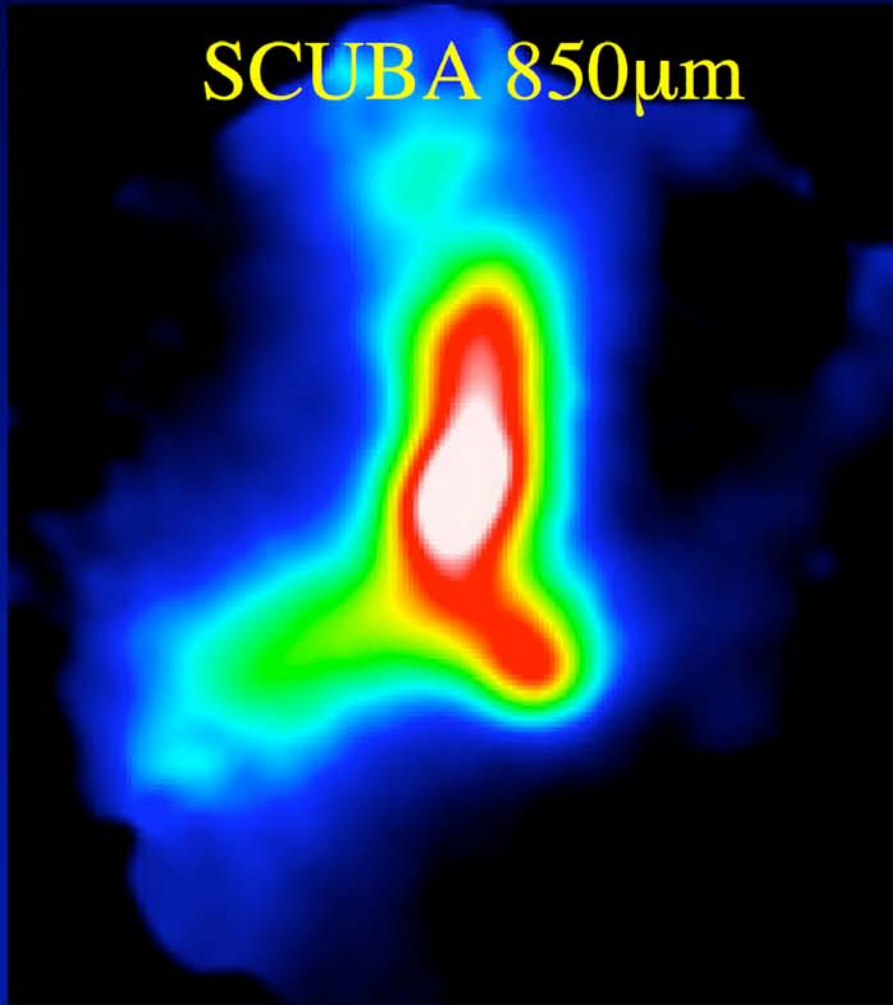


Goddard
Space
Flight
Center

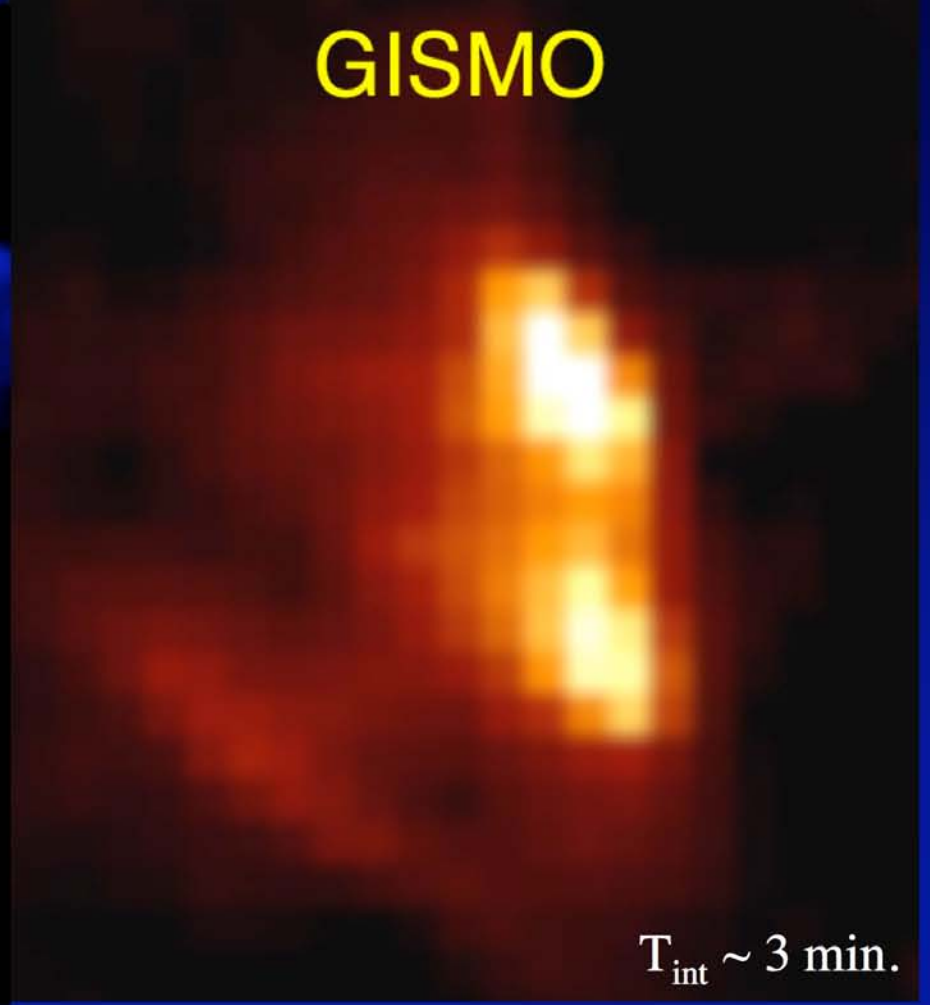
GISMO Run



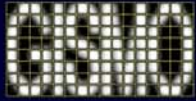
SCUBA 850 μ m



GISMO



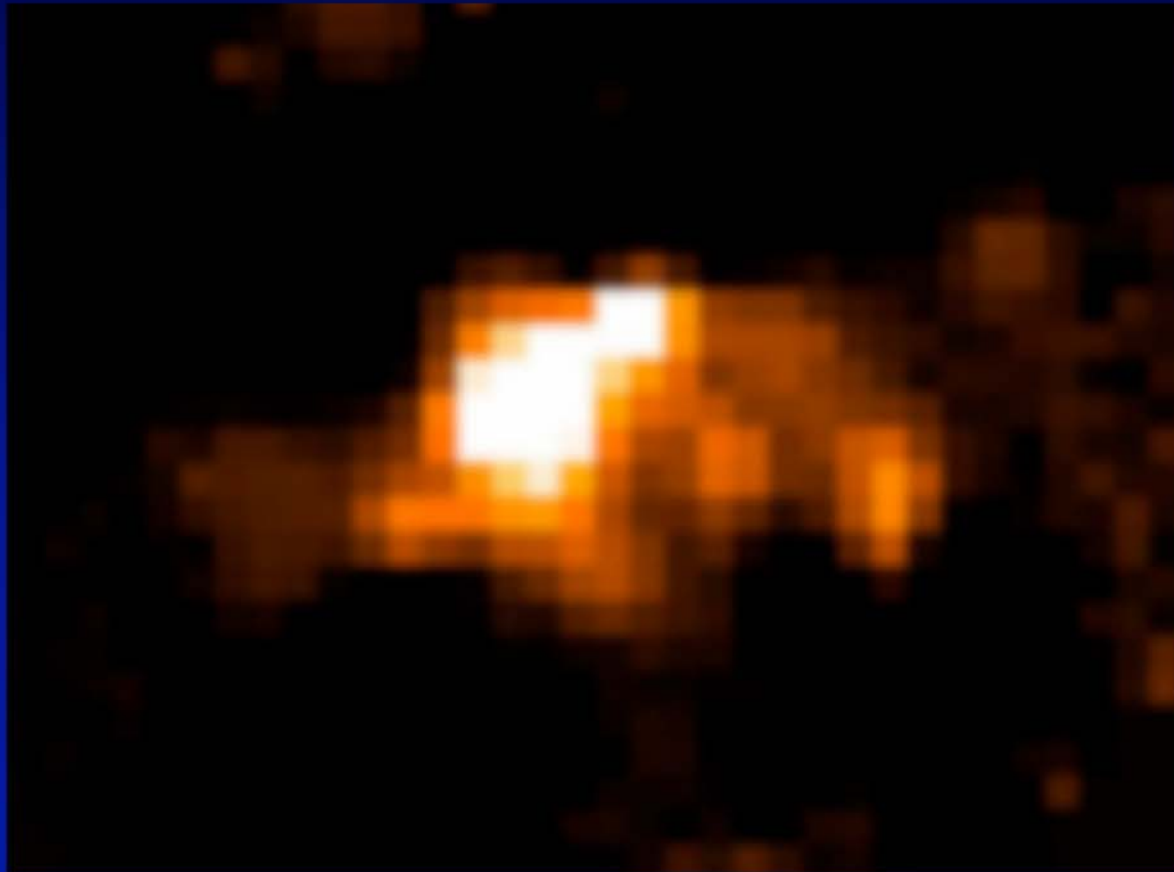
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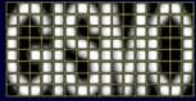
Goddard
Space
Flight
Center



GISMO Run

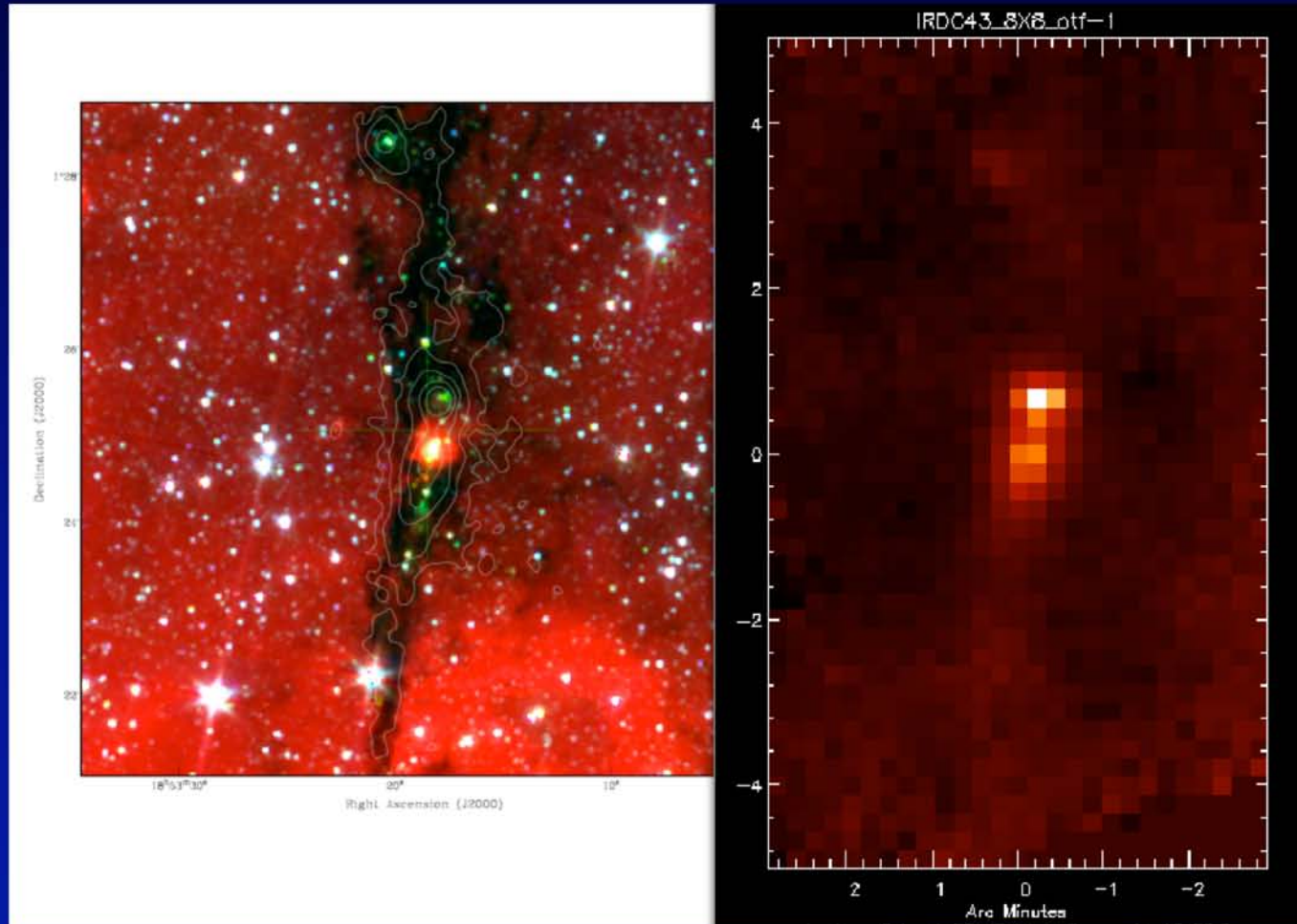


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Goddard
Space
Flight
Center

GISMO Run



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Goddard
Space
Flight
Center

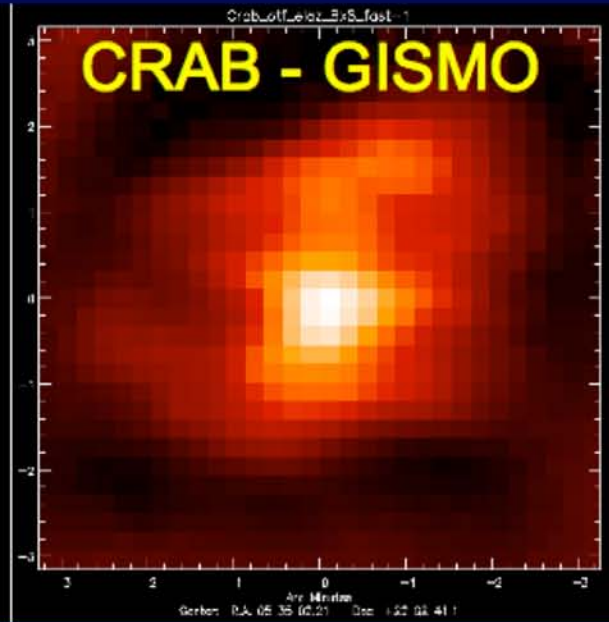
GISMO Run



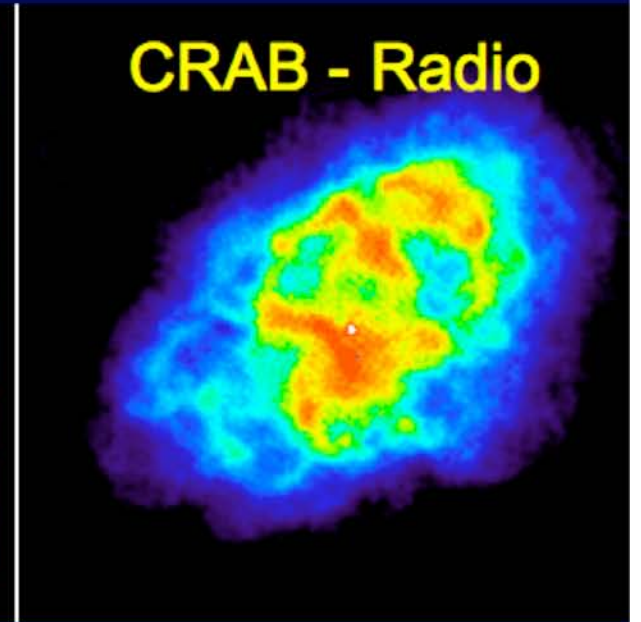
CRAB - IRAC

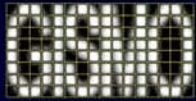


CRAB - GISMO



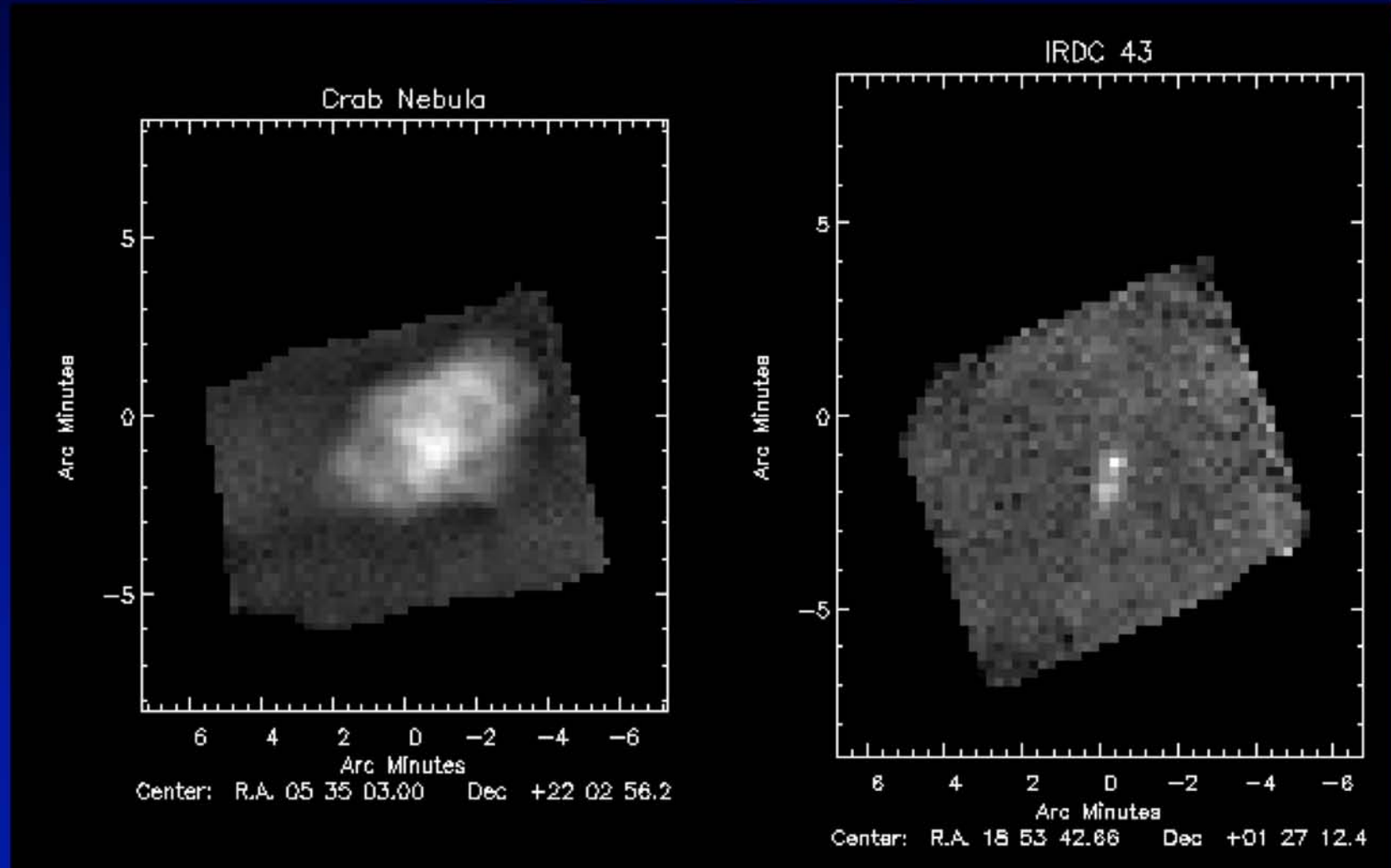
CRAB - Radio



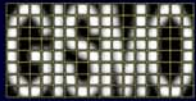


Goddard
Space
Flight
Center

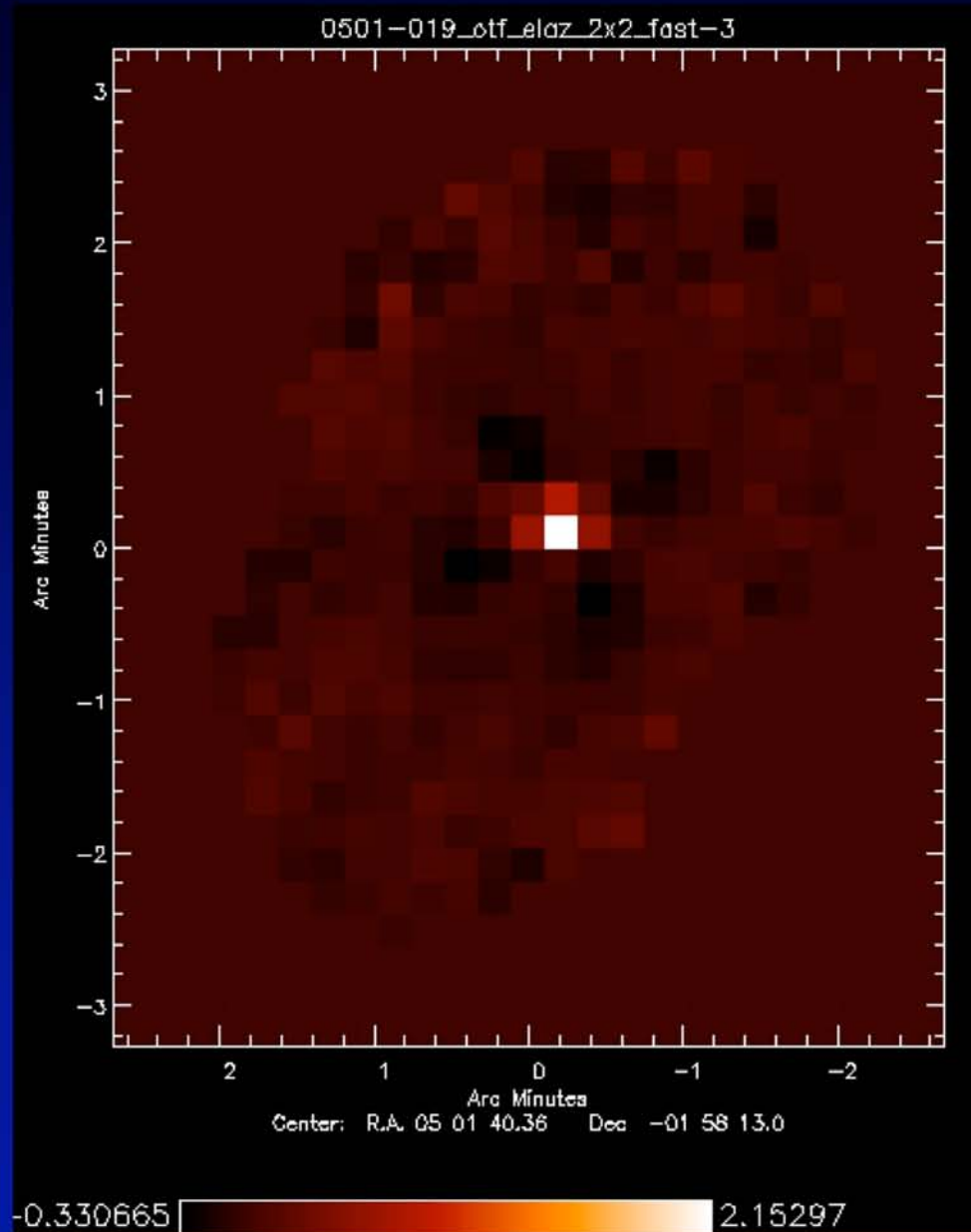
GISMO Run



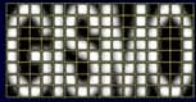
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Goddard
Space
Flight
Center



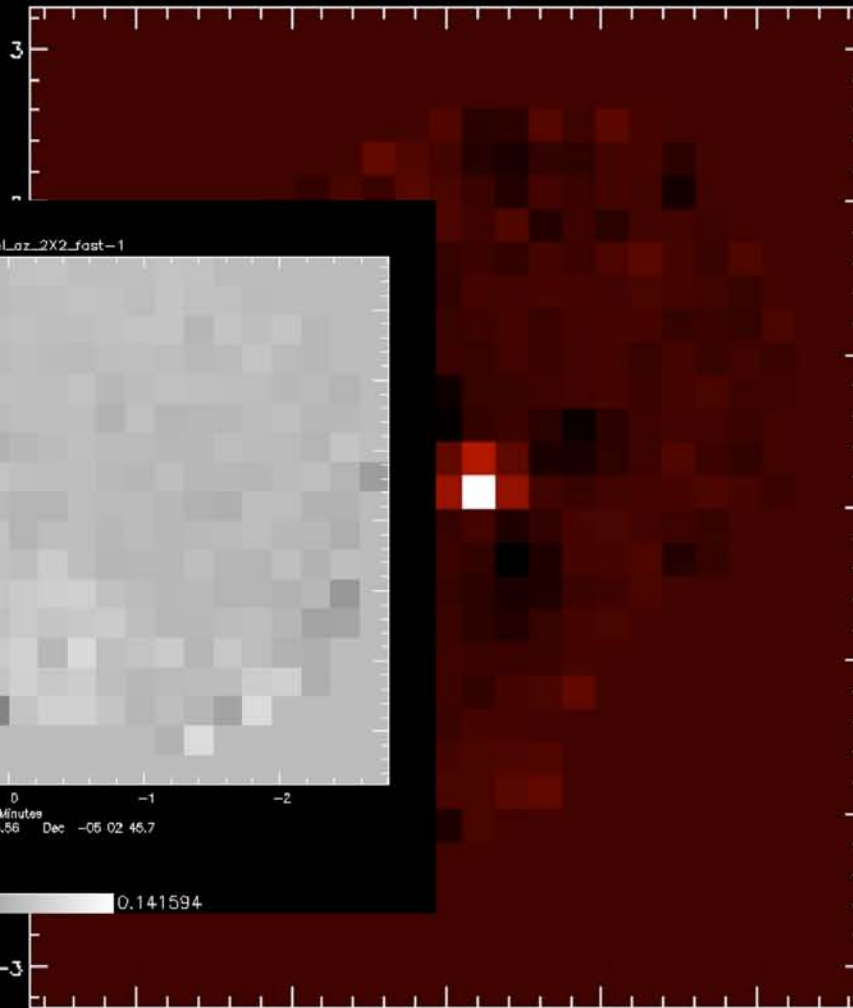
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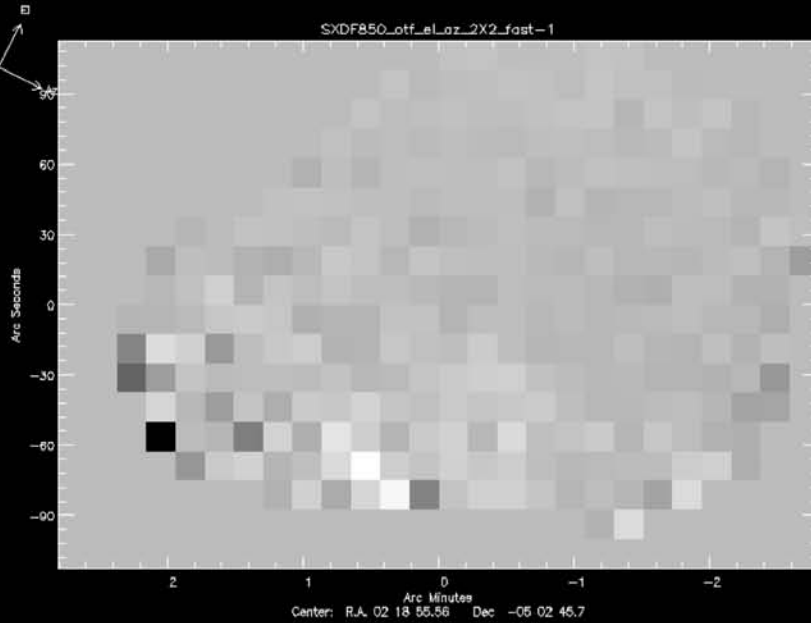
Goddard
Space
Flight
Center



0501-019_0tf_elaz_2x2_fast-3



SXDF850_0tf_elaz_2X2_fast-1

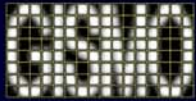


-0.303293 | 0.141594



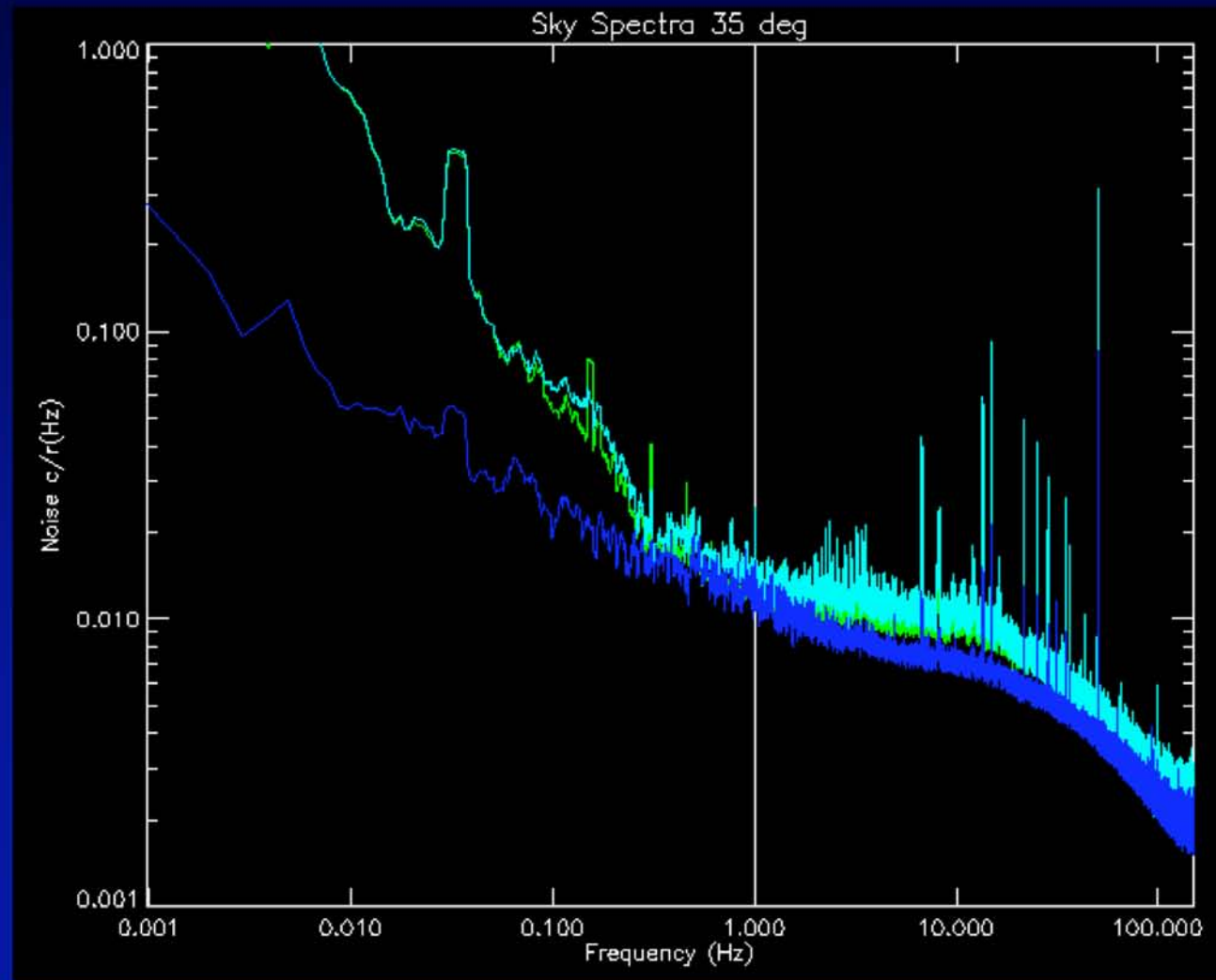
-0.330665 | 2.15297

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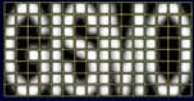


Goddard
Space
Flight
Center

GISMO Run



J. Staguhn, CCAT, UC-Boulder, May 13, 2008



Goddard
Space
Flight
Center

GISMO Run

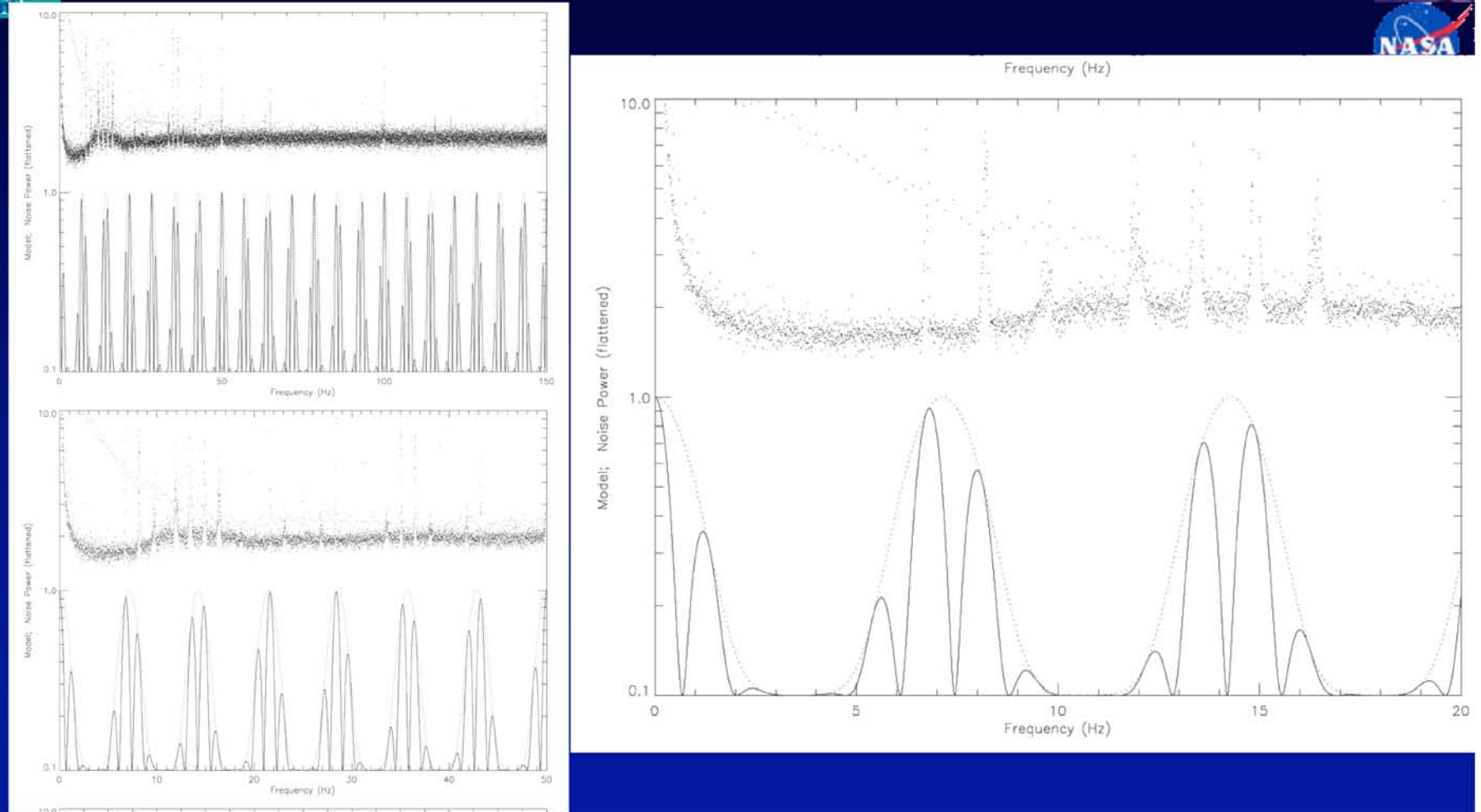
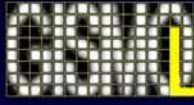
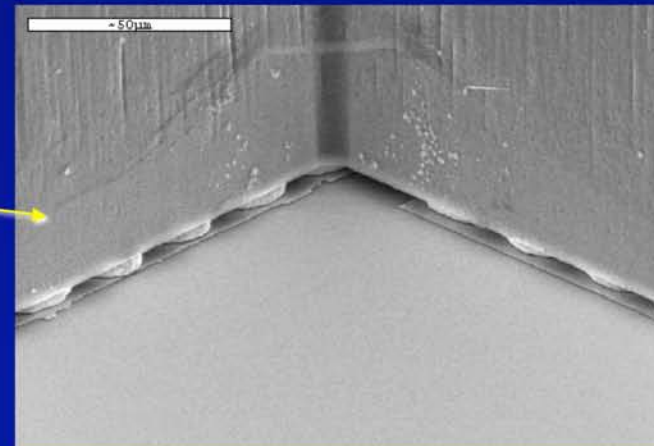
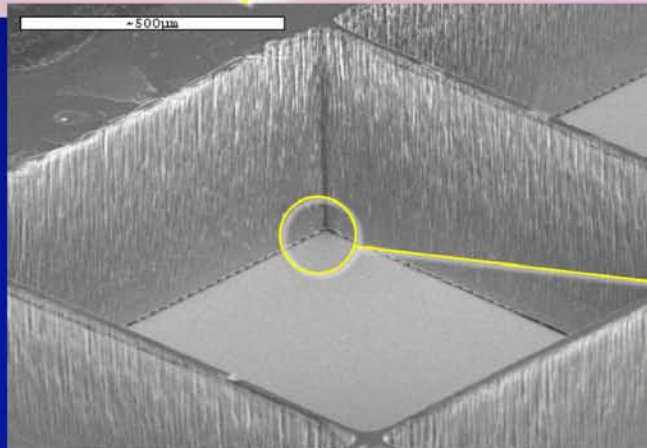
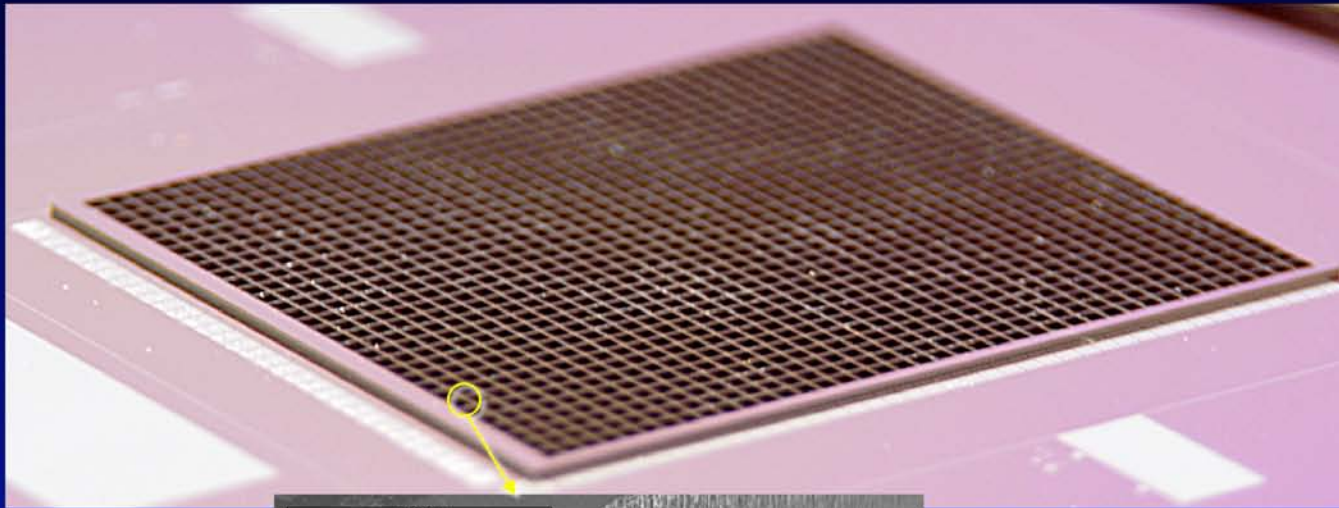


Fig. 3.— The dots show the flattened power spectrum with several clear sets of bands. The same data are displayed in all three panels, but on different frequency ranges. Some bands are strong enough that they extend beyond the top of the plot. The “model” spectrum indicated by the solid line is constructed from $\cos(\pi f/1.352 \text{ Hz})^2 * [\text{III}(7.142 \text{ Hz}) \otimes e^{-0.5f^2/(1.59 \text{ Hz})^2}] + 0.1$. The dotted line shows the envelope of the $\text{III}(7.142 \text{ Hz}) \otimes e^{-0.5t^2/(1.59 \text{ Hz})^2}$ modulation.

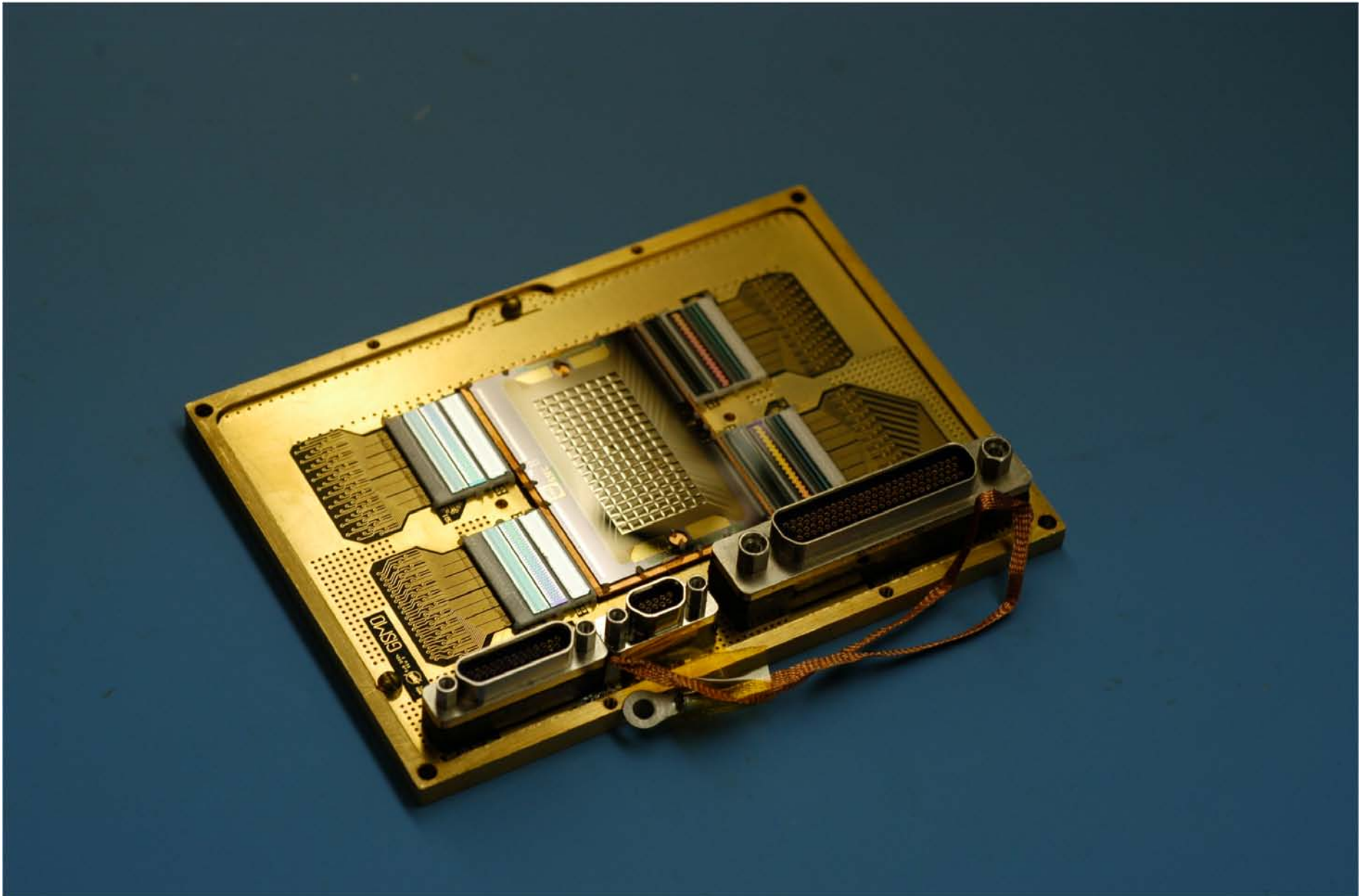


Goddard
Space
Flight
Center

Large Format Array Technologies for SOFIA-SAFIRE: Bump Bonds



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