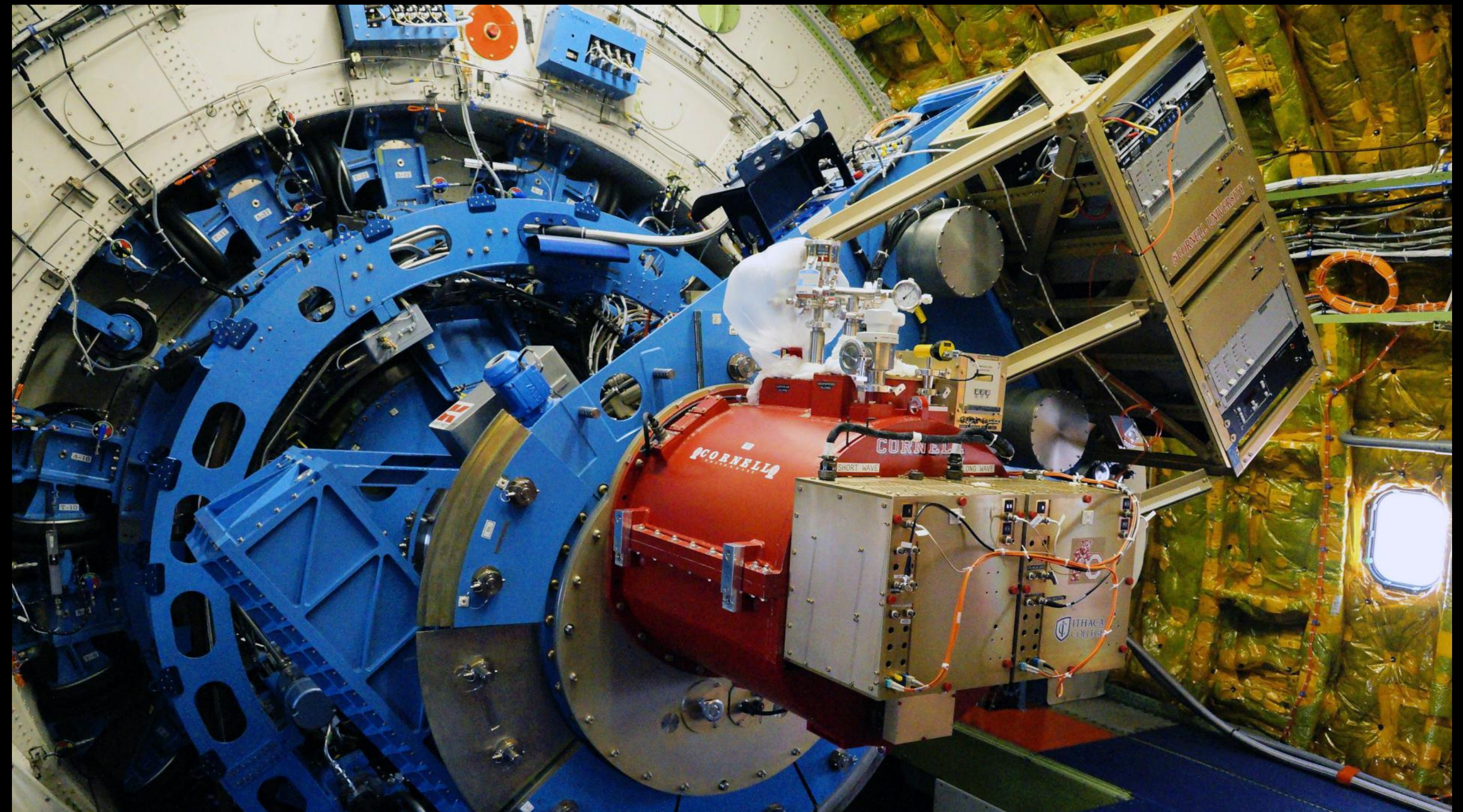


# FORCAST Highlights as of 2020

FORCAST is a scientifically diverse instrument addressing many areas of astronomy:

- Planetary sciences
  - Star formation
  - Evolved stars
  - Debris disks
  - Galaxies
  - Black Holes
- 
- Has been taking data since Cycle 0 (Adams et al. 2012)

FORCAST Instrument Scientists: Nicole Karnath, James Radomski, and Wanggi Lim





# FORCAST is the longest running instrument on SOFIA

Observations of Jupiter were carried out in May 2014

- Spectra probed the upper troposphere
- Compared with Voyager 1 IRIS spectra
- Found strong equator-to-pole gradient in para-H<sub>2</sub>
- Gradient correlated with upper tropospheric hazes, efficient catalysis of hydrogen conversion at the poles

Significant upward mixing  
at low latitudes is  
responsible for the “para-  
hydrogen” detected.

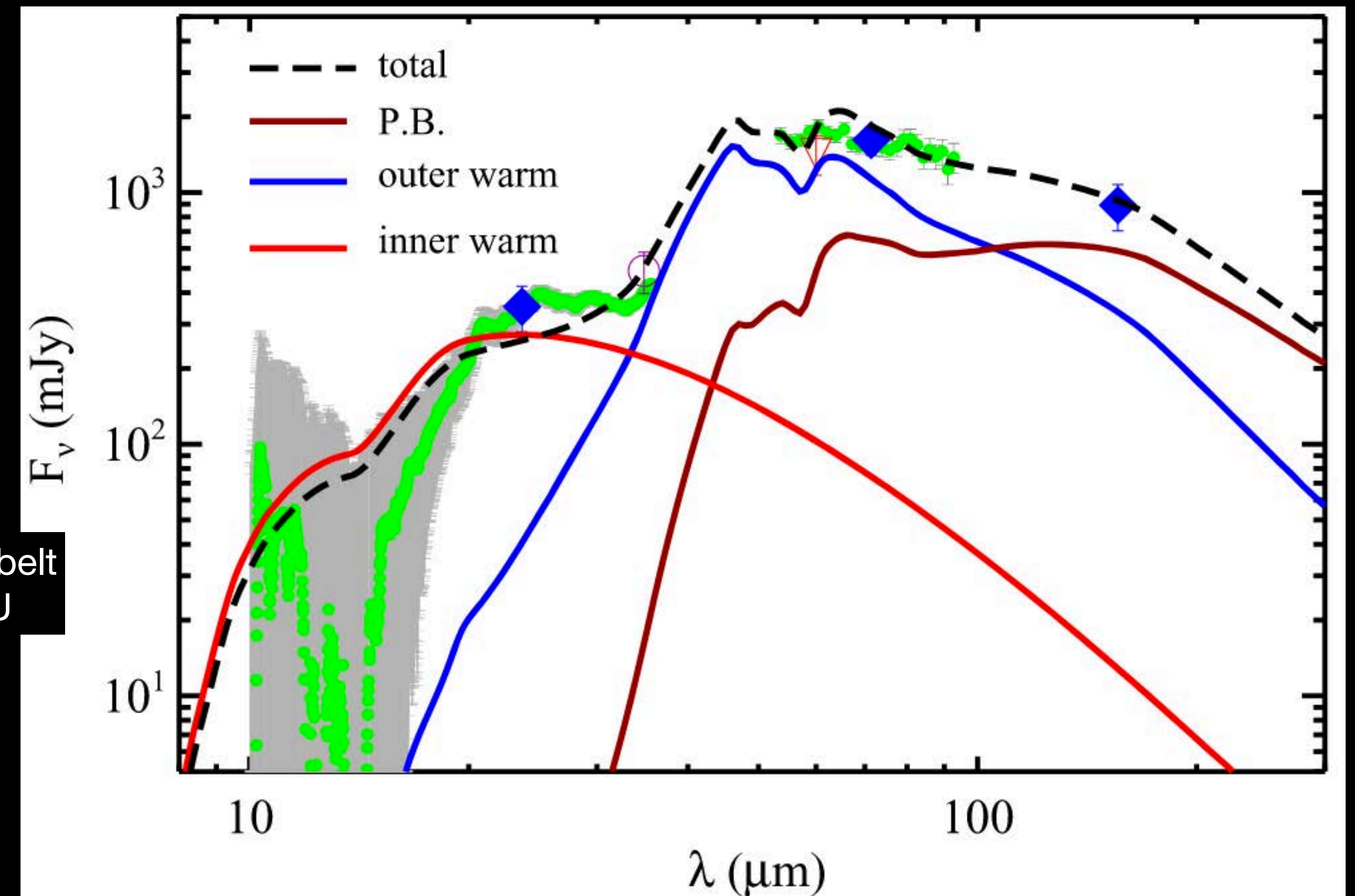
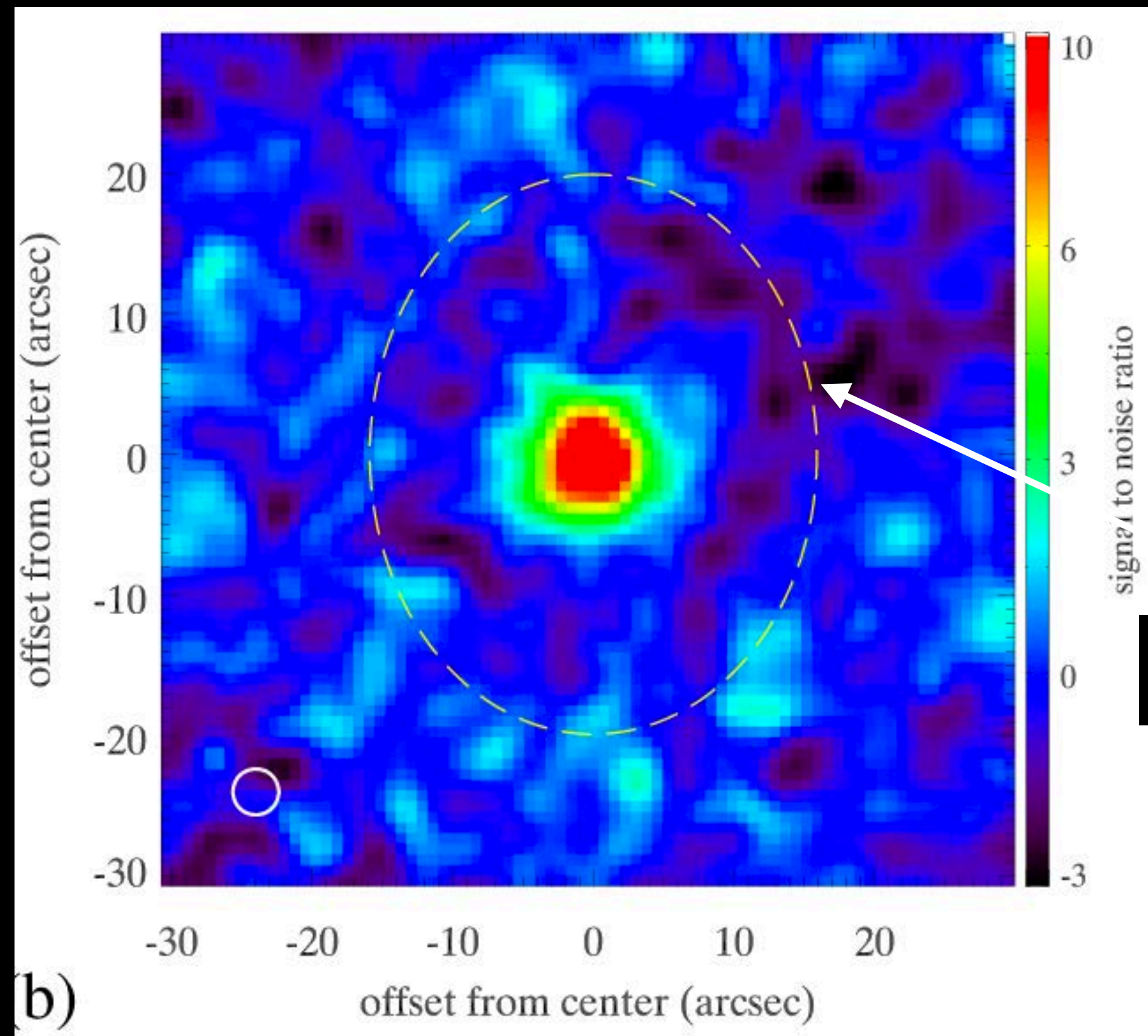


Fletcher et al. (2017)

NASA/SOFIA/USRA/FORCAST Team/James De Buizer (infrared image), Anthony Wesley (visible light image)

# A debris disk detected at 25 AU around $\epsilon$ Eri

The system is  $\sim 3.2$  pc away and 800 Myr. The inner debris disk is likely due to in situ dust-producing planetesimal belt(s)



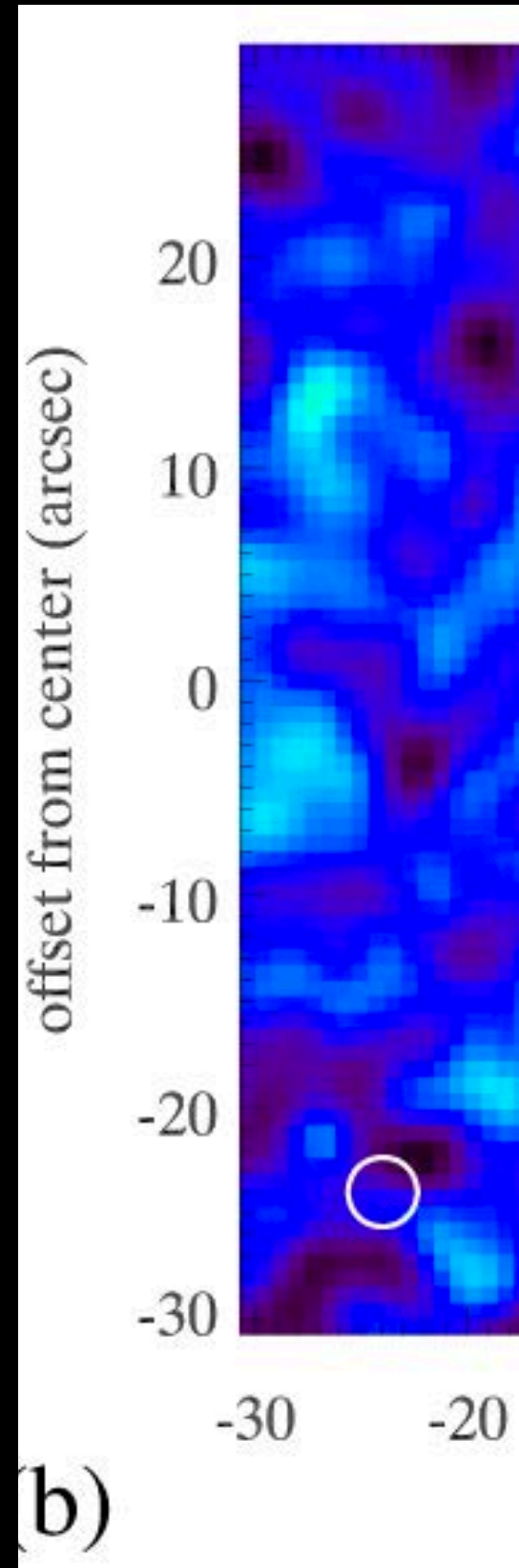
SOFIA/FORCAST 34.8  $\mu\text{m}$  image of  $\epsilon$  Eri smoothed at 1.5 pixels. Final coadded mosaics after stellar subtraction.

$\epsilon$  Eri SED with two warm belts as the red and blue solid lines and the dust at 64 AU in brown.

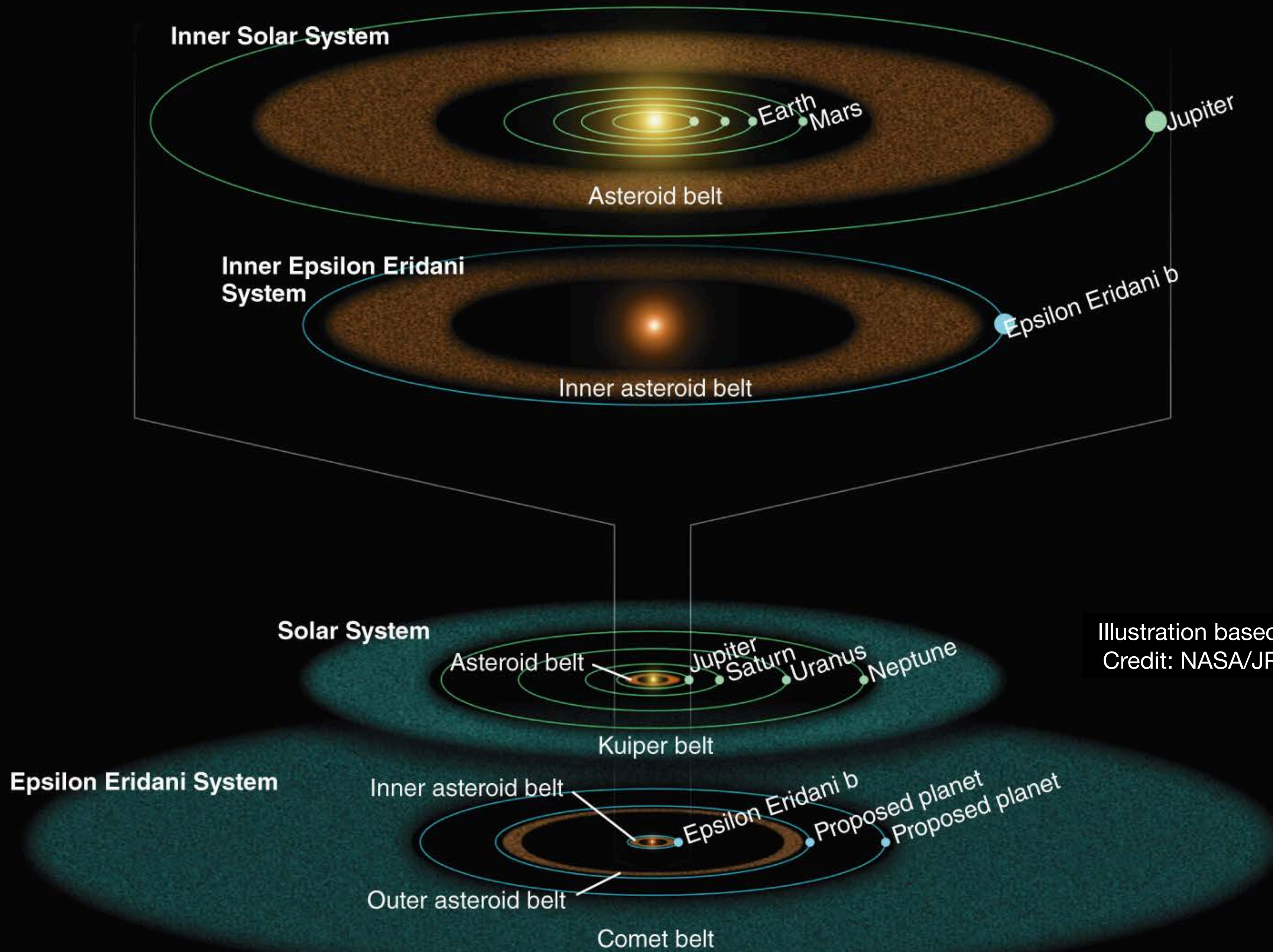
Su et al. (2017)



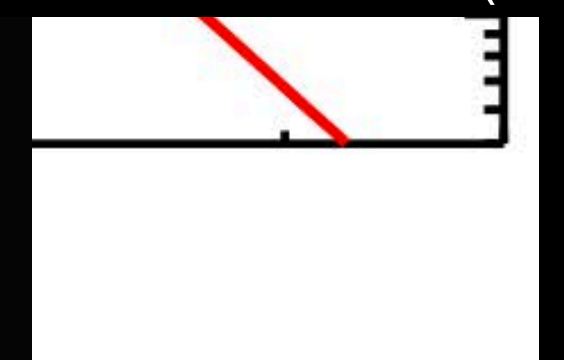
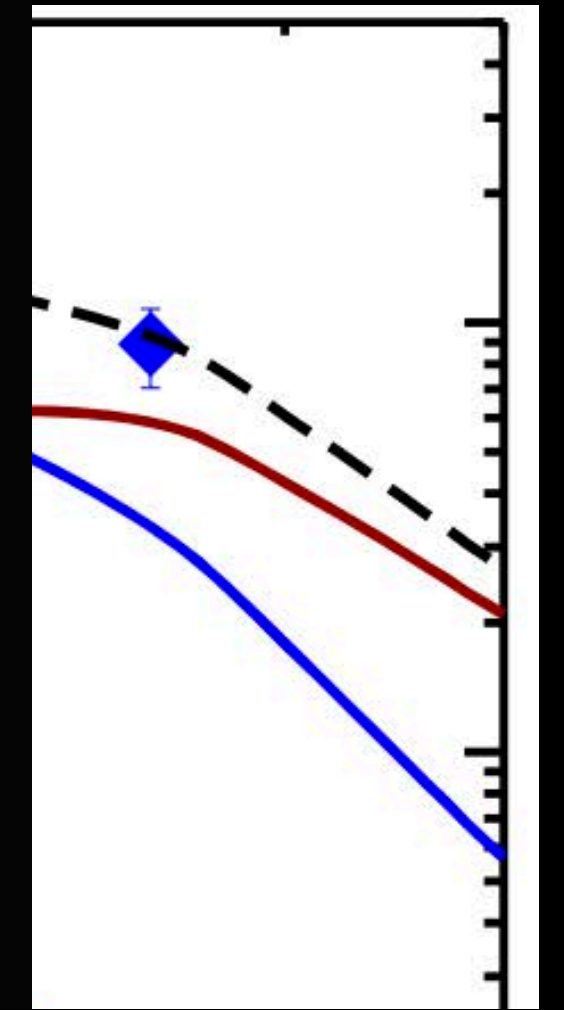
# A del



SOFIA/FOR  
smoothed  
mosaic:



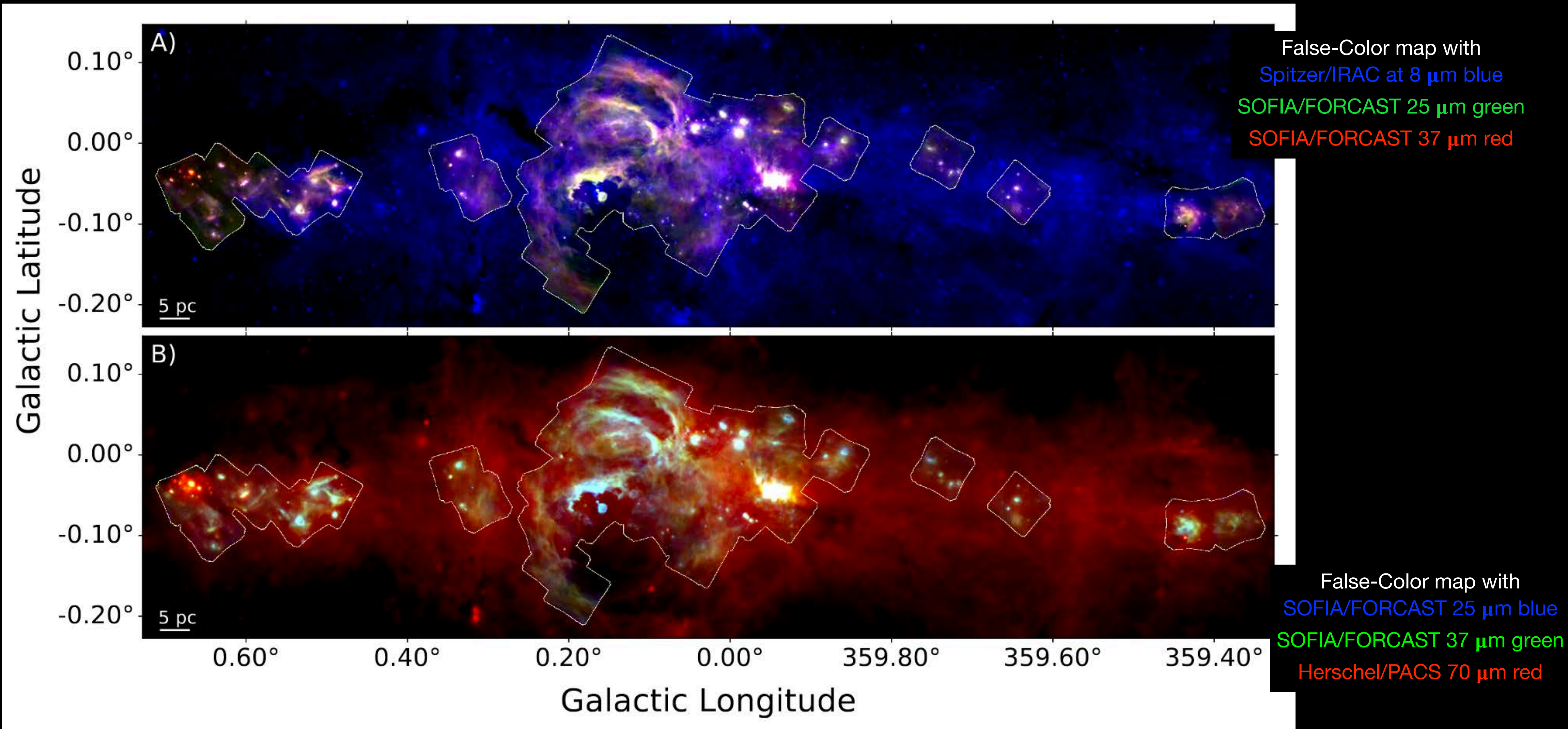
# d ε Eri



the  
just



# Legacy program to characterize star formation in the galactic center



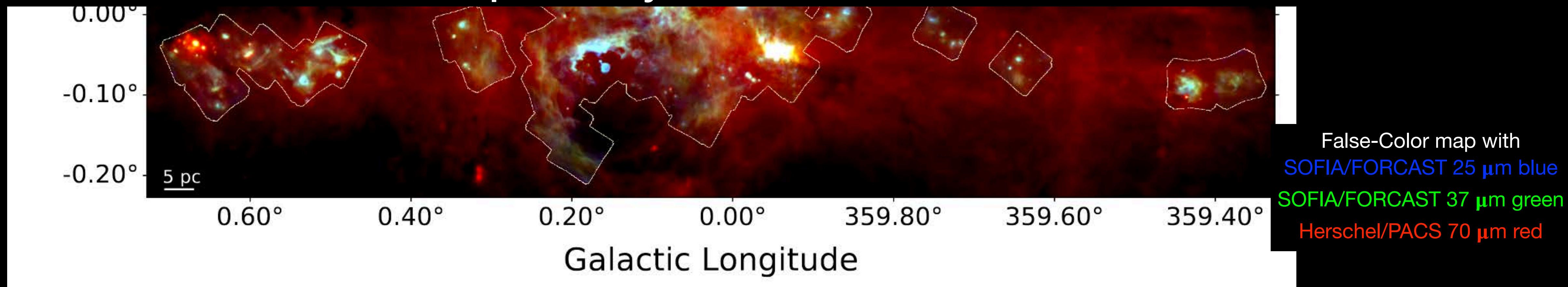


# Legacy program to characterize star formation in the galactic center



Great resource for future studies and synergies with other SOFIA instruments such as HAWC+.

All of this data is publicly available on the IRSA website.

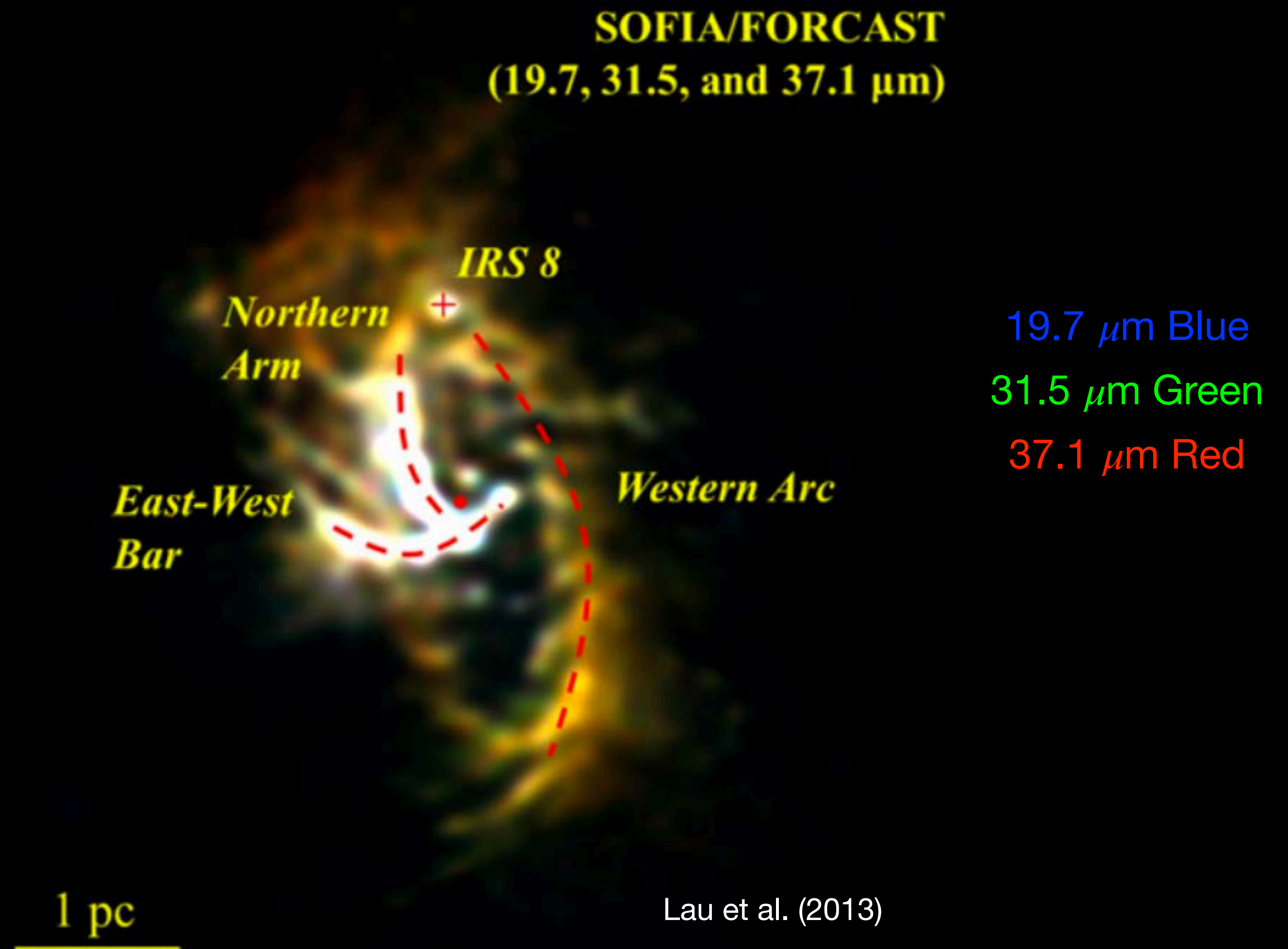




# Circumnuclear ring at the Galactic Center

Observations were carried out in June 2011

- Deconvolved (2.5" beamsize) false color image of the CNR and Sgr A West from FORCAST.
- The streamers of hot, ionized gas and dust within the CNR compose the HII region in Sgr A West.
- The radial temperature gradient across the CNR (ranging from 65 - 85 K) is consistent with the dust being centrally heated by the inner cluster of hot, young stars.

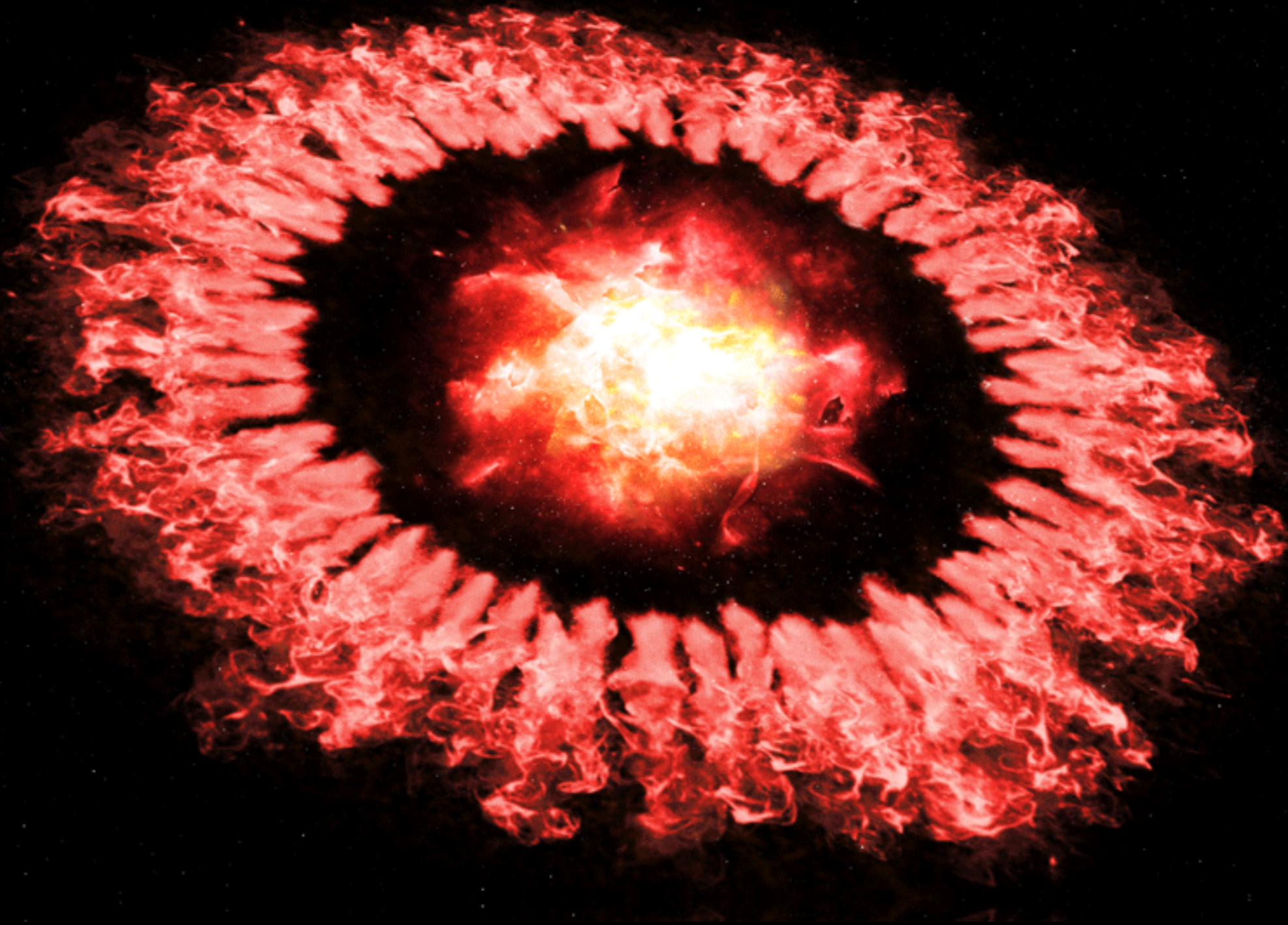




# SOFIA/FORCAST finds dust survives obliteration in Supernova 1987A in 2016

Observations were carried out in July 2016

- SOFIA/FORCAST detected more than 10 times the dust than expected
- This suggests that dust is much more abundant in the wake of a blast wave than theories estimate
- Dust may actually be forming in the wake of the powerful blast wave with from significant growth of existing dust or the formation of a new dust population



This target was observed again in Cycle 7 (July 2019)

Matsuura et al. (2019)



# Surveying the Giant HII Regions in the Milky Way

Constructing SEDs and use models to constrain protostellar parameters, derive luminosity-to-mass ratios, and viral parameters for the regions.

W51A

M17

SOFIA/FORCAST 20  $\mu\text{m}$  blue  
SOFIA/FORCAST 37  $\mu\text{m}$  green  
Herschel/PACS 70  $\mu\text{m}$  red

Several more regions AND  
papers are currently being  
written and analyzed!!!!



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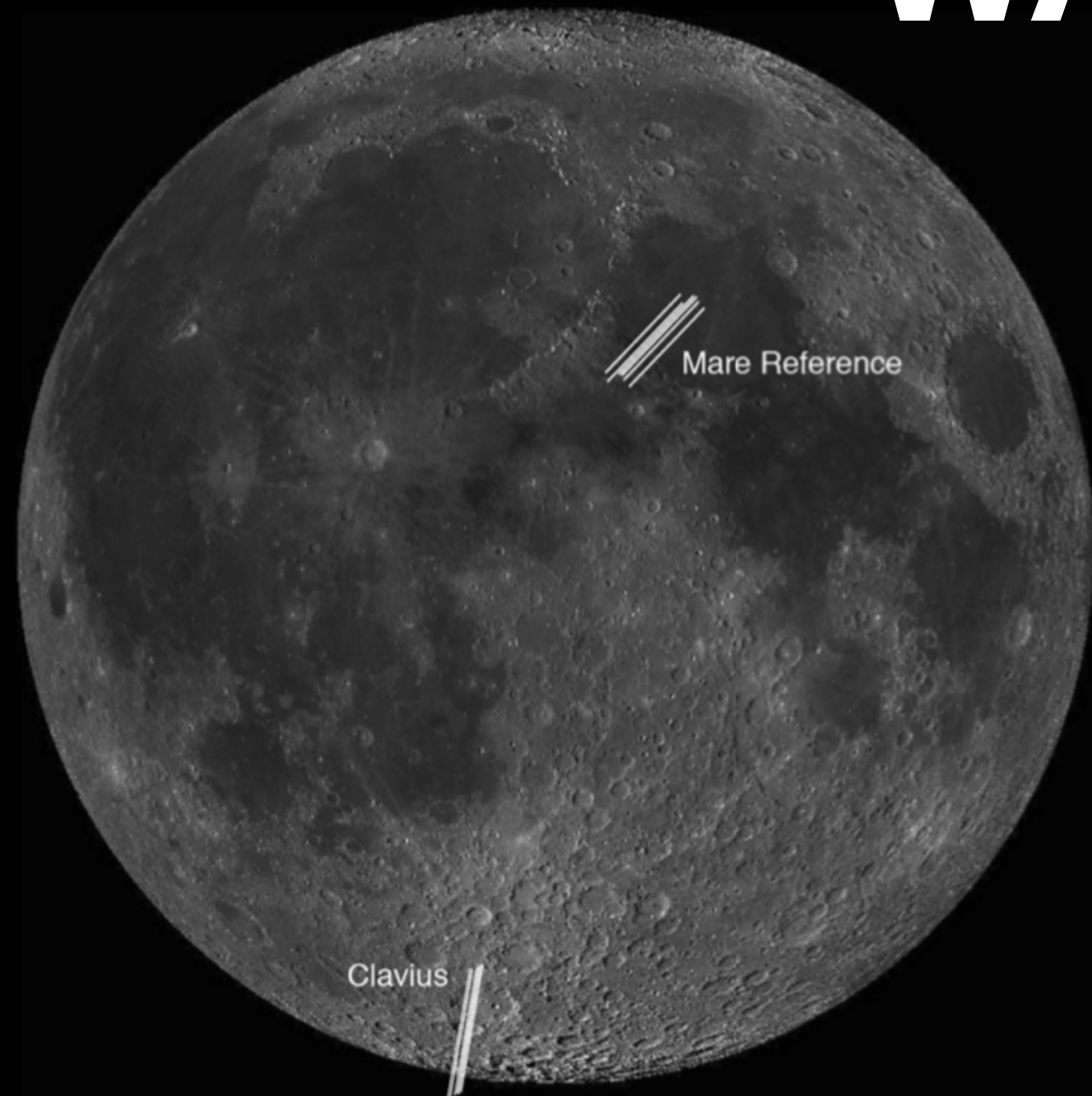
The W51A mosaic was the first level 4 data product from the FORCAST instrument.

SOFIA/FORCAST 20  $\mu\text{m}$  blue  
SOFIA/FORCAST 37  $\mu\text{m}$  green  
Herschel/PACS 70  $\mu\text{m}$  red

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# WATER ON THE MOON!!!

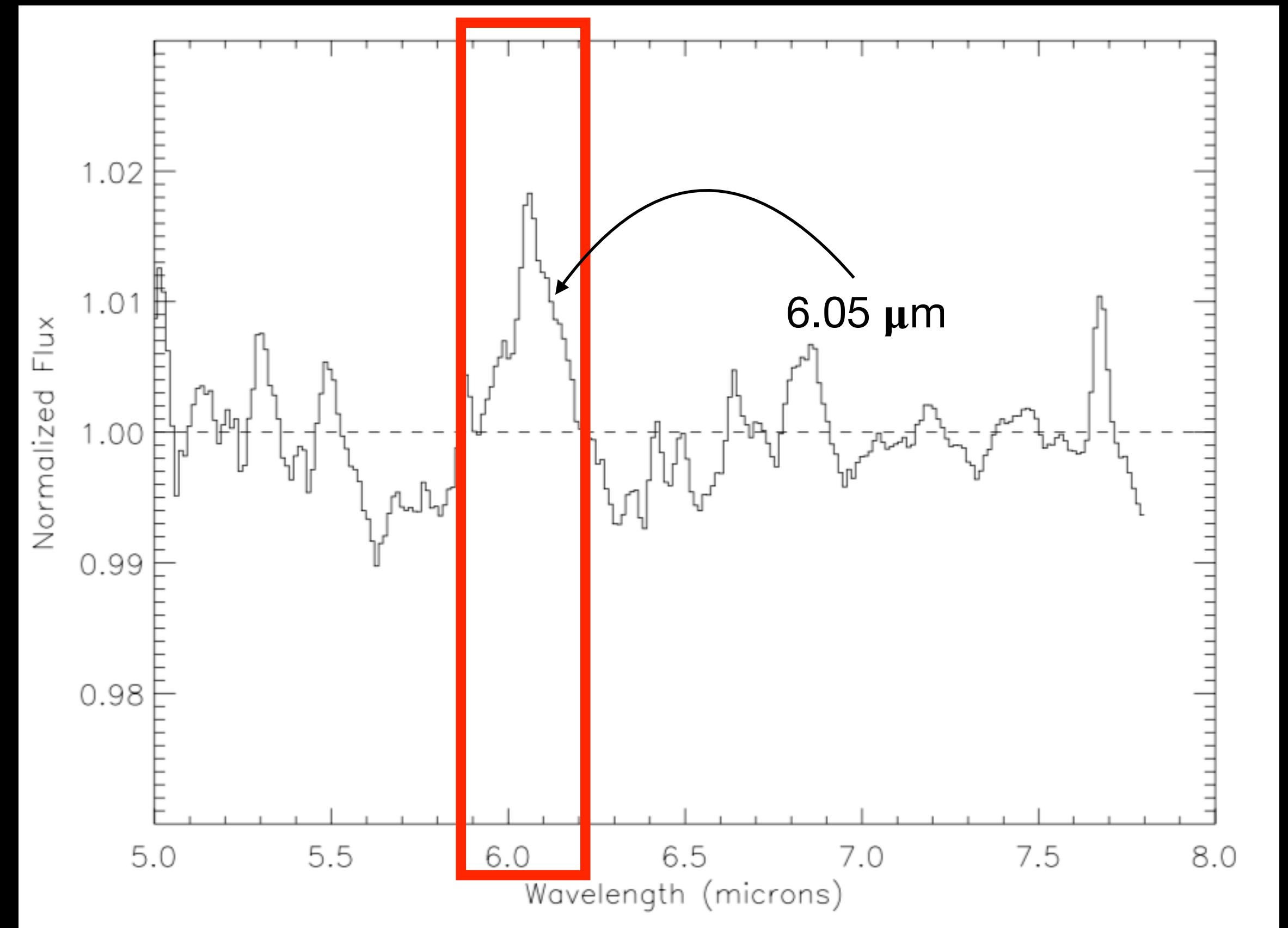


Clavius crater with SOFIA FORCAST slit overlaid

Observations taken on August 30, 2018

Published in Honniball et al. (2020)

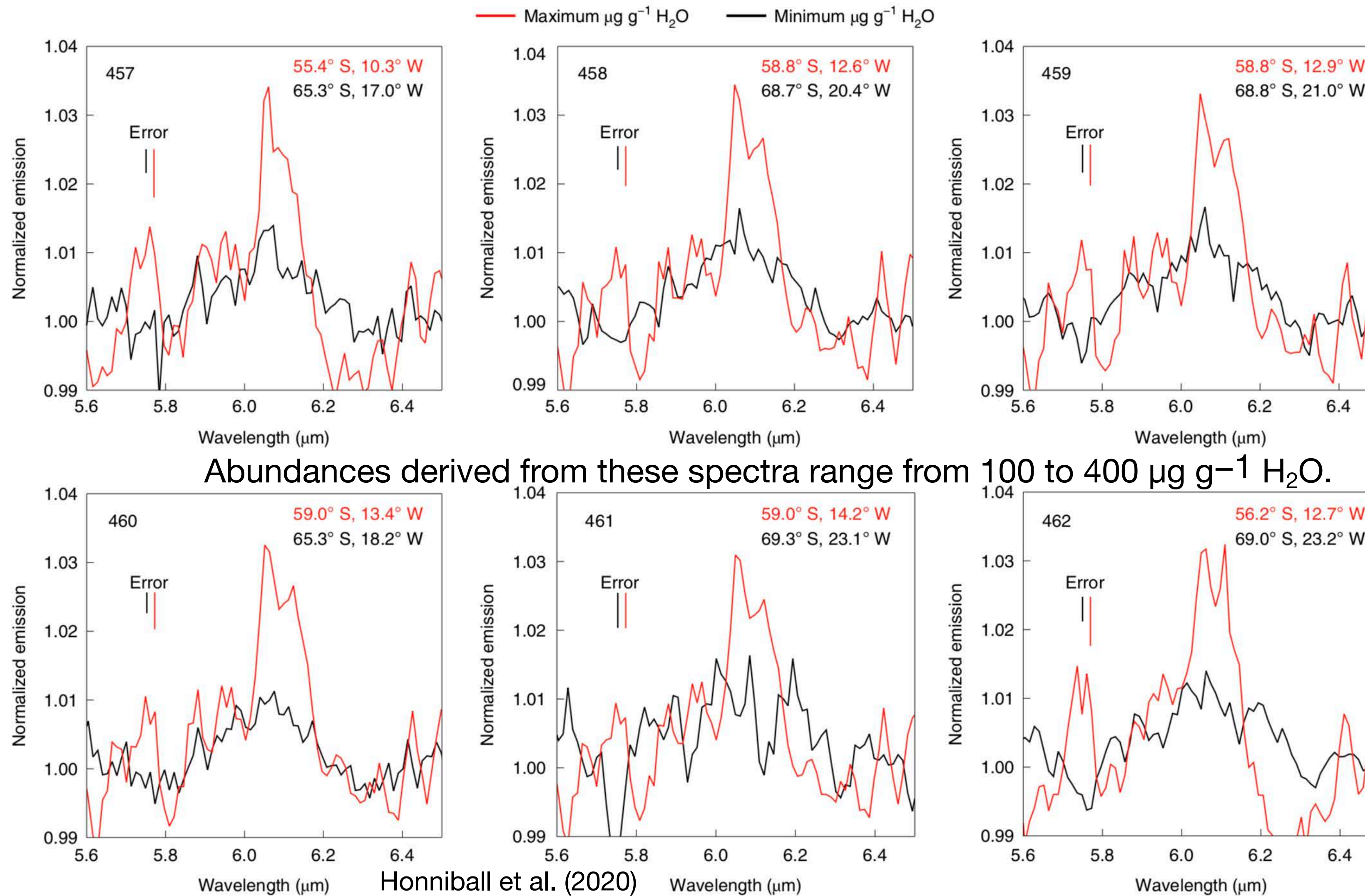
More observations were approved in  
Cycle 8 and are high priority



Ratio spectrum (Clavius region divided by reference region).

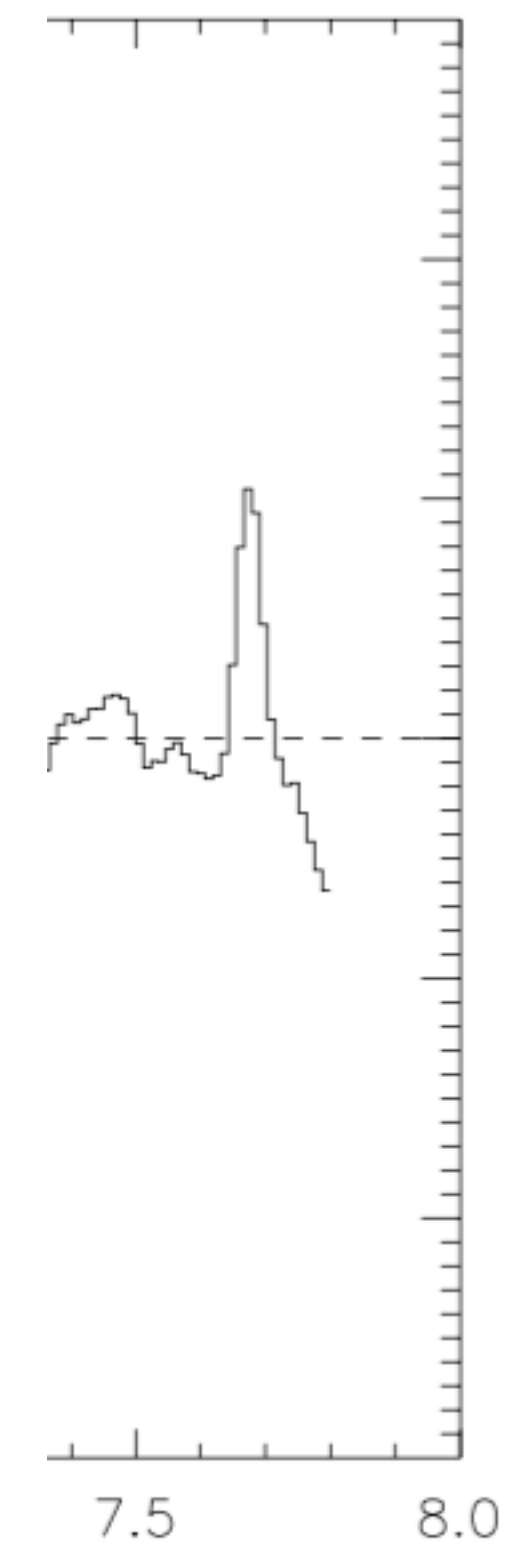


# WATER ON THE MOON!!!



Abundances derived from these spectra range from 100 to 400  $\mu\text{g g}^{-1} \text{H}_2\text{O}$ .

Honniball et al. (2020)



region).

Clavius crater with SOF  
Observations taken  
Published in Honni

More observa  
Cycle 8 at



# Upcoming Observations for FORCAST in Cycle 8

- More Moon observations in search of water in different areas of the surface
- Asteroid studies
- AGN
- Star formation including massive stars, accretion bursts, star formation in the outer galaxy, the protostellar luminosity function
- Debris and transitional disks
- Dust mineralogy of Protoplanetary Nebulae and dust evolution in evolved stars
- Outbursts of high mass stars in binaries