



# SOFIA SUG Director's Report

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Director  
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June 17, 2020

# Outline

- SOFIA's 10<sup>th</sup> Anniversary of First Light
- Science highlights
- Science Mission Operations Vision
- Science & Community Metrics
- Community engagement activities
  - Cycle 9 call
  - Instrument roadmap
- Observatory Status

# Congratulations to SOFIA Team for 10<sup>th</sup> Anniversary of First Light!



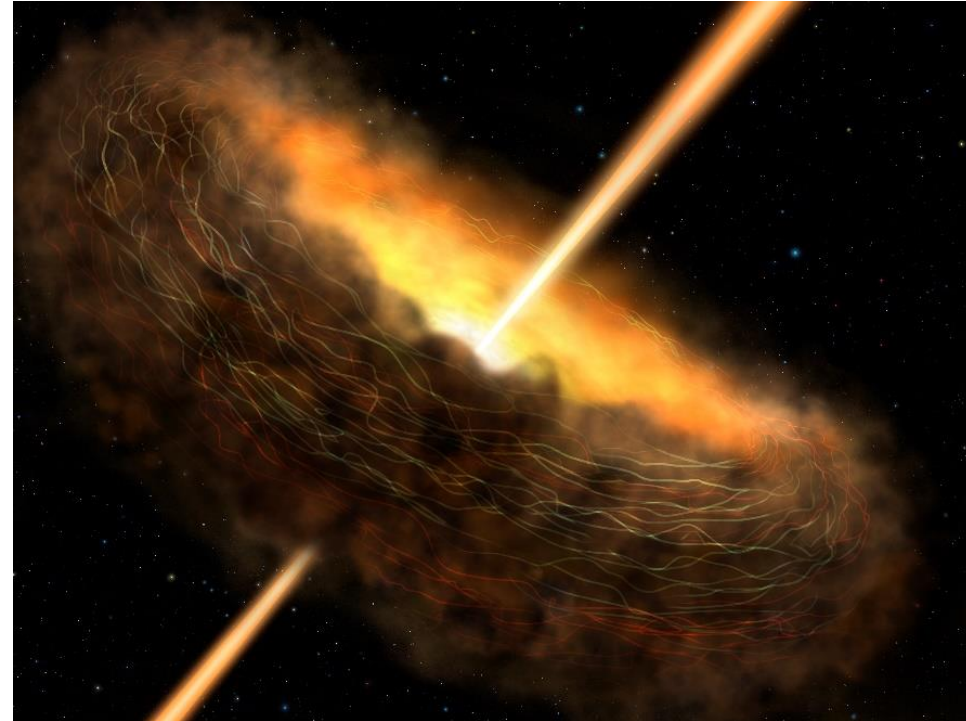


# Science Highlights from past 10 years



**Magnetic Fields May Be Keeping  
Milky Way's Black Hole Quiet**

Image credits: Dust and magnetic fields: SOFIA  
Star field: Hubble Space Telescope



**Magnetic Fields May Be Feeding  
Active Black Holes – Cygnus A**

Illustration credit: NASA/SOFIA/Lynette Cook

# Science Highlights from past 10 years



**Magnetic field alignment over an entire galaxy, NGC 1068**

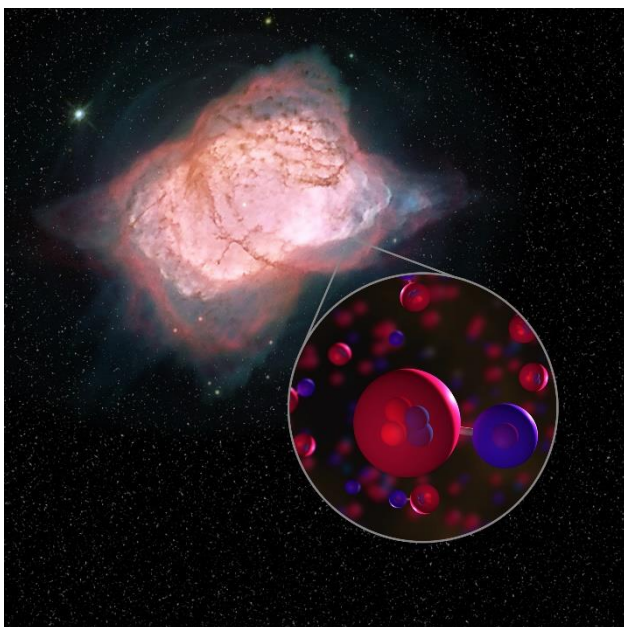
Image credits: NASA/SOFIA; NASA/JPL-Caltech/Roma Tre Univ.



**Weighing a Galactic Wind Provides Clues to the Evolution of Galaxies**

Image credits: NASA/SOFIA; NASA/JPL-Caltech

# Science Highlights from past 10 years



The Universe's First Type of Molecule,  $\text{HeH}^+$ , Helium hydride, Found at Last

Image credits: NASA/ESA/Hubble  
Processing: Judy Schmidt



The excess [CII]  $158 \mu\text{m}$  line emission near this galaxy's center is caused by a jet shocking the gas in the disk.

Illustration credits: ESA/Hubble&NASA and NASA/SOFIA/L. Proudfit

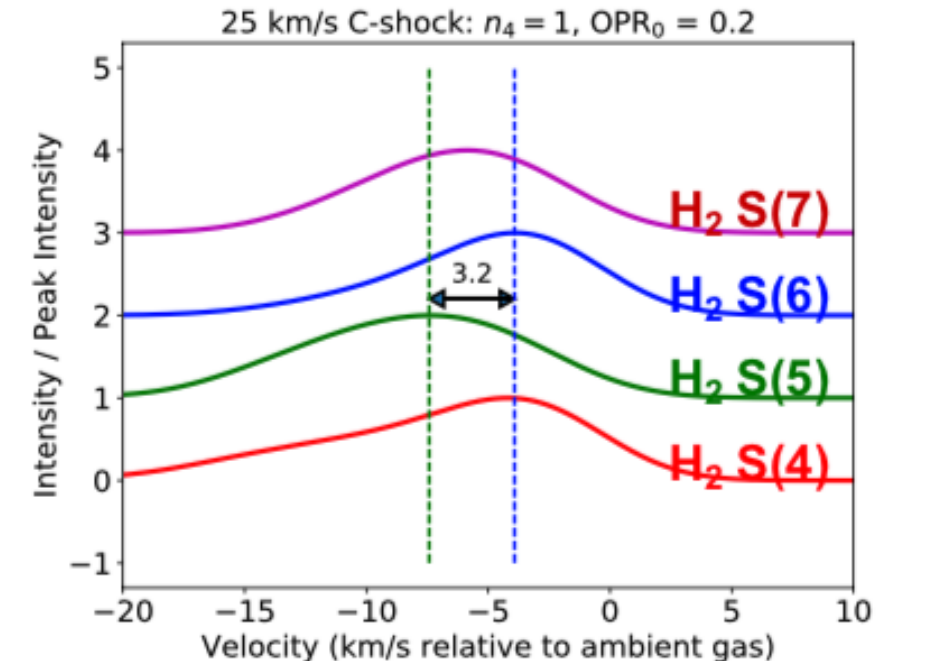
# David Neufeld

## New Evidence for a Special Type of Interstellar Shock

Molecular hydrogen exists in two forms: para-H<sub>2</sub> (proton spins antiparallel,  $J$  even) and ortho-H<sub>2</sub> (spins parallel,  $J$  odd)

In continuous (“C”)-type shocks, the gas is slowly decelerated while the conversion between ortho and para molecular hydrogen is happening

→ We expect a spectral shift between the even- and odd- $J$  lines

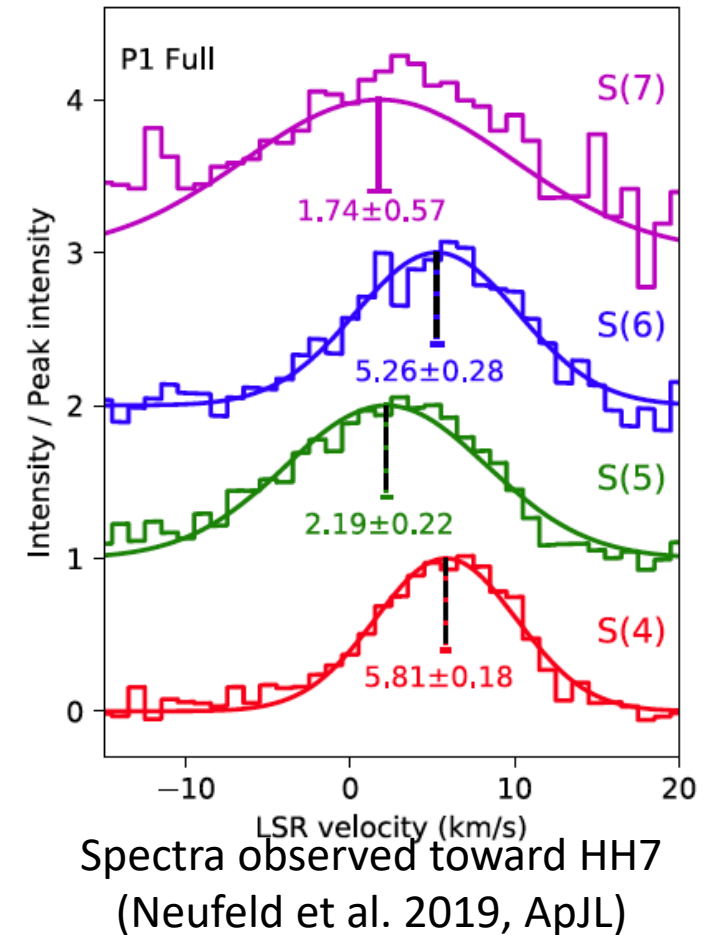


Pierre Lesaffre predictions  
(Paris-Durham shock code)



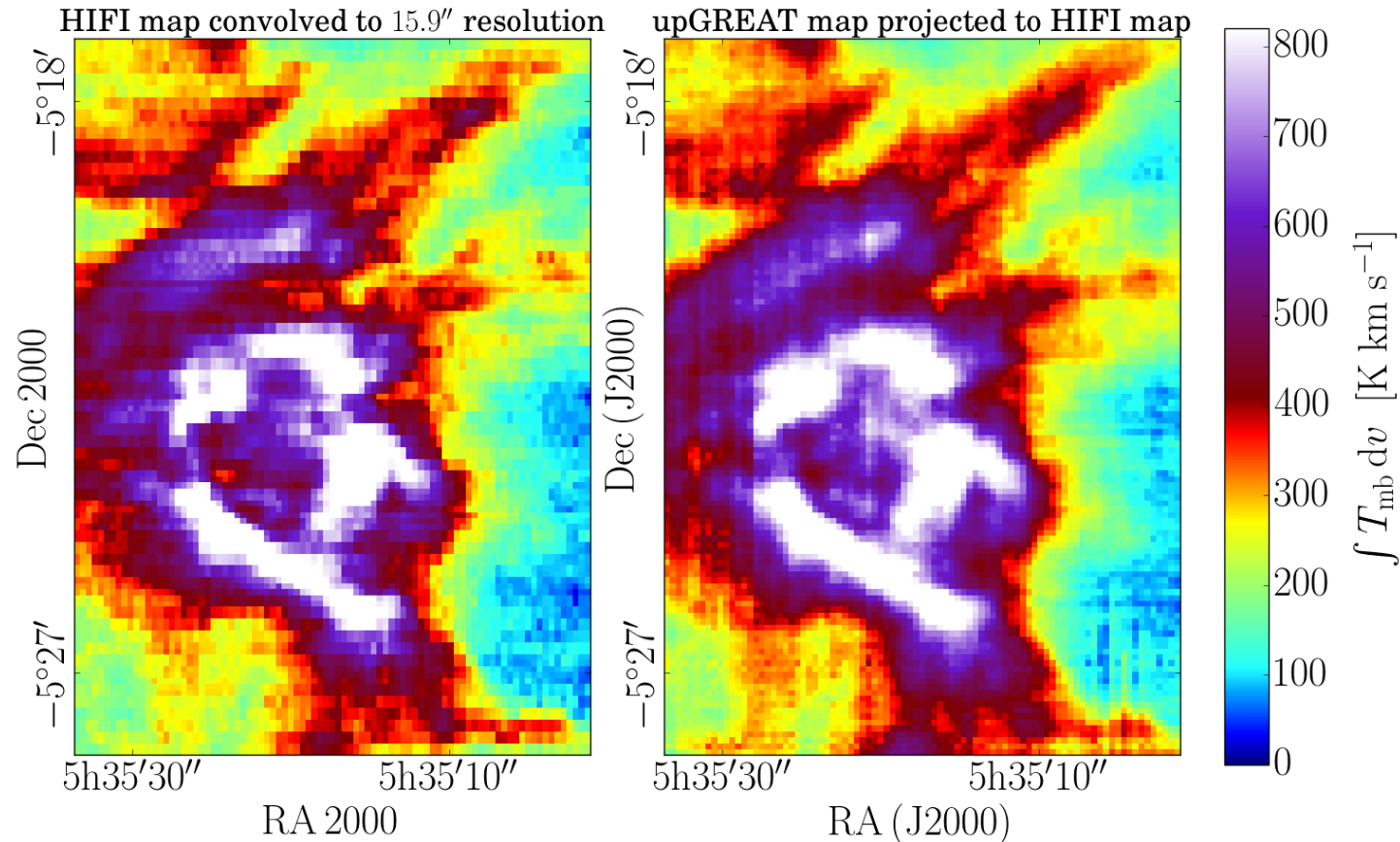
# Prediction Confirmed with SOFIA/EXES

- To test this prediction, we need very high spectral resolution in the 5 – 8  $\mu\text{m}$  region
- EXES, with  $\lambda/\Delta\lambda = 80,000$  and an operating altitude of 41kft, provided a unique opportunity to search for the predicted ortho-para shift





# Alexander Tielens: SOFIA's upGREAT View of Orion

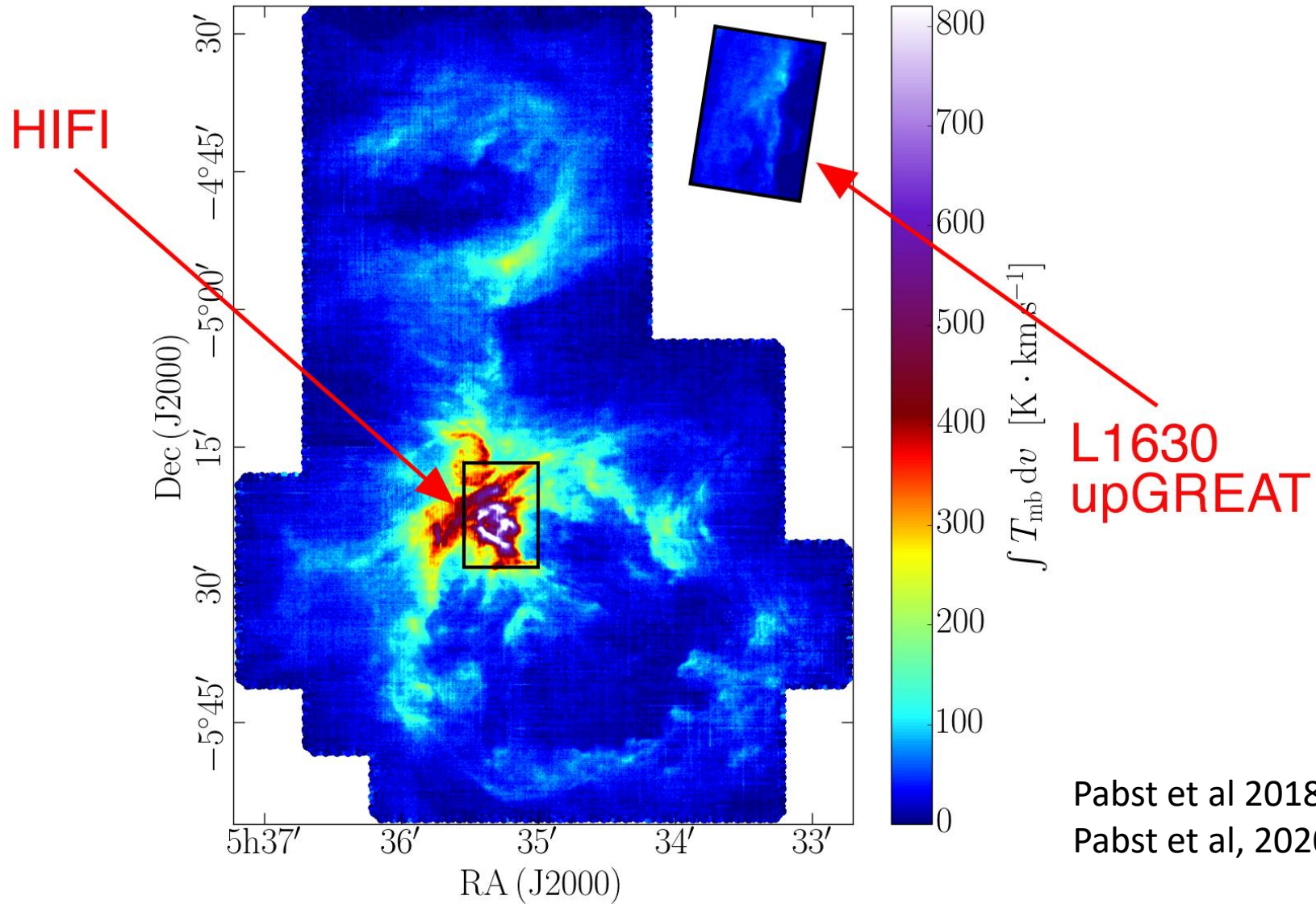


HIFI/Herschel  
9 Hours

upGREAT/SOFIA  
~35 minutes

Goicoechea et al, 2015, ApJ, 812, 75  
Higgins et al 2020, to be submitted

# In Perspective

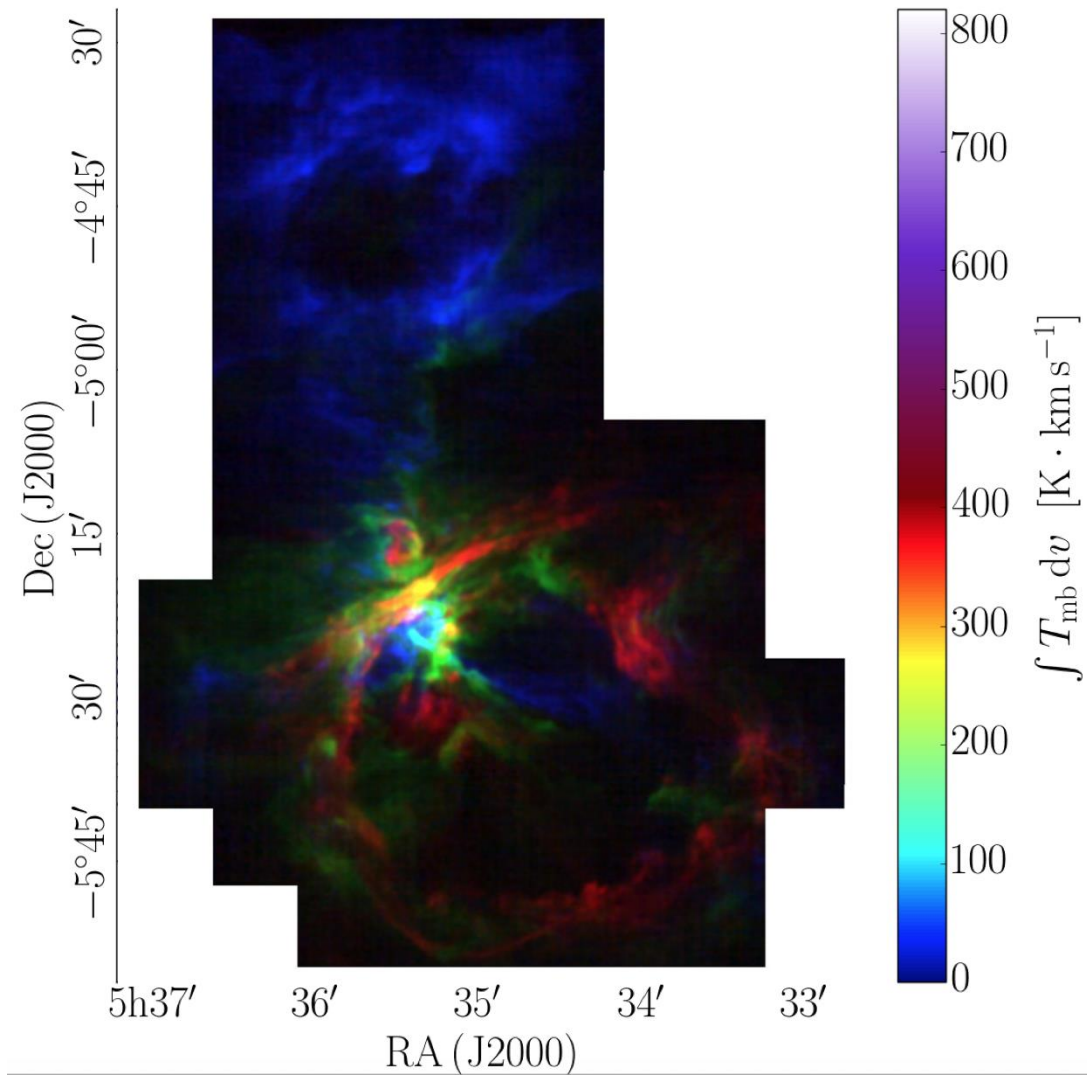


Pabst et al 2018, Nature, 565, 618  
Pabst et al, 2020, A&A, in press

# In Perspective



Cornelia Pabst





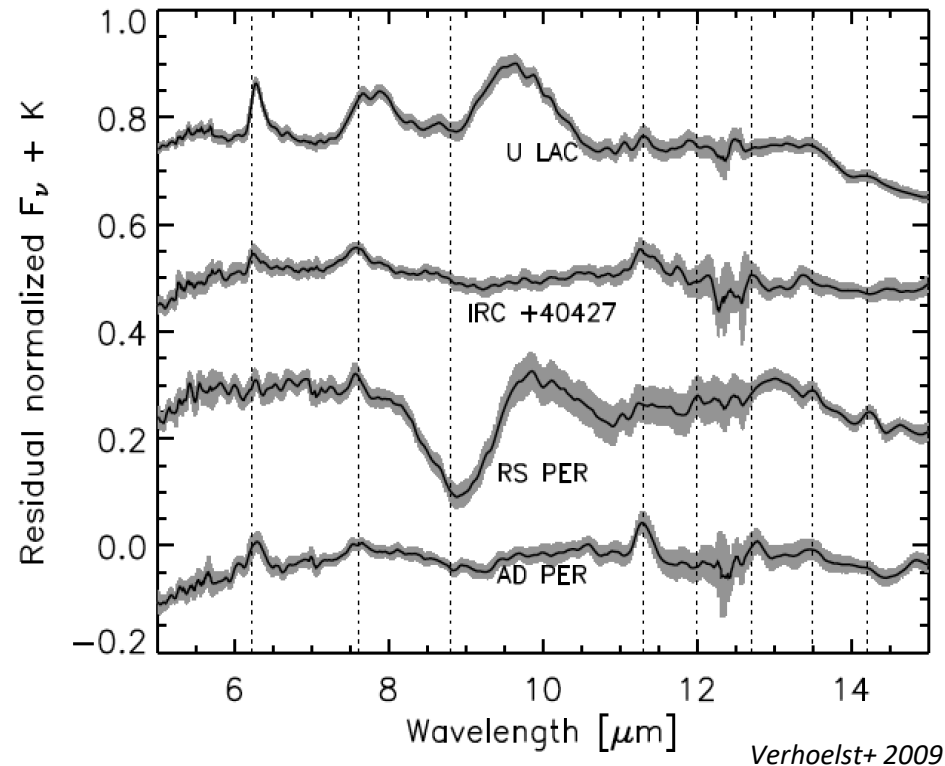
# Emily Levesque: Research for a book on the adventures of observing



- Visits to Palmdale and New Zealand
- Flight, observations and aurora over Antarctica
- Thank you to everyone who made this happen!

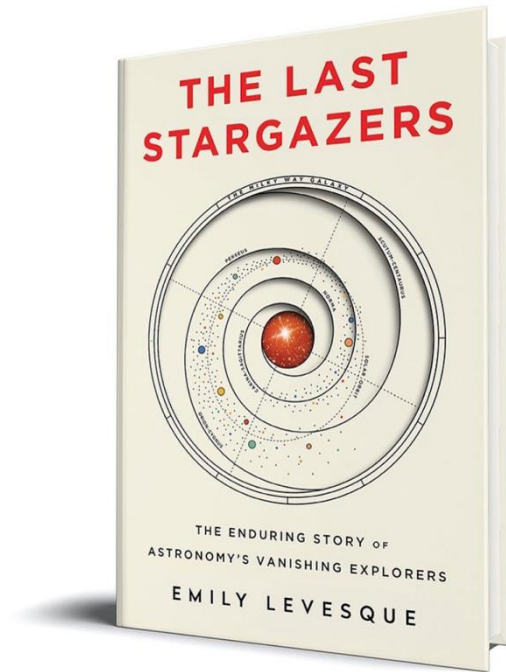


# Mid-IR spectroscopy of the dust around red supergiants



- Content and distribution of circumstellar dust
- RSG-driven contributions to ISM and enrichment
- Mass loss and environments of supernova progenitors

# From Chapter 8, “Flying with the Stratonauts”:



Telescope operator Emily Bevins hit on a description of SOFIA that struck me as perfect. “It’s like a symphony,” she explained, with multiple well-rehearsed groups of people each contributing their own meticulously prepared parts to create a complex but cohesive piece of music.



# SOFIA Legacy Programs: Galactic Center mapping Matt Hankins

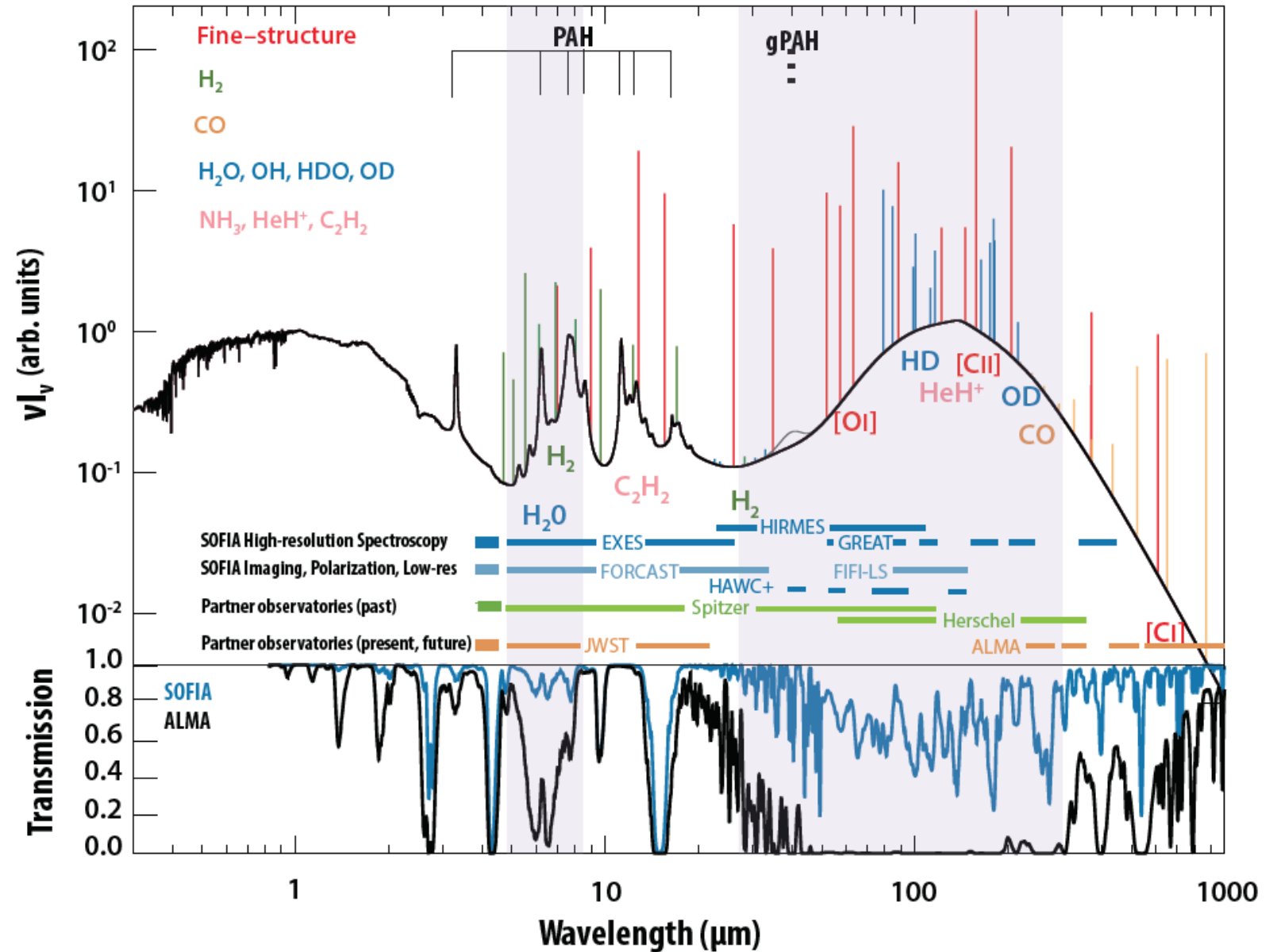


# Vision for SOFIA's Science Mission Operations

- SOFIA holds a critical unique science capability for astronomers



# SOFIA's Science Capability



# Vision for SOFIA's Science Mission Operations

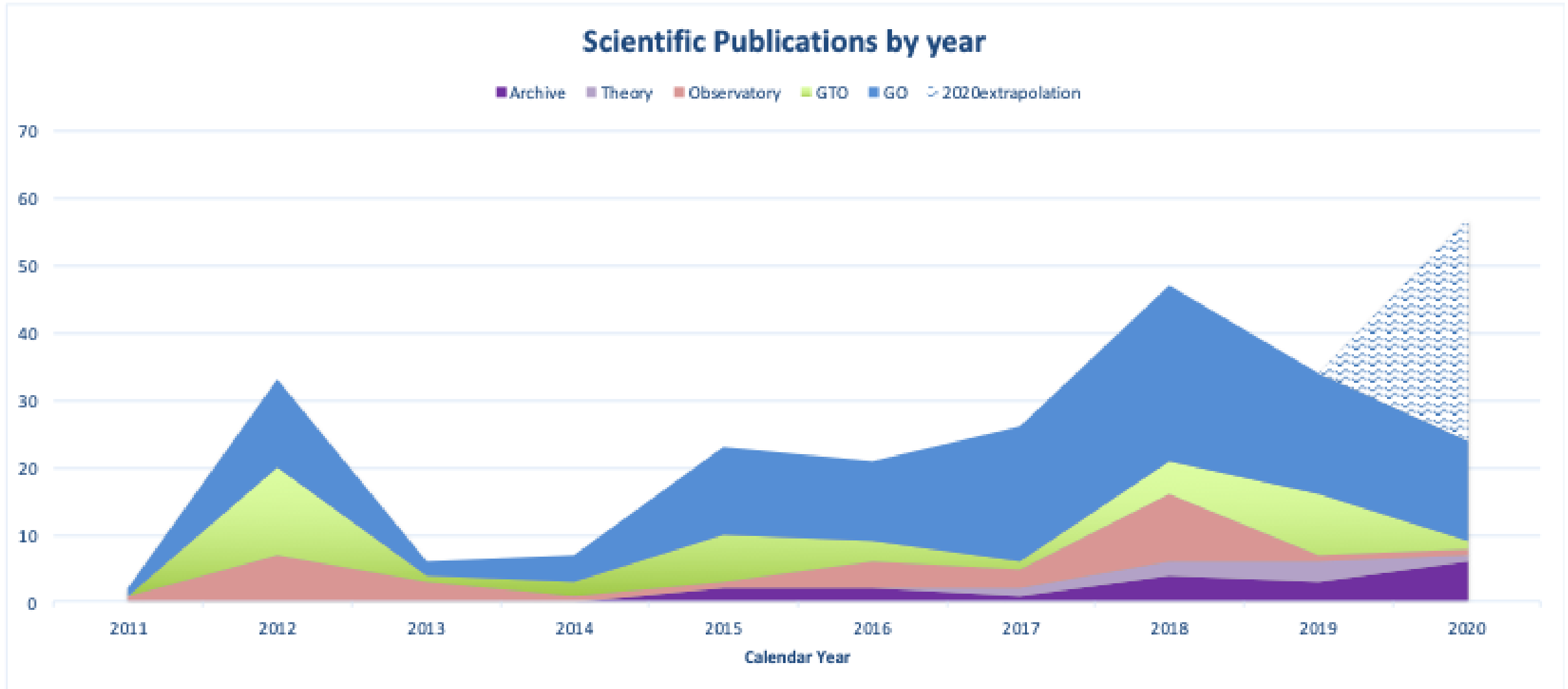
- SOFIA holds a unique, critical science capability for astronomers
- SOFIA has a hard working and dedicated staff – protocols are in place to operate this complex observatory



# Vision for SOFIA's Science Mission Operations

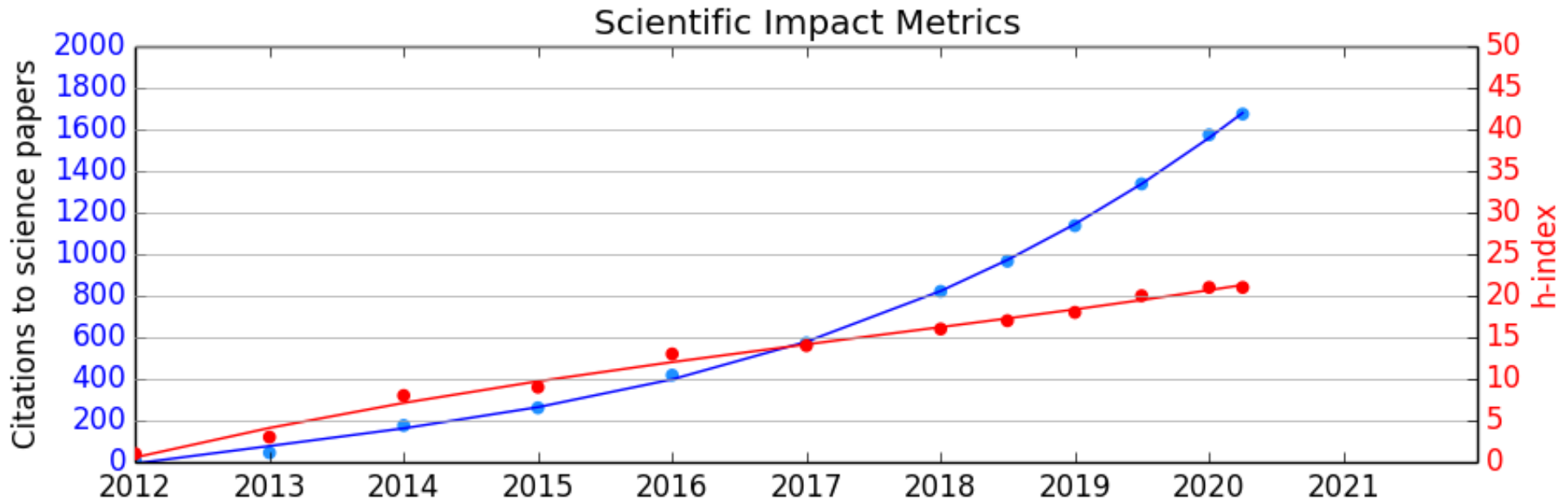
- SOFIA holds a critical science niche for astronomers
- SOFIA has a hard working and dedicated staff –protocols are in place to operate this complex observatory
- FMR provides clear recommendations for improvements
- SOFIA needs to invest and emphasize science, science, science - SMO's domain
- Community building is essential to SOFIA's future
- SOFIA must form partnerships on science with other NASA great observatories and assets to improve community engagement
- SOFIA is working towards an automated data base for SOFIA metrics

# Science Metrics: number of publications



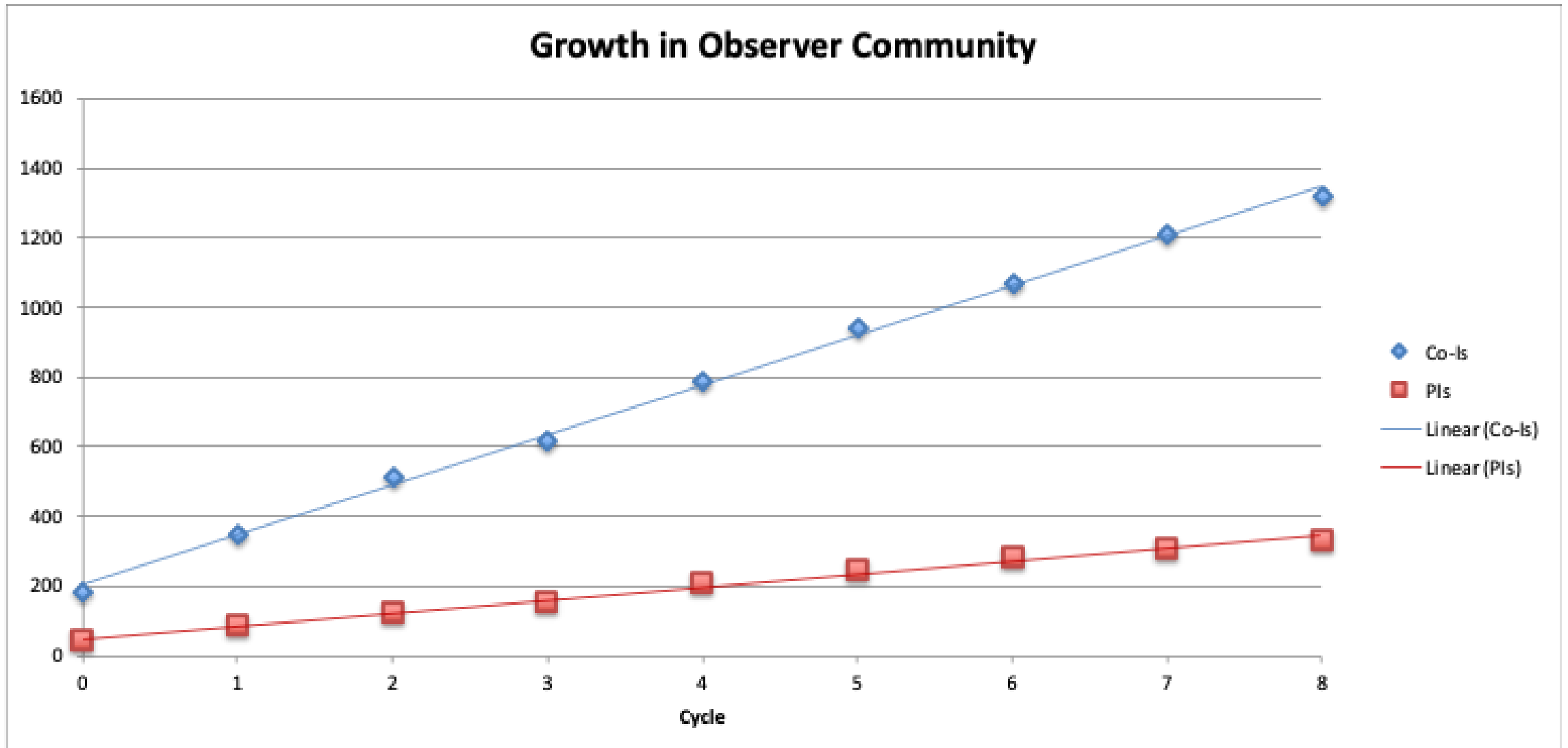


# Science Metrics: Impact



	1/1/12	1/1/13	1/1/14	1/1/15	1/1/16	1/1/17	1/1/18	6/30/18	1/1/19	6/30/19	1/1/20	3/30/20	6/30/20
Citations	8	45	176	261	418	573	821	966	1137	1338	1574	1674	
h-index	1	3	8	9	13	14	16	17	18	20	21	21	

# Unique PIs and Co-Is grow steadily



# Strategy for publications:

- SOFIA observations provide unique data => discovery publications
- Better program selection
  - Higher impact legacy programs
  - Improved technical evaluation process
- Improve user and community support:
  - Higher completion rate, 80% goal
  - Decrease delivery time to get data to GO/Archive
  - Have a “Friend of the Project”

Measures	Productivity: Annual Publications
FY19	36
FY20- current #	33
FY20 Year-End Target	45
SMO goal by 2022	75
FMR goal by 2022	150

# Strategy for publications:

- Increase community participation in SOFIA –
  - IRSA archive,
    - ADAP funded programs
  - legacy programs to fill archive
  - modify call for proposals
    - Shorten proprietary period
    - Increase collaboration with other observatories
- ADAP successful proposals in FY20:
  - Goldsmith/JPL: SOFIA [OI] kinematics & abundance
  - Megeath/U Toledo: Protostellar Variability
  - Pineda/JPL: Electron Density & Nitrogen Abundance

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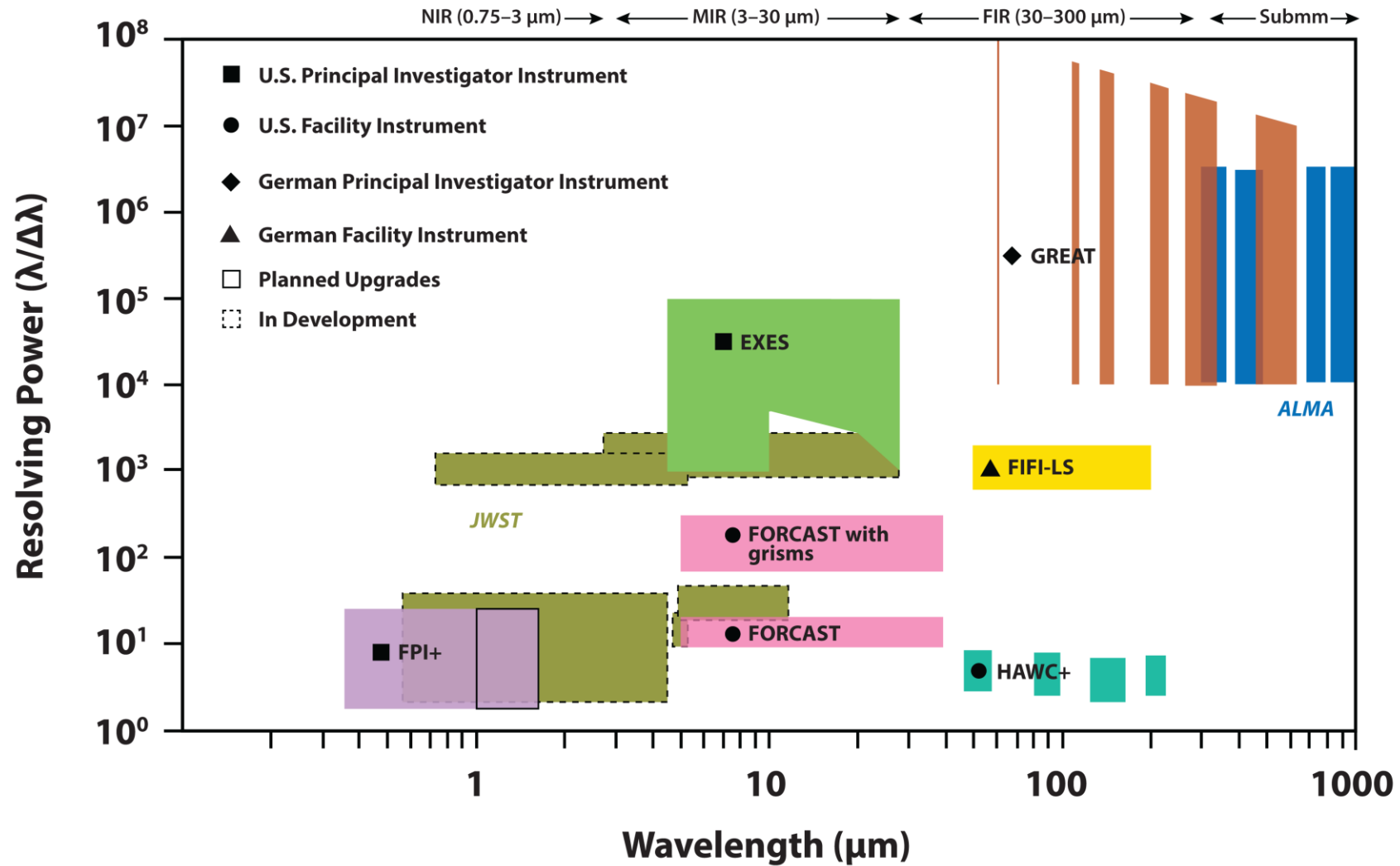
# Legacy Proposals

- Legacy proposals are important to the astronomy community and are part of our Cycle 9 call.
- Build up the archive for ADAP proposals
- Virtual Legacy workshop: June 30 11:00 am to 12:30 pm EDT

# Cycle 9 Call for Proposals

- Significant changes from Cycle 8
- To be discussed later in this SUG meeting by B-G Andersson

# The SOFIA Instruments



# Instrument Roadmap

HIRMES instrument development was terminated by NASA.

NASA has charged the SMO to develop an Instrument Roadmap for SOFIA's future (5 to 10 years).

The Roadmap will be discussed later in this SUG meeting by Jim Jackson.



# Observatory Status

- More details to be discussed later in this SUG meeting by Bill Reach
- SOFIA was grounded mid-March to June in response to covid-19
- Some SOFIA work has begun as NASA Ames and Armstrong research centers begin to re-open. Both are now at Stage 3
- The aircraft will undergo a short mandatory maintenance period before returning to science flights.
- Some Cycle 7 programs could not be executed as planned. All Priority 1 programs, and Priority 2 programs that have been started with significant progress, will be carried over to Cycle 8 or 9.
- Cycle 8 flight planning started, but anticipate flight lost due to COVID
- Working hard on SOFIA return to flight.
  - Identifying flight plans for Palmdale to complete as much as possible of Cycle 8