SOFIA Roadmap

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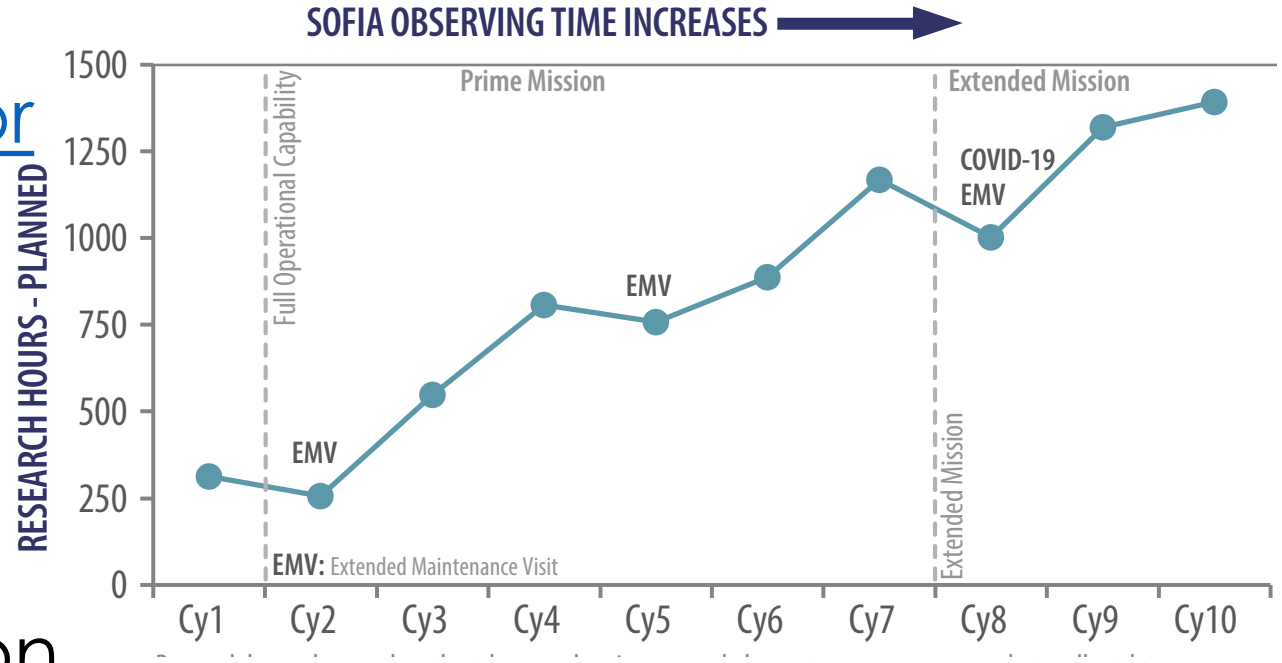
SOFIA Stratospheric Observatory for Infrared Astronomy

SOFIA Science Opportunities

- Cycle 10 Call for proposals: **Deadline was January 28** https://www.sofia.usra.edu/proposing-observing/proposal-calls/cycle-10
- Archival Funding call – May 2022 release, deadline probably July 2022, Stay tuned
- -Last year we awarded $1.8 million for 11 proposals.



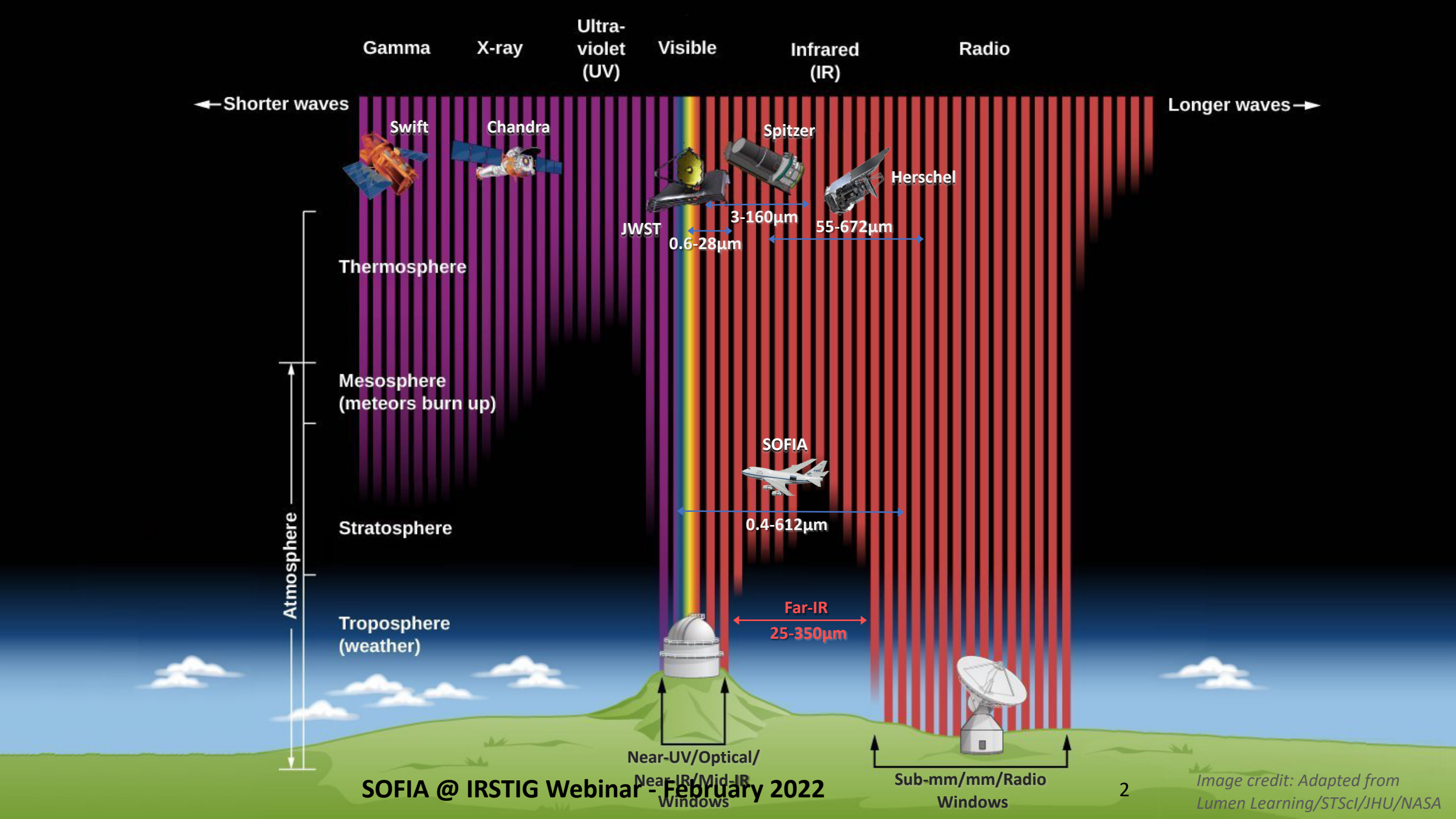


Image credit: Adapted from Lumen Learning/STScI/JHU/NASA

SOFIATelescope

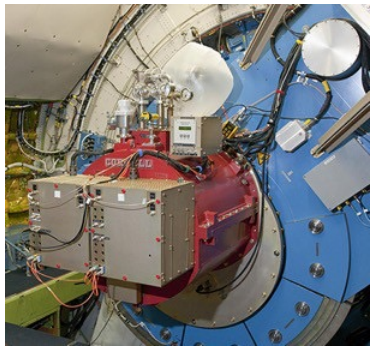
- 2.7 m diameter
- 2.5 m effective area
- Reflective for wavelengths visible through submm
- Nimble, excellent for mapping
- Chopping secondary
- Optical guide camera
- Temperature, 247 K

SOFIA Scientific Instruments

FPI+ Focal Plane Imager Plus

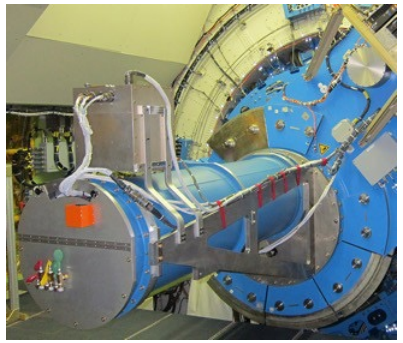
λ = 0.36–1.10 µm
R = 0.9–29.0
Optical Camera, always running!

FORCAST Faint Object Infrared Camera for the SOFIA Telescope



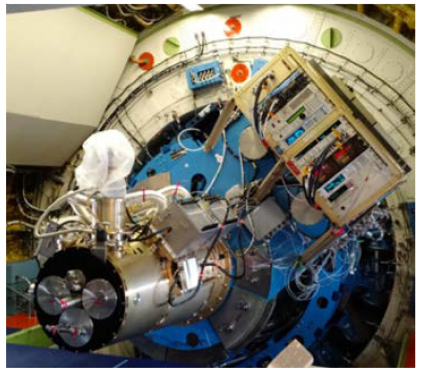
λ = 5–40 µm
R = 100–300
Grism Spectrometer

EXES Echelon-Cross-Echelle Spectrometer



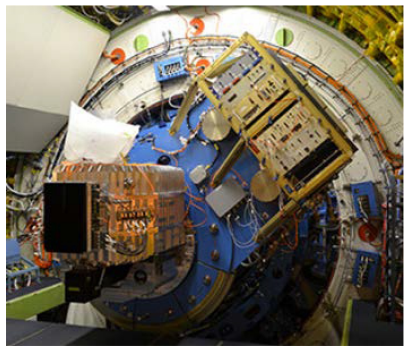
λ = 4.5–28.3 µm
R = 1,000–10^5
High Resolution Spectrometer

HAWC+ High-resolution Airborne Wideband Camera Plus



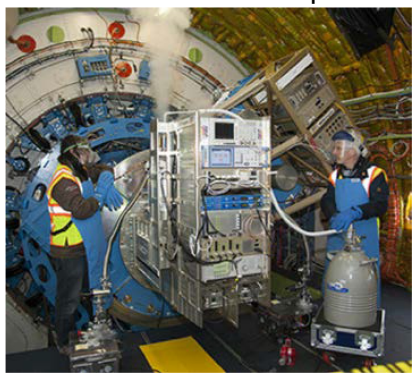
λ = 50–240 µm
R = 2.3–8.8
Bolometer Camera & Polarimeter

FIFI-LS Far Infrared Field-Imaging Line Spectrometer



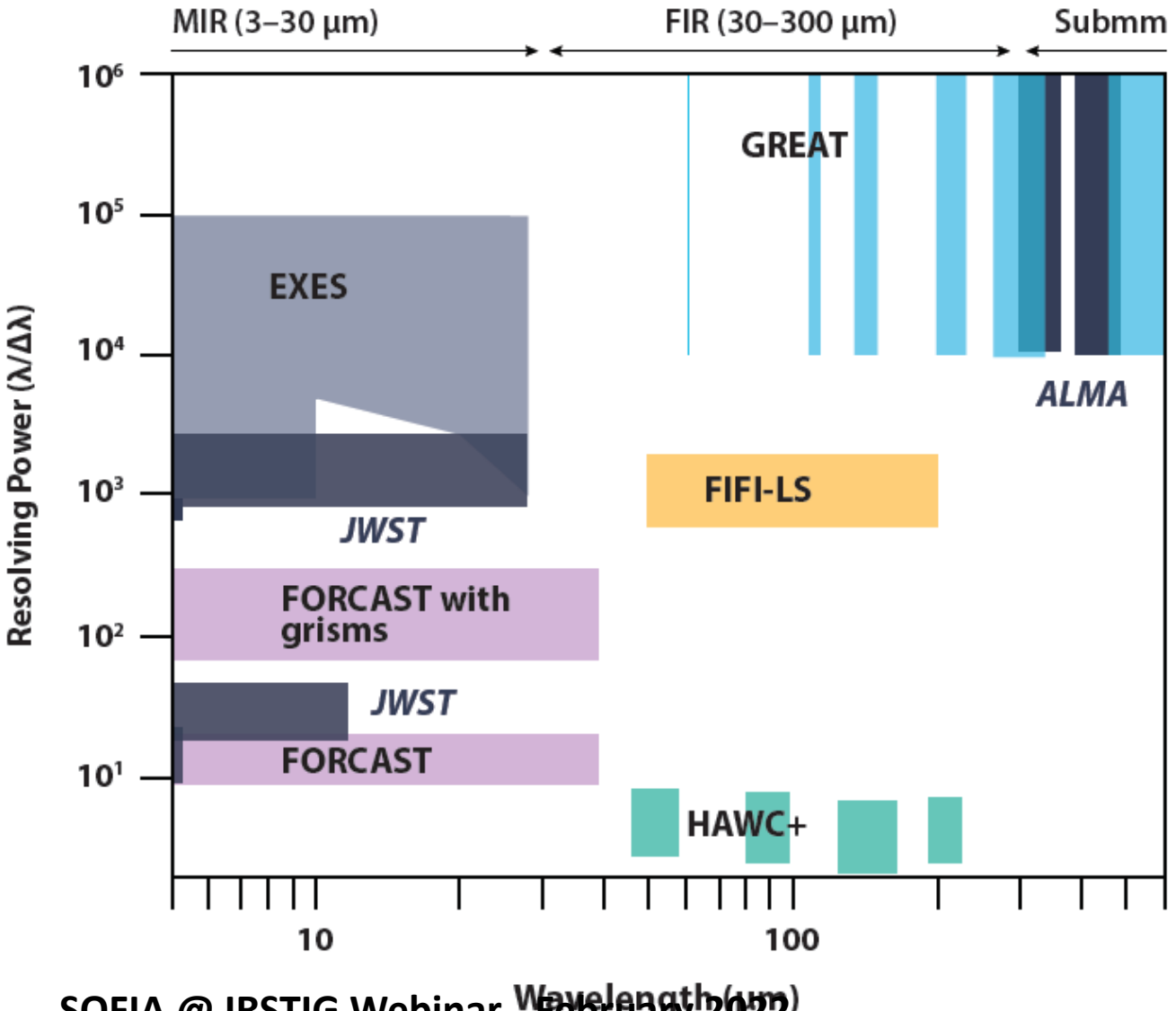
λ = 51–203 µm
R = 600–2,000
Grating Spectrometer

GREAT German Receiver for Astronomy at Terahertz Frequencies



λ = 63–612 µm
R = 10^6–10^8
Heterodyne Spectrometer

SOFIA Instruments are Complementary to JWST and ALMA



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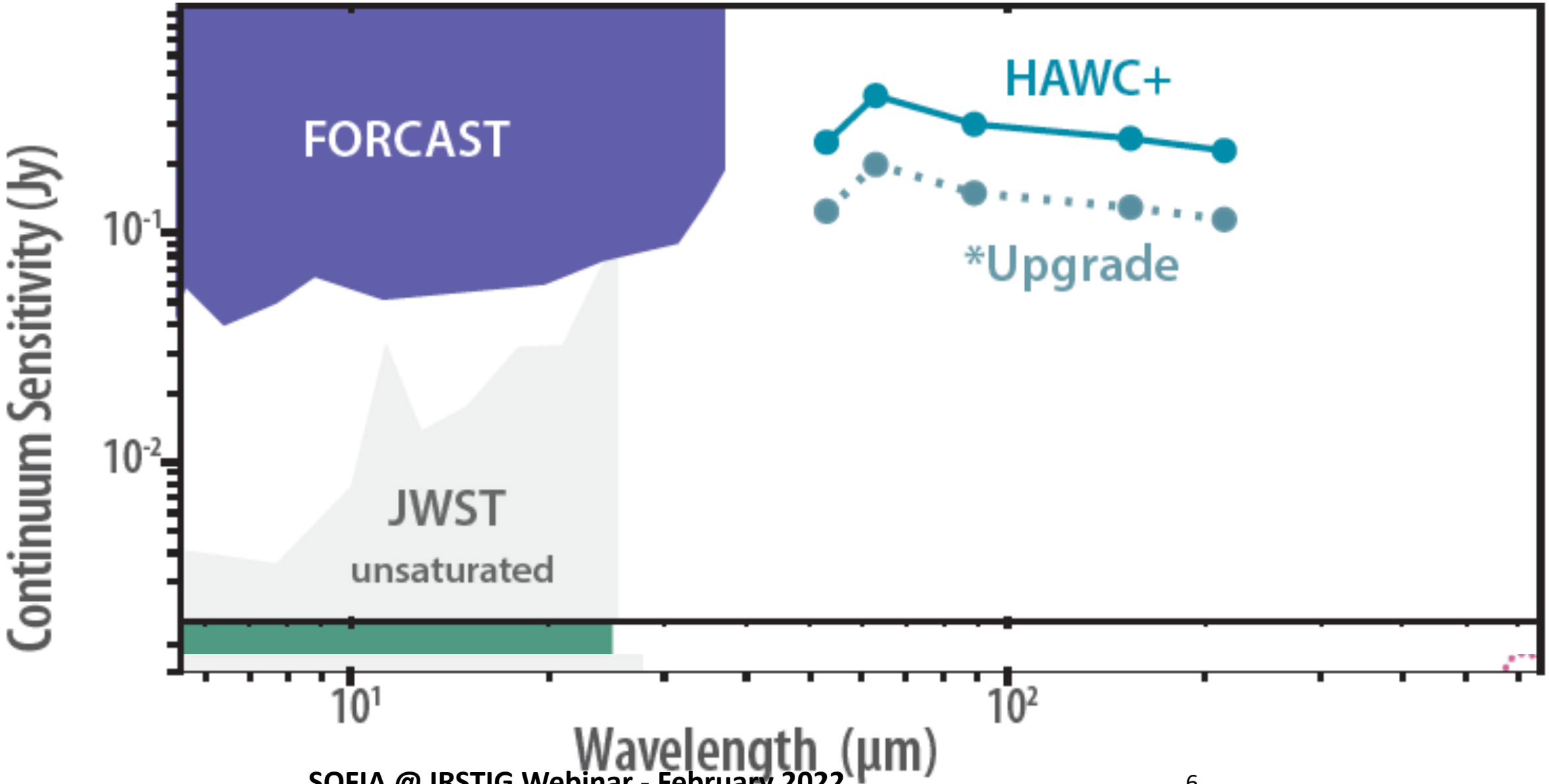

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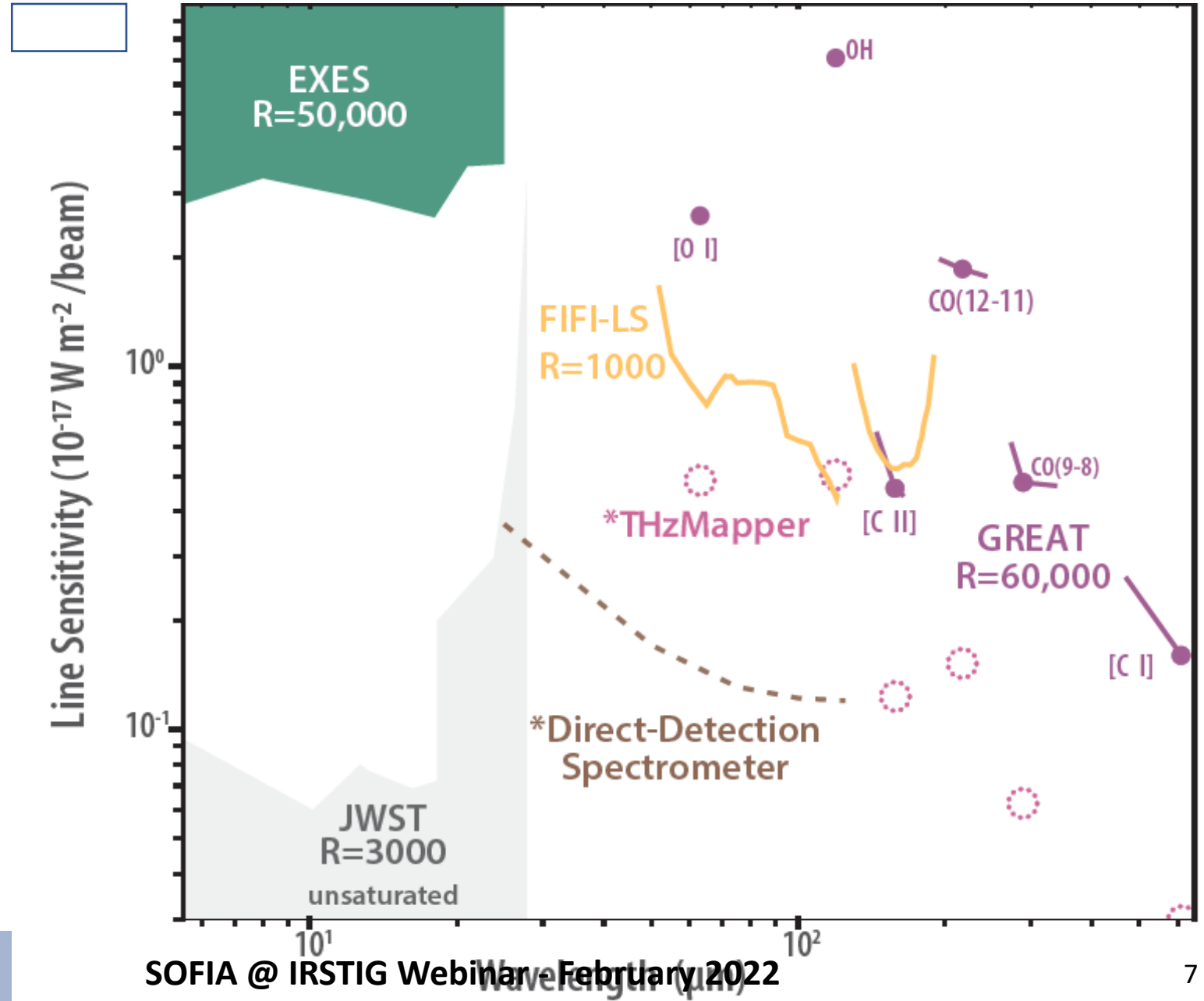
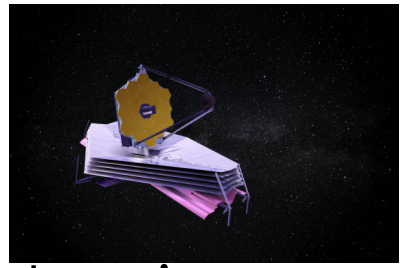


SOFIA and JWST together cover the Universe

https://www.sofia.usra.edu/sites/default/files/2022-01/SOFIA-JWST.pdf

SOFIA

- Only Far-IR observatory
- Ability to fix, update and replace with new instruments to meet new science demands
- Probes bright iconic objects that are too bright for JWST.
- Detailed observations of nearby Universe that calibrate the more distant objects observed by JWST.



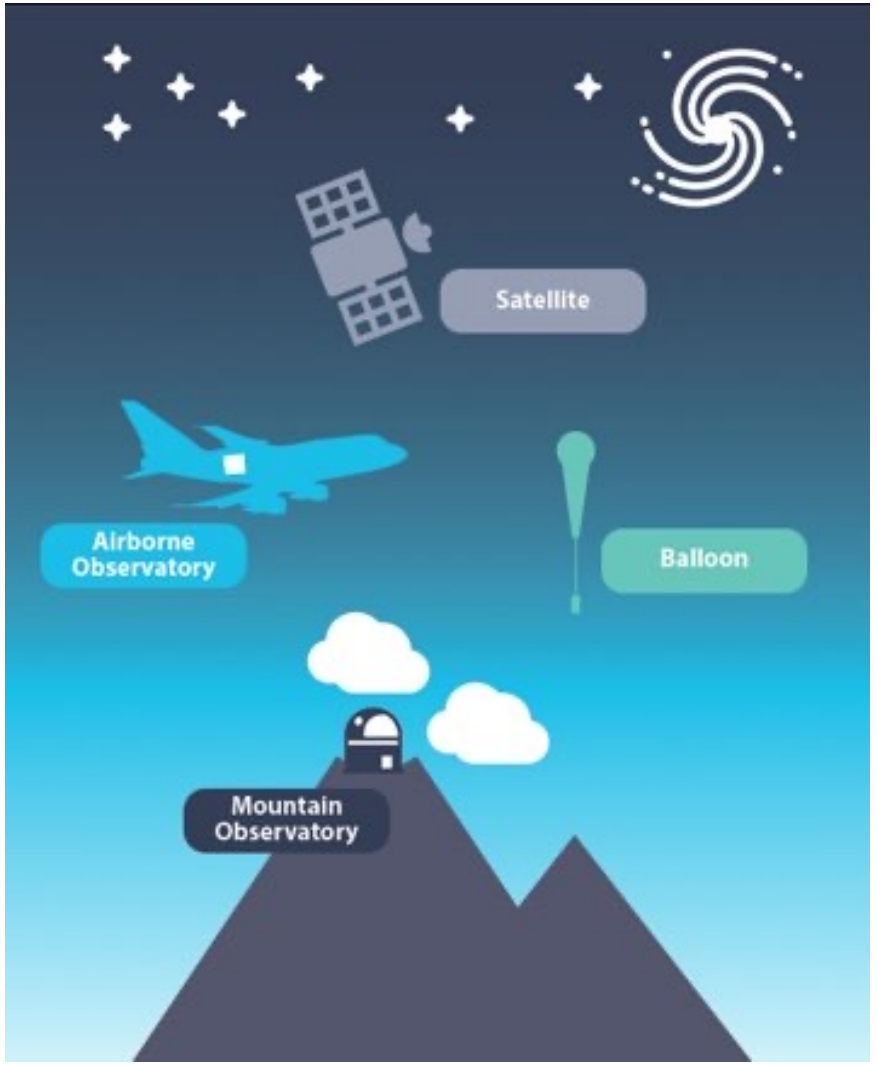
JWST

- Largest space observatory in history working at near and mid-IR wavelengths
- Robust design with 10 yr goal, but not serviceable
- Observe distant universe and faint nearby objects
- JWST offers detailed observations in near/mid-IR that complement what SOFIA finds in the far-IR.

There are 28 SOFIA observing programs that refer to JWST in our queue and we expect more in Cycle 10

SOFIA is an important sub-orbital mission

- Suborbitals such as SOFIA are essential to further science and technology to be used in space missions.
- The balloon program, which is another suborbital portfolio, focuses on PI-driven far-infrared observations
- Far-IR technology developed in balloon platforms can be applied in a more capable instrument on SOFIA which has larger aperture, power, mass and volume envelopes.
- SOFIA offers the only reliable and repeatable suborbital platform
  - Astronomical community proposals direct SOFIA's observational program
  - Instruments can be updated or replaced with new ones
  - Stepping stone between balloon program and space missions
  - Supports a scientifically diverse opportunity for the astronomical community.

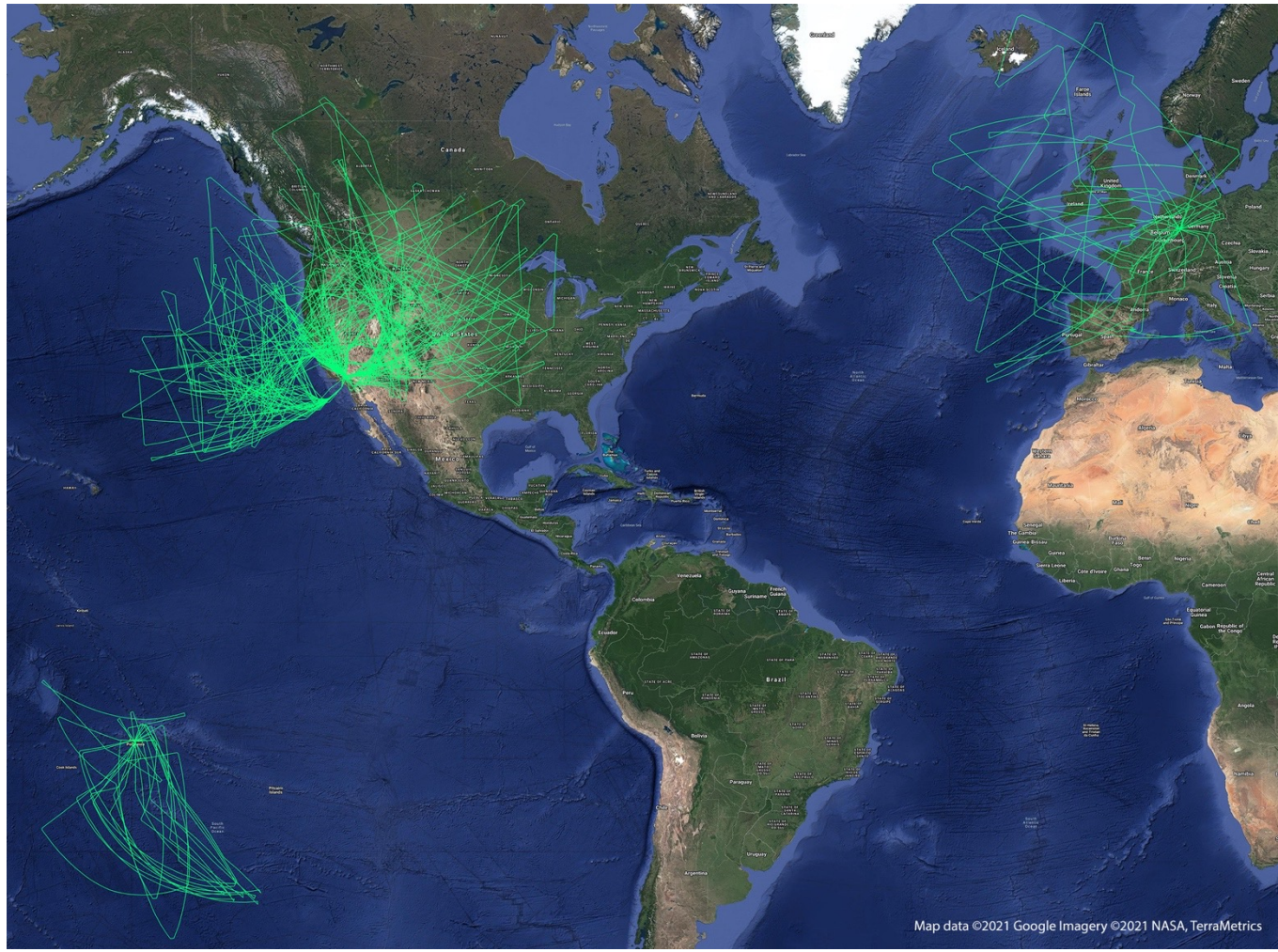


SOFIA Operations 2021

- Crewed mission
- Safely flying during COVID
- Heroic, dedicated team
- Flights from Palmdale
- Deployment in Cologne Germany (Jan.-Feb. 2021)
- Deployment in French Polynesia (July-Aug. 2021)

Follow SOFIA as it flies!

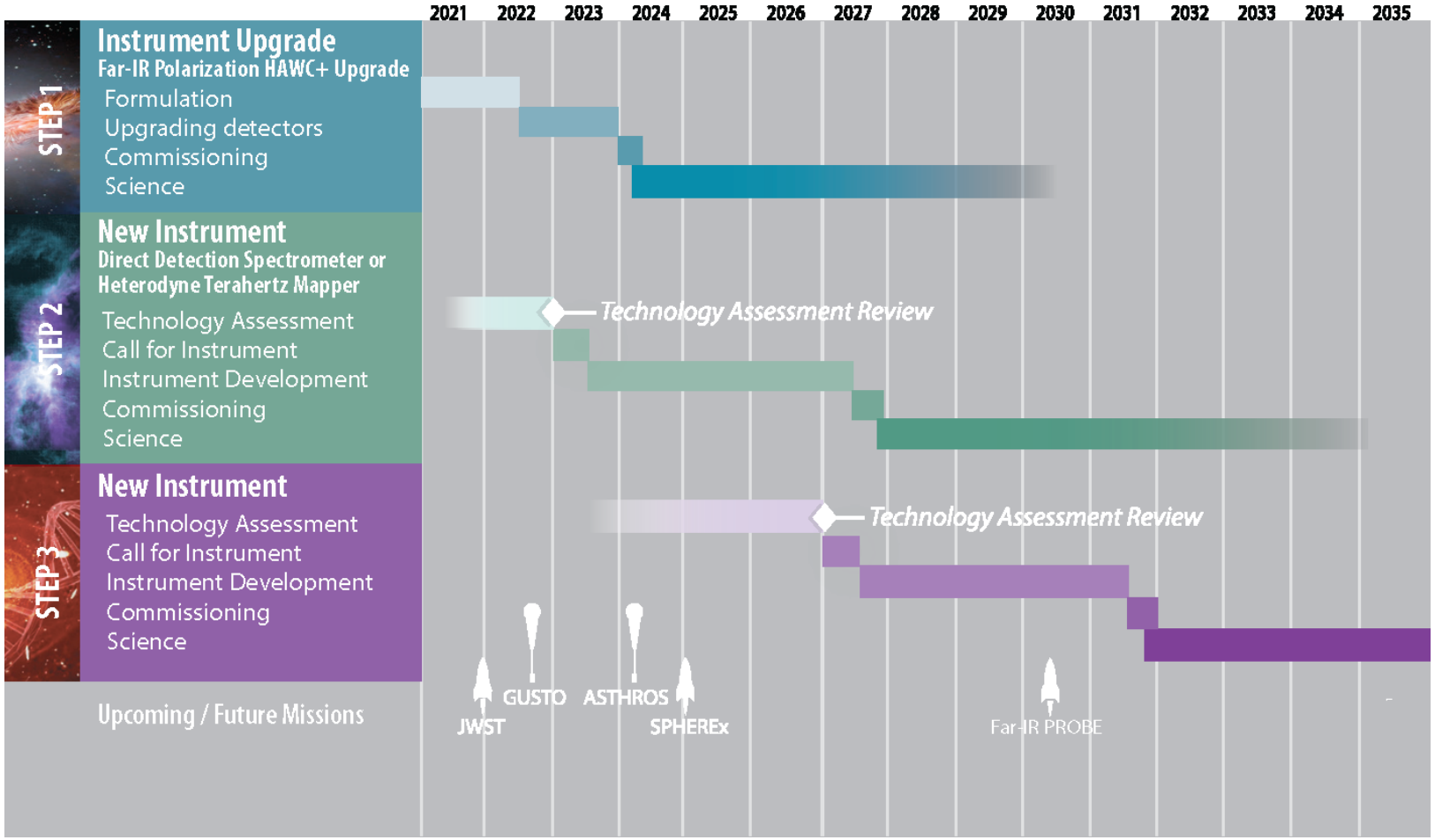
- SOFIA typically flies 4 times a week, Monday to Thursday nights
- You can follow SOFIA as it flies on e.g. https://flightaware.com
- Just type in NASA747



All SOFIA 2021 flight paths

SOFIA Instrument Roadmap

- SOFIA can increase its capability by up to X10 in better sensitivity or mapping speed with new instrument.



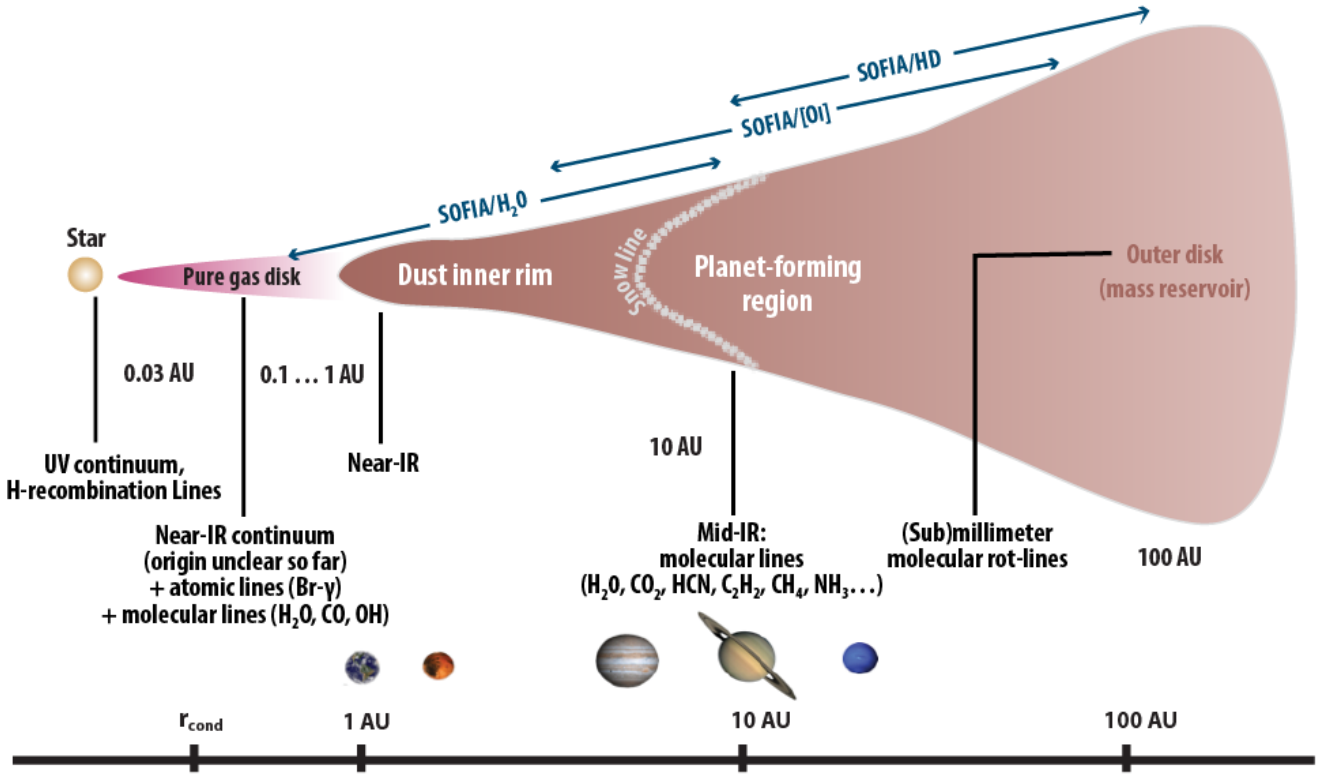
https://www.sofia.usra.edu/sites/default/files/Other/Documents/instrument-roadmap-public.pdf

Instrument Roadmap: Step 1

- Replacing the HAWC+ detectors will increase the mapping speed for magnetic fields by a factor of up to 4
- Formulation phase that has funded GFSC (TES) and NIST (MKIDS) for detector replacement.
- Late spring/summer

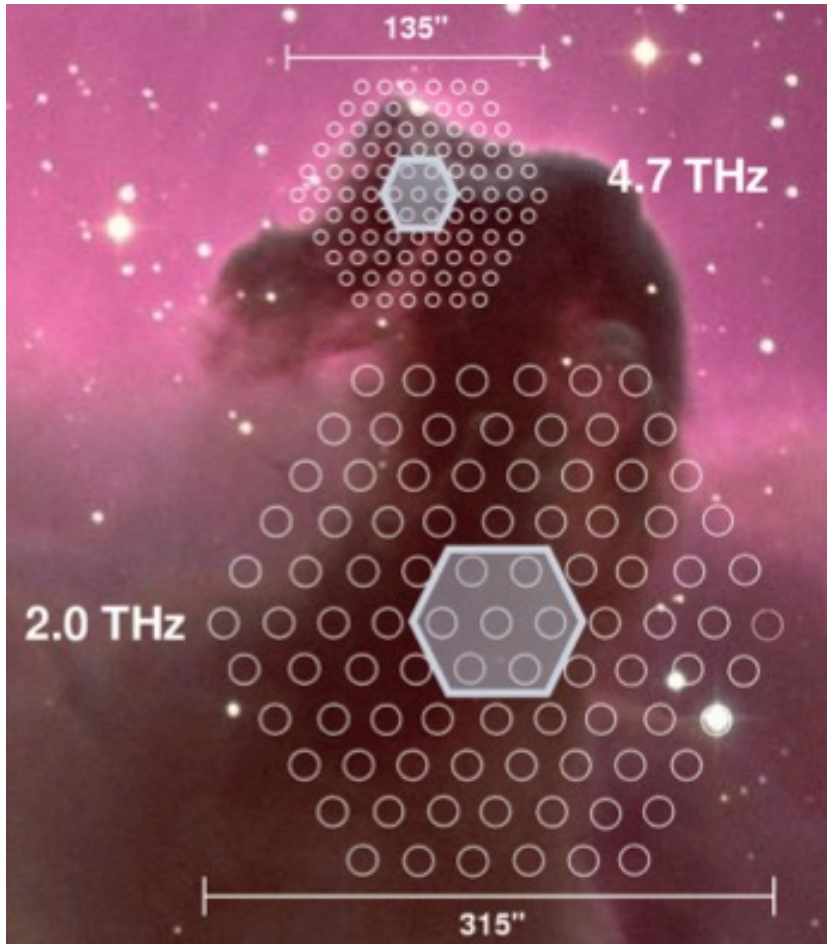
Step 2 Instrument: Concept 1

- Direct-detection 30-120 micron spectrometer
- Measure mass of protoplanetary disks using HD as a proxy for H_2



- Detector sensitivity improvements, x10 required:
  - Transition Edge Sensor (TES) detectors
  - Kinetic Inductance Detectors (KIDs).

Step 2 Instrument: Concept 2



- Terahertz Mapper: 100-pixel Heterodyne Array
- Build on the success of the GREAT instrument
  - 13x faster mapping speed
- Utilize SOFIA's large focal plane
- Complementary to balloon surveys (e.g. GUSTO)

Decadal context for SOFIA

- As mentioned Monday, SOFIA science addresses one half of the Astro2020 decadal science priorities.
- Astro2020 outlines the need for a technology maturation plan for the next set of Great Observatories
- One of these Great Observatories is an IR/FIR observatory like the Origins Space Telescope mission concept
- How can we use SOFIA to help us achieve the Astro2020 vision?