



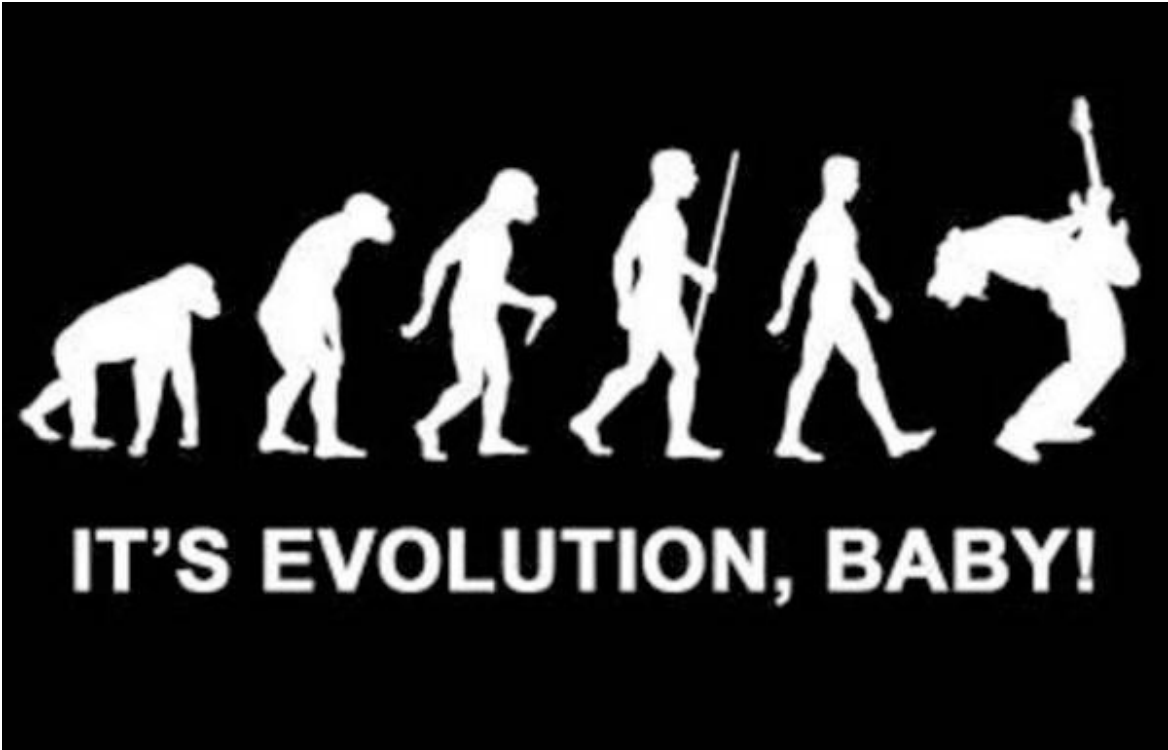
Evolution of the SOFIA Science Instrument Suite

William T. Reach

SOFIA Users Group #9

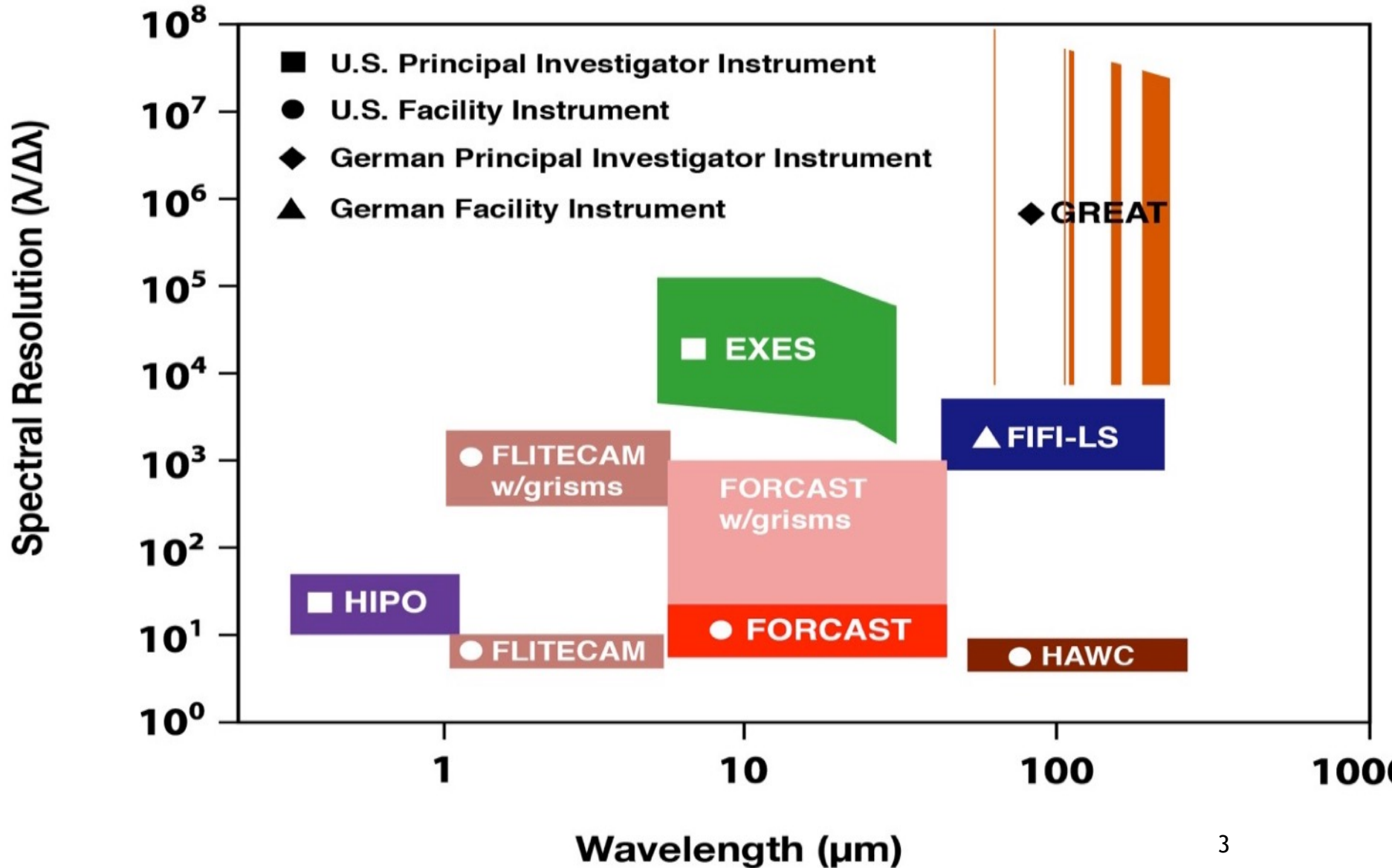
May 2016

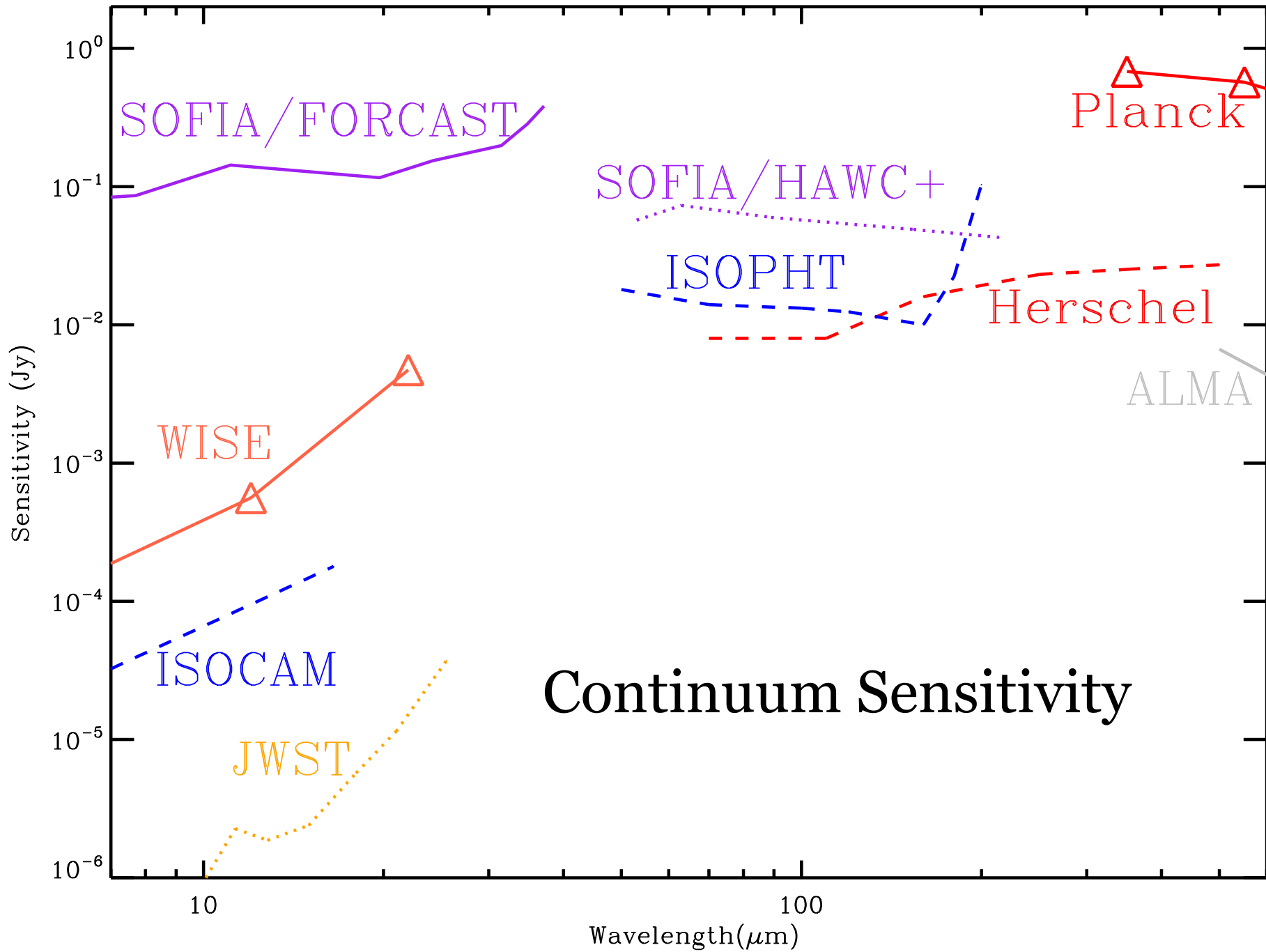


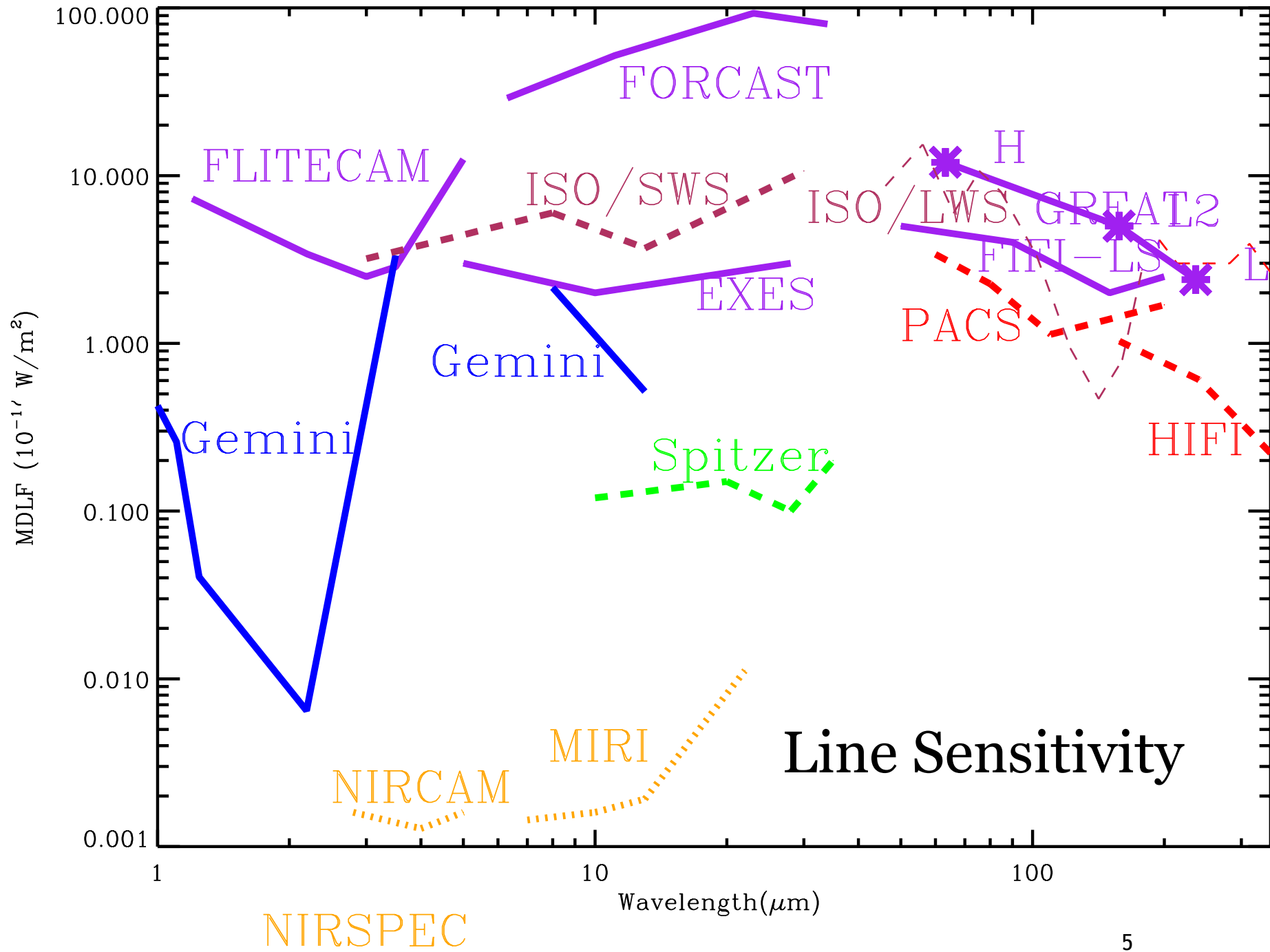




SOFIA's Scientific Instruments









New Science Instruments

- NASA SI Development
 - intends to select 1 Third generation, Facility Science Instrument, to be completed in 2018
 - Future SI Calls are anticipated in notional long-term budget planning, with 4-5 years cadence
- DLR SI Development
 - GREAT continues to evolve:
 - upGREAT: 14-beam L2 array is operational and offered Cycle 5
 - H array: 7-beam H array commissioning now
 - downGREAT: Low-frequency extension planned



Minor Upgrades

- Upgrades were not part of the 3rd generation SI call
- The SOFIA Program can upgrade current SI from within our budget
- Examples of minor upgrades known to be worthy of consideration:
 - Narrow filters in HAWC+ for [C II] and [O I], which were descoped from the 2nd generation proposal for HAWC+
 - New detector for FLITECAM to improve QE, cosmetics, electronics
 - FIFI-LS filter to enable wider wavelength coverage

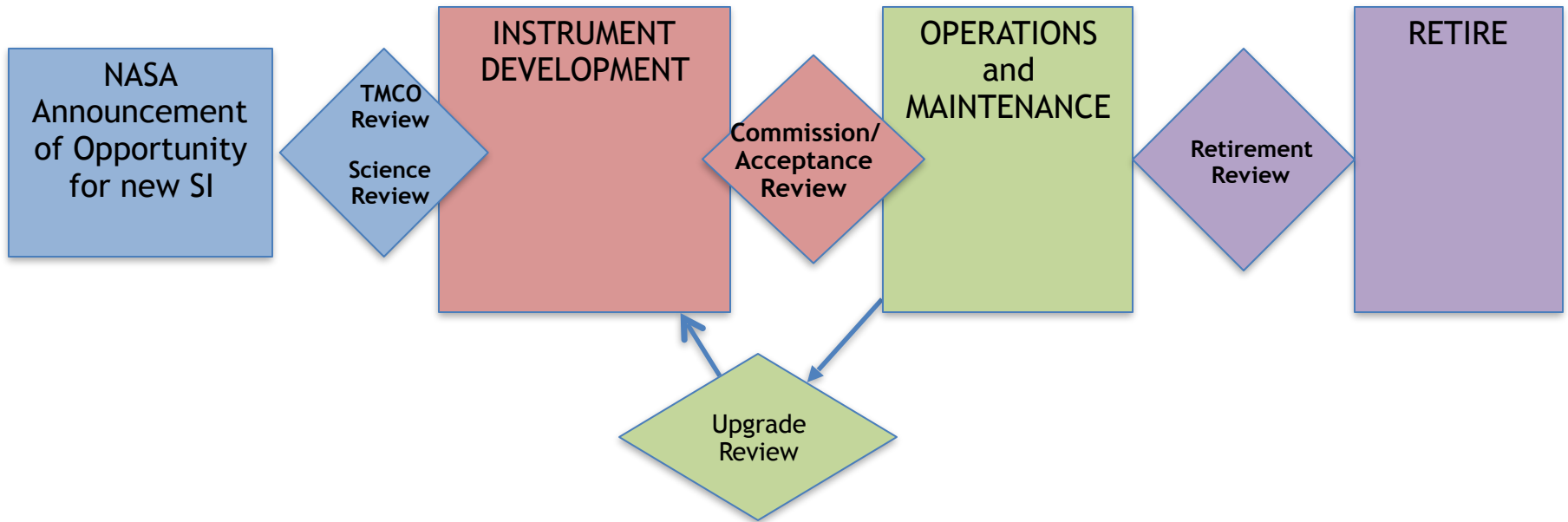


Science Instrument Offerings

- Present status: For Cycle 5, we offer 6 SI
 - Specific modes are not offered every Call
 - HIPO not available in Cycle 5
 - Removed cross-dispersed grisms (insufficient sensitivity to be worth the time spent calibrating) from Cycles 4-5



Science Instrument Life Cycle Flow Chart





SI Retirement

from: SOFIA Concept of Operations

-
- Each SI should reliably contribute high quality science to maximize SOFIA's scientific return
 - Retirement decisions are based primarily on scientific productivity
 - PI instruments can be retired based on excessive maintenance requirements
 - Facility SI will be retired after a time at which the cost of their maintenance and support is no longer commensurate with their ability to competitively deliver science



SI Retirement Criteria

- SI performance has degraded significantly from original capabilities
- SI has failed and requires costly repairs
- SI reliability significantly reduces successful flight hours
- SI operating constraints significantly limit science return
- SI scientific contribution has been marginalized by newer operational technologies, competing observations, or other factors
- The NASA Strategic Plan has restructured relevant scientific priorities



Retirement Process

- SMO Director and Project Scientist co-chair a review for any SI that is not scientifically productive
 - input from the Instrument Team, the general observer community, SMO science and operations staff, and others
- If review recommends retirement, SMO Director and Project Scientist communicate recommendation to NASA HQ (Program Scientist and SMD Astrophysics Director) for US instruments, or to DLR for German instruments



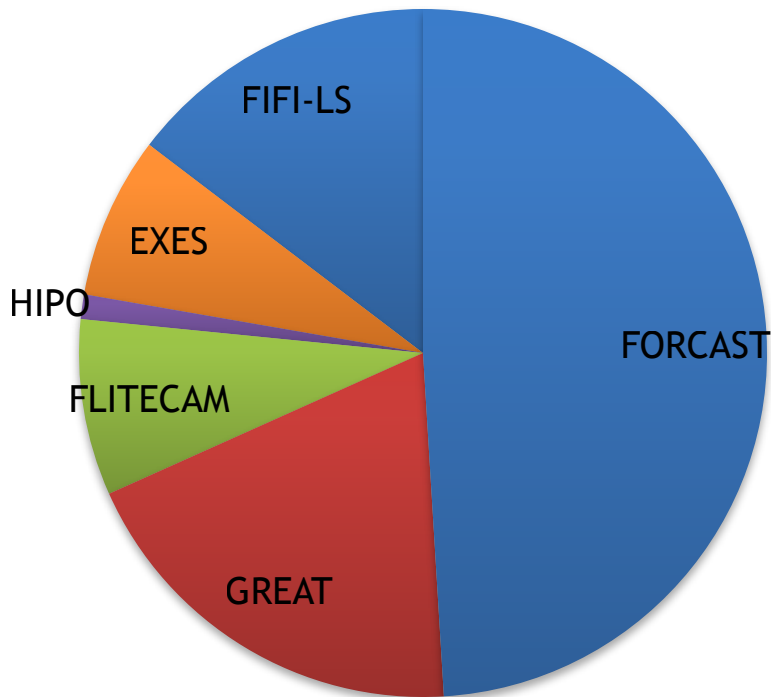
Current Status

- Considerations for continuing to offer an SI
 - Prior call proposal pressure (*next slide*)
 - Cost to continue to offer SI (balanced by SOFIA Program Office)
- Program judgment (**including external committees**) of future potential
 - August 2015: SI Analysis Group evaluation
 - May 2016: requests for input from the SOFIA Users Group

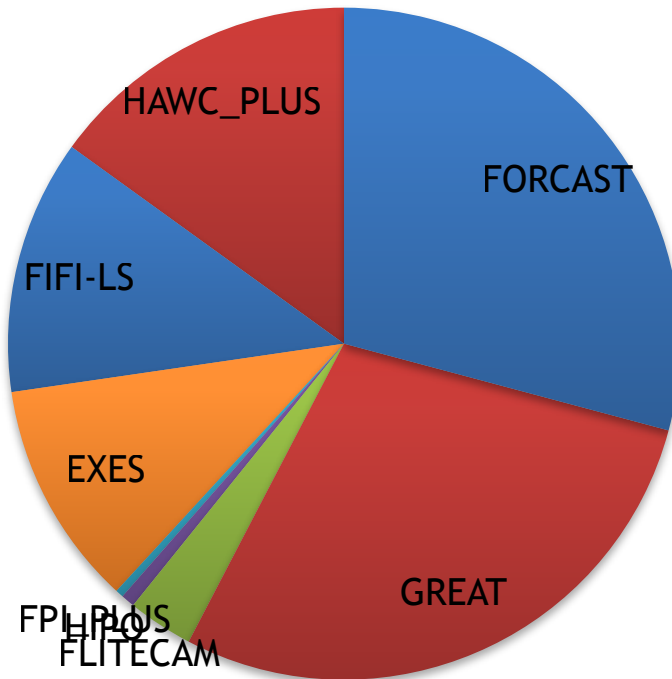


Guest Investigator Demand

Cycle 3 Awarded Time



Cycle 4 Awarded Time





SI Advisory Group Review

- The program convened a review in 2015 July in order to evaluate the current instrument suite. This was a strategic review.
- Chair: T. Roellig for project scientist

Table 1 – Rank Order First-Generation U.S. Science Instruments

| Rank | Name | Science Instrument |
|-------------|-------------|--|
| 1 | FIFI-LS | Field-Imaging Far-Infrared Line Spectrometer |
| 2 | FORCAST | Faint Object InfraRed Camera for the SOFIA Telescope |
| 2 | EXES | Echelon-cross-Echelle Spectrograph |
| 4 | FLITECAM | First-Light Infrared Test Experiment Camera |
| 5 | HIPO | High-Speed Imaging Photometer for Occultations |



Summary of pros and cons for SIs

| | |
|-----------------|---|
| HIPO | + Enables 2-color occultations from deployed large telescope |
| | - Schedule impact of dedicated flight campaigns |
| FLITECAM | + Enables near-IR occultations from deployed large telescope |
| | - SI is marginally operable; ground & JWST coverage |
| FORCAST | + High proposal demand; well-integrated and works smoothly |
| | - WISE survey; ground & JWST; offered 4 cycles average science |
| EXES | + Potential: unique phase space of high-resolution spectroscopy |
| | - Limited target pool and community; N-band from ground |





Notional Evolution of SI suite



| 2016 | | | | | 2017 | | | | | 2018 | | | | | 2019 | | | | | 2020 | | | | | 2021 | | | | | 2022 | | | | | |
|---------|---|----|----|----|---------|----|---|----|----|---------|---|----|---|----|---------|----|---|----|---|---------|----|----|---|----|---------|----|----|----|---|----------|---|----|----|----|---|
| M | N | | | | M | N | | | | M | N | | | | M | N | | | | M | N | | | | M | N | | | | M | N | | | | |
| JF | A | MJ | JA | SO | D | JF | A | MJ | JA | SO | D | JF | A | MJ | JA | SO | D | JF | A | MJ | JA | SO | D | JF | A | MJ | JA | SO | D | JF | A | MJ | JA | SO | D |
| CYCLE 4 | | | | | CYCLE 5 | | | | | CYCLE 6 | | | | | CYCLE 7 | | | | | CYCLE 8 | | | | | CYCLE 9 | | | | | CYCLE 10 | | | | | |

JWST launch

“distant future”



LEGEND

| | | |
|------------|-------------|-----------|
| commission | nominal ops | last call |
|------------|-------------|-----------|





SOFIA Users Group Request

- Comments on overall scheme for SI suite management?
- Separate reviews will be convened to consider merits of individual SI. Inputs on the process are welcome.