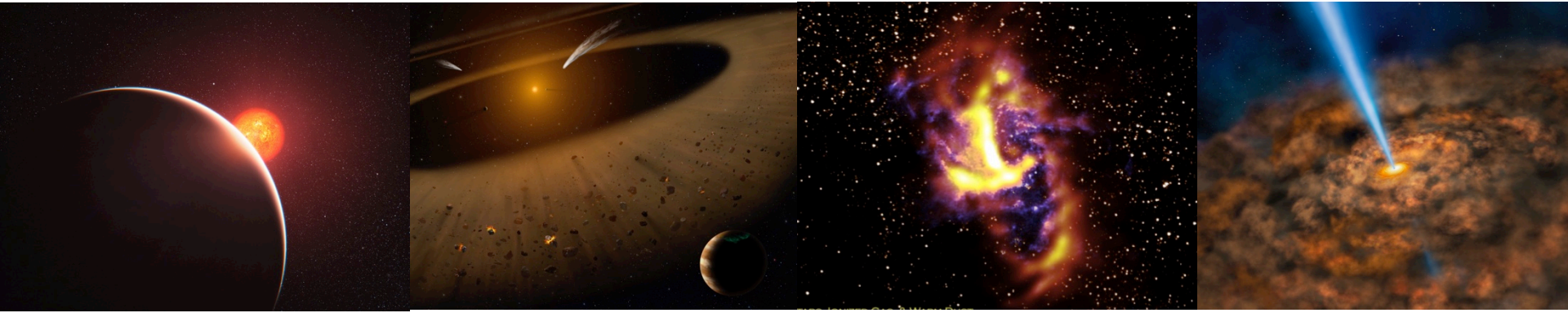

Summary of Recent Science Instrument Surveys

Dr. Thomas Roellig
NASA SOFIA Deputy Project Scientist
SOFIA International Summit - October 8, 2018

Motivation

- Recent external SOFIA reviews have indicated that we may have “too many instruments”. The concern of some of these reviewers is that this complicates the observation scheduling, increases the time tied up in instrument changes, dilutes the science impact of the SOFIA observations by potentially extending the time needed to finish an observing program, and potentially hinders larger-scale science studies.
- The SOFIA new instrument development budget could make use of savings realized by de-commissioning or “taking off-line temporarily” current instrument(s).*
- ~~The SOFIA Senior Review proposal would be strengthened by showing that we have developed and implemented a plan to optimize the science instrument suite as science demand and goals evolve.~~ **OBE but still somewhat valid for 5YSR**
- This was ***NOT*** a cancellation review! It is intended to provide SOFIA management with an independent outside assessment of the future science potential of the current instrument suite.
- **Note: GREAT will remain a German PI-Class instrument and as such, any decisions to upgrade, leave it as is, or retire it will be made by our German SOFIA partners. It is included in this review solely as a point of comparison with respect to the other science instruments.*

The Latest SIAG Review

- The previous SOFIA Science Instrument Advisory Group (SIAG) was convened in July, 2015 – it was time for another review of the SOFIA instrument suite
- The latest review took place on April 3, 2018 and evaluated:
  - EXES
  - FIFI-LS
  - FORCAST
  - GREAT (In all it forms)
  - HAWC+

Review Criteria

- Projected potential for the instrument to produce impactful science within the next five years

- *Proposal pressure (time requested) over the past three annual observing cycles

- *Number of publications and citations resulting from previous observations with that instrument

* *Normalized to time since commissioning*

Review Criteria 2

- Alignment with the SOFIA Science Focus Areas: The Birth of Planets and Stars: Finally Charting the Infall; The Path to Life: Water, Organics, and Dust through Cosmic Time; and Extreme and Hostile Environments: Unveiling Starbursts and AGNs.

- Uniqueness of the instrument in addressing a region of sensitivity/wavelength/spectral resolution/spatial resolution/temporal phase space that is not accessibly by any other current or near-term facility (but only to the extent that this unique region of phase space is expected to yield impactful science), paying particular attention to the potential of JWST.

SIAG Review Board Membership

- Tom Roellig, SOFIA Deputy Project Scientist (Chair)
- Bill Reach, SOFIA Chief Science Advisor
- Judy Pipher, USRA SOFIA Science Council chair
- Matt Greenhouse, SOFIA Users Group chair, SIS member
- Alessandra Roy, DLR
- Alan Rhodes, SOFIA US Science Instrument Development Manager
- Karl Menten, German SOFIA Science Working Group representative

Ex-officio/observers

- Kimberly Ennico SOFIA Project Scientist
- Hal Yorke, SMO Director
- Nancy Rustemeyer, Deputy US Science Instrument Development Manger

Instrument Presentations

- Matt Richter, EXES
- Alfred Krabbe, FIFI-LS
- Andrew Helton, FORCAST
- Rolf Guesten, GREAT
- Darren Dowell, HAWC+

Findings - GREAT

Pros:

- This instrument is very mature, has realized promise, and shows future promise in all of its current configurations.
- GREAT has demonstrated a good track record of publications over the years.

Cons:

- HIRMES may be competitive with the high frequency range of GREAT.

GREAT Cycle 6 Call for Proposals metric: 67.5 submitted for 627 hours, 24.5 accepted for 178 hours

Findings – HAWC+

Pros:

- This instrument shows promise, although it is the least mature of the instruments reviewed here.
- Scientifically this instrument can link its magnetic field measurements with results from other instruments and observatories.
- HAWC+ also has advantage of doing far-IR imaging at a number of wavelengths as well as polarimetry.

Cons:

- The instrument currently has had numerous technical issues, although these have largely been addressed and any remaining continue to be worked.
- Herschel was orders of magnitude more sensitive than HAWC+.
- There has not been much interest in the astronomical community in far IR imaging alone

HAWC+ Cycle 6 Call for Proposals metric: 65.5 submitted for 704 hours, 22 accepted for 156 hours

Findings – FIFI-LS

Pros:

- This instrument is finally getting to the point where it can produce useful results, although it has been on the verge of turning around for a long time and they still have some pipeline issues.
- The blue channel is redundant with HIRMES for galactic science, but is competitive for z>0 science.

Cons:

- The number of FIFI-LS papers is small compared to how long this instrument has been flying. In part this is because this instrument could make use of better-calibrated measurements from the SOFIA water vapor monitor, and also because the team in Stuttgart does not include very many astronomers.
- The Board noted that the data from M51 that was presented still seems not up to the expectations of being significantly better than the heterodyne results from GREAT.
- Both FIFI-LS and EXES have much less proposal demand than the other instruments under review.

FIFI-LS Cycle 6 Call for Proposals metric: 26 submitted for 225 hours, 6.5 accepted for 41 hours.

Findings - FORCAST

Pros:

- Astronomers using FORCAST have published a relatively large number of papers and the instrument is still useful.
- The FORCAST wavelength range is still important for science investigations.
- This instrument may be worth keeping, in storage at least, in case something happens in the time domain.

Cons:

- Although useful, FORCAST was deemed to be more of a workhorse instrument than one that will allow impactful new problems to be investigated. It was noted that this instrument will be partially be hobbled by JWST in three years.
- The Board noted that many ground-based facilities have deleted their similar mid-IR instruments because of a lack of community interest.
- The Board was concerned that the FORCAST detectors were starting to degrade and there are no plans for spares.

FORCAST Cycle 6 Call for Proposals metric: 56.5 submitted for 517 hours, 17 accepted for 134 hours.

Findings - EXES

Pros:

- EXES is unique and is complementary to what is done at much longer wavelengths. This can be seen in their water studies. EXES can study a very different ISM than is done in the longer wavelengths.
- Compared to the other SOFIA instruments EXES is strong in planetary science.

Cons:

- Both EXES and FIFI-LS have much less proposal demand than the other instruments under review.
- EXES is only useful for a restrictive set of science problems and does not have very many papers, and those that have been published have near-zero citations. EXES addresses a new spectral regime that has not been used much and the user community is quite small.
- The Program stated that EXES is the most expensive US instrument to maintain and operate.

EXES Cycle 6 Call for Proposals metric: 20 submitted for 158 hours, 10.5 accepted for 71 hours.