Stratospheric Observatory for Infrared Astronomy

(SOFIA)

Observing Cycle 6

Call for Proposals

June 5, 2017

Version 1.1

This document and all other information pertaining to SOFIA observing Cycle 6 may be found at https://www.sofia.usra.edu/Science/proposals/Cycle6/.

Key Dates

Release of Call for Proposals	May 1, 2017
Call for Proposals Update on Website	June 5, 2017
Proposals Due	June 30, 2017 21:00 PDT (July 1, 2017 04:00 UTC)
Anticipated Announcement of Selections	Early October 2017
Cycle 6 Period	2 February 2018 – 1 February 2019

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Change Log:

May 1, 2017: Original release
June 5, 2017: Formal update:

1) USPOT v3.4.2 has been released to support this update and is required for Cycle 6 proposal preparation and submission. (It may be used to read in AORs prepared using earlier versions of USPOT.)

2) The HAWC+ sensitivities have been revised based on an analysis of data obtained. It is necessary to use DCS v3.4.2 of SITE to estimate exposure times for HAWC+ observations.

3) The overheads for FPI+ observations have been updated in the USPOT v3.4.2 relesase.

4) FORCAST grism observations require the user to include acquisition AORs for each target. The FORCAST Acquisition AOT is available in USPOT v3.4.2 but was not in earlier versions.

5) The HAWC+ ROC has been updated.

1. SOFIA Observing Cycle 6 Program Description

1.0. New Policies and Capabilities for Cycle 6:

- A set of new Acceptance Categories will be implemented in the proposal selection for Cycle 6: "Priority 1", "Priority 2", and "Priority 3". For proposals accepted in the "Priority 1" category, funding will be released at the time of selection and observations will be automatically carried over into the next cycle if incomplete.
- A new proposal category, "Thesis Enabling Programs", has been introduced in Cycle 6. This category is intended to enable and support PhD theses based in a substantial part on SOFIA data. Highly ranked proposals in this category will have "Priority 1" status and include full funding for graduate student support (up to a limit of $100k per year for 2 years). First year funding is released at the time of selection and second year funding one year later (Sec. 2.1.3).
- A Southern Deployment is planned in Cycle 6 and is expected to be made up of two science flight series with two separate science instruments.
- The near-infrared camera and grating spectrometer FLITECAM is not offered for observations in Cycle 6 through this call, either stand-alone or in combination with HIPO. Limited new observations may be requested – particularly if executable during the planned Cycle 5 FLITECAM/HIPO flight series in October 2017 – through the Director's Discretionary Time process (see Sec 2.1)
- As was the case in Cycle 5, the High-speed Imaging Photometer for Occultation (HIPO) is not offered through this call, either stand-alone or in combination with FLITECAM. The instrument is potentially available through Director's Discretionary Time process (see Sec 2.1). High-speed visual photometry is still possible on SOFIA using the Focal Plane Imager Plus (FPI+).
- For GREAT, the seven-pixel arrays: Low Frequency Array (LFA, with 2x7 pixels; 1.9 THz) and High Frequency Array (HFA, with 7 pixels; 4.7 THz) of the upGREAT instrument are offered. The multi-receiver 4GREAT system will be commissioned in July 2017. 4GREAT band 3, equivalent to the L1 receiver in previous calls, and band 4, equivalent to the Ma receiver offered in Cycle 2, are offered as shared risk.
- The proposal preparation for Cycle 6 phase I has been updated from the "SOFIA Proposal Tool" (SPT), based on the HST APT tool, to Unified SOFIA Planning Tool (USPOT), based on the SSPOT tool previously used for phase II inputs (in turn, based on the IPAC SPOT tool.)
- **Proposers are reminded to check the SOFIA website for a formal update to the Call for Proposals provided on June 5, 2017 that incorporates any late changes in the Observatory offerings.**

1.1. Introduction:

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is pleased to invite proposals for Cycle 6 observations, which will take place in the time period 2 February 2018 – February 1 2019. This Call for Proposals solicits proposals for approximately 500 hours of observing time. The Universities Space Research Association (USRA) is issuing this Call on behalf of NASA. Funding to support the selected applicants will also be issued through USRA. Contingent on budget confirmation and NASA approval, the total available Guest Observer funding available for Cycle 6 is expected to be approximately $5M.

This Call is open to all qualified astronomers, in the U.S. and outside the U.S., except for those currently affiliated with German institutions. Astronomers with a German professional affiliation must participate through a separate German Call for Proposals administered by the German SOFIA Institute (Deutsches SOFIA Institut; DSI) on behalf of the German Aerospace Center (Deutsches Zentrum für Luft und Raumfahrt; DLR). DSI personnel, even if based in the U.S., are considered affiliated with a German institution and must submit any proposals to the DLR queue. Scientists based in Germany and affiliated with the European Southern Observatory (ESO) or the European Space Agency (ESA) are considered not to be affiliated with a German institution, and may respond to this Call for Proposals. Only researchers with a U.S. affiliations are eligible to receive financial support through this solicitation (Sec. 1.9).

In addition to the approximately 500 hours available under this Call, approximately 70 hours of observing time will be available to German Guest Observers through the DLR Call. An additional 7% of the Research Hours on SOFIA are set aside as Director's Discretionary Time, and the Science Instrument development teams have an allocation of Guaranteed Time as specified in the SOFIA Science Utilization Policies[1]. Calibration observations are part of the observatory overhead and the required time is accounted for when calculating the total observing time solicited herein.

All proposals that are considered to be scientifically well-justified through scientific peer review will be considered for selection. Preference will be given to substantial investigations that demonstrate significant scientific impact from SOFIA observations.

SOFIA Cycle 6 observations will take place in a number of Science Flight Campaigns over the duration of the cycle. The campaigns will be interspersed with aircraft maintenance and instrument commissioning. A single Southern Hemisphere deployment with two science flight series (instruments) is expected for the Cycle 6 time period, nominally in the boreal summer of 2017.

[1] Available at https://www.sofia.usra.edu/science/sofia-overview/steering-documents

For Cycle 6, SOFIA will offer six instruments. The available instruments will be EXES, FIFI-LS, FORCAST, FPI+, GREAT (upGREAT and 4GREAT, band 3 & 4), and HAWC+. The general capabilities of the instruments are given in the Table below.

Instrument	Description	Coverage	See Footnote
EXES (Echelon-Cross- Echelle Spectrograph)	High Resolution ($R > 10^5$) Echelle Spectrometer	5 – 28 μm	2
FIFI-LS (Field Imaging Far-Infrared Line Spectrometer)	Dual Channel Integral Field Grating Spectrometer	51 – 120 μm 115 – 203 μm	3
FORCAST (Faint Object infraRed CAmera for the SOFIA Telescope)	Mid-IR Dual Channel Imaging Grism Spectroscopy	5 – 25 μm 25 – 40 μm	4
FPI+ (Focal Plane Imager Plus)	Visible light high speed camera	360 – 1100 nm	5
GREAT, upGREAT (German REceiver for Astronomy at Terahertz frequencies)	High resolution ($R>10^6$) heterodyne spectrometer; multi-pixel spectrometer	[0.49-0.635 THz] [0.890-1.100 THz] 1.24-1.39, 1.43-1.5 THz 1.83 – 2.006 THz 2.49-2.59 THz 4.74 THz	6
HAWC+ (High-resolution Airborne Wideband Camera-Plus)	Far-Infrared camera and polarimeter	Five ~20% bands at 53, 63, 89, 154, & 214 μm.	7

1.2. The SOFIA Program

SOFIA is a joint project of NASA and DLR. SOFIA Science Mission Operations (SMO), located primarily at the NASA Ames Research Center, Moffett Field, California, is responsible for the scientific operation of the observatory. The SMO is operated by USRA under contract to NASA. The Deutsches SOFIA Institut (DSI), located at the

[2] Echelon-Cross- Echelle Spectrograph
https://www.sofia.usra.edu/Science/instruments/exes.html
[3] Field Imaging Far-Infrared Line Spectrometer
https://www.sofia.usra.edu/Science/instruments/fifils.html
[4] Faint Object infraRed CAmera for the SOFIA Telescope,
https://www.sofia.usra.edu/Science/instruments/forcast.html
[5] Focal Plane Imager, https://www.sofia.usra.edu/Science/instruments/fpiplus.html
[6] German REceiver for Astronomy at Terahertz frequencies,
https://www.sofia.usra.edu/Science/instruments/great.html . 4GREAT, bands 1 and 2 are not offered in this call, but included in this table for completeness.
[7] High-resolution Airborne Wideband Camera-plus HAWC+,
https://www.sofia.usra.edu/Science/instruments/hawcplus.html

University of Stuttgart, is the primary interface between SOFIA and the German astronomical community. The SOFIA aircraft operations are managed by the NASA Neil Armstrong Flight Research Center. The aircraft itself has its home base at Building 703 of the Neil Armstrong Flight Research Center (formerly the Dryden Airborne Operations Facility, DAOF) in Palmdale, California.

SOFIA is a 2.7m telescope, with an effective, unvignetted, diameter of 2.5m, housed in a Boeing 747-SP aircraft. Observations are typically carried out at altitudes between 11.9 km (39,000 ft) and 13.7 km (45,000 ft.). These altitudes place the observatory above at least 99% and up to 99.8%, of the obscuring atmospheric H_2O vapor. The observatory can operate in the 0.3-1600 μm wavelength range. The six instruments offered in this Call cover the range 0.3-250 μm. These instruments provide imaging, spectroscopic, and polarimetric capabilities for a wide range of scientific investigations.

Full descriptions of the instruments can be found at https://www.sofia.usra.edu/Science/instruments/ .

A list of refereed SOFIA related publications can be found at https://www.sofia.usra.edu/Science/publications/sofia-publications/ . A number of presentations on SOFIA science can be found at the SOFIA Speakers Bureau page at https://www.sofia.usra.edu/conference/local-truth-star-formation-and-feedback-sofia-era-celebrating-50-years-airborne-5https://www.sofia.usra.edu/science/publications/speakers-bureau-materials. In addition, significant amounts of SOFIA science has been presented at the "The Local Truth: Star Formation and Feedback in the SOFIA Era", at the Asilomar Conference Ground in October 2016, and at the "Spectroscopy with SOFIA: New Results & Future Opportunities" at Ringberg castle in March 2017. Most of the presentations for the two meeting can be found on-line at https://www.sofia.usra.edu/conference/local-truth-star-formation-and-feedback-sofia-era-celebrating-50-years-airborne-5 and at https://events.mpifr-bonn.mpg.de/indico/event/16/timetable/?ttLyt=room#20170306.detailed , respectively. (For the latter case, presentation files can be accessed by clicking on a presentation in the timeline and selecting the "Material" option in the pop-up window)

These science cases illustrate the breadth of potential SOFIA capabilities. An overview of SOFIA is presented in Young et al. 2012, ApJ, 749, L17: "Early Science with SOFIA, the Stratospheric Observatory For Infrared Astronomy" and in Temi et al. 2014, "The SOFIA Observatory at the Start of Routine Science Operations: Mission Capabilities and Performance" (ApJS, 212, 24).

1.3. Available Instruments and Observation Configurations

Six instruments will be available for Cycle 6 observations: EXES, FIFI-LS, FORCAST, FPI+, GREAT and HAWC+.

The HAWC+ cryogenic hold time at the completion of formal commissioning, in November 2016, did not meet requirements (or the nominal 10 hour duration of SOFIA flights), leading to restricted flight durations with the instrument. The instrument team will attempt to correct this problem over the summer of 2017, but the results will not be known until after the Cycle 6 proposal deadline. To partially compensate for the loss of HAWC+ observing hours, the SOFIA project has the prerogative to increase HAWC+ flight cadence.

There are a number of observation configurations available or planned for each of the instruments. The following sections describe the observation configurations available for Cycle 6. **Details are available in the Observers Handbook for Cycle 6, which can be found at https://www.sofia.usra.edu/science/proposing-and-observing/sofia-observers-handbook-cycle-6 .**

Each of the SOFIA Science Instruments falls into one of three classes: Facility-class Science Instruments (FSI), Principal Investigator-class Science Instruments (PSI) or Special Purpose Principal Investigator-class Science Instruments (SSI). No SSI instruments are offered in this called. The different classes of instruments require different levels of interaction among the proposer, the science instrument team, and the SMO staff providing support, and are governed by the "SOFIA Science Utilization Policies of the Stratospheric Observatory for Infrared Astronomy (SOFIA)" available at https://www.sofia.usra.edu/science/sofia-overview/steering-documents .

Facility-class Science Instrument (FSI) — A general purpose, reliable and robust instrument that provides state-of-the-art science performance at the conclusion of commissioning and upon acceptance of the instrument by the SOFIA project. FSIs are operated and maintained by the SMO in support of Guest Observers (GOs). No direct interactions with the instrument development team are required to propose for or to use the instrument.

For Cycle 6, FIFI-LS, FORCAST, FPI+ and HAWC+ are considered FSIs.

Principal Investigator-class Science Instrument (PSI) — A general purpose instrument that is developed and maintained by the instrument team throughout its useful operating life. PSIs are operated by the Science Instrument team members, both for their own observations as well as for those of successful GOs. Proposers do not need to consult with the PSI Instrument team before submitting their proposals. However, GOs are encouraged to interact with the Instrument team early, since this maximizes the chances for successful observations. Guest Observers will receive calibrated data for EXES and GREAT through the SOFIA data archive (see Section 1.6).

For Cycle 6, EXES is a PSI.

Proposers are encouraged to work closely with the EXES team in the definition and execution of the observations. Proposers are strongly encouraged to consult the instrument team about the feasibility of their

Cycle 6 projects. Proposers are also encouraged to include EXES team members on their publications, as appropriate.

For Cycle 6, GREAT is a PSI.

For GO publications resulting directly from accepted SOFIA proposals that involve GREAT observations, the GREAT PI may designate up to 3 co-authors for the first publication. After proposal selection, GOs should work with the assigned SMO support scientist to develop the observation details during the Phase II process.

1.3.1. EXES supported configurations in Cycle 6

EXES observations are defined by the observing modes, the spectroscopic configuration, and the central wavelength. The following EXES modes are available for Cycle 6:

Observing modes:

1. Nod mode
   – On-slit nod: Source moved between two points along slit for sky subtraction
   – Off-slit nod: Source moved off slit for sky subtraction

2. Map mode
   – Stepped maps with sky subtraction using edge of map or separate sky observation

Spectroscopic Configurations:

1. High-Medium
   – Echelon plus Echelle grating at angles 35-65˚

2. High-low
   – Echelon plus Echelle grating at angles 10-25˚

3. Medium (long-slit)
   – Echelle grating alone at angles 35-65˚

4. Low (long-slit)
   – Echelle grating alone at angles 10-25˚

Map mode is available for all spectroscopic configurations. For the HIGH_MEDIUM configuration, on-slit nodding is only available if the slit is longer than about four times the FWHM of the PSF (See the SOFIA Observers' Handbook for details). Slit lengths in this mode are a strong function of wavelength and grating angle, and users must consult the online Exposure Time Calculator (ETC) to determine if on slit nodding is possible. The ETC also provides information about expected resolving power and wavelength coverage for the selected instrument configuration.

EXES Configuration summary (See Observers' Handbook for details):

Configurations	Wavelength (μm)	Slit	Max. Resolving Power
High-medium	4.5 – 28.3	(1.4-3.2)"x(4-40)"	100,000
High-low	4.5 – 28.3	(1.4-3.2)"x(<12)"	100,000
Medium	4.5 – 28.3	(1.4-3.2)"x(25-180)"	20,000
Low	4.5 – 28.3	(1.4-3.2)"x(25-180)"	4,000

For the high-resolution modes, there is non-continuous spectral coverage for $\lambda > 19$ μm, but the central wavelength can be tuned so that lines of interest do not fall in the gaps (see the SOFIA Observers' Handbook for details).

The LOW configuration has been found to suffer from saturation from the background causing instrument persistence issues. There are work-arounds that allow the use of the LOW mode, by reducing the instrument sensitivity. These require extra overheads to prepare for and to recover from. GOs interested in LOW mode observations must contact the instrument team ready to discuss their goals and options.

Proposers should use the information on the SOFIA website and the EXES exposure time calculator available at: http://irastro.physics.ucdavis.edu/exes/etc/ to evaluate their proposed observation parameters.

1.3.2. FIFI-LS supported configurations in Cycle 6

FIFI-LS has two independently settable Littrow spectrometers that cover the spectral ranges 51 - 120 μm, and 115 – 203 μm, respectively. The spectrometers are fed by one of two dichroics enabling simultaneous observations of the same target at two wavelengths. FIFI-LS observation configurations for phase I require specification of the integration time, center wavelength and width of the proposed spectra for each of the two spectrometers, and an observing mode.

Observing modes:

1. Symmetric Chop mode: This is a nod-match-chop mode suitable for not too extended sources (smaller than the chop throw). For such sources this is the most efficient observing mode.
2. Asymmetric Chop mode: This mode is suitable for extended sources or crowded regions, where a symmetric chopping is not possible.
3. Bright Object mode: This mode is optimized for very bright sources, where the total observing time is dominated by the telescope moves. It employs an asymmetric chop.
4. Spectral Scan mode: This mode allows the use of FIFI-LS to observe broader spectral features like solid-state features, by consecutively observing adjacent wavelength settings. This mode is especially susceptible to e.g. time variable observing conditions. Potential proposers are strongly encouraged to contact the

FIFI-LS Instrument Scientist, via the SOFIA help desk, during proposal preparation.

All modes allow mapping.

Please see the SOFIA Observers' Handbook for further details of observing modes and instrument capabilities.

1.3.3. FORCAST supported configurations in Cycle 6

The FORCAST imaging configurations require specification of the observing mode and filter. FORCAST spectroscopy configurations require specification of observing mode and grism. The following configurations are available for Cycle 6:

IMAGING

Observing modes:

1. Two position chop and nod (C2N), which is implemented as Nod-Match-Chop
2. Two position large-amplitude chop (2-7 arcmin) with large nod offsets (C2NC2)

Filters:

The full complement of filters available for the FORCAST Short Wavelength Camera (SWC; listed below) exceeds the number of available filter wheel slots. A nominal filter set has been selected for Cycle 6. Depending on the proposal requests, this nominal set may be revised prior to the start of the cycle. If required, the SOFIA Project will consider one filter swap during the duration of Cycle 6. Proposals requesting any of the non-nominal SWC filters should, in addition to justifying their filter preference, discuss the impact on the proposed science if only the "nominal" filter set is available.

For the Short Wavelength Camera (SWC) the nominal filter set for Cycle 6 is:
5.6, 6.4, 7.7, 8.8, 11.1, N' (broadband), 19.7, 25.3 μm
Additional, potentially available, filters for the SWC are:
5.4, 6.6, 11.3, 11.8 μm

For the Long Wavelength Camera (LWC):
31.5, 33.6, 34.8, 37.1 μm

Dichroic:
For Cycle 6, FORCAST can be used in a single channel configuration or dual channel configuration. In dual channel configuration, a dichroic is used to split the incident light towards the short and long wavelength arrays simultaneously. Any short wavelength filter can be used at the same time as any of the long wavelength filters. However, there is significant degradation of throughput for short wavelength filters less than 11 μm and

greater than 30 microns in dual-channel configuration; this information is built into the sensitivity estimator (SITE).

SPECTROSCOPY

Observing modes:

1. Two position chop and nod (C2N), which is implemented as Nod-Match-Chop
2. Two position large-amplitude chop (2-7 arcmin) with large nod offsets (NXCAC)
3. SLITSCAN (A non-zero Map Area must be given) Nod-Match-Chop while stepping slit across a source (SLITSCAN)

Due to their unexpectedly low throughput, the FORCAST cross-dispersed grisms are not offered in Cycle 6. Because long wavelength calibration is limited for the G329 grism using the narrow slit, this mode is not offered. Proposers should consider the capabilities of the EXES low-resolution mode as an alternative way of doing such observations. (Sec 1.3.1)

An exposure time estimator tool is available on the Cycle 6 web page.

Grisms and Slits:

Grism	Wavelength (μm)	Slit	Resolving Power[8]
Long Slit Spectroscopy in the Short Wavelength Camera			
FOR_G063	4.9-8.0	2.4”x191”	180
		4.7” x191”	120
FOR_G111	8.4-13.7	2.4” x191”	300
		4.7” x191”	130
Long Slit Spectroscopy in the Long Wavelength Camera			
FOR_G227	17.6-27.7	2.4”x191”	140
		4.7” x191”	70
FOR_G329	28.7-37.1	2.4” x191”	Not Offered
		4.7” x191”	110

Dichroic:
For Cycle 6, all FORCAST spectroscopic observations will be done using the single channel configuration.

1.3.4. FPI+ supported configurations in Cycle 6

The Focal Plane Imager (FPI+) is the primary tracking camera for the SOFIA telescope. The imager uses a 1024x1024 pixel EMCCD sensor with an 8.7’x8.7’ field of view and

[8] The effective resolving powers (R) for the wide slit are variable depending on the in-flight images quality.

0.51 arcsec pixels. The wavelength range of this visual light instrument is 360 nm to 1100 nm.

Its permanent installation on the SOFIA telescope allows for observing without installation overhead. Individual flight legs can be planned for the FPI+ and can be performed with any other science instrument installed on the telescope SI flange.
The three observing modes, offered in Cycle 6 differ in sensor readout rate and the ability to use the FPI+ for telescope tracking in parallel to acquiring science data.

Observing modes:
FPI_TRACK_SLOW_STARE
- FPI_TRACK_MEDIUM_STARE
- FAST_STARE

Filters:
- Filter carousel 1: u', g', r', i', z' (Sloan Digital Sky Survey) or OPEN
- Filter carousel 2: ND1 (OD=4.0), ND2 (OD=2.6), ND3 (OD=1.3), Schott RG1000 "Daylight" or OPEN

Six spectral filters are available within the FPI+ wavelength range. These are five Sloan Digital Sky Survey filters u' g' r' i' z' and a Schott RG1000 near infrared cut on filter. Additionally three neutral density filters can be used to attenuate bright stars. The ND filters are required for the tracking function of the FPI+ and the optical densities are chosen in a way that stars within the brightness range of $0 < V\ mag < 16$ can be imaged with an exposure time of 1 second. The "daylight" filter is also a requirement for telescope tracking to be able to acquire bright guide stars in twilight. A blocked position in the filter wheel can be used for calibration measurements (e.g. dark frames, bias frames).

Frame rates:
The FPI+ can be operated at high readout rates and achieves high imaging frame rates. The table below summarizes the highest temporal resolutions for acquiring full frames in the three observing modes. When no tracking with the FPI+ is required and sub-frames are selected, the frame rates can increase to a few hundred frames per second.

FPI+ frame rates in frames per second for the acquisition of full frames:

Pixel Binning	FAST_STARE	MEDIUM_STARE	SLOW_STARE
1x1	8.9 fps	3.8 fps	0.9 fps
2x2	17.5 fps	6.9 fps	1.7 fps
4x4	33.6 fps	11.0 fps	3.2 fps

1.3.5. GREAT supported configurations in Cycle 6

GREAT is a dual [array] receiver instrument where the two bands are operated simultaneously, and each band (front end) can be tuned separately. The usable instantaneous bandwidth is channel-dependent. For the LFA and HFA arrays the noise roll-off with intermediate frequency, intrinsic to HEB detectors, limits the usable 3-dB noise bandwidth to typically 3.5 GHz. Each front-end is connected to a digital FFT spectrometer providing 4.0 GHz of bandwidth with 283 kHz spectral resolution (equivalent noise bandwidth).

GREAT observation configurations consist of observing modes, receiver band, and backend selections. In Cycle 6 the two seven-beam upGREAT array receivers, the Low-Frequency Array (2x7 pixels in the LFA; 1.9 THz) and the High-Frequency Array (1x7 pixel HFA; 4.7 THz), are offered. The 4GREAT receiver system band 3 (equivalent to the L1 channel offered in previous cycles), and band 4 (equivalent to the Ma channel offered in Cycle 2), once commissioned, are also offered.

The upGREAT Arrays (LFA and HFA) are 7-beam heterodyne arrays arranged in a hexagonal pattern with a central beam. The spacing between the beams is approximately 2 beam widths. The on-the-fly mapping efficiency using the arrays is approximately an order of magnitude improved over the single pixel configuration (see Risacher et al. 2016, A&A 595, 34 for further details). The dual array mode LFA/HFA will be commissioned in the spring of 2017 and is offered as *shared risk*, contingent on its successful commissioning.

The following are available for Cycle 6:

Receiver bands:

upGREAT Low Frequency Array (LFA): A 7-pixel, dual polarization, array covering 1.83 – 2.006 THz. The array has seven spatial pixels with dual polarizations for each pixel. The tuning range for the two polarizations are slightly offset, with one covering 1.83 - 1.96 THz and the other 1.88 - 2.006 THz. At the low and high frequency ends (<1.88 THz and >1.96 THz), one therefore only 7 pixels, single polarization are available

upGREAT High Frequency Array (HFA): A 7-pixel array covering the [O I] line at 63μm. Because of the limited tuning range of the Quantum Cascade Laser local oscillator, only the frequency range +3/-1 GHz around the 4744.77749 GHz [O I] line will be available. Note that the atmosphere becomes opaque for v>100 km/s.

4GREAT: Bands 3 and 4 of the 4GREAT receiver are offered. For Band 3 the available tuning ranges are 1.24-1.39 THz and 1.43-1.50 THz. For Band 4 the tuning range available is 2.49-2.59 THz, covering the OH ground-state transition.

Receiver Combinations:

For Cycle 6 the two available receiver combinations will be:

- LFA in parallel with HFA
- 4GREAT in parallel with HFA.

Depending on the results of the Call for Proposals, not all combinations may be executed.

Observing modes:

1. Single pointing - position switching (PSW)
2. Single pointing - beam switching (BSW), chopping with the secondary
3. On-the-fly mapping in PSW or BSW mode (OTFMAP_PSW/BSW)
4. Raster mapping in PSW or BSW mode (RASTERMAP_PSW/BSW)

Note: the stability of a heterodyne instrument is characterized partially by its Allan Variance time. This is different for the various technologies used (details are given in the observers handbook)

Backends:
Fast Fourier Transform Spectrometer: 4 GHz bandwidth with 0.283 MHz ENB.

1.3.6. HAWC+ supported configurations in Cycle 6

HAWC+ observation configurations consist of observing modes and filter selections in both Total Intensity and Polarization modes. The following are available for Cycle 6:

TOTAL INTENSITY

Observing modes:

1. Two position chop and nod (C2N) implemented as Nod-Match-Chop (NMC).
2. On-the-fly mapping (OTF).

Filters:

Five filters are available with central wavelengths (bandwidths) as follows –53 (9), [63 (9)], 89 (17), 154 (34), 214 (44) μm.

Note: The current 63-micron band of HAWC+ is saturated by background in most cases. Acquisition of a narrower filter, aimed at limiting the background flux, is being considered, but has not been approved. Observations proposed for the 63-micron band are contingent on this upgrade and are considered Shared Risk.

POLARIZATION

Observing modes:

1. Two position chop and nod (C2N) implemented as Nod-Match-Chop (NMC).

   For each wavelength filter a corresponding half-wave plate (HWP) is used. The filter is matched to the HWP.

1.4. Cycle 6 Schedule

The nominal schedule for the Cycle 6 observing program is as follows:

1 May 2017	Release of Call for Proposals
5 June 2017	Call for Proposals update
30 June 2017, 21:00 PDT	Proposal Submission deadline
1 July 2017, 04:00 UTC	Proposal Submission deadline
Early October 2017	Proposal Selections Announced
2 February 2018 – 1 February 2019	Cycle 6 observing period

SOFIA observations in Cycle 6 will be conducted in a number of Science Flight Campaigns[9] covering the period February 2, 2018 – February 1, 2019. A single Southern Deployment consisting of two science Flight Series is expected to take place during the boreal summer of 2018. Additional single instrument deployments will be considered depending on proposal pressure and available resources. The detailed layout of Science Flight Series within each Science Flight Campaigns will depend on the selected proposals and instrument availability.

[9] SOFIA science observing definitions:

a) *Science Flights* - individual flights primarily devoted to obtaining astronomical science data.
b) *Science Flight Series* - Contiguous series of science flights, all with the same instrument.
c) *Science Flight Campaigns* - One or more science flight series, beginning and ending with a non-science, engineering activity.
d) *Science Observing Cycles* - One or more of flight campaigns that are covered by a single science Call for Proposals.

1.5. General Guidelines and Policies

Observations lost due to observatory or instrument hardware or software failures, weather, or other reasons, will not automatically be rescheduled. The observatory has included contingency flight opportunities in the overall schedule to minimize the impact of lost flights, however, award of an investigation is not a guarantee that the observation will be executed. Sky visibility or other observing constraints may also prevent completion of a selected investigation. In general, with the exception noted in Sec. 2.1, observations than cannot be executed within a given Cycle will need to be re-proposed for in a subsequent Cycle.

Starting in Cycle 6, "Regular Proposals" will be accepted in three bands, "Priority 1", "Priority 2", and "Priority 3", to give the General Observer a better estimate of priority and likelihood of execution. These bands are characterized by:

Priority 1 – *Priority 1* ("will do") proposals are the highest ranked category of proposals. They will strongly drive the scheduling and thus have a high likelihood of completion within Cycle 6. If for technical reasons they cannot be completed within Cycle 6, then *Priority 1* proposals will be carried over into Cycle 7. Full funding for US Priority 1 proposals will be released at the time of acceptance. It is expected that about 25% of the available observing time will be accepted into this category.

Priority 2 – *Priority 2* ("should do") proposals are in the second band of ranking and are likely to be completed within Cycle 6, but the uncertainties of scheduling precludes releasing full funding before the first proposed observations have been started. *Priority 2* proposals will not be carried over into the next cycle if incomplete. It is expected that about 50% of the available observing time will be accepted into this category.

Priority 3 – *Priority 3* ("do if time") proposals are in the lowest band of accepted proposals and will be added to Flight Plans when no higher ranked targets are available. Funding for US-led *Priority 3* proposals will be released incrementally as observations are executed. It is expected that about 50% of the available observing time will be accepted into this category.

Together with "Survey Proposals" (Sec 2.1.4), the above intentionally over-subscribes the expected observing time. As noted in Sec 1.8, the SMO director will implement such an appropriate over-subscription of the available flight to allow for efficiencies and contingencies in flight planning.

The exact selection fractions in each band will depend on target locations and competition.

Observations that are part of an **active Cycle 5 SOFIA program**, but which have not been executed at the time of the Cycle 6 proposal deadline may be re-proposed, but must be clearly identified as such. If the Cycle 5 observation is executed and the Cycle 6

request qualifies as a duplication (target, mode and exposure time) the latter will be disallowed. The proposal may provide potential substitute targets, but must then clearly discuss the relative scientific justification for the original target[s] and the substitute targets.

1.5.1 Proposal Process

The SOFIA Cycle 6 proposal process will consist of two steps – Phase I and Phase II. Phase I requires the preparation and submission of a science justification, a feasibility analysis for the proposed program, and a high level description of the proposed targets and observations. This Phase I proposal will form the basis of the peer review and proposal selection by the SMO Director. Proposals that are awarded observing time based on the evaluation process described in Section 1.9 will subsequently be required to submit Phase II observation specifications following guidelines provided by the SMO. These submissions will provide the SMO and instrument PIs with the detailed definition of each observation to be executed for the program. In addition, proposers affiliated with U.S. institutions will be invited to submit a budget, based on funding guidelines provided by the SMO. Note that detailed observation set-ups (such as the availability of suitable guide stars), which are not required in Phase I, may cause an observation to be deemed unfeasible, once fully defined. Hence the proposer is encouraged to develop their observation as much as possible in Phase I.

SOFIA Cycle 6 Phase I proposals must be prepared and submitted using the new SOFIA Proposal Tool USPOT (https://dcs.sofia.usra.edu/observationPlanning/installUSPOT/uspotDownload.jsp .), which is a Java based application. The prospective proposer should download USPOT to a local computer. The proposal consists of formatted information filled in via the USPOT form fields (such as proposer information, scientific category, instrument, target and exposure information) and a file containing the scientific justification and other information (details in section 2.2.1), to be uploaded in PDF format. The USPOT tool will be used also for phase II inputs and while only some observation parameters are required for phase I submissions, proposers may choose to define their observations in more detail, already in phase I. USPOT is available for most commonly used platforms, including Mac OS X, Windows and Linux.

In order to maximize the future utility of the SOFIA archive and simplify observation duplication checks, the SOFIA project has, starting with Cycle 5, implemented a target naming convention. Appendix B outlines this requirement.

An outline of the proposal preparation process may be found in section 2 and further details about USPOT can be found in the new "USPOT Users Manual" https://www.sofia.usra.edu/science/proposing-and-observing/uspot-manual .

1.5.2. Who May Propose

Participation in the U.S. SOFIA Cycle 6 Program is open to scientists from all categories of U.S. and non-U.S. organizations, including educational institutions, industry, nonprofit institutions, NASA Centers, and other Government agencies. Members of German organizations, including DSI staff stationed in the U.S., must participate through the DSI led program.

Each SOFIA Cycle 6 proposal must identify a single Principal Investigator (PI) who assumes responsibility for the conduct of the scientific investigation. Proposal Co-investigators must have well defined roles in the investigation, which will be evaluated as part of the proposal review process. Following selection by the SMO Director, the SMO staff will communicate formally only with the PI (or a person designated by the PI) of each proposal, except for funding issues where communications will be primarily with the institutional Sponsored Research Office (or equivalent). It is the responsibility of the PI (or designee) to provide the SOFIA project, in a timely manner, all information necessary for implementing observations, and to respond to any questions concerning observational constraints or configurations.

Note: those with a German professional affiliation may participate as Co-Investigators on proposals submitted in response to this Call. They may not be Principal Investigators on the proposals, nor in any way be designated as the contact or lead investigator.

1.5.3. Late Proposals

Consistent with USRA and NASA policy, no late proposals will be considered. A proposal will be considered "on time" only if all necessary components have been received by the published deadline. Note that processing delays at the proposer's home institution, shipment delays of the proposal, or Internet delays, do not excuse the late submission of a proposal.

1.6. Data rights and distribution

All scientific data from SOFIA observations will be distributed via to the user via the SOFIA data archive. Currently this is part of the SOFIA Data Cycle System's Science Archive (https://dcs.sofia.usra.edu/dataRetrieval/SearchScienceArchiveInfo.jsp). In the near future the SOFIA archive will be moved and incorporated into the Infrared Science Archive (IRSA) at the Infrared Processing & Analysis Center (IPAC). The transition is expected to be transparent to the archive user and will be announced and documented by the SMO, well in advance.

All data will be archived as Level 1 data (raw). Where appropriate, Level 2 (corrected for instrumental and atmospheric effects), Level 3 (flux calibrated), and, if available, Level 4 (enhanced) will also be archived.

These data will be accessible to the general community after an exclusive use period of twelve months. The exclusive use period for all data products will end twelve months

after the GO is given access to the calibrated (level 3 or higher) data through staging to the SOFIA data archive. Proposers are encouraged to consider waiving this exclusive use period to enhance the availability of their data sets for archival research and to broaden the impact of their observations.

1.7. Targets for Observations

All scientifically valid observations may be proposed for, with the exception of those duplicating the ones in the "Reserved Observations Catalog" lists (Appendix A), designated by each Science Instrument team. Duplication of observations (target, mode and exposure time) obtained in earlier cycles are generally not allowed, and if proposed for must be identified as such, and the necessity for duplication must be explicitly justified.

1.7.1. Reserved Observations

As part of the instrument development contracts, the instrument teams were awarded a limited amount of Guaranteed Time Observing (GTO). To protect the interests of the instrument development teams, the SOFIA Science Mission Operations has allowed the those teams with remaining GTO time for Cycle 6 to set aside a limited number of targets and associated exposure times as "Reserved Observations". German PSIs, in addition, receive an updated allocation of observing time in each cycle for which such reserved observations are given. These reserved observations may not be proposed for. For Cycle 6 Reserved Observation Catalogs (ROCs) exist for FIFI-LS, GREAT and HAWC+. The Reserved Observations Catalogs can be found in Appendix A.

A Reserved Observation consists of the combination of position on the sky, instrument, observation configuration, and length of observation. The observation configuration encompasses the basic scientific intent of the observation by specifying, for example, the wavelength range for broad-band photometry or grism spectroscopy or the frequency of observation for GREAT. Similarly, proposed observations are considered duplicate to previously observed observations if they duplicate the combination of position on the sky, instrument, observation configuration, and length of observation. Hence, observations of the same target but in different filters are not considered duplicates.

The ROCs for the instruments are independent of each other. The current ROCs also only apply to Cycle 6, and the Instrument PIs will have the opportunity to revise them prior to subsequent proposal calls.

If a reserved observation is proposed for, the justification for such a duplication must be clearly addressed in the proposal. At a minimum, any such proposals must aim to achieve a signal-to-noise ratio of twice that expected from the Reserved Observation or have a scientifically justified duplication such as for temporal variability studies. Final determination of acceptability of proposed observations rests with the SMO Director.

1.8. Proposal Evaluation and Selection Process

Proposals submitted in response to this Call will be evaluated in a competitive peer review. The peer review panel, including its chair, will be recruited from the astronomical community and be subject to the standard NASA procedures and rules.

The following factors will be used in evaluating proposals for the SOFIA Cycle 6 Program.

1. The overall scientific merit of the proposed investigation.
2. The broader scientific impact of the investigations to astronomy.
3. The feasibility of accomplishing the objectives of the investigation.
4. The degree to which the investigation uses SOFIA's unique capabilities.
5. The competence and relevant experience of the Principal Investigator and any collaborators to carry the investigation to a successful conclusion.

The scientific review panels will be given an assessment of the technical feasibility of each proposal as determined by the SMO. After acceptance of an observing program, successful proposers must provide the required inputs to detailed observing plans for submission to the SMO. Instructions for completing these Phase II inputs will be distributed to the PIs of the selected proposals.

Proposals of all sizes will be considered. For Cycle 6, the SMO encourages substantial investigations with significant impact and plans to allocate roughly 20% of the available observing time to high scientific impact proposals in excess of 50 hours. The time available for large proposals is not limited to this allocation, and up to 100% of all the available time may be assigned to these larger proposals if the Time Allocation Committee, and SMO Director judge them sufficiently meritorious.

The SOFIA project reserves the right to select only a portion of a proposer's investigation, in which case the PI of the proposal will be given the opportunity to accept or decline the implementation of the partial selection.

Because of the complicated process of flight scheduling involving sky visibility, instrument availability, and the need to produce efficient flight plans, selection of an investigation does not guarantee observation. At the discretion of the SMO director, an appropriate over-subscription of the available flight times may be accepted via the peer review process with an associated prioritization, which will allow for contingencies in flight planning. The SMO Director will approve the implementation of the observing prioritization and target selection.

1.9. Funding for U.S.-based Investigators

Funds for awards under this solicitation are expected to be available to investigators at U.S. institutions subject to the annual NASA budget cycle. It is expected that the Cy 6 budget for such grants will be approximately $5M.

At the discretion of the SMO Director, U.S.-based Co-Investigators on successful non-U.S. proposals (accepted through this solicitation), will also be eligible for funding. Such requests will require a clear justification of the funding requirements of the U.S.-based co-I. As described above in Sec 1.5.2., the Phase I proposal must provide a well defined role for the U.S.-based co-investigator in the investigation.

Budgets should not be submitted with the proposals in response to this Call. The **selected** investigators will receive a funding guideline from the SOFIA Science Center based on the scope of the approved observing program, complexity of the data analysis, and the available budget for the SOFIA Cycle 6 program. One of the inputs to this budget guidance will be the scope and complexity of anticipated data analysis associated with the program. Proposers are asked to include a description of the data analysis plan as part of the Technical Feasibility section of their Phase I proposal. A budget summary and narrative description of how these funds will be used must be submitted after the receipt of the guideline. The deadline for budget submittal will be announced after the proposal selection and included in the funding guidelines document. An institutional signature will be required when a budget is submitted.

It is noted that archival SOFIA data may represent the primary source for an Astrophysics Data Analysis Program (ADAP) Proposal under the NASA Research Opportunities in Space and Earth Sciences (ROSES) solicitation, (https://science.nasa.gov/researchers/sara/grant-solicitations/).

1.10. Proposer Participation in Observations

The SOFIA Program encourages SOFIA GOs to participate in the flights executing their observations. While no dedicated financial support for such activities is available, the GO may use part of their allocated grant to cover associated expenses. Note, however, that observations from many different programs are usually executed on any given flight. This has several impacts on GO in-flight participation: 1) Only a limited number of observations in the GOs program are likely to be executed on any given flight. 2) While optimizations of a given observation are possible in-flight, the ability to interactively modify a program is limited to the specific observation. Changes that would affect the remainder of the flight plan (e.g. target changes), or that could cause conflicts with other accepted programs (such as filter settings not originally awarded to the current program), will generally not be allowed. 3) With the many different required and requested flight crew complements the number of "Astronomer seats" on any given flight is limited. For a given flight, if the number of GOs requesting seats exceeds the number available, then

the SMO Director will decide on which GOs will be invited on that flight.

1.11. Outreach

1.11.1 Airborne Astronomy Ambassadors program

The NASA Airborne Astronomy Ambassadors (AAA) program run by the SETI institute is planned to continue during Cycle 6. However, due to the reorganization of NASA's education activities, individual NASA missions, including SOFIA, no longer have separate education programs. Hence, no funding for such activities will be available through the Cycle 6 process. Voluntary participation in the NASA Airborne Astronomy Ambassadors program is encouraged. GOs with programs executing during Airborne Astronomy Ambassador flight weeks may be contacted by the AAA program managers in regards to helping explain their experiments and provide other background information to the teacher participants.

Further information about the AAA program can be found on the SETI Institute's web site (https://www.seti.org/aaa). Specific questions can be addressed to the SOFIA Education Director, Dr. Dana Backman (dbackman@sofia.usra.edu).

1.11.2 News Releases and Presentations

SOFIA captures the imagination and attention of media and the public. To continue this successful publicity, SOFIA observers have a responsibility to share potentially newsworthy results with the public and NASA/DLR have an interest in helping them reach a larger audience and gain a bigger impact. Specifically, NASA and DLR retain the right to be the initial organizations to issue news releases and web feature stories regarding SOFIA results. Therefore, if a GO believes that there is a possibility that new results could be of interest to a wide public audience, the PI should contact the SOFIA Public Affairs Officer Nicholas Veronico (nveronico@sofia.usra.edu) who will evaluate the news value of the results, communicate with NASA and DLR Headquarters, and then work with the GOs on the most suitable course of action. Releasing results without coordinating with the program or agency will prevent the result from being included in a subsequent NASA/DLR news release.

NASA and the DLR will jointly issue news releases associated with SOFIA observations during Cycle 6. The U.S. SOFIA Public Affairs officer and the German/DSI Public Affairs counterpart will coordinate the news release process. Other relevant news releases by participating organizations (including PI institutions) should be coordinated with the SOFIA program, NASA and DLR. Other presentation material based on the Cycle 6 observations can be generated by any member of the proposal team and will be considered part of the team's collective set of material. Any member of the team may use these materials (e.g., in public science talks or conference proceedings).

1.11.3 Internal NASA Presentations

Noteworthy SOFIA results are of great interest to NASA. GOs are encouraged to support internal presentations to SOFIA management, with the understanding that results will be made public only with the agreement of the GO. GOs will also be encouraged to make early results available in more public venues such as the SOFIA website and presentations.

2. Proposal Preparation and Submission

2.1. Types of Programs

Five types of programs are solicited in response to this Call: Regular Programs, Impact Programs, Thesis Enabling Programs, Survey Programs, and Target of Opportunity Programs. A single proposal may not mix different program types.

A limited fraction (approximately 25% of allocated observing time) of the most highly ranked Regular Programs in Cycle 6 will be assigned status as "Priority 1" and will be carried over between cycles if they fail to be scheduled during the Cycle 6 period. Proposers do not need to, and cannot, request this status, as it will be assigned by the SMO Director, as part of the proposal selection process. The SMO Director will communicate such assignments directly to affected GOs.

With the exception of regular programs in the 'Priority 1" category and Impact Programs, proposals are active only for the duration of the Cycle 6 observing period. Accepted observations not executed during Cycle 6, for whatever reason, will not be carried over to future cycles.

2.1.1. Regular Programs

Observations of specific targets with known positions and timing constraints (including targets with no constraints) will constitute regular observing programs. This includes also time critical observations and observations of known Solar System objects.

The intent is to execute all the highly ranked observations accepted in a regular program. Of necessity, efficient scheduling of SOFIA requires a larger pool of candidate observations in a given Cycle. The SMO director may therefore accept regular proposals as "Priority 3" over and above the maximum available ~500 hours. Such programs will be scheduled at lower priority than those accepted as "Priority 1" or "Priority 2", but with the intent to execute as large a fraction of the observations as possible.

2.1.2. Impact Programs

To enable significant, flexible, investigations of important problems in astrophysics, SOFIA in Cycle 4 introduced the program category "Impact Programs". This category is valid also in Cycle 6. These are multi-year programs of approximately 50-100h each of

exposure time, aimed at addressing high-importance scientific problems. Impact Programs may utilize any combination of offered SOFIA instrument and modes. Impact programs are not, primarily, intended to enable large general survey programs, but should be targeted to answer specific scientific questions. Given the potential broad interest of Impact Programs, proposers are encouraged to waive the exclusive use period for these data sets to allow earlier access to the widest community. Note that broader impact is an evaluation factor for Cycle 6 proposals. Proposals that leverage synergy with existing and future NASA programs are particularly encouraged.

All targets of an accepted Impact Program are expected to be observed. The original proposal should include a complete target list on which the proposal will be evaluated, but target modification will be allowed as per below. Because of the operational and budget impact, Impact Proposals with large target pools only available during Southern Hemisphere deployments, especially if requesting multiple instruments, will require an especially high scientific justification.

Accepted Impact Programs will be carried out in several phases:

After proposal selection and an expedited Phase II process, a sub-section of the proposed observations (~10-15h) will, in coordination between the program PI and the SMO, be selected and prioritized for early observations. The intent of these early observations is to demonstrate the technical approach to the observing program prior to scheduling the balance of the program.

After these initial observations have been performed and analyzed, but prior to the release of the Cycle 7 CfP, a review will be convened by the SMO Director to evaluate and confirm the viability of the science goals of the program. Upon the successful completion of this first review, the impact program PI will be allowed to update the target list and observation details (subject to SMO Director approval and regular observation duplication restrictions), including instrument mode modifications. The full program will be targeted for completion in two observing cycles, but depending on the size of the accepted program, instrument requests, and target distribution, observations may stretch over three. The program PI will be allowed, with SMO Director approval, to update the remaining observing program prior to the release of the CfP for each affected observing cycle.

A second review of the program will take place during the second observing cycle (for Cycle 6 Impact Programs, nominally May 2019) which will evaluate the progress of the program, including observational progress, data reduction status and schedule for delivery of high level products and core publications. Upon the successful conclusion of this second review, the remainder of the impact program will be executed at heightened priority.

2.1.2.1. Joint Impact Programs

To encourage US-German collaborations and to optimize the proposed programs, SOFIA will consider joint Impact Program proposals. These shall be submitted as identical proposals (Scientific and technical justification, target pool, observation request, etc.), except for the Principal Investigator, which must adhere to the usual affiliation constraints (Section 1.5.2). Note that the due date for the US submission of any Joint Impact Proposals is June 30, 2017.

A time request distribution adhering to the 80/20 US-German SOFIA total allocations will be assumed (i.e. a joint proposal pair requesting 100h, will be treated as an 80h proposal in the U.S. selection and a 20h proposal in the German selection).
The title of such proposals must start with the phrase: "Joint Impact Proposal:". The two peer review processes will evaluate such proposal pairs independently. If both reviews approve the proposals, a joint program will be executed with the U.S. and German PIs treated as co-PIs. If the joint proposal is declined in the U.S. selection, the German proposal will automatically be declined. Should the German peer review decline the proposal, while the U.S. review recommends approval, the SMO Director will have the authority to approve the U.S. proposal as stand alone, nominally at the 80% U.S. partial request. The same funding restrictions apply as for regular proposals (Section 1.9)

2.1.3. Thesis Enabling Programs

Starting with Cycle 6, the SOFIA program introduces a new program category aimed at enhancing the support for and execution of doctoral theses based, in a substantial part, on SOFIA observations. Proposals to this category require a well-defined thesis program and an identified student. The PI (nominally the thesis advisor) can request up to two years of graduate student funding at the standard rate at the host university (capped at $100k per year). A description of the thesis project, the role of SOFIA data, the anticipated time line, and a short biographical sketch of the identified student must be included. An additional page is allowed for this material. Contingent on a sufficient ranking by the peer review, these programs will be awarded "Priority 1" status (Section 1.5) and have their first year's funding released at proposal acceptance. The second year's funding will be released one year later, after submission of a status report to the SMO Director, demonstrating progress in the thesis project.

2.1.4. Survey Programs

The Survey proposal category are intended to allow studies of a target class, as well as provide the SOFIA program flexibility in flight planning. These programs should identify a sample of targets and observations with a common scientific justification. The selection of survey proposals will be primarily judged on scientific merit, but samples with uniform sky distributions will be prioritized as they provide the best flexibility in flight planning.

The intent is that a useful fraction of the targets in a given survey program will be observed, but with no specific target observation guaranteed to be executed. The

proposal should discuss and justify a scientifically useful sample size for completion. For example, the target pool could consist of a large number of stars of a particular characteristic. The proposer should specify how many objects of this pool need to be observed to provide a scientifically useful result.

2.1.5. Target of Opportunity Programs

Target of Opportunity (ToO) proposals are invited. Both programs with known targets, but unknown timing of the observations, such as observations of a specific target at an unknown time (e.g. an identified recurrent nova in outburst), and programs targeting a class of astronomical events, but with unknown targets and timings (such as observations of an as yet unidentified comet or supernova), will be considered. For ToO observations, the proposal should contain a discussion of the triggering criteria, the required turn-around time between triggering and observation, and any other timing constraints.

Since SOFIA can only observe with a single instrument at the time, rapid turn-around ToO requests with a specific instrument may be difficult to implement. Hence, ToO proposals should also address the viability and utility of observing the event/target with each of the available SOFIA instruments.

The SMO Director will have ultimate authority in recommending or rejecting the request that a selected ToO program be activated.

Observations of specific Solar System targets or events whose times of occurrence can be predicted in advance (e.g. occultations) ***do not*** *constitute ToO observations and should not be flagged as such, but should be submitted at Regular Proposals.*

Director's Discretionary Time

In addition to the above, the SOFIA program accepts proposals for Director's Discretionary Time programs. This category is intended for short, urgent observations that could not have been foreseen at the time of the proposal Call and that cannot wait for the next proposal cycle. In exceptional cases, proof-of-concept observations may be requested through the DDT path, as well as special circumstance observations such as for HIPO or FLITECAM. However, a strong justification for not proposing such observations through the regular proposal process will be required. **DDT proposals are not solicited through this Call for Proposals**, and should be directly addressed to the SMO Director, Dr. Harold Yorke. Further information about the DDT program can be found at the SOFIA web site under: https://www.sofia.usra.edu/science/proposing-and-observing/proposal-calls/sofia-directors-discretionary-time

2.2. Proposal Preparation

Each Cycle 6 proposal must be prepared using the new SOFIA USPOT tool. The proposal information is entered directly, while text sections including the scientific justification and feasibility analysis should be in PDF files, uploaded via USPOT[10].

Proposals must be written in English. The length of each section of the proposal should not exceed the page limits indicated in Section 2.2.2, using single-spaced 8.5x11 inch or A4 format with 1 inch (2.5 cm) margins. Proposals must be printed to PDF files with a font size no smaller than 11 points (about 6 characters per cm). Reviewers will only be provided the portion of each proposal that complies with the page limits.

The abstract provided using the Proposal Information form is limited to 300 words (see Section 2.1.2).

2.2.1 The SOFIA USPOT tool

The SOFIA proposal tool USPOT provides the user with a form-based interface for preparing a proposal and for electronic submission to the SOFIA Science Mission Operations. The USPOT is based on the IPAC SPOT tool which has already, in modified form, been used to prepare SOFIA phase II inputs in earlier cycles. After downloading the appropriate package and following the installation instructions, the user starts a new proposal by launching the USPOT application. The proposer then fills out the necessary form fields including proposer information, abstract, instrument(s), and target lists. The Science and Technical Justification may be prepared using any text editor (e.g. MS Word, LaTeX, etc...) and saved as a PDF file. Using USPOT, the proposer then identifies this PDF file on a local disk for attachment to the proposal summary information. When the proposal is complete, the user submits the complete proposal directly to the SMO using USPOT. Upon successful submission, a unique identifier is returned for later reference. Proposals that have been submitted to the SMO can be ***resubmitted*** using USPOT at any time up to the proposal deadline (note that old versions are not retained). On-line help for USPOT is available as a pop-up function in the application. A new USPOT manual has also been prepared by the SMO.

2.2.2 Proposal Text Sections (To be uploaded as a single PDF file)

Proposal Sections – The uploaded PDF file must contain the following sections in the order indicated for each proposed observing program. The page length limits are indicated.

1. **Scientific Context (up to 0.5 pages)** – Briefly summarize the proposed investigation with the following elements:
   Context – What is the context and significance of this proposal to the broader

[10] https://dcs.sofia.usra.edu/observationPlanning/installUSPOT/uspotDownload.jsp

field of astronomy?
Aims – How will the observations address the specific scientific questions in this proposal?
Methods – What are the key measurement techniques utilized in this investigation? How do they pertain to the unique capabilities of SOFIA?
Synergies – How does the proposed work share synergies with observations with other observatories, especially JWST or ALMA, and other laboratory/theory efforts?
Anticipated results – What are the expected data sets that will be produced in this investigation?

2. **Scientific Justification (up to 3 pages)** - Describe the scientific objectives of the proposed investigation, clearly stating the goals and their significance to astronomy, and why SOFIA data are essential to the investigation. The results and status of previous, related, SOFIA observations should be summarized. The page limit includes all text, figures and tables. An additional page for references only is allowed.

3. **Feasibility (up to 2.5 pages)** – This section forms the basis for assessment of the technical feasibility of the proposed observations. The requested exposure time for each observation must be justified. The section should include the expected target fluxes and the signal-to-noise ratio required for each observation. The source (or method) for the flux estimates, and their accuracies should be mentioned. Where applicable the spectral resolution required must be explicitly stated. Any other information about the proposed observations that would help the reviewer relate the technical needs to the scientific goals should be included in this section. Observing overheads and other indirect time estimates should follow the instructions given in the Observers Handbook. This section should also contain the justification for special calibration procedures, if they have been requested (Section 3.2.2).

   The technical feasibility section should include a brief discussion of the anticipated data analysis needed to accomplish the investigation. Specifically, describing the analysis tasks performed by proposers after receiving the calibrated data from the SOFIA Science Center will assist the reviewers in assessing the scope of the proposed effort.

4. **Principal Investigator and Co-Investigator Biographical and Publication Data (one page for the PI with one additional page for CoIs)**. A short biographical sketch for the PI should be provided and include a list of the most recent refereed publications relevant to the scientific proposal. Short biographical data, including their roles in the proposed project, should be provided for the CoIs. For Thesis Enabling Programs, a short biographical sketch of the identified student should be included.

5. For **"Thesis Enabling Programs", one additional page** should be included to describe the thesis project, including the expected role of SOFIA data and an estimated time line. A short biographical sketch for the identified student should be included.

2.2.3. Exposure time estimates

Estimates of exposure times for imaging with FORCAST, FPI+, and HAWC+ can be made using the SOFIA Instrument Time Estimator (SITE)[11], a web-based tool that provides total integration time or S/N for a given instrument, filter(s), source type (point, extended, emission line) and water vapor overburden. Algorithms and assumptions used are given in the help link on the SITE webpage.

Stand-alone Exposure Time Calculator (ETC) tools for the FORCAST grism mode and for EXES, FIFI-LS and GREAT observations are also available on the SOFIA web site under Cycle 6 information.

2.2.4. Sky availability during Cycle 6

The sky availability for SOFIA observations is constrained by several factors, including the need to return to the Palmdale, California home base at the end of a flight and the avoidance of restricted airspace. Due to these constraints, the southernmost declination available on flights departing and landing in Palmdale is -36˚. This limit is calculated based on limits of flight plans and telescope pointing. Note that, depending on the sensitivity of a given observation to atmospheric opacities, the limiting Declination may be significantly more stringent in practice.

Flight rules generally require the cavity door be closed 30 minutes prior to local sunrise and that SOFIA land no later than the time of sunrise. The detailed rules for observations close to sunrise are complex. Any proposal considering observations that would require being executed close to sunrise are strongly encouraged to contact the SMO in advance of submittal.

The instantaneous pointing of the telescope, relative to the aircraft, is restricted to ±3˚ cross-elevation (on the port (left hand) side of the plane) and elevations between 21 and 58 degrees (unvignetted). A somewhat larger vignetted elevation range is possible, but the proposer should contact the SMO regarding possible performance issues.

The SMO has used the Cycle 4 and 5 accepted observations and Flight Series (by instrument) to produce "sky-availability density maps" showing where on the sky targets that would be particularly advantageous for SOFIA flight planning efficiency would be located. Links to these maps may be found on the Cycle 6, Phase I page (https://www.sofia.usra.edu/science/proposals/cycle6/phase_I) in the "Complementary

[11] https://dcs.sofia.usra.edu/proposalDevelopment/SITE

Sky Positions" section. Targets in these areas of the sky, particularly in selected survey proposals, generally have a higher probability of being scheduled into flight plans than a target of equal importance located in a more popular high-density region.

2.2.4.1. Southern Deployments

The SOFIA Program expects to conduct a single Southern Hemisphere deployment with two science instruments during Cycle 6. The deployment flights would occur during the June-August 2017 period out of Christchurch, New Zealand. The number of supportable flights as well as the number of instruments available during the proposed deployments will be dependent on the funding for SOFIA during the Cycle 6 period. It is expected that the deployment will be limited to two instruments. The over-all scientific justification (number and urgency of accepted proposals) for the different instruments will be a key determinant in which instruments will be selected for deployment.

In order to allow for a potentially broader pool of Southern Hemisphere science, starting in Cycle 4, highly ranked proposals for targets only observable during a Southern Hemisphere deployment, but requesting an instrument not selected for deployment in that cycle, may be held over for up to two cycles for possible future instrument selection for southern deployment. The PIs of such proposals will be given the option of having the proposal carried over, and if so given the opportunity to submit a short (about one-half page) update to the proposal in time for subsequent proposal deadlines. The proposals, and update information, will be reviewed by subsequent peer reviews to confirm the continued scientific merit and validity of the proposed investigation. The titles, abstracts and observing requests for these “carried-over” proposals will be disclosed in the proposal solicitation information for the affected, subsequent, cycles.

Southern Targets Proposal Statistics, Cy 4 (US queue) [12]

Instrument	Proposed	Fraction Proposed	Approved	Fraction Approval
	[h]	[%]	[h]	[%]
EXES	0	0	0	N/A
FIFI-LS	22.4	29	11.0	49
FLITECAM	0.4	0.5	0	0
FORCAST	34.5	45	23.9	69
GREAT	10.6	14	6.5	61
HAWC+	8.8	12	0	0
Total	76.6	100	41.4	54

[12] Column 3 shows the fraction of time for each instrument relative to the total requested for targets with Dec<-30˚ by all proposals. Column 5 lists the fraction of proposed time, for Dec<-30˚ (observable only on deployment) approved for each instrument. Yellow shading highlights the instruments deployed.

Southern Targets Proposal Statistics, Cy 5 (US queue)

Instrument	Proposed	Fraction Proposed	Approved	Fraction Approval
	[h]	[%]	[h]	[%]
EXES	0	0	0	N/A
FIFI-LS	81.6	28.9	30.7	38
FLITECAM	5.0	1.8	0	0
FORCAST	84.3	29.9	37.1	44
GREAT	56.8	20.1	12.5	22
HAWC+	54.7	19.4	0	0
Total	282.4	100	80.3	29

There were no proposals submitted to the Cycle 5 US queue for southern targets, which were not selected, but which would qualify for such automatic carry-over into Cycle 6. The preceding tables provide statistics, by instrument, for proposals and selections requesting targets locate south of Dec=-30˚ for Cycles 4 and 5.

2.2.4.2. Southern Suitcase Deployments

The SOFIA program is studying the option of performing one or several shorter duration, single instrument, Southern Deployments, to support additional instrument Science Flight Series, or science observation of southern targets not available during the boreal summer deployment. The implementation of such additional deployments will be contingent on resources and the scientific justification of submitted proposals.

2.2.4.3. Detailed Observation-Scheduling Planning

SOFIA proposers are not expected to lay out flight plans or perform detailed visibility analysis for their proposals. Such considerations are also not needed for the phase I proposals. The SMO staff and the instrument teams will do the flight planning for the observing program. General target availability for a specific set of dates can be judged using the SOFIA Visibility Tool (VT). The stand-alone version is available for down-loading at:
https://dcs.sofia.usra.edu/observationPlanning/installVT/

2.3. Proposal Submittal

Proposals must be submitted using the USPOT application. Upon successful upload, the system will generate an automatic message acknowledging the submittal. A confirmation email will be sent to the address provided in the proposal. Details about USPOT may be found in the Observers' Handbook and the USPOT manual.

Proposals can be resubmitted at any time before the proposal due date. Note that a resubmitted proposal **replaces** all previously submitted versions - the SMO keeps only the latest proposal submission associated with a given proposal number.

3. Observations and Data

3.1. Flight Planning & Target Prioritization

Flight planning is not part of the proposal process. However, source selection with the constraints of an airborne observatory in mind can increase the ability of a program to be scheduled. It may be expected that certain regions of the sky, such as the inner Galactic Plane, and Orion will be oversubscribed. These targets force SOFIA to fly westward, when observing out of Palmdale, since they are towards the south (and the telescope looks out on the port - left-hand - side of the aircraft). Since, in regular operations, SOFIA has to return to Palmdale at the end of each flight, targets in the northern half of the sky will be required for roughly the same amount of time as these southern regions. (Note that southern and northern half of the sky here does not refer to south and north of the celestial equator but to sources culminating south or north of the local zenith.)

The ranking by the peer review panel and selection by the SMO Director will result in a prioritized target pool, which will be provided to the SMO staff. The SMO will then produce flight plans in consultation with the instrument teams and proposal PIs. The effort will be carried out under the scientific direction of the SMO Director.

3.2. Data Processing, Calibration and Distribution

3.2.1 Data Processing, Archiving and Distribution

The SMO will be responsible for the processing of data obtained by Facility Class Science Instruments. The instrument development teams will be responsible for the data reduction for Principal Investigator Class Instruments. All scientifically meaningful data obtained during the Cycle 6 phase will be made available to observers via the SOFIA Science Archive.

Currently the SOFIA Science Archive is part of the SOFIA Data Cycle System's Science Archive (https://dcs.sofia.usra.edu/dataRetrieval/SearchScienceArchiveInfo.jsp). Work is under way to move and incorporate the SOFIA Science Archive into the Infrared Science Archive (IRSA) at the Infrared Processing & Analysis Center (IPAC). The transition is expected to be transparent to the archive user and will be announced and documented by the SMO, well in advance.

3.2.2 Calibration

The programmatically required photometric calibration accuracy for SOFIA observations is 20%. Cycle 6 proposals for which this calibration level is adequate do not need to include time for calibration observations, with the exceptions noted below. Proposers wishing to implement specific calibration strategies may request to do so, but must

identify the specific calibration target observations to accomplish these goals and explicitly request the observing time required. The calibration strategies and targets will be evaluated in the technical and science reviews, and if recommended by the review process will be treated as part of the proposal.

The required calibration accuracy is routinely achieved or exceeded for FIFI-LS, FLITECAM, FORCAST and GREAT observations, except in spectral regions of strong telluric interference. The calibration of HAWC+ observations is still being evaluated in detail. The photometric calibration of HAWC+ data is also expected to be verified to meet the formal requirement, by the time of the release of this call. The calibration of polarimetric data, is still not fully verified.

The EXES temperature-controlled blackbody source provides flux calibration to better than 20%. Corrections for the impact of Earth's atmosphere using the blackbody are accurate in wavelength regions where the atmospheric transmission is >0.50 and is spectrally smooth over the region of interest. Projects needing additional telluric calibration should include such requests in the phase I proposal. Because of the difficulty of scheduling a given telluric calibrator with the science target in a given flight, the specific calibrator will need to be chosen at the time of flight planning in consultation between the program PI, the instrument PI and the SMO support scientist. For such observation, a separate observation entry should be entered via USPOT with name "Cal_target", where "target" is the name of the associate science target (i.e. "IRC+10216" and "Cal_IRC+10216"), and given the coordinates RA:12:00:00, Dec:+90:00:00. The observing request for such a telluric standard observation will depend on the mode and wavelength observed. For specific questions, please contact the SMO or the EXES instrument PI, Dr. Matt Richter.

Further information on the calibration status of the SOFIA instruments can be found in the Observers' Handbook and the SOFIA website.

4. Contacts and Further Information

For further information about the Cycle 6 Call for Proposal or help in preparing proposals, please see the "Information for Researchers" (https://www.sofia.usra.edu/Science/) section of the SOFIA web site, or contact the SOFIA help desk at sofia_help@sofia.usra.edu.

Questions about the SOFIA Guest Observer program can be directed to the SOFIA the SOFIA User Support lead Dr. Ravi Sankrit (rsankrit@sofia.usra.edu), or the Associate Director for Science Operations, Dr. B-G Andersson (bg@sofia.usra.edu),

For further information about the SOFIA Science project, please contact the above, or the Science Mission Operations Director, Dr. Harold Yorke (hyorke@sofia.usra.edu)

Note:
Some of the following lists of Reserved Observation Catalogs contain entries for both observation intended to be executed in Cycle 6, and observations already performed by the instrument teams as part of their Guaranteed Time Observing (GTO) programs. For detailed information about completeness of the GTO observation, please follow the Duplication Checking procedure laid our on the Cycle 6, Phase 1 web pages (Ihttps://www.sofia.usra.edu/science/proposals/cycle6/phase_I), or contact the SOFIA help desk (sofia_help@sofia.usra.edu).

Appendix A1 - GREAT Cycle 6 Reserved Observations Catalog (ROC)

Science	Object Name	RA	DEC	ν_1	ν_2	ν_3	area	Time
		(2000)	(2000)	[THz]			arcmin	[hr]
PP disks	HD100546	11:33:25.4	-70:11:41.2	all lines			0.3	0.5
	HD50138	06:51:33.4	-06:57:59.5	all lines			0.3	0.5
	HD97048	11:08:03.3	-77:39:17.4	all lines			0.3	0.5
Star formation cores	SgrB2(M)(N)	17:47:20.4	-28:23:07.0	#1	#2	OI	2	2.0
	NGC2023	05:41:38.4	-02:15:32.5			OI	3	1.0
	NGC2024	05:41:45.2	-01:55:45.0			OI	2	1.0
	Orion-KL	05:35:15.1	-05:22:26.6	#1	#2	OI	2	1.5
	IRAS16172	16:21:02.0	-50:35:09.0	CO	CO/CII	OI	5	0.7
	IRAS16177	16:21:31.0	-50:25:48.0	CO	CO/CII	OI	5	0.7
	NGC6334I	17:20:53.3	-35:47:01.5	#1	#2	OI	5	3.0
	W33A	18:14:39.4	-17:52:00.0			OI	1	0.3
	G29.96	18:46:03.8	-02:39:22.0	#1	#2	OI	1	0.3
	G31.41	18:47:34.3	-01:12:46.0	#1	#2	OI	1	0.3
	G48.66	19:21:49.6	+13:49:31.2	CO	CO/CII	OI	2	1.0
	W51D	19:23:43.8	+14:30:26.0			OI	2	0.6
	W58N	19:59:59.9	+33:25:45	CO	CO/CII	OI	5	1.0
	NGC7538	23:13:45.3	+61:28:10.0			OI	2	0.6
Outflow studies	IRAS05358+3543	05:39:13.1	+35:45:50.0	CO	#2	OI	1	0.5
	HH212	05:43:51.4	-01:02:53.0	CO	#2	OI	2	0.7
	NGC2071	05:47:04.7	+00:21:44.0	CO	#2	OI	2	1.0
	HH111	05:51:46.3	+02:48:30.0	CO	#2	OI	2	0.7
	HH46	08:25:13.1	-51:00:36.0	CO	#2	OI	1	0.5
	BHR71	12:01:36.3	-65:08:53.0	CO	#2	OI	2	1.0
	HH54	12:55:50.3	-76:56:23.0	CO	#2	OI	2	0.5
	G327-0.6	15:53:08.8	-54:37:01.0	CO	#2	OI	2	0.5
	IRAS17233-3606	17:26:42.5	-36:09:18.0	CO	CO/CII	OI	1	1.0
	AG012.81-0.20	18:14:13.5	-17:55:32.0	CO	#2	OI	2	0.5
	IRAS16547-4247	16:58:17.2	-42:52:08.9	CO	#2	OI	1	1.0

	AG015.03-0.67	18:20:22.4	-16:11:43.8	CO	#2	OI	3	0.5
	IRAS20126+4104	20:14:25.1	+41:13:32.0	CO	#2	OI	1	0.5
Stars	O-Ceti	02:19:20.8	-02:58:43.0	CO	CO/CII	OI	1	0.5
	IK-Tau	03:53:28.9	+11:24:21.7	CO	CO/CII	OI	1	0.5
	ALF-Ori	05:55:10.3	+07:24:25.0	CO	CO/CII	OI	1	0.5
	VY-CMa	07:22:58.3	-25:46:03.1	CO	CO/CII	OI	1	0.5
(P)PNe	CRL618	04:42:53.6	+36:06:53	CO	CO/CII	OI	0.5	0.5
	OH231.8+4.2	07:42:16.8	-14:42:52.1	CO	CO/CII	OI	0.5	0.5
	NGC6537	18:05:13.1	-19:50:34.9	CO	CO/CII	OI	0.5	1.0
	BD+30 3639	19:34:45.2	+30:30:58.8	CO	CO/CII	OI	0.5	0.5
	NGC6572	18:12:06.3	+06:51:13.0	CO	CO/CII	OI	0.5	1.0
	M2-9	17:05:37.8	-10:08:32.4	CO	CO/CII	OI	0.5	0.5
	CRL2688	21:02:18.7	+36:41:37.8	CO	CO/CII	OI	0.5	0.5
	IRAS21282+5050	21:59:58.4	+51:03:59.8	CO	CO/CII	OI	0.5	0.5
Galactic PDRs	IC63	00:58:55.0	+60:53:11.0	CO	CII	OI	2	1.0
	OMC3	05:12:30.0	-05:03:45.0	CO	CII	OI	7	1.5
	OMC2	05:35:25.0	-05:12:30.0	CO	CII	OI	7	1.5
	M8	18:03:37.0	-24:23:12.0	CO	CII	OI	4	2.0
	IC1396	21:40:42.3	+58:16:10.0	CO	CII	OI	60	3.0
SMC PDRs	N12A	00 46 40.2	-73 06 11.0	NII	CII	OI	1	1.0
	N88	01:24:08.5	-73:08:53.2			OI	1	0.5
Galactic Center Studies	SgrA	17:45:39.9	-29:00:28.2	NII/ CO	CII		70[(1)]	20
	M+0.253	17:46:09.0	-28:42:40.0	CO	CII	OI	3	1.0
	SgrA	17:45:39.9	-29:00:28.2			OI	4	3.0
Cl-chemistry	Saturn, Jupiter	HCl		1.25		OI	-	0.75
H-chemistry	Mars	HDO, ($H_2{}^{16}O$), $H_2{}^{18}O$		1.27	1.89	OI	-	0.75
nearby nuclei	NGC253	00:47:33.1	-25:17:17.6	all bands			1	1.5
	M82	09:55:52.2	+69:40:49.6	all bands			1	2.0
	NGC4945	13:05:27.5	-49:28:05.6	all bands			1	1.5
	Cen-A	13:25:27.6	-43:01:08.9		CII	OI	1	1.5
MHD shocks	IC443	06:17:42.5	+22:21:30.0	all bands			40	2.0
	W28F	18:01:52.3	-23:19:25.0			OI	2	1.0
	3C391	18:49:22.3	-00:57:22.0	CO	CO/CII	OI	2	1.0
	W44 E/F	18:56:28.4	+01:29:55.0	CO	CO	OI	2	1.0

Times given in the last column are total integration times (on and off source), but no overheads due to calibration/facility inefficiencies have been added. Min map size of observation is one

arcmin (though in most cases this will be the central beam only). In most targets "CO" refers to the J–transition accessible in bands L1-L2, including selected isotopologues.

Frequency (THz) Species
set-up #2 (in band L2): 1.81 (NH3), #2 (OH), 1.9 ([CII]), CO(16-15)
set-up #1 (in band L1): 1.39 (OD), CO

(1) Galactic Center Survey between SgrC and SgrB, 0.3 deg along galactic plane

Appendix A2 – HAWC+ Cycle 6 Reserved Observations Catalog (ROC)

Source Name	Band (λ)	RA	Dec	map area	Time	mode
	#/[μm]	(J2000)	(J2000)	[arcmin]	[h]	
NGC253	A (53)	00 47 33.1	-25 17 18	3 x 2	0.5	polarimetry
NGC253	C (89)	00 47 33.1	-25 17 18	5 x 3	0.5	polarimetry
NGC891	D (155)	02 22 33.4	+42 20 57	7 x 5	3.5	polarimetry
W3_OH	C (89)	02 27 04.7	61 52 24.7	5 x 3	1.4	polarimetry
W3_OH	E (216)	02 27 04.7	61 52 24.7	10 x 6	0.3	polarimetry
NGC1068	A (53)	02 42 40.7	-00 00 48	3 x 2	1.4	polarimetry
NGC1068	C (89)	02 42 40.7	-00 00 48	5 x 3	1	polarimetry
IRAS4A	D (155)	03 29 10	+31 13 32	7 x 5	1.5	polarimetry
IRAS4A	E (216)	03 29 10	+31 13 32	10 x 6	1.3	polarimetry
HL Tau	A (53)	04 31 38	+18 13 58	3 x 2	0.6	polarimetry
HL Tau	C (89)	04 31 38	+18 13 58	5 x 3	0.5	polarimetry
HL Tau	D (155)	04 31 38	+18 13 58	7 x 5	0.5	polarimetry
HL Tau	E (216)	04 31 38	+18 13 58	10 x 6	0.6	polarimetry
L1527	D (155)	04 39 54	+26 03 10	7 x 5	1.6	polarimetry
L1527	E (216)	04 39 54	+26 03 10	10 x 6	1.4	polarimetry
L1544	E (216)	05 04 16.6	25 10 48.0	10 x 6	3	polarimetry
OMC1	A (53)	05 35 17.8	-05 23 17.1	6 x 6	1.9	polarimetry
OMC1	C (89)	05 35 17.8	-05 23 17.1	8 x 8	2.4	polarimetry
OMC1	D (155)	05 35 17.8	-05 23 17.1	8 x 8	0.3	polarimetry
OMC1	E (216)	05 35 17.8	-05 23 17.1	8 x 8	0.3	polarimetry
SN 1987A	C (89)	5 35 28	-69 16 11	5 x 3	0.6	total intensity
SN 1987A	D (155)	5 35 28	-69 16 11	7 x 5	0.4	total intensity
SN 1987A	E (216)	5 35 28	-69 16 11	10 x 6	0.5	total intensity
Vela C	C (89)	08 59 25.4	-43 45 58.9	5 x 3	1.4	polarimetry
Vela C	E (216)	08 59 25.4	-43 45 58.9	10 x 7	1.4	polarimetry
M82	A (53)	09 55 52.7	+69 40 46	3 x 2	1.1	polarimetry
M82	D (155)	09 55 52.7	+69 40 46	7 x 5	0.5	polarimetry
M51	E (216)	13 29 56.2	+47 13 50	10 x 6	3.5	polarimetry
Arp220	D (155)	15 34 57.1	+23 30 11	7 x 5	1	polarimetry
RhoOph L1688	A (53)	16 26 32.2	-24 23 32.2	3 x 3	3.3	polarimetry

RhoOph L1688	C (89)	16 26 32.2	-24 23 32.2	6 x 6	3	polarimetry
RhoOph L1688	D (155)	16 26 32.2	-24 23 32.2	7 x 5	1.5	polarimetry
NGC6334I	A (53)	17 20 53.3	-35 47 00	3 x 2	0.3	total intensity, 2 epochs
NGC6334I	C (89)	17 20 53.3	-35 47 00	5 x 3	0.3	total intensity, 2 epochs
NGC6334I	D (155)	17 20 53.3	-35 47 00	7 x 5	0.3	total intensity, 2 epochs
NGC6334_S	A (53)	17 20 19.1	-35 54 45.0	3 x 3	1	polarimetry
NGC6334_S	C (89)	17 20 19.1	-35 54 45.0	5 x 3	0.3	polarimetry
NGC6334_S	D (155)	17 20 19.1	-35 54 45.0	8 x 5	0.3	polarimetry
NGC6334_S	E (216)	17 20 19.1	-35 54 45.0	10 x 7	0.3	polarimetry
CND	A (53)	17 45 40	-29 0 28	4.8 x 4.8	4	polarimetry
CMZ Warm Dust Survey	C (89)	17 45 54	-28 54 28	42 x 18	5	polarimetry
Sickle	A (53)	17 46 15	-28 48 11	9 x 5.4	3	polarimetry
M17	A (53)	18 20 29.3	-16 10 01.6	3 x 3	1	polarimetry
M17	C (89)	18 20 29.3	-16 10 01.6	8 x 8	1.9	polarimetry
M17	D (155)	18 20 29.3	-16 10 01.6	10 x 10	0.3	polarimetry
M17	E (216)	18 20 29.3	-16 10 01.6	10 x 10	0.3	polarimetry
L1157	E (216)	20 39 06	+68 02 16	10 x 6	2.5	polarimetry
NGC7023_POS1	C (89)	21 01 30	+68 09 48	3.5 × 3.5	2	polarimetry
NGC7023_POS2	D (155)	21 01 36.9	+68 09 48	6 × 6	1.5	polarimetry
NGC7023_POS2	E (216)	21 01 36.9	+68 09 48	6 × 6	1	polarimetry
BL Lac	E (216)	22 02 43.3	+42 16 40	10 x 6	1	polarimetry
Cas A	C (89)	23 23 24	+58 48 54	5 x 5	1	polarimetry

Appendix A3 – FIFI-LS Cycle 6 Reserved Observations Catalog (ROC)

Reserved Objects Cycle 6

Target	RA (J2000)	DEC (J2000)	Extent (arcmin)	Lines B λ in μm	Lines R λ in μm	Time (h)
Brick	17:46:08.6	-28:42:46.0	3 x 5	[OI] λ63 OH λ79	[OI] λ145 [CII] λ157	3
W43-main	18:47:40.0	-01:57:00.0	5 x 5	[OIII] λ52 [OIII] λ88 OH λ79	[OI] λ145 [CII] λ157 CO (14-13) λ186	1
W40 - IRS5	18:31:14.82 18:31:21	-02:03:49.8 -2:06:51	2 x 2 2 x 1	[OI] λ63 [OIII] λ88	[CII] λ157 [OI] λ145 CO (16-15) λ163	1
DR21(OH)	20:39:00.7	+42:22:46.7	1 x 1	[OIII] λ52 [OIII] λ88	[OI] λ145 [CII] λ157	1
DR21	20:38:59.9	+42:19:32	1 x 1	[OIII] λ52 [OIII] λ88	[OI] λ145 [CII] λ157	1
SgrA*	17:45:40	-29:00:28	2.5 x 2.5	OH λ79 OH λ119 [NIII] λ57	CO (16-15) λ163 CO (19-18) λ137 CO (20-19) λ130	2
M83	13:37:00.9	-29:51:57	3 x 3	[OIII] λ88 [OI] λ63	[CII] λ157 CO(14-13) λ186	3
IC10	00:20:17.3	+59:18:13.6	5 x 5	[NIII] λ57	[OI] λ145	1.5
NGC4449	12:28:11.12	+44:05:36.8	2 x 2	[OIII] λ52 [NIII] λ57	[OI] λ145 [CII] λ157	3
NGC5253	13:39:55.96	-31:38:24.4	1x1	[OIII] λ52 [NIII] λ57	[OI] λ145 [CII] λ157	3
NGC 4038/ NGC 4039	12:01:53.5	-18:52:40	2x2	[OIII] λ52 [NIII] λ57	[OI] λ145 [CII] λ157	6
NC253	00:47:33	-25:17:18	2x2	[OI] λ63 [OIII] λ52	[OI] λ145 [CII] λ157	2.5
N159 E&W LMC	05:40:19 05:39:36	–69:44:52 -69:46:00	2 x 2 each	[OIII] λ52 [NIII] λ57	[OI] λ145 [CII] λ157	1
N11 LMC	04:56:51.4	-66:24:44	3X3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1.5
N44 LMC	05:22:06.9	-67:56:46	3X3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1.5
N66 SMC	00:59:27.4	-72:10:11	3X3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1.5

Cycle 4 scheduled GTO observations

M82	09:55:52.2	69:40:47	2x4	[OIII] λ52	[CII] λ157	3
M42	05:35:15.3	-05:22:48	2x1	[OIII] λ52 [OIII] λ88 [NIII] λ57	CO(22-21) λ118 CO(17-16) λ153 CO(16-15)λ 163	2
He2-10	08:36:15.1	-26:24:34	1x1	CO(27-26)λ97 CO(25-24)λ104	CO(17-16) λ153 CO(16-15)λ 163	2
NGC1569	04:30:51.0	64:50:50	2x1	[OIII] λ52	[OI]λ145	4
SgrA*	17:45:40	-29:00:28	10 x 10	[OI] λ63 [OIII] λ88 OH λ119	[CII] λ157 [OI] λ145 CO (14-13) λ186	6

Appendix B - Standard Target Names

Target names provide unique designations for the targets in the proposal. These names will also be used to designate targets in the SOFIA data archive. Prospective proposers and archival researchers also use these names to simplify queries of whether SOFIA has previously observed a particular object. The archives will be most useful if consistent naming conventions are used, and duplication checking is better facilitated if standard names are utilized to the greatest extent possible. These guidelines are based on drafts generated by the NASA/JWST program office and as such are intended to provide a more uniform approach to proposal and archival target names for infrared observers on NASA missions.

The following conventions should be followed in naming targets:

- A new target name must be defined for each (celestial) target. For example, for several pointings within a galaxy, one might define target names such as NGC4486-NUC, NGC4486-JET, NGC4486-POS1, and NGC4486-POS2.
- Only letters, numerals, hyphens, periods (.), and + or – are allowed in target names; other punctuation is not permitted (e.g., BARNARDS-STAR is valid, but BARNARD'S-STAR is not). Greek letters must be spelled out (e.g., ALPHA-ORI).
- Degree signs must be represented by an upper-case "D" (e.g., CD-42°14462 becomes CD-42D14462).

B1.1 Catalog Name

If your target is in a well-known catalog (e.g. SDSS, NGC, PG), then use that catalog designation for the target name. This is the name your object will have in the SOFIA Archive, so please try to select the most common name for the target, to make it easier for archive researchers to find your target and for proposers and SOFIA staff to perform efficient target duplication checks. If you are unsure whether your target has an established catalog name, please perform a coordinate search in SIMBAD and/or NED. If your proposed target is coincident with an existing catalog target, please consider using the existing catalog target. For uncataloged targets, see Section B1.2.

B1.2 Uncataloged Targets

For the **Standard Target Name,** objects that have not been cataloged or named must be assigned one of the following designations:

1. Isolated objects must be designated by a code name (the allowed codes are STAR, NEB, GAL, STAR-CLUS, GAL-CLUS, QSO, SKY, FIELD, and OBJ), followed

by a hyphen and the object's J2000 equatorial coordinates, if possible, rounded to seconds of time and seconds of arc (e.g., for a star at J2000 coordinates RA: 1H 34M 28S, DEC: –15D 31' 38", the designation would be STAR-013428-153138).

2. Uncataloged objects within star clusters, nebulae, or galaxies must be designated by the name of the parent body followed by a hyphen and the rounded J2000 coordinates, if possible, of the object (e.g., for a target within NGC 224 with J2000 coordinates RA: 0H 40M 12S, DEC: +40D 58' 48", the designation would be NGC224-004012+405848).
3. Positions within nebulae or galaxies may also be designated by the name of the parent object followed by a hyphen and a qualifier. The qualifier should be brief, but informative (e.g., the jet in NGC 4486 could be designated NGC4486-JET). Other examples are: NGC5139-ROA24, LMC-R136A, ABELL30-CENTRAL-STAR, NGC205-NUC.