Stratospheric Observatory for Infrared Astronomy (SOFIA)

Observing Cycle 10

Call for German Proposals

December 17, 2021

Version 1.1

There are two different Calls for Proposals for SOFIA's Cycle 10:
1) the *SOFIA Legacy Program (SLP)* and
2) SOFIA's regular *Observing Cycle 10* (this document).
Documentation and other information pertaining to these Calls may be found at
https://www.dsi.uni-stuttgart.de/en/research/observation-cycles/

Key Dates

Release of Call for German Proposals	November 5, 2021
Call for Proposals Update on Website	December 17, 2021
Proposals Due	January 29, 2022 06:00 CET (January 29, 2022 05:00 UTC)
Anticipated Announcement of Selections	May 2022
Cycle 10 Period	October 1, 2022 – September 30, 2023

Table of Contents

Change Log:

November 5, 2021: Original release

1. SOFIA Observing Cycle 10 Program Description

1.0. New Policies and Capabilities for Cycle 10

- As of October 1, 2021, EXES is a facility science instrument (FSI).
- The GREAT instrument is currently only funded through Cycle 10. Regular proposals are invited, but any accepted programs will be "Shared Risk" in the sense that even *Priority 1* and *2* programs will only be executed to the extent possible in the remaining availability of the instrument (fall of 2023). As noted in the accompanying Call for *Legacy* Proposals, no new *Legacy* proposals will therefore be accepted for this instrument.
- As for Cycle 9, the Cycle 10 SOFIA is implementing dual-anonymous review by removing the names of Principal Investigators (PIs) and Co-Investigators (Co-Is) from the proposals prior to presentation to the TAC panels. This **does not** include the Call for German Proposals. Check the instructions in this document (Section 2.3.2.).
- A new sub-category of programs called *Multi-Cycle Target Monitoring* programs has been introduced this Cycle and is intended to allow long-term monitoring of time variable targets. For Cycle 10 these programs will extend up to three cycles. This category may be combined with a *Target of Opportunity* trigger.
- For Cycle 10, SOFIA plans to carry out three Southern deployments: a long deployment scheduled approximately June through September 2023, and two short deployments in November 2022 and March 2023. The long deployment will offer GREAT and HAWC+. The fall 2022 deployment will offer FIFI-LS and the spring 2023 deployment will offer EXES.
- The 63 μm (band B) filter of HAWC+ is offered as shared risk in Cycle 10.
- The FIFI-LS on-the-fly mapping mode is offered as a standard mode in Cycle 10.
- The capability to tune to the two polarizations of the GREAT LFA to different frequencies for simultaneous observations of different lines is offered.
- The latest version (v 4.4.1 or later) of USPOT must be used to submit proposals for Cycle 10. Earlier versions cannot be used to submit proposals.

1.1. Introduction

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is pleased to invite proposals for Cycle 10 observations, which will take place from October 1, 2022 to September 30, 2023.

The Call for Proposals (Call, CfP), issued on behalf of Deutsches Zentrum für Luft- und Raumfahrt (DLR) by the Deutsches SOFIA Institut (DSI), is open to all qualified astronomers, currently affiliated with German research institutions. DSI personnel, based in the US, are considered affiliated with a German institution. Scientists based in Germany and affiliated with the European Southern Observatory (ESO) or the European Space Agency (ESA) are considered to be not affiliated with a German institution, and may respond to the US Call for Proposals at https://www.sofia.usra.edu/proposing-observing/proposal-documents.

Of the available Research Hours in Cycle 10, about 20% will be reserved for and allocated by DLR, through DSI. This Call for Proposals solicits proposals for approximately 100 hours of Guest Observer (GO) time available for the general community. This pool of time remains after setting aside ~77 h for Guaranteed Time Observers (GTO), ~12 h (7%) of Director's Discretionary Time (DDT) as specified in the SOFIA Science Utilization Policies[1], and 19 h of expected high priority carry-over time from Cycle 9. We assume that 9 h of high priority General Observer (GO) programs and 10 h of joint legacy programs with German participation will remain incomplete from Cycle 9. All these numbers are calculated with observational overheads due to calibrations, turns, telescope setup, etc. already taken into account and correspond to the times that result from the respective instrument time estimators. About 25% of the time, containing lower priority observations, will be scheduled in so-called alternative flights, that can be replaced by canceled high priority flights, to maximize the likelihood of high priority program completion.

In addition, approximately 100 hours are available through the parallel SOFIA Legacy Program proposal (https://www.sofia.usra.edu/science/proposing-and-observing/proposal-documents). Successful Joint Legacy Programs with an identified German Co-PI will be sponsored at the 20% level with time from the German pool of GO time specified above.

A second cycle of the stand-alone SOFIA Archival Research Program (SARP) is also planned. The release of a CfP for the SARP (to analyze data from the SOFIA Science Archive) is expected in the late spring of 2022.

All observing proposals that are considered to be scientifically well-justified through scientific peer review will be considered for selection through this Call. Preference will be given to substantial investigations that demonstrate significant scientific impact from SOFIA observations. Programs using multi-wavelength data from major facilities (ALMA,

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

APEX, HST, IRAM, Spitzer, etc.) in conjunction with SOFIA are highly encouraged. Programs that will inform future JWST observations are also highly encouraged.

For Cycle 10, SOFIA will offer six instruments. The available instruments are EXES, FIFI-LS, FORCAST, FPI+, GREAT (upGREAT and 4GREAT), 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 Imager and Grism Spectrometer	5 – 25 μm 25 – 40 μm	4
FPI+ (Focal Plane Imager Plus)	Visible Light High Speed Camera	360 – 1100 nm	5
GREAT*, upGREAT/4GREAT (German REceiver for Astronomy at Terahertz frequencies)	High Resolution (R>10^6) Heterodyne Spectrometer; Multi-Pixel Spectrometer	0.491-0.555 THz 0.560-0.635 THz 0.890-0.984 THz 0.990-1.092 THz 1.240-1.395 THz 1.427-1.525 THz 1.835 – 2.007 THz 2.49-2.59 THz 2.060-2.065 THz 4.7448 THz	6
HAWC+ (High-resolution Airborne Wideband Camera-Plus)	Far-Infrared Camera and Polarimeter	five bands at 53, 63**, 89, 154, & 214 μm	7

[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
[7] High-resolution Airborne Wideband Camera-plus HAWC+,
https://www.sofia.usra.edu/Science/instruments/hawcplus.html

* GREAT is offered in Cycle 10 as Shared Risk, as to program completion.
**HAWC+ 63 μm band is offered in Cycle 10 as Shared Risk.

SOFIA Cycle 10 observations will take place in number of Science Flight Campaigns[8] interleaved with a single aircraft maintenance period. A long deployment to the southern hemisphere in the July-September time period will consist of two science flight series. Two shorter southern deployments will bring a single instrument each. The shorter deployments allow out-of-season southern targets not previously observable with SOFIA.

The deployment schedule for Cycle 10 is:

CYCLE 10	
Date	**Instrument(s)**
November 2022	FIFI-LS
March 2023	EXES
July-Sep 2023	GREAT and HAWC+

Cycle 10 contains the first southern deployment for EXES. For future planning, we anticipate the following southern deployments during Cycle 11:

CYCLE 11 (notional)	
Date	**Instrument(s)**
November 2023	GREAT
March 2024	FORCAST
July-Sep 2024	FIFI-LS and HAWC+

The deployment dates **will be adjusted** based upon the proposals accepted and logistical concerns. A northern flight series will be inserted if there is insufficient demand for a deployment flight series.

1.2. The SOFIA Program

SOFIA Program is a joint project of NASA and DLR. SOFIA Science Mission Operations (SMO), located primarily at the NASA Ames Research Center in Moffett Field, California,

[8] 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.

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 University of Stuttgart, under contract to DLR, is the primary interface between SOFIA and the German astronomical community, supports the SMO and is responsible for the maintenance of the SOFIA telescope. 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 (AFRC); formerly the Dryden Airborne Operations Facility) in Palmdale, California.

SOFIA is a 2.7 m telescope, with an effective, unvignetted, diameter of 2.5 m, 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 CfP cover the range 0.36–612 μm. These instruments provide imaging, spectroscopic, and polarimetric capabilities for a wide range of scientific investigations.

Instrument characteristics relevant to the Cycle 10 CfP can be found in Section 3.2. Complete descriptions of the instruments and their capabilities can be found at https://www.sofia.usra.edu/Science/instruments. Links to the SOFIA publication archives, and selected observatory and instrument papers can be found in Appendix C.

1.3. Cycle 10 Schedule

The nominal schedule for the Cycle 10 observing program is as follows:

5 November 2021	Release of Call for German Proposals
17 December 2021	Call for German Proposals update
29 January 2022, 06:00 CET	Proposal Submission deadline
29 January 2022, 05:00 UTC	Proposal Submission deadline
May 2022	Proposal Selections Announced
15 June 2022	Phase II deadline for accepted proposals
1 October 2022 – 30 September 2023	expected Cycle 10 observing period

SOFIA observations in Cycle 10 will be conducted over the period October 1, 2022 to September 30, 2023. Three Southern Deployments are planned for Cycle 10 as described above. The schedule is presented as currently planned, but may be subject to change.

1.4. General Guidelines and Policies

Observing requests of all sizes will be considered through this CfP. In addition, a separate CfP for SOFIA *Legacy* programs (https://www.sofia.usra.edu/science/proposing-and-observing/proposal-documents) specifically solicits large programs, including the development of tools and higher-level

data products. Large programs (of any size, up to the total offered) that do not meet the characteristics of *Legacy* science may be proposed through this CfP

Beginning with Cycle 6, "*Regular* proposals" have been 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 as follows:

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 10 and will remain active through Cycle 11. If, for technical reasons, they cannot be completed within Cycles 10 and 11, then Priority 1 proposals will be carried over into the following cycle. It is expected that about 25% of the available Cycle 10 observing time will be accepted into this category. Proposers do not need to, and cannot, request this status, as it will be assigned by the SMO Deputy/Director, as part of the proposal selection process. The SMO Deputy/Director will communicate such assignments directly to relevant GOs.

Priority 2 ("**should do**") proposals are likely to be completed within Cycle 10. Priority 2 proposals will remain active through Cycle 11 but will not be initiated in the following cycle if inactivated. Substantially executed Priority 2 programs will be carried over into future cycles. It is expected that about 50% of the available Cycle 10 observing time will be accepted into this category.

Priority 3 ("**do if time**") proposals will be added to Flight Plans when no higher ranked targets are available. Priority 3 proposals will remain active through Cycle 11 but will not be carried over into the following cycle if incomplete. It is expected that about 50% of the available Cycle 10 observing time will be accepted into this category.

The observing time allocated to the regular programs, together with the "*Survey* Proposals" (Sec. 2.1.3), intentionally over-subscribes the available time in order to allow for inefficiencies and contingencies in flight planning (Sec 3.3). The exact selection fractions in each band will depend on target locations and competition

Observations lost due to observatory or instrument hardware or software failures, weather, or other reasons, will be returned to the scheduling pool but will not be rescheduled automatically. The observatory has included contingency flight opportunities in the overall schedule to minimize the impact of lost flights, but 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. All proposals are available for activation for two cycles from Cycle 10; *Priority 1* regular proposals and accepted "*Thesis-Enabling*" (Sec. 2.1.4) proposals will be automatically carried forward into the following cycle if incomplete.

Priority 1 regular proposals and accepted "***Thesis-Enabling***" proposals from Cycle 9 will be automatically carried forward into Cycle 10, thus, accepted proposals in these categories from Cycle 9 should not repropose to this CfP. Observations that are part of an **active *Priority 2* or *3* Cycle 9 SOFIA program**, but which have not been executed at the time of the Cycle 10 proposal deadline may be re-proposed and clearly identified as such – see Section 2.1.5 Resubmitted Proposals.

Because of the highly constrained nature of SOFIA observation scheduling and the large planning overheads incurred in such observations, observations that require SOFIA to be located in a specific geographical area at a specific time (typically occultation observations), or observations that must be made in a single time window less than four hours in duration, should be entered with a minimum time request of six hours per event (even if the targeted event is shorter). Such programs will, however, be funded based on the actual observing time needed. This applies also to highly time constrained "Multi-Cycle Target Monitoring Programs" (Sec. 2.1.2)

Consistent with the NASA SMD Science Plan, the SOFIA project is encouraging high intellectual risk/high impact proposals. While scientific merit and likelihood of publication are key parts of the selection criteria, well motivated proposals of this type will receive special attention in the review and selection process.

1.4.1. Proposal Process

The SOFIA Cycle 10 proposal process will consist of two parts: 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 Deputy/Director. Proposals that are awarded observing time based on the evaluation process described in Section 1.5 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. 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 10 Phase I proposals must be prepared and submitted using the Unified SOFIA Proposal and Observation Tool (USPOT: https://dcs.arc.nasa.gov/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. USPOT will also be used for Phase II inputs and, whereas only some observation parameters are required for Phase I

submissions, proposers may elect to define their observations in greater detail 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 Science 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 USPOT Manual https://www-sofia.atlassian.net/wiki/spaces/USPOTMAN/overview.

1.4.2. Who May Propose

Leading a proposal in the German SOFIA Cycle 10 Program is open to scientists from all categories of German scientific organizations, including foreign nationals affiliated with German institutions. German DSI staff members of SOFIA in the US and Germany are also encouraged to submit proposals through this Call. There is no restriction as to the nationality and affiliation of the Co-Is.

Each SOFIA Cycle 10 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 Deputy/Director, the SMO staff will communicate formally only with the PI (or a person designated by the PI) of each proposal. 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 non-German professional affiliation may participate as Co-Investigators on proposals submitted in response to this Call. They may not be PIs on the proposals, nor in any way be designated as the contact or lead investigator.

1.4.3. Late Proposals

Consistent with DSI and DLR 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.

1.5. Proposal Evaluation and Selection Process

Proposals submitted in response to this Call will be evaluated in a competitive peer review conducted by the DSI. The peer review panel, including its chair, will be recruited from the astronomical community by the DSI.

The following factors will be used in evaluating proposals for the SOFIA Cycle 10 Program.

- The overall scientific merit of the proposed investigation.
- The broader scientific impact of the investigations to astronomy.
- The feasibility of accomplishing the objectives of the investigation, as well as the timely publication of previously awarded SOFIA observations.
- The degree to which the investigation uses SOFIA's unique capabilities.
- The competence and relevant experience of the PI and any collaborators to carry the investigation to a successful conclusion.

Reviewers will be instructed to pay particular attention to the path to publication section.

Proposals providing synergies with major observing facilities will be given particular consideration. 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.

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 complexity 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 Deputy/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 Deputy/Director will approve the implementation of the observing prioritization and target selection.

1.6. Funding for German-based Investigators

1.6.1. "Verbundforschung" Grant

The DLR Space Agency (Raumfahrtagentur im DLR – DLR RFA) supports the use of selected satellite and airborne missions and their data reduction with financial resources from the Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie – BMWi). SOFIA is one of these selected observatories. The next deadline for submitting grant applications is expected to be January 2022 for a start in mid 2022. The DLR website will be updated accordingly. All applications will be evaluated by an external review committee.

Important Information:

- Grants can be requested after the observing proposal has been accepted, but funding can start only after the data have been acquired.
- The acceptance of the observing proposal does not guarantee award of the grant.
- The grants are applied for by the host institute, not by the scientists themselves.
- The host institute must be German.
- Grants to co-authors of SOFIA proposals are also possible, but priority will be given to the principal investigator.
- The grants cover salary and travel and can run up to three years.
- Detailed time plan and budget must be provided.

Information from the previous grant round can be found on the DLR website: http://www.dlr.de/rd/desktopdefault.aspx/tabid-4354/7065_read-10478/.

1.6.2. German SOFIA Postgraduate Conference Program

The German Aerospace Center (DLR) supports postgraduate students to present their work based on SOFIA observations at a conference of their choice. Through this program, young scientists are helping DLR in achieving its goal to establish SOFIA as a renowned asset for the astronomical community. In return, they are given the opportunity to present their original research to an international audience, and are provided with networking opportunities that may prove invaluable in their future career.

To apply:

- Download and fill in the application form found on the DSI website https://www.dsi.uni-stuttgart.de/en/research/
- Send the document to SOFIA@dlr.de

Additional Requirements & Information:

- The data come either from the student's SOFIA observations or from the SOFIA archive (link to archive https://irsa.ipac.caltech.edu/applications/sofia/).
- The subsidy is intended for conferences throughout the graduate studies up until 6 months after the thesis defense.
- The conference can be selected by the student, but the selection must be approved by the supervisor.
- The contribution to the conference can be either an oral or a poster presentation. The former is preferred.
- The material intended for the conference contribution shall be already in preparation for peer review journals, or already accepted or published.
- The student shall be the first author of this publication.
- Only students affiliated with German universities or research institutes are eligible.
- The subsidy covers the travel costs, conference fee, and accommodation up to 1500 Euro per student.
- The reimbursement will occur after conference attendance.

- The number of selected students depends on available funds and may change from year to year.
- Applications are considered throughout the year.
- The application process will take approximately 3 months from date of submission.

2. Proposal Preparation and Submission

2.1. Types of Programs

Three types of programs are solicited in response to this CfP: Regular programs including *Multi-cycle Target Monitoring* programs, *Survey* programs, and *Target of Opportunity* programs. A single proposal may not mix these three different program types. Proposers of Regular programs and S*urvey* programs can also request status as a *Thesis-Enabling* program. If not selected as a *Thesis-Enabling* program, then these proposals revert back to their original designation and can still be selected as a Regular program or a survey Program. Proposers for Target of Opportunity programs may not request status as a Thesis-Enabling Program.

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 also includes 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. By necessity, efficient scheduling of SOFIA requires a larger pool of candidate observations in a given Cycle. The SMO Deputy/Director may therefore accept *Regular* proposals as *Priority 3* over and above the maximum available 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. *Multi-Cycle Target Monitoring* Programs

For Cycle 10 a new sub-category of programs called *Multi-Cycle Target Monitoring* is offered. For Cycle 10, an extent of up to three (3) cycles is offered for observations.

This category is intended to allow long-range, time-domain science, specifically the monitoring of specific targets (including variable stars, known irregular transient sources, etc.).

The proposal should clearly describe and justify, in the Science Justification, the observation cadence (timing constraints, or sampling pattern) or sampling (minimal and maxima observation frequency, without specific observing dates) required for the proposed program over the full proposed active period (up to three years).

Because of SOFIA scheduling constraints, proposers are strongly encouraged to consider and discuss timing and instrument flexibilities of their monitoring programs. Particularly for programs requiring absolute timing constraints (specific observing dates or weeks) instrument flexibility may be critical to the feasibility of such programs. For the proposal, the nominal instrument and monitoring request should be used to calculate the required observing time. As for regular proposal, observations that must be made in a specific time window less than four hours in duration, should be entered with a minimum time request of six hours per event (even if the targeted event is shorter). Such programs will, however, be funded based on the actual observing time needed.

The GREAT instrument is currently not funded beyond the first part of Cycle 11. Hence *Multi-cycle Target Monitoring* programs that **require** this instrument will not be accepted.

Target of Opportunity (ToO) observations are allowed under this sub-category (i.e., the monitoring program is initiated if, and only if, a specified event takes place), but the period for program triggering is limited to the first cycle. The need for long-term monitoring of the *ToO* target, after triggering, should be discussed in the Science Justification section. The same rules as for regular *ToO* program activation applies, including the triggering approval by the SMO Deputy/Director (Sec 2.1.6).

The *Multi-Cycle Target Monitoring* programs may be proposed as *Thesis Enabling*, except when involving a *ToO* component.

The full duration of the monitoring program is limited to three cycles, independent of when the triggering request is submitted (i.e., the duration of a program triggered at the end of Cycle 10, is still limited to the end of Cycle 12). The monitoring should be limited to the target that the *ToO* triggering applied to.

This category may not be used to extend the active status of regular programs that are not specifically targeted at variable source monitoring.

2.1.3. Survey Programs

The *Survey* proposal category is 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 and with shorter observing times per object 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 clearly identify and justify a scientifically useful sample size for completion. The proposer should specify more observations than fit into the allotted time, so it is easier to find

observations that can act as fillers of open legs in a schedule, improving overall observatory efficiency. Providing more targets increases the probability of program completion. The scientific justification should, however, be based on the identified scientifically useful sample.

2.1.4. Thesis-Enabling Programs

Thesis-Enabling programs are aimed at enhancing the support for and execution of doctoral theses based in a substantial part on SOFIA observations. While funding is only provided to US-based PhD students, **PhD students affiliated to German institutions**, who are PIs of given proposals, can increase their chances for program completion by soliciting "Thesis-Enabling Program" status in USPOT, while uploading the proposal. Such a status may be granted by the Time Allocation Committee (TAC), only to proposals accepted as **Priority 1** or **2**.

2.1.5. Resubmitted Proposals

Starting in Cycle 9 programs stay active for two cycles, as described in Sec. 1.4. However, programs that have been accepted as ***Priority 2*** or ***Priority 3*** in Cycle 9 but not yet completed may be resubmitted for Cycle 10, for instance to attain a higher priority, if identified as resubmitted proposals in USPOT (note that ***Priority 1*** proposals are automatically continued into Cycle 10 if not observed, so should not be resubmitted[9]). Resubmitted proposals are an exception to the normal rule that targets included in accepted Cycle 9 proposals will be removed as duplicates if included in a Cycle 10 proposal; for a resubmitted proposal, a target will only be removed as a duplicate if it is actually observed in Cycle 9.

For a resubmitted proposal, the integration times on targets may be changed, targets removed, and the proposal text updated. However, no new targets or new wavelength observations of existing targets may be added to those requested in the original proposal. If proposers wish to add new wavelengths or new targets, these should be submitted separately as a new proposal rather than as a resubmitted proposal. New targets or wavelengths submitted as part of a resubmitted proposal are considered non-compliant and will be removed.

The inclusion of targets in a resubmitted proposal is based on the *accepted* target list of the original program. If targets were included in the original proposal but were disallowed (e.g., because they required a southern deployment and the instrument requested was not included in that deployment) then a request to observe these targets should be submitted as a new proposal, *not* as a resubmitted proposal.

When observations of a target across multiple cycles are necessary for monitoring purposes, a new proposal should be submitted and justified for each cycle, or a new

[9] Proposal modifications for Priority 1 observations should be addressed to the SMO Deputy/Director.

proposal could be submitted as a *Multi-cycle Target Monitoring* program" (Sec. 2.1.2). This is not considered a resubmitted proposal.

The resubmitted proposals category is intended only for programs accepted for the current cycle but not yet completed. Declined proposals from previous cycles should be submitted as new proposals.

Resubmitted proposals will be assessed by the Time Allocation Committee (TAC) together with new proposals. There is no guarantee that a resubmitted proposal will receive the same priority as the original proposal, or that it will be accepted for scheduling in the upcoming cycle.

For resubmitted proposals, any changes of PI (or U.S. lead investigator for non-U.S.-led programs) or PI institution must be approved by the SMO Deputy/Director.

2.1.6. Target of Opportunity Programs

Target of Opportunity (ToO) proposals are invited in response to this Call. Both programs with known targets, but unknown timing of the observations (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.

Proposals targeting the possible *ToO* observations of new local supernovae are solicited and encouraged, but will reviewed for, and form the basis of, the membership of the envisioned science-steering committee advising the SMO Deputy/Director on such observing campaigns. The proposal should take the form of a regular *ToO* proposal aimed at acquiring data on a local supernova event, but may also include discussions of available facilities, unique theoretical or modeling capabilities, etc. In the case that a new local supernovae takes place, this science-steering committee will advice the SMO Deputy/Director on the implementation a community-advised campaign of observations and the data will become public immediately for the community. The time will be charged to Director's Discretionary time.

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 a time, rapid turn-around *ToO* requests with a specific instrument may be difficult to implement, except for FPI+, which is always mounted. Hence, *ToO* proposals not meant for FPI+ should also address the viability and utility of observing the event/target with each of the available SOFIA instruments.

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

*Note: Observations of specific Solar System targets or events whose times of occurrence and position can be predicted with sufficient accuracy in advance **do not** constitute ToO observations and should not be flagged as such but should be submitted as Regular Proposals.*

2.1.7. Director's Discretionary Time Programs

In addition to the above, the SOFIA program accepts proposals for *Director's Discretionary Time (DDT)* programs. This category is intended for short, urgent observations that could not have been foreseen at the time of the CfP and that cannot wait for the next proposal cycle. In exceptional cases, proof-of-concept observations may be requested through the *DDT* path. However, a strong justification for not proposing such observations through the regular proposal process will be required. ***DDT* proposals are not solicited through this CfP**. Further information about the *DDT* program can be found at the SOFIA website under:
https://www.sofia.usra.edu/science/proposing-and-observing/proposal-calls/sofia-directors-discretionary-time

2.2. Proposal Preparation

Each Cycle 10 proposal must be prepared using USPOT. The proposal information is entered directly into USPOT, 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 2.2.1, 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 entered directly into USPOT is limited to 300 words.

2.2.1. Proposal Text Sections

2.2.1.1. Main Body (to be uploaded as a single PDF file)

The uploaded "Science PDF Attachment" must contain the following sections in the order indicated, for each proposed observing program. The page length limits are indicated.

[10] https://dcs.arc.nasa.gov/observationPlanning/installUSPOT/uspotDownload.jsp

Please note that for proposals longer than 8 pages total, DCS will return a warning about a too long proposal document. If all individual section limits have been adhered to, this warning may be ignored.

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 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 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 2 pages + 1 additional for references only)**
   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.

3. **Feasibility and Path to Publication (up to 2 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 addressed. 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 Observer's Handbook. This section should also contain the justification for special calibration procedures, if they have been requested (Section 3.5.2).

   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.

   Describe the plans for and constraints on the generation and timely submittal of research publications based on the proposed observations. If the requested SOFIA

data depend on synergies with other observations or theoretical work, describe the status of those efforts.

Timely publication of previously awarded SOFIA observation is a critical part of the proposal evaluation. Proposers should clearly explain the status and progress towards publication of such observations in "**Status of SOFIA Observations in the Last Three Years"** field in the USPOT form.

4. **Principal Investigator and Co-Investigator Biographical and Publication Data (1/2 page for the PI; 1/2 page for all Co-Is)**
   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 Co-Is.

5. **Thesis-Enabling Programs, for proposals with a PhD student as a PI (one additional page)**
   Include a description of the thesis project that contains the expected role of SOFIA data and an estimated timeline.

2.2.2. Exposure Time Estimates

Estimates of exposure times for individual SOFIA instruments can be made using the SOFIA Instrument Time Estimator (SITE)[11], a web-based tool that provides total integration time or signal-to-noise 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.

Printouts to PDF of the complete set of parameters used in SITE and/or other time estimators should be added as Appendix to the end of the proposal. This will help with the technical feasibility analysis at the SMO and will not count towards the page limit.

2.2.3. Sky Availability During Cycle 10

The sky availability for SOFIA observations is constrained by several factors, including the need to return to 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.

[11] https://dcs.arc.nasa.gov/proposalDevelopment/SITE/index.jsp

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-Helpdesk (sofia_help@sofia.usra.edu) 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).

The SMO has used accepted observations and Flight Series (by instrument) from earlier observing cycles 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 10 page (https://www.sofia.usra.edu/proposing-observing/proposal-calls/cycle-10) in the "Complementary 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 high-density region.

2.2.3.1. Long Southern Deployment

The SOFIA Program expects to conduct a long Southern Hemisphere deployment during Cycle 10, in the boreal summer of 2023. This "long" deployment is expected to be executed out of Christchurch (New Zealand), contingent on local Covid-19 restrictions in the deployment site, and will include the GREAT and HAWC+ instruments.

Due to the high demand for southern targets in the Galactic plane with the GREAT instrument, and the guaranteed time already committed to the legacy programs, **Cycle 10 proposals requesting the GREAT instrument for targets near the Galactic Center or in the Inner Galaxy are unlikely to be awarded observing time.** Other targets outside of this region, e.g., targets in the Magellanic Clouds, requiring the GREAT instrument will be considered in Cycle 10.

2.2.3.2. Short Southern Deployment

For Cycle 10, the SOFIA program also plans two shorter-duration, single-instrument Southern Hemisphere deployments to support observation of southern targets not available during the long deployment, or for other location-critical observations, not possible for flights out of Palmdale. Note that such short deployments are contingent on budget and operational constraints. Observations requiring the short deployment should be highlighted in the Feasibility section of the proposal. For Cycle 10, SOFIA plans to execute two short deployments: during November 2022 with the FIFI-LS instrument and a March 2023 deployment with EXES.

See table , Section 1.1.

2.2.3.3. 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 therefore 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 downloading at:
https://dcs.arc.nasa.gov/observationPlanning/installVT/.

2.3. Proposal Submittal

2.3.1. The Unified SOFIA Proposal and Observation Tool (USPOT)

Proposals must be submitted using the USPOT application (v4.4.1 or later) available at the SOFIA Data Cycle Systems (DCS) web pages (https://dcs.arc.nasa.gov/). 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 Observer's Handbook and the USPOT Manual.

Proposals must use the latest version of USPOT (v4.4.1 or later) to submit proposals for Cycle 10. Earlier versions cannot be used to submit proposals.

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 can be repeatedly updated in USPOT and uploaded to DCS at any time before the proposal due date. Please see the USPOT manual
(https://www-sofia.atlassian.net/wiki/spaces/USPOTMAN/overview)
for instructions on how to update your proposal rather than submitting a new (duplicate) proposal. **Note that an updated proposal replaces all previously submitted versions - the SMO keeps only the latest proposal submission associated with a given proposal number.**

Online help for USPOT is available as a pop-up function in the application.

2.3.2. Two PDF Attachments in USPOT

Starting from Cycle 9, **two PDF attachments** must be submitted to USPOT, as NASA introduces a double blind review process for their proposal queue. This process is **NOT** required for proposals in the German (DLR) queue and for that you do not need to change the way you are normally writing proposals. However, researchers proposing for the German queue still need to submit **two PDF-files** to the system.

The first file should contain the full proposal (like in previous cycles) as a single file using the USPOT option "**Science PDF Attachment**". The second file required as option "**Team PDF Attachment**" should **NOT** contain any proposal text, but should rather be the **dummy-file** "German-Queue.pdf" that can be downloaded from the DSI website (https://www.dsi.uni-stuttgart.de/en/research/observation-cycles/German-Queue.pdf). Please, for uniformity, just submit the file "German-Queue.pdf" as the second file and do not use any other file nor include any text additions. Only the first file submitted as "**Science PDF Attachment**" should contain all information pertaining to your proposal (including PI and co-Is biographical and publication data) and only this file will be reviewed by the TAC.

The text from USPOT: "*SOFIA is working towards a fully dual-anonymous proposal process. As part of this effort, please ensure that the PI and team are not identified in the science PDF*." **should be ignored by the PIs from the German institutions**! The Dual Anonymous Review **does not** apply to the German Call for Proposals nor the German Time Allocation Committee for Cycle 10!

3. Observations and Data

3.1. Targets for Observations

All scientifically valid observations may be proposed, with the exception of those duplicated from Collaborative Reserved Observations Catalog (CROC) lists (Appendix A), designated by each Science Instrument team, and observations that duplicate previously made observations.

In contrast to Reserved Observation Catalogs of other facilities, the CROCs do not automatically prohibit proposals for the listed sources. Observations of targets in the GREAT CROC or in the FIFI-LS CROC may be proposed with the prior permission of the instrument's PI, who may allow these observations, or may propose a collaborative proposal. GOs wishing to observe objects in one of these CROCs should therefore contact the instrument's PI in advance to reach agreement on collaboration. The SMO should be notified prior to proposal submission that this agreement has been reached and that the observations are permitted.

Duplication of observations (target, mode, and exposure time) obtained in earlier cycles is generally not allowed, and if proposed, must be identified as such and the necessity for duplication must be explicitly justified. Duplication of active proposals is also generally not allowed; these are identified by the SMO during the review process. Observers who wish to resubmit targets from a currently active proposal should see Section 2.1.5 Resubmitted Proposals.

Proposed observations are considered to duplicate previously observed or reserved 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 or at different wavelengths are not considered duplicates. For instructions on identifying duplicate observations, please see the Duplication Checking procedure laid out in the USPOT Manual at
https://www-sofia.atlassian.net/wiki/spaces/USPOTMAN/overview.

3.1.1. Program Completion

Accepted *Priority 1* programs are planned for full completion (see Sec. 1.4 for *Priority 2* and *3*). In practice, and unless the program nature clearly requires 100% completion (e.g. complete time sampling of a variable source, etc.), programs are considered completed when 80% of the allocated observing time has been successfully executed. The SMO Director may declare programs or targets completed if the requested signal-to-noise ratio has been achieved, even with less than the requested time (such as observations taken under better than expected atmospheric conditions). The SMO Director may also declare programs completed at a lower level, if the assumptions of the proposal are clearly not met in practice (e.g. target samples that are significantly fainter than expected and cannot be detected in the time allocated).

3.1.2. Reserved Observations

As part of the instrument development contracts, the instrument teams were awarded a limited amount of Guaranteed Time Observations (GTO). Those teams with remaining GTO time for Cycle 10 have used these allocations to set aside a limited number of targets and associated exposure times as Reserved Observations that are listed in the respective Collaborative Reserved Observation Catalogs (CROCs). In addition, the GREAT team receives an updated allocation of observing time in each cycle for which such reserved observations are specified. These reserved observations may not be proposed for, unless the GO has contacted the instrument PI and received permission to do so. The instrument PI can request to remain involved as part of a joint proposal, but may also decline to join the proposal. The instrument teams are not required to accept such invitations. For Cycle 10, CROCs exist for FIFI-LS and GREAT (see 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.

The CROCs for the instruments are independent of each other. The current CROCs also only apply to Cycle 10, 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.

3.1.3. Shared Risk Observations

The SOFIA program will endeavor to execute all accepted observations. To provide the maximum complement of capabilities, some instruments and modes are offered either before being fully commissioned or where maintenance or instrument availability issues are possible that may put these modes at a larger risk. These modes are here classified as "Shared Risk." For the purpose of this CfP we define "Shared Risk" observations as those whereby the availability or characteristics of an instrument, one or more of its observing modes, and/or pipeline reduction software are known to be uncertain or questionable. Observations with instruments still under development will therefore always be "Shared Risk." In addition, for instruments where critical parts are known to be at risk of failure, and where the resources to replace these parts may not be guaranteed, the relevant observations may also be "shared risk." For instance, because of the limited lifetime of local oscillators and the uncertain characteristics of local oscillators near the band limits, some frequencies of the GREAT receivers may not be available throughout the observing Cycle. Because of the uncertainties in the availability of the GREAT instrument beyond the first part of Cycle 11, GREAT observations (also in *Priority 1* and *2*) are therefore considered "Shared Risk" in terms of completion for Cycle 10 programs.

3.1.4. Data rights

For regular programs, the data will be accessible to the general community after an exclusive use period of six months. The exclusive use period for all data products will end six months after the GO is given access to the calibrated (Level 3 or higher) data through staging to the SOFIA Science Archive (Sec. 3.5.1). In exceptional cases a longer proprietary period may be granted by the SMO Director upon written request. Approved *Thesis-Enabling* programs will have a twelve-month proprietary period.

Proposers are strongly 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.

3.2. Available Instruments and Observation Configurations

Six instruments are expected to be available for Cycle 10 observations: EXES, FIFI-LS, FORCAST, FPI+, GREAT and HAWC+. The EXES instrument is being offered as a facility instrument, for the first time, in Cycle 10. The availability of the GREAT instruments for Cycle 10 is contingent on the completion of Memoranda of Understanding between the SMO and the instrument teams, and between NASA and DLR.

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 10. Details are available in the Observer's Handbook for Cycle 10, accessible at https://www-sofia.atlassian.net/wiki/spaces/OHFC1/overview.

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 Call. 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. FSIs are operated and maintained by the SMO in support of Guest Observers (GOs). FSIs may be offered for shared risk observations prior to completed commissioning. Generally, no direct interactions with the instrument development team are required to propose for or to use the instrument. However, the FIFI-LS instrument team still has guaranteed time available during Cycle 10 and has therefore developed a CROC. The FIFI-LS PI has agreed to consider Cycle 10 proposal requests for observing objects in the FIFI-LS CROC (see Section 3.1).

For Cycle 10, EXES, FIFI-LS, FORCAST, FPI+ and HAWC+ are 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 GREAT through the SOFIA Science Archive (see Section 3.5).

For Cycle 10, 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.

3.2.1. EXES Supported Configurations in Cycle 10

EXES observations are defined by the observing modes, the spectroscopic configuration, and the central wavelength. The following EXES modes are available for Cycle 10:

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 Observer's 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 tool to determine if on-slit nodding is possible. The tool also provides information about expected resolving power and wavelength coverage for the selected instrument configuration.

EXES Configuration summary (See Observer's 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 Observer's 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, and the instrument team is conducting further tests aimed at mitigating the issue. Observations with EXES in the LOW configuration are therefore offered as *shared risk*. The current workarounds require extra overheads to prepare for and to recover from, thus 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 accessible through SITE to evaluate their proposed observation parameters.

3.2.2. FIFI-LS Supported Configurations in Cycle 10

FIFI-LS has two independently settable Littrow spectrometers with R = 500 – 2000 that cover the spectral ranges 51 – 120 μm, and 115 – 203 μm, respectively. The spectrometers are fed by one of two dichroics, which enables simultaneous observations of the same target at two wavelengths (see the Observer's Handbook for details). 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 symmetric chopping is not possible.
3. Total Power mode: This mode is suitable for very extended sources or very crowded regions, where asymmetric chopping is not possible. It is an unchopped mode.
4. On The Fly Mapping mode: This mode is suitable for the mapping of bright, extended sources, with data being taken while the telescope is being actively driven. It is an unchopped mode. Potential proposers are strongly encouraged to contact the FIFI-LS Instrument Scientists, via the SOFIA help desk, during proposal preparation.

All modes allow mapping.

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

3.2.3. FORCAST Supported Configurations in Cycle 10

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 10:

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 10. 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 10. *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 10 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

* Due to a defect in the filter, the use of these filters are only available for single channel mode. If used in the dichroic, there is a possibility of ghosting (~few percent) for sources brighter than ~1 Jy. The F111 filter is recommended for most programs. Only available in single-channel configuration.

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

Dichroic:
For Cycle 10, 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 except the 5.6μm and the broadband N' 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 μm in dual-channel configuration; this information is built into the sensitivity estimator (SITE).

Mosaicking:
The FORCAST pipeline now supports mosaicking of imaging observations to form Level 4 data products covering a larger area than a single observation.

Dithering:
In order to minimize the effects of artifacts on the array, dithering is required for all FORCAST imaging observations. For both NMC and C2NC2 imaging observations, five dither positions are recommended.

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)

Note that the acquisition images taken for set-up of spectroscopic observations should not be used for scientific analysis. If imaging/photometry is required for the scientific analysis of the spectroscopic observations, such exposures must be requested separately as part of the proposal.

Due to their unexpectedly low throughput, the FORCAST cross-dispersed grisms are not offered in Cycle 10. 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 3.2.1)

An exposure time estimator tool is available on the Cycle 10 web page.

Grisms and Slits:

Grism	Wavelength (μm)	Slit	Resolving Power[12]
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

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

FOR_G329	28.7-37.1	2.4” x191”	Not Offered
		4.7” x191”	110

Dichroic:
For Cycle 10, all FORCAST spectroscopic observations will be done using the single channel configuration.

3.2.4. FPI+ Supported Configurations in Cycle 10

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 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 overheads. 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 10 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

3.2.5. GREAT Supported Configurations in Cycle 10

GREAT is a dual [array] receiver instrument, whereby the two receivers are operated simultaneously, and each receiver (front end) can be tuned separately. GREAT observation configurations consist of observing modes, receiver band, and backend selections. In Cycle 10, GREAT is offered in two configurations: i) the two-polarization-each seven-beam upGREAT Low-Frequency Arrays (2x7 pixels in the LFA; 1.9 THz) together with the High-Frequency Array (1x7 pixel HFA; 4.7 THz); and ii) the 4GREAT receiver system with 4 simultaneous single pixel frequency bands together with the HFA array.

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).

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 (https://www.aanda.org/articles/aa/abs/2016/11/aa29045-16/aa29045-16.html) for further details).

The following are available for Cycle 10:

Receiver bands:

The table below gives the tuning ranges for GREAT offered in Cycle 10. The LFA has two polarizations: horizontal (LFAH) and vertical (LFAV), with the [OI] line at 2.06 THz (145 µm) only available in the vertical polarization; tuning the LFA to the [OI] line is offered on a ‘best effort’ basis due to limited availability of local oscillators that work at these frequencies. For Cycle 10 the ability to tune each LFA polarization to a separate frequency across the entire LFA band is offered as *shared risk*. Observers should check the Observer’s Handbook for details.

GREAT channels and tuning ranges:

Channel	*Tuning range*
HFA	4744.77749 GHz +/- ~100 km/s
LFAH	1835 – 2007 GHz
LFAV	1835 – 2007 GHz 2060 – 2065 GHz ([OI] 145 μm)
4G4	2490 – 2590 GHz
4G3	1240 – 1395 GHz 1427 – 1525 GHz
4G2	890 – 984 GHz 990 – 1092 GHz
4G1	491 – 555 GHz 560 – 635 GHz

4GREAT Band 1 (4G1) and Band 2 (4G2) are offered as *shared risk* observations. **Observers requesting 4GREAT should clearly specify in the proposal which 4GREAT frequencies are essential for their science and which are less important.**

Receiver Combinations:

For Cycle 10 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)
5. Honeycomb OTF map in PSW or BSW mode

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 Observer's Handbook)

Backends:

Fast Fourier Transform Spectrometer: 4 GHz bandwidth with 0.283 MHz Equivalent Noise Bandwidth.

3.2.6. HAWC+ Supported Configurations in Cycle 10

HAWC+ observation configurations consist of observing modes and filter selections in both Total Intensity and Polarization modes. The following are available for Cycle 10:

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.

* The 63 μm (band B) filter is offered as shared risk in Cycle 10.

POLARIZATION

Observing modes:

1. Two position chop and nod (C2N) implemented as Nod-Match-Chop (NMC).
2. SCANPOL – OTF map with polarization capability. (Offered as *Shared Risk* in Cycle 10.)

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

While Total Intensity observations are offered in two modes—two-position chop and nod (C2N) implemented as Nod-Match-Chop (NMC), and on-the-fly mapping (OTF)—the observatory *strongly discourages* the use of C2N for total intensity imaging. OTF offers improved sensitivity with a roughly 30% gain in on-source efficiency over the traditional C2N observing technique. To request/plan a total intensity observation in USPOT, select the "HAWC PLUS OTFMAP" AOR mode.

Additionally, note that Polarization observations are also offered in both C2N and OTFMAP modes. For acquiring these data, we recommend the use of the C2N configuration, though scan-polarimetric observations (OTFMAP-polarimetry) is offered as shared-risk. See section 7.2.1.1 of the Cycle 10 Observer's Handbook for more information. For questions on both total intensity and polarization mapping, please contact the SOFIA help desk or the HAWC+ team directly.

3.3. 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. As regular operations require SOFIA 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 Deputy/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.

3.4. Proposer Participation in Observations

The SOFIA Program encourages 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:
i) Only a limited number of observations in the GOs program are likely to be executed on any given flight.
ii) 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.
iii) 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 which GOs will be invited on that flight.

3.5. Data Processing, Calibration and Distribution

3.5.1. Data Processing, Archiving and Distribution

Processing and distribution of SOFIA data is accomplished through the SOFIA Data Cycle System (https://dcs.arc.nasa.gov/) and the Infrared Science Archive (IRSA). The SMO is 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 Cycle 10 will be made available to observers via the SOFIA Science Archive. 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.

SOFIA's science archive has recently completed its transition to the Infrared Science Archive (IRSA) hosted by the Infrared Processing & Analysis Center (IPAC) as its primary data archive. SOFIA data from Cycle 1 onwards are now searchable through IRSA SOFIA Archive, including both archival data and proprietary data. An IRSA account is required to download proprietary data. Note that the SOFIA Data Cycle System website is still online and active, and is the main portal for tasks related to SOFIA proposals and AORs (Phase I and II).

3.5.2. Calibration

The programmatically required photometric calibration accuracy for SOFIA observations is 20%. Cycle 10 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 in the standard observing modes for all SOFIA science instrument observations, except in spectral regions of strong telluric interference. The modes offered here as *shared risk* (EXES observations in the LOW configuration, HAWC+ scanning-polarimetry mode; FIFI-LS OTF mapping mode; 4GREAT bands 1 and 2) are expected to meet the 20% requirement, but as part of the shared risk constraints, cannot be guaranteed to do so.

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 observations, a separate observation entry should be entered via USPOT with name “Cal_target”, where “target” is the name of the associate science target (e.g., “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.

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

3.5.3. Acknowledgements in Scientific Publications

In concurrence with DLR policy, the following sentence of acknowledgements in scientific publications based on SOFIA data should be included (English or German): (https://www.sofia.usra.edu/science/publications/information-authors)

Based [in part] on observations made with the NASA/DLR Stratospheric Observatory for Infrared Astronomy (SOFIA). SOFIA science mission operations are conducted jointly by the Universities Space Research Association, Inc, under NASA contract NNA17BF53C, and the Deutsches SOFIA Institut, Universität Stuttgart under DLR Space Administration contract 50 OK 2002. SOFIA is carried out by the DLR Space Administration with funding by the Federal Ministry for Economic Affairs and Energy based on a resolution by the German Bundestag.

Die Veröffentlichung basiert [in Teilen] auf Beobachtungen des NASA/DLR Stratosphären Observatoriums für Infrarot-Astronomie (SOFIA). SOFIA wird gemeinsam betrieben durch die Universities Space Research Association, Inc. unter dem NASA-Vertrag NAS2-97001 und durch das Deutsche SOFIA Institut, Universität Stuttgart unter dem DLR-Raumfahrtmanagement Vertrag 50 OK 2002. SOFIA wird im Auftrag des DLR-Raumfahrtmanagements mit Mitteln des Bundesministeriums für Wirtschaft und Energie aufgrund eines Beschlusses des Deutschen Bundestages durchgeführt.

4. Outreach

The SOFIA project strongly encourages observing programs to include an Education & Public Outreach (E&PO) component, supported by the DSI Outreach office. The proposer does not need to add any E&PO text to the submitted observing proposal. For selected programs, the SOFIA Outreach staff will contact the program PI during the Phase II stage, to collaborate in designing an E&PO program related to the program's science.

4.1. Educational Outreach (SOFIA German Ambassadors program)

For E&PO planning purposes, proposers are requested to indicate, in their Phase I submittals, whether or not they are interested in one particular E&PO option, namely the SOFIA German Ambassadors program (SGAP). Participation in the SGAP program will involve a partnership between the GI team and a team of educators who will be put in contact with the scientists before the observing flight(s) of the program in question. The educator team will be trained by DSI Outreach to understand the planned investigation, will fly on SOFIA with a flight facilitator/escort, and then continue to partner with the GI team in a mutually agreeable fashion after the flight(s). The selection of the SGAP

educators is carried out through a proposal process, which runs in parallel to the Cycle 9 observing proposal process.

Please note that by choosing the SGAP option the proposer is not required to recruit the educators, give them materials, or fund their activities; the DSI Outreach office will provide all such support. If the SGAP program option is chosen, and the GI chooses to participate in the SOFIA observing flight(s) for their program, the SGAP team (plus escort) will accompany them on the flight(s). Changes due to the program / flight schedule may have to be considered on short notice.

The proposal cover page in USPOT includes a button allowing the proposer to indicate an interest in participating in the SGAP program. The SOFIA project requests that you indicate whether you are interested in participating in the SGAP program in the Phase I stage since this will provide important information for the planning, execution and review of the SGAP educator proposal and selection process. The choice of whether or not to indicate an interest in participating in the SGAP program will not affect the evaluation of the Cycle 9 observing proposal.

4.2. 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. NASA and 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 DSI public affairs head Dörte Mehlert (mehlert@dsi.uni-stuttgart.de) or the Education and Public Outreach Social Media Specialist Anashe Bandari (abandari@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 and/or DLR news release.

NASA and the DLR will jointly issue news releases associated with SOFIA observations during Cycle 10 and 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 10 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).

4.3. 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.

5. Contacts and Further Information

For further information about the Cycle 10 Call for Proposals or help in preparing proposals, please see the "Information for Researchers" (https://www.sofia.usra.edu/science) section of the SOFIA website, or contact the SOFIA help desk at sofia_help@sofia.usra.edu.

For further information about the SOFIA Science project, please contact the above, the SMO Director, Dr. Margaret Meixner, or the Deputy Director, Dr. Bernhard Schulz.

Appendix A – Collaborative Reserved Observations Catalogs (CROCs)

Note that some of the following lists of CROCs contain entries for both observations intended to be executed in Cycle 10, and observations already performed by the instrument teams as part of their Guaranteed Time Observation (GTO) programs. For detailed information about completeness of the GTO observation, please follow the Duplication Checking procedure laid out in the USPOT Manual at https://www-sofia.atlassian.net/wiki/spaces/USPOTMAN/overview, or contact the SOFIA help desk (sofia_help@sofia.usra.edu).

As stated in Section 3.1, observations of targets in the GREAT CROC or in the FIFI-LS CROC may be proposed with the prior permission of the instrument's PI. GOs wishing to observe objects in one of these CROCs should therefore contact the instrument PI in advance to reach agreement on collaboration. The SMO should be notified prior to proposal submission that this agreement has been reached and that the observations are permitted.

Appendix A1 - GREAT Cycle 10 Collaborative Reserved Observations Catalog

Science	Object Name	RA	DEC	4G	LFA	HFA	Area	Time
		(2000)	(2000)		[THz]		arcmin	[hr]
Proto-Planetary Disks								
Star formation cores	SgrB2(M)(N)	17:47:20.4	-28:23:07.0	all	#2	OI	2	2.0
	NGC6334I	17:20:53.3	-35:47:01.5	#1	#2	OI	5	3.0
	W33A	18:14:39.4	-17:52:00.0	#1	#2	OI	1	0.5
	G10.62	18 10 28.7	-19 55 50.0	#1	#2	OI	1	0.5
	G10.47	18 08 38.2	-19 51 50.0	#1	#2	OI	1	0.5
	G34.26	18 53 18.6	01 14 58.0	#1	#2	OI	1	0.5
	G327.3	15 53 08.5	-54 37 05.1	#1	#2	OI	1	0.5
	G330.95	16 09 53.0	-51 54 55.0	#1	#2	OI	1	0.5
	G351.58	17 25 25.0	-36 12 45.3	#1	#2	OI	1	0.5
	IRAS1629	16 32 22.8	-24 28 36.5	#1	#2	OI	0.5	1.0
Outflow studies	IRAS05358+3543	05:39:13.1	+35:45:50.0	#1	#2	OI	1	1
	IRAS17233-3606	17:26:42.5	-36:09:18.0	#1	#2	OI	1	1.5
	IRAS20126+4104	20:14:25.1	+41:13:32.0	#1	#2	OI	1	0.5
(P)PNe	CRL618	04:42:53.6	+36:06:53	#1	CII/OI	OI	0.25	1.5
	OH231.8+4.2	07:42:16.8	-14:42:52.1	#1	CII/OI	OI	0.5	1.5

	BD+30 3639	19:34:45.2	+30:30:58.8	#1	CII/OI	OI	0.5	1.0
	NGC6572	18:12:06.3	+06:51:13.0	#1	CII/OI	OI	0.5	2
	M2-9	17:05:37.8	-10:08:32.4	#1	CII/OI	OI	0.5	1.0
	CRL2688	21:02:18.7	+36:41:37.8	#1	CII/OI	OI	0.5	120
	NGC6302	17:13:44.2	-37:06:15.9	#1	HeH+	OI	0.5	1.0
	NGC6537	18:05:13.1	-19:50:34.7	#1	HeH+	OI	0.5	1.0
	IRAS21282+5050	21:29:58.4	+51:04:00.3	#1	CII/OI	OI	0.5	1.5
Galactic PDRs	IC1396 (3 sub-regions)	21:40:39.0 21:34:24.0 21:46:21.6	+58:22:48.0 +57:48:00.0 +57:37:40.8	CI/CO	CII/OI	OI	20 60 20x60	1.0 3.0 2.0
	NGC2024	05 41 45.2	-01 55 45.0		CII/OI	OI	1	2.0
	IC1848W	02 52 00	60 06 00	#1	CII/OI	OI	40	4.0
	IC1848E	03 00 30	60 20 00	#1	CII/OI	OI	40	4.0
LMC/SMC PDRs	N159	05 39 51.1	-69 45 12.9		OI	OI	1	1
	30Dor	05 39 03.0	-69 07 36.0		OI	OI	1	1
	N66	00 59 06.9	-72 10 29.6		OI	OI	1	1
Galactic Center	CMZ	17:45:39.9	-29:00:28.2	#1	CII	OI	70[(1)]	20
solar system	Saturn, Jupiter			HCl, OI, CH4			-	1.0
	Mars	HDO, ($H_2{}^{16}O$), $H_2{}^{18}O$		all	OI	OI	-	0.7
nearby nuclei	Cen-A	13:25:27.6	-43:01:08.9	#1	CH/OI	OI		2.0
	NGC4945	13:05:27.5	-49:28:05.6	all bands			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	all bands			2	1.0
	3C391	18:49:22.3	-00:57:22.0	all bands			2	1.0
	W44 E/F	18:56:28.4	+01:29:55.0	all bands			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, including selected isotopologues. [CII] does include studies of the ^{13}C isotopologue.

Frequency (THz) Species
set-up #1 (in 4GREAT): [CI], CO, OH
set-up #2 (in LFA): NH3, OH, [CII], CO, OI

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

Appendix A2 – FIFI-LS Cycle 10 Collaborative Reserved Observations Catalog

Target	RA (J2000)	DEC (J2000)	Extent (arcmin)	Lines B λ in μm	Lines R λ in μm	Time (h)
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 -02:06:51	2 x 2 2 x 1	[OIII] λ88	[CII] λ157	1
M83	13:37:00.9	-29:51:57	3 x 3	[OIII] λ88 [OI] λ63	[CII] λ157 CO(14-13) λ186	2
NGC253	00:47:33	-25:17:18	2 x 2	[OI] λ63 [OIII] λ52	[OI] λ145 [CII] λ157	3
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	3 x 3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1
N44 LMC	05:22:06.9	-67:56:46	3 x 3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1
N66 SMC	00:59:27.4	-72:10:11	3 x 3	[OIII] λ52 [OI] λ63	[CII] λ157 [OI]λ145	1
NGC4254	12:18:49.63	14:24:59.36	3 x 3	[OI] λ63	[CII] λ157	3
CND	17:45:40	-29:00:28	4 x 4	OIII] λ52 [NIII] λ57	[CII] λ157 CO(14-13) λ186	3

Times given in the last column are total observation times including standard overheads. Rest wavelengths are given for the identified spectral lines, not observing wavelengths on the source.

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 Science 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 uncatalogued targets, see Section B1.2.

B1.2. Uncatalogued 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. Uncatalogued 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.

Appendix C – SOFIA Bibliographic Resources

A list of refereed SOFIA related publications can be found at https://www.sofia.usra.edu/Science/publications/sofia-publications/.
In addition, significant amounts of SOFIA science have 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" conferences at Ringberg castle in March 2017 and February 2019. Most of the presentations for the three meetings 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,

https://events.mpifr-bonn.mpg.de/indico/event/16/timetable/?ttLyt=room#20170306.detailed, and

https://events.mpifr-bonn.mpg.de/indico/event/87/timetable/?ttLyt=room#20190121.detailed, respectively.

(For the Ringberg conferences, 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" (https://iopscience.iop.org/article/10.1088/2041-8205/749/2/L17/meta) and in Temi et al. 2014, ApJS, 212, 24: "The SOFIA Observatory at the Start of Routine Science Operations: Mission Capabilities and Performance" (https://iopscience.iop.org/article/10.1088/0067-0049/212/2/24/meta).

A special, open access issue of the Journal of Astronomical Instrumentation on SOFIA and its instruments was published in December 2018. It can be found online at https://www.worldscientific.com/toc/jai/07/04.

A focus issue of the Astrophysical Journal highlighting SOFIA science was published in January 2019. It can be found online at https://iopscience.iop.org/journal/2041-8205/page/Focus_on_SOFIA.