Stratospheric Observatory for Infrared Astronomy (SOFIA)

SOFIA Legacy Science Program

Call for Proposals

June 1, 2018

Version 1.0

There are two different Calls for Proposals for SOFIA's Cycle 7: 1) the *SOFIA Legacy Science Program* (this document) and 2) SOFIA's regular *Observing Cycle 7*. Documentation and other information pertaining to these Calls may be found at https://sofia.usra.edu/researchers/proposing-and-observing/proposal-resources.

Key Dates

Release of Call for Proposals	June 1, 2018
Call for Proposals Update on Website	July 16, 2018
Proposals Due	September 7, 2018 21:00 PDT (September 8, 2018 04:00 UTC)
Anticipated Announcement of Selections	November 2018
Implementation Period	SOFIA Cycles 7 & 8

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Change Log:

June 1, 2018: Original release
July 16, 2018: Formal update:

1. SOFIA Legacy Sciences Program Description

1.0. New Policies and Capabilities for Cycle 7:

- With this call the SOFIA Science Missions Operations (SMO) introduces a new type of observing program called the SOFIA Legacy Program (SLP)
- The SOFIA Legacy Program Call for Proposals is distinct from the Observing Cycle 7 Call for Proposals but is issued concurrently with that call.
- The SOFIA Legacy Program Call for Proposals is also distinct from the Legacy Science Program included in NASA's ROSES-2018 Announcement of Opportunity "SOFIA Next Generation Instrumentation" (NNH18ZDA001N-S4THG), which is directly associated with the next generation instrumentation AO.

1.1. Introduction:

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is pleased to invite proposals for the first round of SOFIA Legacy Programs (SLP), aimed at generating astronomical data of significant value to the astronomical community by yielding results addressing specific science goals as well as providing a rich archival data set for future analysis. The SOFIA project expects to select two SLPs per solicitation to be executed over two observing cycles. The programs are expected to be allocated approximately 100 hours of observing time each (approximately 50 hours of observations per cycle). Larger well justified programs will also be considered, but would still be expected to be executable over a two cycle period.

This call provides specific information for the structure and submission requirements for the SLPs, which differ from the regular Cycle 7 proposals (e.g. explicit budgets are required for SLP proposals). General information regarding the SOFIA project, its instruments and the proposal process can be found in the regular Cycle 7 Call for Proposals (Cy7_CfP; *https://sofia.usra.edu/researchers/proposing-and-observing/proposal-resources*).

This Call is open to all qualified astronomers, in the U.S. and outside the U.S. Proposals submitted by coherent teams are particularly encouraged.

1.2. The SOFIA Legacy Program

The purpose of the SOFIA Legacy Program category is to encourage and enable larger science programs, with well-defined goals, which will lead to significant advances in their fields of study. To enable such programs, an appropriate amount of observing time and resources will be made available. These programs may, in addition to SOFIA observing time, request support for theory or laboratory efforts, the development of software tools, supporting data sets and similar activities directly supporting the science goal of the SLP. SLP proposals are strongly encouraged to include the generation and distribution of supporting tools and level 4 data products or associated and/or supporting data. Significant resources (approximately $1M/year) have been set aside to support these programs. However, only astronomers with a US affiliation will be eligible for funding.

Preparations for the observations associated with SLPs will follow the same process as regular SOFIA programs. The proposal team will be responsible for the definition and preparation of the program and observations, with support of the SMO staff. The SMO will carry out the observations, with optional participation from the proposal teams. The SLP observations will, generally, be interspersed with observations for regular Cycle 7 and 8 programs.

The SOFIA data from the SLPs will be processed through the regular SMO pipeline routines (where applicable; see Cy7_CfP, sec. 3.5). The resulting data will not have any

exclusive use ("Proprietary") period. Higher-level data products generated by the proposal teams will be archived on a schedule negotiated with the SMO.

SLPs submitted to the Cycle 7 solicitation may request any combination of the available SOFIA instruments including, for second-year observations, HIRMES[1] (https://sofia.usra.edu/science/instruments/HIRMES). Proposers requesting the use of the Principal Investigator Class Science Instruments (PSI) GREAT or EXES, are encouraged to contact the respective Principal Investigators (Dr. Rolf Güsten of the Max Planck Institute for Radio Astronomy, and Dr. Matthew Richter of University of California, Davis) to ensure their availability to execute the proposed observations.

1.3. General Guidelines and Policies

1.3.1 General Proposal Guidelines

Proposals submitted in response to this call should address a scientific problem of significant and broad importance, in any area of astronomy. Supporting activities, including theoretical work, laboratory efforts, software development and (limited amounts of) supporting observations, and the assembly and possible re-processing of supporting data are also allowed. The generation of software tools and level 4 data products that can be used for future research are particularly solicited. Programs providing clear synergies with other major current facilities, such as the James Webb Space Telescope (JWST), the Atacama Large mm-wave Array (ALMA) and the Infrared Telescope Facility (IRTF) are encouraged. However, no explicit connection (or "joint queue" process) is in place.

The proposal should clearly state the scientific problem and its relevance. The different parts of the program should be clearly connected and justified. A clear path to timely publications is critical.

Any supplementary data sets proposed or required should be described as to relevance, structure and status (for instance; open access, pipeline processed archives; existing, but not fully processed; or proposed, but not acquired observations – accepted or pending)

The proposals should describe the specific activities proposed and the relevant expertise of the PI and proposal team. The purpose, structure and implementation of software tools for processing beyond the standard SOFIA pipeline processing should be described in detail. For deliverable items and tasks (such as processing software, Level 4 data products etc.) a work plan is required in the implementation narrative, with an

[1] Because HIRMES is still in development, the specifics for such observations will be revisited and reviewed by the SMO, after commissioning, before being implemented.

accompanying resource loading (to be included in the budget and discussed in the budget narrative).

Theoretical work including model development and implementation as well as laboratory studies may also be proposed. For such proposals, the methodology and procedures and their relevance to the SOFIA Legacy Program should be clearly described.

In contrast to the regular SOFIA cycle proposals, SLPs proposals must include a budget request. This allows the proposal PI to match the proposed effort and products to the resources needed to accomplish the work and should be described in the budget narrative. A budget template is provided. As with regular proposals, the SMO Director may choose to select parts of an SLP program and offer only partial funding.

1.3.2. Targets for SOFIA Legacy Proposals

Each SOFIA Legacy Proposal must describe the proposed targets for the program. Target lists, containing a larger set than achievable within the requested time are acceptable in phase I, if justified. Such target pools will then be finalized in the acceptance process and Phase II preparation (or, for survey-type programs, in the flight planning). Such target pools should, however, be of limited over-subscription (i.e. a factor 2-3 of the requested time). The SOFIA standard duplication rules apply (Cy7_CfP Sec. 3.1) relative to both GTO ROC targets as well as regular program targets.

1.3.3. Legacy Program Constraints and Feasibility

The scientific merit and reach of the proposed SLP science is of paramount importance in the proposal selection process, and the SOFIA project will consider very highly ranked SLP programs requiring non-standard/dedicated scheduling and other special considerations. However, because of the size of the SLP, and the intent to execute them in parallel to the regular Cycle 7 (and 8) programs, the unique characteristics of the SOFIA observatory, their feasibility will depend of a number of additional factors. We discuss these here to allow proposal teams to optimize their programs and to ensure the selectability of the proposals.

Programs that request limited contiguous (<3 hours per flight), and total (<20 hours total) duration observations per target, distributed over the northern sky, do not need to discuss scheduling constraints in detail, unless specific timing requirements apply. However, those proposal requesting large amounts (>20 hours) of observing times over limited areas of the sky (especially for inner Galaxy and southern sources), or time constrained scheduling, should consider the impacts of the following scheduling constraints on their programs:

- SOFIA is scheduled in multi-week, single instrument, Science Flight Series. Instrument changes typically require three days. Therefore, instrument series are usually at least three weeks in duration.

- Flight crew staffing rules normally limits SOFIA to three, or occasionally at most, four nights per week, with a maximum "wheels-up-to-wheels-down" duration of 10 hours per flight.

Hence, high time-cadence observations with multiple instruments, or tightly time constrained observations, will require additional down time and inefficiencies.

- Because of the need to return to the home base – whether in Palmdale or on a deployment site – typical flight legs on target are limited to about 3 hours duration. Longer contiguous flight legs are possible but cause significant inefficiencies.

For large programs "balancing" observations from the regular target pool may not be available to allow efficient flight plans. Observations requiring special scheduling will be charged the additional overheads incurred.

- The annual Southern deployment is limited to 7 weeks with two instruments. Suitcase deployments (Cy7_CfP Sec 2.2.3.2.) may be possible for additional time on the Southern Sky but have limited flight cadence. Large requests for southern hemisphere observations will therefore require strong scientific justification.
- Observations with the PSIs – EXES and GREAT – require the PI team to be present. While the SMO and the PI teams endeavor to support all requested observations, the availability of either PI team, for a specific time period, cannot be guaranteed in advance.

1.3.4. Who May Propose

Participation in the SOFIA Legacy Program is open to scientists from all categories of U.S. and non-U.S. organizations, including educational institutions, industry, nonprofit institutions, NASA Centers, and other Government agencies. Astronomers with German affiliations are also invited to respond to this call for SOFIA Legacy Programs (see Sec. 1.3.5).

Each SOFIA Legacy Program proposal must identify a single Principal Investigator (PI). All members of a proposal team must have clearly identified roles, responsibilities and tasks, with well-defined time and resource allocations and commitments. Junior members may be identified by positions only (e.g. to-be-identified post-doctoral fellows). If a PI is from a non-U.S. organization, then a lead Co-I from a U.S. organization must be named, if funding for the U.S. members of the team is being requested.

Proposals from multi-institution teams are encouraged, when enhancing the science return of the program. Such teams may include government and non-government groups, U.S. and non-U.S., including staff members at the DSI and SMO.

1.3.5. Joint Legacy Programs

Joint proposals by astronomers affiliated with non-German and German institutions[2] are also invited. Such proposals shall identify a non-German and a German co-PI. If funding is requested, the non-German co-PI must be affiliated with a US institution and will be considered the PI of the program. If no funding is requested, the proposal must clarify who will be the formal PI (and primary contact for the SMO). For such proposals, the requested observing time will be proportioned with an 80/20 ratio from the NASA and DLR allocations.

Proposals including individual German co-Is will not automatically be considered "Joint Proposals", unless the German co-I is identified as co-PI.

1.3.6. Late Proposals

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

1.4. Data rights and distribution

The scientific data from SOFIA Legacy Program observations will be processed via the regular SOFIA pipeline process (at the SMO for FSIs and by the instrument teams for PSIs) and be distributed to the community via the SOFIA data archive.

As for regular GO programs, all data will be archived as Level 1 data (raw). Where appropriate, Level 2 (corrected for instrumental and atmospheric effects) and Level 3 (flux calibrated) will be provided by the SMO, or the PSI science teams. In addition, the data generated by any accepted Level 4 processing will be archived in a similar manner.

For the SOFIA Legacy Programs level 1-3 data will be accessible to the community immediately upon completion of processing and will not have any exclusive use periods. Level 4 data from the SLP teams will be archived and publically available as they are delivered, based on agreements with the SMO.

1.5. Proposal Evaluation and Selection Process

The proposals for SLP participation will be evaluated by a review committee, which will advise the SMO Director. This review will be separate from the general Cycle 7 time allocation committee (TAC). The findings and recommendations of the SLP review will be coordinated with the regular Cycle 7 TAC and the SMO Director and (DSI) Deputy

[2] I.e. institutions whose proposals would under the Regular call be submitted to the NASA/USRA and DLR/DSI queues, respectively.

Director. As for regular SOFIA observing proposals, the SMO Director is the selection official for the SLP proposals.

The following factors will be used in evaluating proposals for the SOFIA Legacy Program participation.

- The scientific merit of the proposed activities and enhancement of the SLP.
- The competence and relevant experience of the Principal Investigator and collaborators.
- The utility and value of the proposed analysis and tool development
- The utility and value of proposed supporting data sets
- For Joint Legacy Programs a substantial participation from non-German team members is required.

The SMO director may select part of the proposed work and offer a concomitantly modified budget. He may also, after consultations with the DSI Director and SMO Deputy Director decline Joint Legacy Programs that do not meet the programmatic priorities of both NASA and DLR.

1.6. Funding for U.S.-based Investigators

Funds for awards are expected to be available to investigators at U.S. institutions subject to the annual NASA budget cycle. It is expected that the total budget for the first round of the SOFIA Legacy Programs will be approximately $1M per year. The nominal grant period for these awards will be up to three years, with funding disbursed on an annual basis. Nominally, one or two programs will be selected per cycle. It is expected that the grant disbursement will be evenly distributed over the period of performance, unless explicitly justified and approved by the SMO.

The budget and disbursement should be fully justified in the budget narrative. Funding can be allocated for salary support, including student or post-doctoral researcher support. Direct costs, such as computer hardware software licenses, travel support etc. are also expected. Proposals in response to this call must include an itemized budget outlining the costs and assignments required to complete the proposed work.

Only researchers with U.S. affiliations are eligible to receive financial support through this Legacy Science Program. All funding will be disbursed through the proposal PI's institution.

For the legacy proposals selected, the total allocated funding requested for year 1 will be released at the time that both USRA and the recipient institution have agreed on the terms and conditions of the grant. The second and third year's funding is contingent on satisfactory annual cost and technical progress reports, submitted to the SMO Director via the SOFIA/USRA contracts office.

2. Proposal Preparation

Each SOFIA Legacy Program proposal must be prepared using the SOFIA USPOT tool. The proposal information is entered directly, while text sections including the scientific justification, feasibility analysis, budgets and budget narrative, should be uploaded via USPOT[3] as a single PDF files.

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, using single-spaced 8.5x11 inch or A4 format with 1 inch (2.5 cm) margins. Proposals must be printed to PDF files with a font size no smaller than 11 points (about 6 characters per cm). Reviewers will only be provided the portion of each proposal that complies with the page limits.

The abstract provided using the Proposal Information form is limited to 300 words.

2.1 The SOFIA USPOT tool

The SOFIA proposal tool USPOT provides the user with a form-based interface for preparing a proposal and for electronic submission to the SOFIA Science Mission Operations. The USPOT is based on the IPAC SPOT tool which has already, in modified form, been used to prepare SOFIA phase II inputs in earlier cycles. After downloading the appropriate package and following the installation instructions, the user starts a new proposal by launching the USPOT application. The proposer then fills out the necessary form fields including proposer information, abstract, instrument(s), and target lists. The Science and Technical Justification may be prepared using any text editor (e.g. MS Word, LaTeX, etc...) and saved as a PDF file. Using USPOT, the proposer then identifies this PDF file on a local disk for attachment to the proposal summary information. When the proposal is complete, the user submits the complete proposal directly to the SMO using USPOT. Details about USPOT may be found in the Observers' Handbook and the USPOT manual. On-line help for USPOT is available as a pop-up function in the application.

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

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

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

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

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

2. **Scientific Justification (up to 5 pages)** - The proposals should describe the observations and activities proposed. Any supplementary data sets proposed or required should be described as to relevance, structure and status (for instance; open, pipeline processed archives; existing, but not fully processed; or proposed, but not acquired observations – accepted or pending). The purpose, structure and implementation of software tools for processing beyond the standard SOFIA pipeline processing should be described in detail. For theoretical work, the importance and relevance to the specific SLP should be clearly described.

3. **Feasibility and Path to Publication (up to 3 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 Observers Handbook. This section should also contain the justification for special calibration procedures, if they have been requested (Cy7_CfP Sec. 3.5.2).

   The technical feasibility section should include a brief discussion of the anticipated data analysis, new tools, and laboratory/theoretical work needed to accomplish the investigation. Specifically, describing all tasks performed by proposers to enhance 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.

4. **Budget (budget form(s) + up to 2 pages of Budget Narrative)** – A budget outlining the requested support, in salary and other direct costs, as well as requested overheads is required. For the purpose of the proposal, a budget form is provided at https://www.sofia.usra.edu/Science/SLP-budget_Form (for accepted proposals, the SOFIA/USRA Contracts Manager will work with the proposer's Sponsored Research Office to generate a mutually acceptable budget format). A budget narrative of up to two pages is also required. For multi-institution programs, the lead institution shall describe the tasking and support for each collaborating organization, but may use separate budget forms. Funding profiles deviating significantly from an evenly distribution over the three-year period should be explicitly justified.

5. **Implementation Narrative (up to 2 pages)** – Justify the allocation and time commitments of the proposal team and their primary proposed focus. The expertise and qualifications of the proposal team, as related to the proposed activities should be provided. For software and/or supporting data, describe the acquisition/generation and time plan for delivery to the SLP and SOFIA. For theoretical work, describe the implementation of that work in supporting the goals of the SLP.

6. **Principal Investigator and Co-Investigator Biographical and Publication Data (one page for the PI with one-half additional page per Co-I)**. 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.

2.3. Proposal Submittal

Proposals must be submitted using the USPOT application. Upon successful upload, the system will generate an automatic message acknowledging the submittal, and generating a unique identifier for later reference. A confirmation email will be sent to the address provided in the proposal.
Proposals can be resubmitted at any time before the proposal due date. Proposals that have been submitted to the SMO can be ***resubmitted*** using USPOT at any time up to the proposal deadline (note that old versions are not retained).

3. SOFIA Legacy Program, Round 1, Schedule

The nominal schedule for the SOFIA Legacy Program (SLP) observing program is as follows:

1 June 2018	Release of Call for Proposals
16 July 2018	Call for Proposals update

7 September 2018, 21:00 PDT	Proposal Submission deadline
8 September 2018, 04:00 UTC	Proposal Submission deadline
November 2018	Proposal Selections Announced
December 2018	Initial Science Team meeting
Cycle 7 & 8	SLP Round 1 observations and analysis

4. Contacts and Further Information

For further information about the Cycle 7 Call for Proposal or help in preparing proposals, please see the "Information for Researchers" (https://www.sofia.usra.edu/Science/) section of the SOFIA web site, or contact the SOFIA help desk at sofia_help@sofia.usra.edu.

Questions about either the SOFIA Guest Observer (GO) program or the SOFIA Legacy Program (SLP) can be directed to the SOFIA User Support lead, Dr. Randolf Klein (rklein@sofia.usra.edu), or the Associate Director for Science Operations, Dr. B-G Andersson (bg@sofia.usra.edu).

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