Stratospheric Observatory for Infrared Astronomy

(SOFIA)

Observing Cycle 1

Call for Proposals

December 13, 2011

This document and all other information pertaining to SOFIA observing Cycle 1 may be found at http://www.sofia.usra.edu/Science/proposals/cycle1.

Table of Contents

Change Log:

In the final release of this Call for Proposals, on December 12, 2011 the following changes have been implemented compared with the initial release:

Section 1.3.1: For FLITECAM, only observing modes short-ward of 3.6 μm will be offered in Cycle 1

Section 1.3.2: The existing FORCAST grism 4 was damaged in the fall of 2011. It is, however, the observatory's intent to replace the unit before or during Cycle 1. Thus observations using this mode may be proposed, but might only be available later in the cycle.

Section 2.2.3: A exposure time estimator for FLITECAM grism mode observations has been added to the SOFIA web site.

Minor additional, language, edits were performed and the resulting file posted December 13, 2011.

1. SOFIA Observing Cycle 1 Program Description

1.1. Introduction:

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is pleased to invite proposals for Cycle 1 observations, which will take place in the time period August 2012 - August 2013.

The Cycle 1 observations will be divided among four Science Flight Campaigns. The campaigns will be interspersed with instrument commissioning and periods of aircraft maintenance and upgrades. For Cycle 1, the available instruments will be the near-infrared camera FLITECAM[1], including its grism modes, the mid-infrared camera FORCAST[2], including its grism modes, the heterodyne spectrometer GREAT[3], and the high-speed optical photometer HIPO[4]. The combination of HIPO/FLITECAM will also be available. Some modes will only become available as the instrument in question is commissioned, which will impact the sky availability for those modes over the Cycle 1 observing period. Some instrument modes will be in their development phase during part of Cycle 1, and observations in these modes are to be regarded as shared-risk. This means that unanticipated observatory performance limitations might impact the quality of the data, if obtained, or even the ability to acquire data for accepted Cycle 1 proposals.

Of the available Research Hours in Cycle 1, 20% will be reserved for and allocated by the German Aerospace Center (Deutsches Zentrum für Luft und Raumfahrt; DLR), through the German SOFIA Institute (Deutches SOFIA Institut; DSI). In addition, 7% of the Research Hours are set aside as Director's Discretionary Time. The FLITECAM, FORCAST and HIPO Science Instrument teams will be granted approximately 50 hours of the available US Cycle 1 observing time for their Guaranteed Time Observations. Observatory calibrations are performed as a service and the anticipated amount is subtracted prior to calculating the available observing time.

---

[1] First Light Infrared Test Experiment CAMera, http://www.sofia.usra.edu/Science/instruments/instruments_flitecam.html
[2] Faint Object infraRed CAmera for the SOFIA Telescope, http://www.sofia.usra.edu/Science/instruments/instruments_forcast.html
[3] German REceiver for Astronomy at Terahertz frequencies, http://www.sofia.usra.edu/Science/instruments/instruments_great.html
[4] High-speed Imaging Photometer for Occultation, http://www.sofia.usra.edu/Science/instruments/instruments_hipo.html

This Call for Proposals solicits proposals for the remaining, approximately 200 hours, of observing time. It is being issued on behalf of NASA by the Universities Space Research Association (USRA). Funding to support the selected applicants will also be issued through USRA. Contingent on budget confirmation and NASA approval the total available General Investigator funding available for Cycle 1 is expected to be approximately $600k.

The Call is open to all qualified astronomers, in the US and outside the US, except for those currently affiliated with German institutions. Astronomers with a German professional affiliation must participate through the DLR/DSI led Cycle 1 program. DSI personnel, even if based in the US, are considered affiliated with a German institution and must submit any proposals to the DLR/DSI queue. Scientists based in Germany and affiliated with the European Southern Observatory (ESO) or the European Space Agency (ESA) are considered not to be affiliated with a German institution, and may respond to this Call for Proposals.

A small number of SMO staff members will be directly involved in the proposal solicitation process for Cycle 1, and will therefore recuse themselves. Other SMO staff members may propose. Only researchers with a US affiliation are eligible to receive financial support through this solicitation.

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

1.2. The SOFIA Project

SOFIA is a joint project of NASA and DLR. SOFIA Science Mission Operations (SMO), located primarily at the NASA Ames Research Center, Moffett Field, California, is responsible for the scientific operation of the observatory. The SMO is operated by USRA under contract to NASA. The Deutsches SOFIA Institut (DSI), located at the University of Stuttgart, is the primary interface between SOFIA and the German astronomical community. The SOFIA aircraft development is managed by the NASA Dryden Flight Research Center. The aircraft itself has its home base at the Dryden Airborne Operations Facility (DAOF) in Palmdale, California.

SOFIA is a 2.7m telescope, with an effective diameter of 2.5m, housed in a Boeing 747-SP aircraft. Observations are typically carried out at altitudes between 37,000 and 45,000 feet. 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 region, and the seven first generation instruments (four of which are offered in this Call) cover the range 0.3-250 μm. These instruments will become operational over the next several years, and will provide imaging and spectroscopic capabilities for a wide range of scientific investigations. Descriptions of the instruments can be found at http://www.sofia.usra.edu/Science/instruments/.

A number of science cases (Design Reference Mission Case Studies) may be found at http://www.sofia.usra.edu/Science/science_cases/ .
A recent paper, "Status of the Stratospheric Observatory for Infrared Astronomy (SOFIA)" provides an overview of SOFIA and is available at http://www.sofia.usra.edu/Science/proposals/cycle1/ASR48_2011_Gehrz_etal.pdf .

1.3. Available Instruments and Observation Configurations

Four instruments will be available for Cycle 1 observations: FLITECAM, FORCAST, GREAT and HIPO. The HIPO/FLITECAM combination will also be offered. There are a number of observation configurations planned for each of these instruments, but not all of them will be offered during Cycle 1. The following sections describe the observation configurations available for Cycle 1. Details are available in the Observers Handbook for Cycle 1 which can be found at http://www.sofia.usra.edu/Science/proposals/cycle1/ .

Each of the first-generation SOFIA Science Instruments falls into one of three classes and is designated as either a Facility-class Science Instrument (FSI), a Principal Investigator-class Science Instrument (PSI) or a Special Purpose Principal Investigator-class Science Instrument (SSI). 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 Policy" available at http://www.sofia.usra.edu/Science/documents/ .

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

For Cycle 1, FORCAST and FLITECAM imaging are considered FSI modes.

For Cycle 1, FORCAST and FLITECAM grism spectroscopy are considered "shared risk" modes (see section 1.5).

In the current schedule, FSI-mode observations with FORCAST could begin as early as August 2012, and with FLITECAM as early as March 2013.

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 will be operated by the Science Instrument team members, both for their own observations as well as for those of successful GIs. Proposers do not need to consult with the PSI Instrument team before submitting the proposals. However, GIs are encouraged to interact with the Instrument team as early as practicable, since this maximizes the chances for successful observations. Guest Investigators will receive calibrated data from the GREAT team.

For Cycle 1, all GREAT observations are considered PSI modes.

For publications that involve GREAT observations, the GREAT PI may designate up to 3 co-authors.

Special Purpose Principal Investigator-class Science Instrument (SSI) — A special purpose instrument, specifically designed for a particular observation or set of observations not possible or practical with FSIs or PSIs. It is expected that the Science Instrument Team will operate an SSI. *GIs can only use an SSI by partnering with the Instrument Team prior to proposal submission.*

For Cycle 1, HIPO and the HIPO/FLITECAM combination are considered SSI.

1.3.1. FLITECAM supported configurations in Cycle 1

FLITECAM observation configurations consist of observing modes and filter selections in imaging mode and observing modes and grism selections in spectroscopy mode. The following are available for Cycle 1.

IMAGING

Observing modes:

1. Stare (with possible 5 and 9 point dither)
2. Nod Off Array

Filters:

Broad-band: J, H, K,

Narrow-band: Pa α, Pa α continuum, Water Ice (3.08 μm), PAH (3.29 μm)

The Order Sorting Filters (H_W, K_W, K_{long}; used for grism spectroscopy) are **not** offered as stand alone filters.

Initial in-flight testing of FLITECAM was performed in the fall of 2011. These observations confirm the sensitivity estimates in SITE for J, H, K and Paschen-α.

Howevere, an elevated background was seen in the longer wavelengths. The instrument team is confident that this will be rectified before, or during, instrument commissioning, but the expected sensitivities are therefore uncertain for long wavelength observations. For this reason, we are not offering L or M band observations in Cycle 1, nor the LMA *grism mode (grism A with the L+M order sorting filter). We are offering the PAH (3.29μm) and Water Ice (3.08μm) filters, and the "LMB" grism mode, but stress that these are shared risk observations, and that if the elevated backgrounds are not (fully) rectified, accepted proposals requesting these filters will be executed only after a case-by-case analysis of their actual feasibility.*

We expect the long wavelength modes to be available in Cycle 2. Once FLITECAM is commissioned, proposals for time critical observations using the long wavelength modes may also be considered for Director's Discretionary Time

SPECTROSCOPY

Observing modes:

1. Nod

The spectroscopic observing mode has not yet been demonstrated successfully, so the efficiency and sensitivity cannot be accurately estimated prior to this Call for Proposals. Proposers should use the information on the SOFIA website on December 12, 2011 to determine sensitivity and should not expect performance to exceed those numbers.

Grisms

Grism	Order	Order Sorting Filter	Wavelength Coverage	Resolving power (2" slit)*
A	3	H_{wide}	1.497 – 1.977	900
A	2	K_{long}	2.216 – 2.784	900
B	3	J	1.14 – 1.424	900
B	2	H_{wide}	1.649 – 2.076	900
B	1	L+M	3.07 – 4.16	900
C	4	H	1.445 – 1.801	900
C	3	K_{wide}	1.872 – 2.346	900
C	2	L+M	2.756 – 3.467	900

* Estimated prior to commissioning

1.3.2. FORCAST supported configurations in Cycle 1

FORCAST observation configurations consist of observing modes and filter selections in imaging mode and observing modes and grism selections in spectroscopy mode. The following are available for Cycle 1:

IMAGING

Observing modes:

1. Two position chop and nod (C2N), which may be implemented as either Nod-Match-Chop or Nod-Perpendicular-Chop
2. Two position large-amplitude chop (2-8 arcmin) with large nod offsets (C2NC2)

Filters:

For the Short Wavelength Camera (SWC):
6.4, 6.6, 7.7, 11.1, 19.7, 24.2 μm

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

Dichroic:
For Cycle 1, FORCAST can be used in a single channel configuration or dual channel configuration. In dual channel configuration, a dichroic is used to split the incident light towards the short and long wavelength arrays simultaneously. Any short wavelength filter can be used at the same time as any of the long wavelength filters. However, there is significant degradation of throughput for short wavelength filters less than 11 microns and greater than 30 microns in dual-channel configuration; this information is built into the sensitivity estimator (SITE).

SPECTROSCOPY

Observing modes:

1. C2N (two position chop and nod).
2. C2NC2 (two position large-amplitude chop with large nod offsets).

Although the observing modes for spectroscopy are the same as for imaging, the restrictions on actual chop and nod parameters would be different. (Details may be found in the Observers Handbook.) The spectroscopic observing mode has not yet been demonstrated successfully, so the efficiency and sensitivity cannot be accurately estimated prior to this Call for Proposals. Proposers should use the information on the SOFIA website on December 12, 2011 to determine sensitivity and should not expect performance to exceed those numbers.

Grisms and Slits:

Grism	Wavelength	Slit	Resolving Power
Long Slit Spectroscopy in the Short Wavelength Camera			
G1	4.7-7.8 μm	2.4”x191”	200
		4.7” x191”	100
G3	8.4-13.7 μm	2.4” x191”	300
		4.7” x191”	150

Cross Dispersed Spectroscopy in the Short Wavelength Camera			
G2xG1	4.7-7.8 µm	2.4”x11.25”	1200
G4xG3	8.4-13.7 µm	2.4”x11.25”	800
Long Slit Spectroscopy in the Long Wavelength Camera			
G5	17.6-27.7µm	2.4”x191”	140
		4.7” x191”	70
G6	28.7-37.1µm	2.4” x191”	220
		4.7” x191”	110

In the fall of 2011, FORCAST grism 4 was damaged. We expect to replace the unit and therefore the mode is still being offered in Cycle 1. Depending on the details of the re-procurement of the grism, the mode may be available all, or only part of, Cycle 1.

Dichroic:
For Cycle 1, all FORCAST spectroscopic observations will be done using the single channel configuration.

1.3.3. GREAT supported configurations in Cycle 1

GREAT observation configurations consist of observing modes and receiver band and backend selections. The following are available for Cycle 1:

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)

Receiver bands:

GREAT is a dual channel receiver where the two bands are operated simultaneously. Each band (front end) can be tuned separately, each with an instantaneous bandwidths of up to about 1.5 GHz. The usable bandwidth is typically 1.2 GHz, depending on tuning. Each band is also fed to three different backends: an AOS, and two digital FFT spectrometers (AFFTS, XFFTD), providing frequency resolutions from 1.6 MHz - 76 kHz. For Cycle 1 the offered configurations are: L1a - L2 and L1b - L2.

The frequency ranges of the receiver bands are:

Band L #1a: 1.252 THz – 1.392 THz

Band L #1b: 1.417 THz - 1.52 THz

Band L #2: 1.815 THz - 1.91 THz

Note that not all frequencies are available within these bands, and availability will depend on specific performance of the local oscillators. Potential users should consult with the instrument handbook and the GREAT instrument team.

The GREAT team will offer on a best effort, shared risk mode the M1 channel tuned to the 2.51 THz OH line with a velocity range of +/- 50 km/s Local Standard of Rest. As a shared risk mode, the availability and performance will be dependent on future development progress. The M1 channel would nominally be available in the second GREAT campaign in Spring-Summer 2013 and only after successful demonstration in flight. The channel will be operated in parallel to L2.

Backends:

Acousto-Optical Spectrometers (AOS):

4 x 1 GHz bandwidth with 1.6 MHz Equivalent Noise Bandwidth (ENB).

Fast Fourier Transform Spectrometers:

AFFTS: 2 x 1.5 GHz bandwidth with 0.212 MHz ENB

XFFTS: 2 x 2.5 GHz bandwidth with 0.088 MHz ENB.

1.3.4. HIPO supported configurations in Cycle 1

HIPO observation configurations consist of observing modes and filter selections in imaging mode. (The HIPO/FLITECAM combination has the same modes as HIPO, with the additional FLITECAM filters and grisms available.) The following are available for Cycle 1:

Observing modes:

1. Single frames
2. Basic Occultations
3. Fast Occultations

Filters:

For the Blue channel: U, B, V, R

For the Red channel: V, R, I, Methane

Dichroic configurations:

There are two dichroics available with cut-offs at 575 and 675 nm. Use of the R filter in the blue channel requires the 675 nm dichroic instead of the alternative 575 nm dichroic. The choice of dichroic is determined by a preference for where to split the wavelength coverage of the 'blue' and 'red' channels. For example, the 675 nm dichroic permits simultaneous observation of occulations in R and I bands in the 'blue' and 'red' CCD channels, respectively.

HIPO also supports a no-dichroic, 'red' channel only configuration using the B, V, R, I, and methane filters.

Custom configurations based upon special requests:

With pre-proposal consultations, HIPO can accommodate custom filters and dichroics for specific observations. A 'bare CCD' configuration without re-imaging optics is also available.

Instrument configurations are provided on a per-flight basis whereas observing strategies are on a per observation basis. Additional engineering readout modes are also available for special purpose observations in collaboration with the HIPO instrument team.

1.4. Cycle 1 Schedule

The nominal schedule for the Cycle 1 observing program is as follows:

November 2011	Release of Call for Proposals.
December 13, 2010	**Release final Call for Proposals**
	Final sensitivity upgrades to the SITE tool released.
	Proposal ingest opened.
January 27, 2012, 23:59 PST	Proposal Submission deadline.
March 2012	Proposal Selections Announced.
August 2012 – August 2013	Cycle 1 observing period.

There will be four Science Flight Campaigns during Cycle 1[5]. The detailed layout of Science Flight Series within each Science Flight

---

[5] 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.

Campaigns will depend on the selected proposals and instrument availability.

1.5. General Guidelines and Policies

The instrument configurations used during Early Science (FORCAST imaging and GREAT spectroscopy, HIPO occultation), and pre-commissioning observations during observatory characterization flights (FLITECAM, HIPO) provide a level of testing and experience to complement the upcoming commissioning periods. FORCAST is to be commissioned as a facility instrument in the Summer of 2012 and FLITECAM in Spring of 2013. Cycle 1 observations will be undertaken as envisioned in the Science Utilization Policy, as Shared Purpose Operations.

Shared Risk observations: Cycle 1 observations in the FORCAST & FLITECAM grism instrument configurations will be undertaken as "shared-risk" observations. GREAT observations with the M1 configuration are considered shared risk. Shared risk observations have a high degree of uncertainty in the achievable data quality. If significant problems are found during instrument commissioning, then accepted shared-risk observations will have a higher risk of not being done than supported mode observations. The data delivery timeline is also more uncertain for shared-risk observations, since testing and verification of the pipelines will not have been completed prior to the beginning of the Cycle 1 observations.

For all observations, the observatory is not at its full capabilities or efficiency. Should observations be lost due to schedule delays in observatory or instrument commissioning, due to observatory or instrument hardware or software failures, weather, or other reasons, the observations will not automatically be rescheduled. In general, the observations will need to be proposed for again in a subsequent Cycle.

1.5.1 Proposal Process

The SOFIA Cycle 1 proposal process will consist of two steps – Phase 1 and Phase 2. Phase 1 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 1 proposal will form the basis of the peer review and proposal selection by USRA. Proposals that are awarded observing time based on the evaluation process described in Section 1.9 will subsequently be required to submit Phase 2 observation specifications following guidelines provided by the SMO. These submissions will provide the SMO and instrument PIs with the detailed definition of each observation to be executed for the program. In addition, proposers affiliated with U.S.

---

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.

institutions will be invited to submit a budget, based on funding guidelines provided by USRA.

SOFIA Cycle 1 Phase 1 proposals must be prepared and submitted using the SOFIA Proposal Tool (http://dcs.sofia.usra.edu/proposalDevelopment/installSPT), which is a Java based application. The prospective proposer should download SPT to a local computer. The proposal consists of formatted information filled in via the SPT 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. SPT is available for most commonly used platforms, including Mac OS X, Windows and Linux (http://dcs.sofia.usra.edu/proposalDevelopment/installSPT/index.jsp).

An outline of the proposal preparation process may be found in section 2 and further details about SPT in the Observers Handbook.

1.5.2. Who May Propose

Participation in the US SOFIA Cycle 1 Program is open to scientists from all categories of US and non-US organizations, including educational institutions, industry, nonprofit institutions, NASA Centers, and other Government agencies. Members of German organizations, including DSI staff stationed in the US, must participate through the DLR led program.

Note: those with a German professional affiliation may participate as CoIs 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.

Each SOFIA Cycle 1 proposal must identify a single Principal Investigator (PI) who assumes responsibility for the conduct of the scientific investigation. Proposal Co-Investigators must have well defined roles in the investigation, which will be evaluated as part of the proposal review process. Following selection by the SMO Director, the SMO staff will communicate formally only with the PI (or a person designated by the PI) of each proposal, except for funding issues where communications will be primarily with the institutional Sponsored Research Office (or equivalent). It is the responsibility of the PI (or designee) to provide the SOFIA project, in a timely manner, all information necessary for implementing observations, and to respond to any questions concerning observational constraints or configurations.

1.5.3. Late Proposals

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

1.6. Data rights and distribution

All scientific data from SOFIA observations will be distributed via the SOFIA Data Cycle System's Science Archive (https://dcs.sofia.usra.edu/dataRetrieval/SearchScienceArchiveInfo.jsp)

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 also be archived.

These data will be accessible to the general community after a proprietary period of twelve months, starting at the ingestion of each data set into the archive.

1.7. Targets for Observations

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

1.7.1. Reserved Observations

As part of the instrument development contract, the instrument teams were awarded a limited amount of Guaranteed Time Observing (GTO). To protect the interests of the instrument development teams, the SOFIA project has allowed the Cycle 1 instrument teams to set aside a limited number of targets and associated exposure times as "Reserved Observations". These reserved observations may not be proposed for in Cycle 1.

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 Reserved Observation Catalogs for the instruments are independent of each other. The Reserved Observation list only applies to Cycle 1, and the Instrument PIs will have the opportunity to revise their Reserved Observation Catalog prior to subsequent proposal calls.

Requests for an observation in the Reserved Observation Catalogs may only be proposed for scientific investigations that cannot be accomplished or were not intended to be accomplished by the Instrument Team. The spirit of these restrictions is to protect science objectives, and therefore observations that closely resemble any in the Reserved Observation Catalogs would also be disallowed.

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. (Since the Reserved Observation Catalogs for the instruments are independent of each other, a target in one Catalog may be proposed for using a different instrument, without the above exposure time minimum.) Final determination of acceptability of proposed observations rests with the Science Mission Operations Director.

The Reserved Observations Catalogs can be found in Appendix A.

1.8. Proposal Evaluation and Selection Process

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

Based on the results of the peer review, a recommendation for the total program will be submitted to the SMO Director, who will make the final proposal selection.

The following factors will be used in evaluating proposals for the SOFIA Cycle 1 Program.

1. The overall scientific merit of the proposed investigation.
2. The feasibility of accomplishing the objectives of the investigation given the early stage in the characterization of the observatory and instruments.
3. The degree to which the investigation uses SOFIA's unique capabilities.
4. The competence and relevant experience of the Principal Investigator and any collaborators to carry the investigation to a successful conclusion.

The scientific review panels will be given an assessment of the technical feasibility of each proposal as determined by the SMO. After acceptance of an observing program, successful proposers must provide the required inputs to detailed observing plans for submission to the SMO. Instructions for completing these Phase 2 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.

At the discretion of the SMO director, an appropriate over-subscription of the available flight times may be accepted via the peer review process with an associated prioritization, which will allow for contingencies in flight planning. The implementation of the observing prioritization and target selection will be approved by the SMO director.

1.9. Funding for US-based Investigators

Limited funds for awards under this solicitation are expected to be available to investigators at U.S. institutions subject to the annual NASA budget cycle. Successful proposers at U.S. institutions, including U.S. Co-Investigators on successful non-U.S. proposals, will be eligible for funding. It is expected that the Cycle 1 General Investigator support will be consistent with other NASA-sponsored observing programs. The funding level for US affiliated proposal PIs and US Co-Is on non-US led proposals may be different, at the discretion of the SMO Director. Budgets should not be submitted with the proposals in response to this Call. The selected investigators will receive a funding guideline from USRA based on the scope of the approved observing program and the available budget for the SOFIA Cycle 1 program. A budget summary and narrative description of how these funds will be used must be submitted after the receipt of the guideline. The deadline for budget submittal will be announced after the proposal selection and included in the funding guidelines document. An institutional signature will be required when a budget is submitted.

Grants disbursement will be implemented in three steps. A first installment of $5k will be disbursed at the completion of the Phase 2 submission, to support the work required to generate the detailed observing plan. A final installment of $2k will be disbursed after completion and delivery of the final report. The remaining part of the grant will be disbursed after successful completion of the initial observations in the program. Deviations from this disbursement schedule can, for exceptional circumstances, be requested through the SMO Director.

1.10. Proposer Participation in Observations

SOFIA GIs are encouraged to participate in the on-board observations and can contribute to the success of their observations. However, observations from many different programs are usually executed on any given flight. This has several impacts on GI in-flight participation: 1) Only a limited number of observations in the GIs program are likely to be executed on any given flight. 2) While many optimizations of a given observation are possible in-flight, the ability to interactively modify a program is limited to the specific observation. Changes that would affect the remainder of the flight plan (e.g. target changes), or that could cause conflicts with other accepted programs (such as filter settings not originally awarded to the current program), will generally not be allowed. 3) With the many different required and requested flight crew complements the number of "Astronomer seats" on any given flight is limited. For a given flight, if the number of GIs requesting seats exceeds the number available, then the SMO Director will decide on which GIs will be invited on that flight.

1.11. Outreach

1.11.1 Education and Public Outreach

The SOFIA project strongly encourages observing programs to include an Education & Public Outreach (E&PO) component, supported by the SOFIA 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 2 stage, to collaborate in designing an E&PO program related to the program's science.

For E&PO planning purposes, proposers are requested to indicate, in their Phase 1 submittals, whether or not they are interested in one particular E&PO option, namely the Airborne Astronomy Ambassadors (AAA) program. Participation in the AAA 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 SOFIA 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 AAA educators is carried out through a proposal process which runs in parallel to the Cycle 1 observing proposal process.

Please note that by choosing the AAA option the proposer is not required to recruit the educators, give them materials, or fund their activities; the SOFIA Outreach office will provide all such support. If the AAA program option is chosen, and the GI chooses to participate in the SOFIA observing flight(s) for their program, the AAA team (plus escort) will accompany them on the flight(s).

The proposal cover page in SPT includes a button allowing the proposer to indicate an interest in participating in the AAA program. The SOFIA project requests that you indicate whether you are interested in participating in the AAA program in the Phase 1 stage since this will provide important information for the planning, execution and review of the AAA educator proposal and selection process. The choice of whether or not to indicate an interest in participating in the AAA program will not affect the evaluation of the Cycle 1 observing proposal.

1.11.2 Press Releases and Presentations

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

Press releases associated with SOFIA observations during Cycle 1 will be jointly released by NASA and the DLR. The US SOFIA Public Affairs officer and his German/DSI Public Affairs counterpart will coordinate the press release process. Other relevant press releases by participating organizations (including PI institutions) should be coordinated with the SOFIA program, NASA and DLR. Other presentation material based on the Cycle 1 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).

2. Proposal Preparation and Submission

2.1. Types of Programs

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

In addition, the SOFIA program will start accepting proposals for Director's Discretionary Time programs sometime in the early part of Cycle 1[6]. This category is intended for short, urgent observations that could not have been foreseen at the time of the proposal call and that cannot wait for the next proposal cycle. In exceptional cases, proof-of-concept observations may be requested through the DDT path. However, a strong justification for not proposing such observations through the regular proposal process will be required. DDT proposals are not solicited through this Call for Proposals, and should be directly addressed to the SMO Director, Dr. Erick Young.

All proposals are active only for the duration of the Cycle 1 observing period. Accepted observations not executed during Cycle 1, for whatever reason, will not be carried over to future cycles.

2.1.1. Regular Programs

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

[6] Director's Discretionary Time will be available after "Full Operational Capability" (FOC) is declared, currently expected to be achieved in late September 2012.

The intent is to execute all the observations accepted in a regular program.

2.1.2. Survey Programs

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

The intent is that a substantial fraction of the targets in a given survey program will be observed, but with no given target observation guaranteed to be executed. The proposal should discuss and justify a minimally useful fraction of completion.

2.1.3. Target of Opportunity Programs

For Cycle 1, Target of Opportunity (ToO) proposals are invited. Both programs with known targets, but unknown timing of the observations, such as observations of a specific target at an unknown time (e.g. an identified recurrent nova in outburst), and programs targeting a class of astronomical events, but with unknown targets and timings (such as observations of an as yet unidentified comet or supernova), will be considered. For ToO observations, the proposal should contain a discussion of the triggering criteria, the required turn-around time between triggering and observation, and any other timing constraints.

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

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

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

2.2. Proposal Preparation

Each Cycle 1 proposal must be prepared using the SOFIA Proposal Tool (SPT). The proposal information is entered directly, while text sections including the scientific justification and feasibility analysis should be in PDF files, uploaded via SPT[7].

---

[7] http://dcs.sofia.usra.edu/proposalDevelopment/installSPT/index.jsp

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

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

2.2.1 The SOFIA Proposal Tool (SPT)

The SOFIA Proposal Tool (SPT) provides the user with a simple form-based interface for preparing a proposal and for electronic submission to the SOFIA Science Mission Operations. After downloading the appropriate package and following the install instructions, the user starts a new proposal by launching the SPT 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 SPT, 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 SPT. Upon successful submission, a unique identifier is returned for later reference. Proposals that have been submitted to the SMO can be ***resubmitted*** using SPT at any time up to the proposal deadline (note that old versions are not retained). On-line help for SPT is available as a pop-up function in the application.

Please note that "Blackout Periods", and "Long Term Observations" are not supported in Cycle 1 and will be ignored in the SPT form.

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

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

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

2. **Feasibility (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 mentioned. Where applicable the spectral resolution required must be explicitly

stated. Any other information about the proposed observations that would help the reviewer relate the technical needs with the scientific goals should be included in this section. Observing overheads and other indirect time estimates should follow the instructions given in the Observers Handbook. This section should also contain the justification for special calibration procedures, if they have been requested (Section 3.2.2).

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

2.2.3. Exposure time estimates

Estimates of instrument sensitivities for imaging with FLITECAM and FORCAST can be made using the SOFIA Instrument Time Estimator (SITE)[8], a web-based tool that provides total integration time or S/N for a given instrument, filter(s), source type (point, extended, emission line) and water vapor overburden. Algorithms and assumptions used are given in the help link on the SITE webpage.

An exposure time estimator tool for FLITECAM grism observations has been added to the SOFIA web site under Cycle 1 information. For GRISM observations with FORCAST, a tutorial for estimating exposure times is made available on the SOFIA Cycle 1webpages.

For GREAT an exposure time estimator tool is available at the DSI web site

(http://www.dsi.uni-stuttgart.de/observatorium/beobachtungen/GREAT_time_estimator.html)

Because this call for proposals is being issued prior to in-flight commissioning of some instrument modes, the sensitivities of some of the instruments are somewhat uncertain. The SOFIA Observers Handbook provides instructions for the best estimate parameters to be used for Cycle 1 proposals.

2.2.4. Sky availability during Cycle 1

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

Current flight rules prohibit observations when the sun is above the local horizon.

8 http://dcs.sofia.usra.edu/proposalDevelopment/SITE

The instantaneous pointing of the telescope, relative to the aircraft, is restricted to ±3° cross-elevation (on the left hand side of the plane) and elevations between 15 and 75 degrees (20 and 60 degrees unvignetted). GREAT can only observe when the beam is unvignetted to avoid unwanted reflections and standing waves.

The SOFIA Program expects to perform one southern hemisphere deployment during the Cycle 1 period. In contrast to the Kuiper Airborne Observatory, SOFIA southern hemisphere deployments will be made for a limited duration with only one science instrument per deployment. The exact timing and instrument selection for the Cycle 1 southern hemisphere deployment will depend on the proposal selection, but the anticipated window will be a two-week period in the May-July 2013 timeframe.

Deployments required for other target availability reasons (occultation observations, etc.) will be considered on a case-by-case basis.

The SOFIA Visibility Tool (VT)[9] provides the capability to estimate what date, time, and aircraft heading are required to observe an astronomical target from a given point on the earth's surface. The tool distinguishes between unvignetted and vignetted observations, includes an easy selection of common SOFIA takeoff locations, can simultaneously plot up to sixteen sources, and shows sunrise and sunset times on the plots.

Cycle 1 proposers are not expected to lay out flight plans or perform detailed visibility analysis for their proposals. Flight planning will be done by the SMO staff and the instrument teams.

2.3. Proposal Submittal

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

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

3. Observations and Data

3.1. Flight Planning & Target Prioritization

Flight planning is not part of the proposal process. However, source selection with the constraints of an airborne observatory in mind can increase the ability of a program to be

[9] http://dcs.sofia.usra.edu/observationPlanning/visibilityToolMain.jsp

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 westwards since they are towards the south (and the telescope looks out on the port - left-hand - side of the aircraft). Since, in regular operations, SOFIA has to return to Palmdale at the end of each flight, targets in the northern half of the sky will be required for roughly the same amount of time as these southern regions. (Note that southern and northern half of the sky here does not refer to south and north of the celestial equator but to sources culminating south or north of the zenith.) Sources that culminate close to the zenith have additional schedule constraints as the SOFIA telescope has an upper elevation limit of 60° unvignetted view.

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

3.2. Data Processing, Calibration and Distribution

3.2.1 Data Processing, Archiving and Distribution

The SMO will be responsible for the data obtained of FSI observations.

All scientifically meaningful raw data obtained during the Cycle 1 phase will be made available to observers via the SOFIA Science Archive in standard FITS format. The data will be made available to the proposal PIs as soon as is feasible after each flight. It is expected that the raw (level 1) data will be available to the Proposal PI within 24 hours of the end of each flight.

When appropriate, Level 2 scientific data (corrected for instrumental and atmospheric effects) will be available in the SOFIA Archive within 2 weeks after the completion of the flight series in which they are taken. Level 3 scientific data (flux calibrated) will be available in the SOFIA Archive within 8 weeks after the completion of the flight series in which they are taken (contingent on completion of funding negotiations for pipeline support activities).

Data obtained using PSIs will be subject to different sets of guidelines, which may vary from one instrument to another.

The data reduction for GREAT observations will be the responsibility of the GREAT team. Raw data will be provided in FITS format within two days of a given flight. Quick-look data products shall be provided by the GREAT team to guest investigator teams within 2 weeks after a campaign. Calibrated data products in CLASS format of open time projects shall be provided by the GREAT team to the SMO within 45 days of the end of a flight series. These files shall be ingested into the archive for exclusive access by the investigation team for a period of one year.

Raw data will be distributed to the Cycle 1 teams remotely via the SOFIA Science

Archive, or locally via direct data transfer or by removable media, as agreed by the teams and the SMO.

3.2.2 Calibration

Because this Call for Proposals is being issued prior to commissioning of some instruments and prior to the first usage of several modes, the data calibration is somewhat uncertain, particularly for the shared risk modes.

It is expected that a photometric calibration accuracy of at least 20% will be achieved for FLITECAM and FORCAST imaging, and for GREAT observations except in spectral regions of strong telluric interference. Absolute calibration for HIPO is not expected to be an issue, but may be brought up by the proposer during discussions with the Instrument PI before preparing and submitting a proposal.

Cycle 1 proposals do not need to include time for calibration target observations. Observations of astronomical calibrators will be allocated as general overhead and will be obtained at a Cycle 1 wide level. Proposers wishing to implement specific calibration strategies may propose to do so, but must identify the specific calibration target observations to accomplish these goals and explicitly request the observing time to accomplish these observations. 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.

4. Contacts and Further information

For further information about the Cycle 1 Call for Proposal or help in preparing proposals, please see the "Information for Researchers" (http://www.sofia.usra.edu/Science/) section of the SOFIA web site, or contact the SOFIA help desk at sofia_help@sofia.usra.edu.

Questions about the SOFIA General Investigator program can be directed to the SOFIA Science Operations Manager, Dr. B-G Andersson (bg@sofia.usra.edu), or SOFIA User Support Scientist Dr. Ravi Sankrit (rsankrit@sofia.usra.edu).

For further information about the SOFIA Science project, please contact the above, or the Science Mission Operations Director, Dr. Erick T. Young (eyoung@sofia.usra.edu)

Appendix A1- FLITECAM Reserved Observations Catalog (ROC)

Table1: Target List for PAH observations

Target	RA (J2000)	Dec (J2000)	Itime + O/H[1]	Type	Filters	Grism
HB 5	17 47 56.19	-29 59 41.9	1 hr	PN	PAH (3.29 μm)	3.3 μm
NGC 6790	19 22 56.97	+01 30 46.5	1 hr	PN	PAH (3.29 μm)	3.3 μm
BD +30 3639	19 34 45.23	+30 30 58.9	1 hr	PN	PAH (3.29 μm)	3.3 μm
NGC 6886	20 12 42.81	+19 59 22.7	1 hr	PN	PAH (3.29 μm)	3.3 μm
M 3-35	20 21 03.77	+32 29 23.9	1 hr	PN	PAH (3.29 μm)	3.3 μm
SH2-106	20 27 27.1	+37 22 39.0	1 hr	HII Region	PAH (3.29 μm)	3.3 μm
NGC 7027	21 07 01.59	+42 14 10.2	3 hr	PN	PAH (3.29 μm)	3.3 μm
IRAS 21282+5050	21 29 58.42	+51 03 59.8	1 hr	PN	PAH (3.29 μm)	3.3 μm
IC 5117	21 32 31.03	+44 35 48.5	1 hr	PN	PAH (3.29 μm)	3.3 μm
M 4-18	04 25 50.83	+60 07 12.7	1 hr	PN	PAH (3.29 μm)	3.3 μm
CRL 618	04 42 53.67	+36 06 53.2	1 hr	PN	PAH (3.29 μm)	3.3 μm
Orion Bar	05 32 55.3	-05 26 50.5	4 hr	HII Region	PAH (3.29 μm)	3.3 μm
HD44179	06 19 58.22	-10 38 14.7	1 hr	Red Rectangle	PAH (3.29 μm)	3.3 μm
Alpha Vul	19 28 42.32	+24 39 53.6	0.5 hr	Calibrator	PAH (3.29 μm)	3.3 μm
75 Cyg	21 40 11.11	+43 16 25.8	0.5 hr	Calibrator	PAH (3.29 μm)	3.3 μm
HD 10074	01 39 07.73	+36 32 36.1	0.5 hr	Calibrator	PAH (3.29 μm)	3.3 μm
HD 13746	02 14 42.16	+30 23 41.2	0.5 hr	Calibrator	PAH (3.29 μm)	3.3 μm

1. Total on-target integration time plus 30% overhead; total of 20 hours. Each observation requires a minimum of two narrow band images (on/off the PAH feature) and a 3.3 micron grism-mode spectrum. Up to ten "map" positions will be needed on the largest objects.

Table2: Brown Dwarfs

Target	RA (J2000)	Dec (J2000)	Itime + O/H[1]	Type	Filter
Ydwarf1	20 56 28.90	+14 59 53.3	1 hr	J=19	J, L
Tdwarf1	18 04 35.40	+31 17 06.1	1 hr	18.8	J, L
Tdwarf2	23 44 46.25	+10 34 15.8	1 hr	18.8	J, L
Tdwarf3	07 22 27.27	-05 40 29.9	1 hr	16.5	J, L
Tdwarf4	17 41 24.26	+25 53 19.5	1 hr	16.5	J, L

1. Total on-target integration time plus 30% overhead; total of 5 hours. Each observation requires a minimum of two spectra, one in J and one in L. Only ABBA nodding will be used.

Appendix A2 - FORCAST Imaging Reserved Observations Catalog (ROC)

Object Name	RA	Dec	Extent	SWC	LWC	Observing
	(J2000)	(J2000)	(arcmin)	Filter	Filter	time
				[μm]	[μm]	[hours]
Alpha Lyr	18:36:56.34	+37.1:47:01.3	3.2x3.2	0	34.8	15.83
Fomalhaut	22:57:39.05	-29:37:20.1	3.2x3.2	0	34.8	1.36
HD 141569	15:47:20.2	-03:46:12	3.2x3.2	6.3	0	0.25
HD 141569	15:47:20.2	-03:46:12	3.2x3.2	7.7	0	0.25
HD 141569	15:47:20.2	-03:46:12	3.2x3.2	8.6	0	0.25
HD 141569	15:47:20.2	-03:46:12	3.2x3.2	11.1	37.1	0.25
HD 141569	15:47:20.2	-03:46:12	3.2x3.2	11.3	37.1	0.25
Sag A West, Arches, filaments	17:45:50.5	-28:49:28	12.8x9.6	6.3	0	0.56
Sag A West, Arches, filaments	17:45:50.5	-28:49:28	12.8x9.6	6.6	0	0.56
Sag A West, Arches, filaments	17:45:50.5	-28:49:28	12.8x9.6	7.7	0	0.50
Sag A West, Arches, filaments	17:45:50.5	-28:49:28	12.8x9.6	19.7	31.4	0.35
Sag A West, Arches, filaments	17:45:50.5	-28:49:28	12.8x9.6	24.2	37.1	1.28
LBV G0.120 – 0.048	17 46 05.63	-28 51 31.9	3.2x3.2	6.3	0	0.047
LBV G0.120 – 0.048	17 46 05.63	-28 51 31.9	3.2x3.2	6.6	0	0.047
LBV G0.120 – 0.048	17 46 05.63	-28 51 31.9	3.2x3.2	7.7	0	0.042
LBV G0.120 – 0.048	17 46 05.63	-28 51 31.9	3.2x3.2	19.7	31.4	0.0083
LBV G0.120 – 0.048	17 46 05.63	-28 51 31.9	3.2x3.2	24.2	37.1	0.03
"Pistol" star, Sickle region	17:46:15.3	-28:50:04	3.2x3.2	6.3	0	0.047
"Pistol" star, Sickle region	17:46:15.3	-28:50:04	3.2x3.2	6.6	0	0.047
"Pistol" star, Sickle region	17:46:15.3	-28:50:04	3.2x3.2	7.7	0	0.042
"Pistol" star, Sickle region	17:46:15.3	-28:50:04	3.2x3.2	19.7	31.4	0.0083
"Pistol" star, Sickle region	17:46:15.3	-28:50:04	3.2x3.2	24.2	37.1	0.03
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	5.4	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	6.3	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	6.6	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	7.7	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	8.6	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	11.1	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	11.3	0	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	19.7	31.4	0.5
NGC 253	00:47:33.13	-25:17:17.8	3.2x3.2	24.2	37.1	0.5
M82	09:55:52.2	+69:40:47	3.2x3.2	5.4	0	0.41
M82	09:55:52.2	+69:40:47	3.2x3.2	8.6	0	0.037
M82	09:55:52.2	+69:40:47	3.2x3.2	11.1	0	0.046
M82	09:55:52.2	+69:40:47	3.2x3.2	19.7	0	0.0028

M82	09:55:52.2	+69:40:47	3.2x3.2	24.2	0	0.0076
NGC 4038/9	12:01:52	-18:52:02.9	3.2x3.2	19.7	31.4	1.13
NGC 4038/9	12:01:52	-18:52:02.9	3.2x3.2	19.7	37.1	1.13
NGC1068	02:42:40.83	-00:00:48.4	3.2x3.2	19.7	31.4	0.33
NGC1068	02:42:40.83	-00:00:48.4	3.2x3.2	19.7	37.1	0.33
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	5.4	0	0.9
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	6.3	0	3.64
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	6.6	0	0.0014
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	7.7	0	3.29
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	11.1	0	2.08
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	19.7	31.4	0.17
Arp 299	11:28:32.8	+58:34:45	3.2x3.2	19.7	37.1	0.17
M16	18:18:51.5	13:49:30	3.2x3.2	6.3	0	0.53
M16	18:18:51.5	13:49:30	3.2x3.2	6.6	0	2.16
M16	18:18:51.5	13:49:30	3.2x3.2	7.7	0	0.15
M16	18:18:51.5	13:49:30	3.2x3.2	0	33.5	0.91
M16	18:18:51.5	13:49:30	3.2x3.2	19.7	34.8	0.47
M16	18:18:51.5	13:49:30	3.2x3.2	24.2	37.1	1.17
M17	18:20:30	-16:10:11	9.6x9.6	6.3	0	1.18
M17	18:20:30	-16:10:11	9.6x9.6	6.6	0	1.18
M17	18:20:30	-16:10:11	9.6x9.6	7.7	0	1.07
M17	18:20:30	-16:10:11	9.6x9.6	0	33.5	0.15
M17	18:20:30	-16:10:11	9.6x9.6	19.7	34.8	0.07
M17	18:20:30	-16:10:11	9.6x9.6	24.2	37.1	0.16
W51	19:23:40	+14:31:08	6.4x6.4	6.3	0	0.26
W51	19:23:40	+14:31:08	6.4x6.4	6.6	0	0.26
W51	19:23:40	+14:31:08	6.4x6.4	7.7	0	0.23
W51	19:23:40	+14:31:08	6.4x6.4	0	33.5	0.093
W51	19:23:40	+14:31:08	6.4x6.4	19.7	34.8	0.048
W51	19:23:40	+14:31:08	6.4x6.4	24.2	37.1	0.12
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	6.3	0	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	6.6	0	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	7.7	0	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	0	31.4	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	0	33.5	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	19.7	34.8	0.4
Orion BNKL, Trapezium, Bar	05:35:16.0	-05::23:17	12.8x9.6	24.2	37.1	0.4
HV Tau	04:38:35.311	+26:10:38.49	3.2x3.2	19.7	31.4	0.43
HV Tau	04:38:35.311	+26:10:38.49	3.2x3.2	24.2	37.1	1.21
DK Tau	04:30:44.243	+26:01:24.79	3.2x3.2	19.7	31.4	0.043
DK Tau	04:30:44.243	+26:01:24.79	3.2x3.2	24.2	37.1	0.12
IT Tau	04:33:54.708	+26:13:27.70	3.2x3.2	19.7	31.4	0.43
IT Tau	04:33:54.708	+26:13:27.70	3.2x3.2	24.2	37.1	1.21
HK Tau	04:31:50.576	+24:24:17.84	3.2x3.2	19.7	31.4	0.11

HK Tau	04:31:50.576	+24:24:17.84	3.2x3.2	24.2	37.1	0.31
GG Tau B	04:32:30.326	+17 31 40.67	3.2x3.2	19.7	31.4	0.043
GG Tau B	04:32:30.326	+17 31 40.67	3.2x3.2	24.2	37.1	0.12
FX Tau	04:30:29.617	+24:26:45.04	3.2x3.2	19.7	31.4	0.17
FX Tau	04:30:29.617	+24:26:45.04	3.2x3.2	24.2	37.1	0.48
FQ Tau	04:19:12.798	+28:29:33.01	3.2x3.2	19.7	31.4	0.43
FQ Tau	04:19:12.798	+28:29:33.01	3.2x3.2	24.2	37.1	1.21
FV Tau	04:26:53.502	+26:06:54.06	3.2x3.2	19.7	31.4	0.043
FV Tau	04:26:53.502	+26:06:54.06	3.2x3.2	24.2	37.1	0.12
Haro 6-28	04:35:56.837	+22:54:36.22	3.2x3.2	19.7	31.4	0.86
Haro 6-28	04:35:56.837	+22:54:36.22	3.2x3.2	24.2	31.4	0.86
UZ Tau	04:32:42.962	+25:52:31.09	3.2x3.2	19.7	31.4	0.043
UZ Tau	04:32:42.962	+25:52:31.09	3.2x3.2	24.2	37.1	0.12
GH Tau	04:33:06.216	+24:09:33.72	3.2x3.2	19.7	31.4	0.17
GH Tau	04:33:06.216	+24:09:33.72	3.2x3.2	24.2	37.1	0.48
NGC 2024	05:41:43	-01:50:30	6.4x6.4	19.7	31.4	0.10
NGC 2024	05:41:43	-01:50:30	6.4x6.4	24.2	37.1	0.44
S106	20:27:27	37:22:48	6.4x3.2	19.7	31.4	0.66
S106	20:27:27	37:22:48	6.4x3.2	24.2	31.4	0.66
S106	20:27:27	37:22:48	6.4x3.2	0	37.1	1.45
Serpens	18:30:00.0	01:15:00	12.8x12.8	19.7	31.4	0.10
Serpens	18:30:00.0	01:15:00	12.8x12.8	0	37.1	0.089
L988-e	21:03:58	50:14:38	12.8x12.8	19.7	31.4	0.10
L988-e	21:03:58	50:14:38	12.8x12.8	0	37.1	0.089

* This table is a summary of the full ROC containing additional information about targets and observing strategies. The Full ROC is available, as a .pdf file, at the Cycle 1 web site. Please consult the detailed, full, ROC when deciding if a potential proposed observation would constitute a duplication of the observations listed herein.

Appendix A3 - FORCAST grism Reserved Observations Catalog (ROC)

Target	RA (J2000)	Dec (J2000)	S/N	Obs time/ slit pos [h]	Obs time [h]	Map Area	Mode	Grism [µm]
Orion A, BN/KL	05 35 14.16	-05 22 21.5	20	0.25	1	3'x3'	Long slit	5-8, 8-13.7, 17-28, 28-40
Orion A, BN/KL	05 35 14.16	-05 22 21.5	20	0.5	2	30"x30"	Short slit /high res.	5-8, 8-13.7
Orion A Bar North	05 32 56.0	-05 26 30.0	20	3.0	6.0	3.2'x3.2'	Long slit	5-8, 8-13.7, 17-28, 28-40
Orion A, Bar South	05 32 49.0	-05 27 15.0	20	3.0	6.0	3.2'x3.2'	Long slit	5-8, 8-13.7, 17-28, 28-40
Sgr A*	17 42 29.31	-28 59 18.5	40	0.125	1.25	3.2'x3.2'	Long slit	5-8, 8-13.7, 17-28, 28-40
NGC 7027	21 05 09.37	+42 02 03.8	20	0.125	1.0	±20" EW	Long slit	5-8, 8-13.7, 17-28, 28-40
NGC 7027	21 05 09.37	+42 02 03.8	20	0.25	2	±20" EW	Short slit /high res.	5-8, 8-13.7
AFGL 2688	21 00 19.37	+36 29 44.3	20	0.125	0.25	±10" EW	Long slit	5-8, 8-13.7, 17-28, 28-40
AFGL 2688	21 00 19.37	+36 29 44.3	10	0.125	0.25	±10" EW	Short slit /high res.	5-8, 8-13.7

Appendix A4 - GREAT Cycle 1 Reserved Observations Catalog (ROC)

Science	Object Name	RA	DEC	ν_1	ν_2	ν_3	area	Time
		(2000)	(2000)	[THz]			arcmin	[hr]
OD & OH	IRAS16293-2422	16:32:22.6	-24:28:33.0	1.39	1.84	2.51	1	0.3
	Oph-A	16:26:27.2	-24:23:34.0	1.39	1.84	2.51	1	0.3
	SgrB2(M)	17:47:20.4	-28:23:07.0	1.39	1.84	2.51	2	0.6
	Sgr A*	17:45:51.7	-28:59:08.7	1.39	1.84	2.51	1	0.3
	W28A	18:00:30.4	-24:04:00.0	1.39	1.84	2.51	1	0.3
	W31C	18:10:28.7	-19:55:50.0	1.39	1.84	2.51	1	0.3
	W33A	18:14:39.4	-17:52:00.0	1.39	1.84	2.51	1	0.3
	W49N	19:10:13.2	+09:06:12.0	1.39	1.84	2.51	1	0.3
	DR21(OH)	20:39:00.7	+42:22:46.7	1.39	1.84	2.51	2	0.6
	W43-MM1	18:47:47.0	-01:54:28.0	1.39	1.84	2.51	1	0.3
	IRAS18089	18:11:51.5	-17:31:29.0	1.39	1.84	2.51	1	0.3
	AFGL2591	20:29:24.7	+40:11:19.0	1.39	1.84	2.51	1	0.3
	W3-OH/IRS1	02:25:40.6	+62:05:51.0	1.39	1.84	2.51	3	0.6
	G31.41	18:47:34.3	-01:12:46.0	1.39	1.84	2.51	1	0.3
	G29.96	18:46:03.8	-02:39:22.0	1.39	1.84	2.51	1	0.3
	IRAS05271+3059	05:30:21.0	+31:01:26.0	1.39	1.84	2.51	1	0.3
	IRAS05345+3536	05:38:00.0	+35:58:59.0	1.39	1.84	2.51	1	0.3
	IRAS20406+4555	20:42:20.0	+46:05:39.0	1.39	1.84	2.51	1	0.3
	NGC7538	23:13:45.3	+61:28:10.0	1.39	1.84	2.51	2	0.6
	W51D/E1	19:23:43.8	+14:30:26.0	1.39	1.84	2.51	2	0.6
	G34.26	18:53:18.6	+01:14:58.0	1.39	1.84	2.51	1	0.3
	G10.47	18:08:38.2	-19:51:50.0	1.39	1.84	2.51	1	0.3
	G5.89	18:00:30.4	-24:04:02.0	1.39	1.84	2.51	1	0.3
	Orion-KL	05:35:15.1	-05:22:26.6	1.39	1.84	2.51	2	0.6
	Orion-Bar	05:35:22.1	-05:25:13.4	1.39	1.84	2.51	2	0.6
p-H_2D^+ / o-D_2H^+	IRAS16293E	16:32:29.4	-24:28:52.6	1.37		1.48	1	1.0
	SgrB2(M)	17:47:20.4	-28:23:07.0	1.37		1.48	1	1.0
	W28A	18:00:30.4	-24:04:00.0	1.37		1.48	1	1.0
	W31C	18:10:28.7	-19:55:50.0	1.37		1.48	1	1.0
	W33A	18:14:39.4	-17:52:00.0	1.37		1.48	1	1.0
	G34.3+0.1	18:53:18.7	+01:14:58.0	1.37		1.48	1	1.0
	W49N	19:10:13.2	+09:06:12.0	1.37		1.48	1	1.0
OH/CO studies of	IRAS16293-2422	16:32:22.6	-24:28:33.0	CO	1.84	2.51	1	0.5

	IRAS18151-1208	18:18:10.3	-12:07:27.0	CO	1.84	2.51	1	0.5
	IRAS17233-3606	17:26:42.5	-36:09:18.0	CO	1.84	2.51	1	0.5
	IRAS05358+3543	05:39:13.1	+35:45:50.0	CO	1.84	2.51	1	0.5
	IRAS20126+4104	20:14:25.1	+41:13:32.0	CO	1.84	2.51	1	0.5
	IRAS16272	16:30:58.7	-48:43:55.0	CO	1.84	2.51	1	0.5
	IRAS12326	12:35:35.9	-63:02:29.0	CO	1.84	2.51	1	0.5
	IRAS16065	16:10:20.0	-52:06:13.2	CO	1.84	2.51	1	0.5
	IRAS16060	16:09:51.4	-51:55:06.9	CO	1.84	2.51	1	0.5
	IRAS16547	16:58:16.9	-42:52:07.0	CO	1.84	2.51	1	0.5
	eta Carinae	10:45:03.6	-59:41:04.3	CO	1.84	2.51	1	0.5
	HH212	05:43:51.4	-01:02:53.0	CO	1.84	2.51	2	0.7
	BHR71	12:01:36.3	-65:08:53.0	CO	1.84	2.51	2	0.7
	HH111	05:51:46.3	+02:48:30.0	CO	1.84	2.51	2	0.7
	VLA1623	16:26:26.4	-24:24:30.0	CO	1.84	2.51	2	0.5
	NGC2071	05:47:04.7	+00:21:44.0	CO	1.84	2.51	2	0.5
	NGC1333	03:28:55.6	+31:14:37.1	CO	1.84	2.51	3	1
	HH54	12:55:50.3	-76:56:23.0	CO	1.84	2.51	2	0.5
	G327-0.6	15:53:08.8	-54:37:01.0	CO	1.84	2.51	2	0.5
OH in stars	ALF-Ori	05:55:10.3	+07:24:25.0	CO	1.84	2.51	1	0.5
	U-Ori	05:55:49.2	+20:10:31.0	CO	1.84	2.51	1	0.5
	VY-CMa	07:22:58.3	-25:46:03.1	CO	1.84	2.51	1	0.5
	OH231.8+4.2	07:42:16.8	-14:42:52.1	CO	1.84	2.51	1	0.5
	O-Ceti	02:19:20.8	-02:58:43.0	CO	1.84	2.51	1	0.5
	IK-Tau	03:53:28.9	+11:24:21.7	CO	1.84	2.51	1	0.5
	NGC7027	21:07:01.6	+42:14:10.2	CO	1.84	2.51	1	0.5
Galactic PDRs	IC1396	21:40:42.3	+58:16:10.0	CO	1.46	1.91	60	5.0
	DR21OH	20:39:00	+42:22:43.0	CO	1.46	1.91	4	1.0
	IC63	00:58:55	+60:53:11.0	CO	1.46	1.91	2	1.0
	Carina N	10:43:30.9	-59:34:16.3	CO	1.46	1.91	3	2.0
	NGC3603	11:15:08.9	-61:16:50.0	CO	1.46	1.91	3	2.0
	IRAS16172-5028	16:21:00.4	-50:35:21.1	CO	1.46	1.91	3	2.0
LMC PDRs	N159	05:39:57.2	-69:44:33.0	CO	1.46	1.91	2	1.0
	30 Dor	05:38:42.4	-69:06:03.3	CO	1.46	1.91	2	1.0
	South1	05:41:56.7	-70:22:42.2	CO	1.46	1.91	1	0.5
	South2	05:40:39.2	-70:08:36.5	CO	1.46	1.91	1	0.5
	NE	05:46:48.1	-69:24:03.1	CO	1.46	1.91	1	0.5
	SE	05:47:59.3	-70:39:08.7	CO	1.46	1.91	1	0.5
	N44	05:22:08.0	-67:56:12.0	CO	1.46	1.91	1	0.5
SMC PDRs	N76	01:04:01.2	-72:01:52.3	CO	1.46	1.91	1	0.5
	N66	00:59:27.4	-72:10:10.7	CO	1.46	1.91	1	0.5
	N83/N84	01:14:21.0	-73:17:12.0	CO	1.46	1.91	1	0.5
	Bar-N	00:48:00.0	-73:06:00.0	CO	1.46	1.91	1	0.5
	Bar-S	00:48:00.0	-73:16:00.0	CO	1.46	1.91	1	0.5
Galactic Center Studies	Sickle	17:46:14.7	-28:48:55.9	CO	1.84	2.51	3	0.75
	Arches_E1	17:45:51.0	-28:48:22.0	CO	1.84	2.51	3	0.75

	NGC4945	13:05:27.5	-49:28:05.6	CO	1.84	2.51	1	0.7
	Cen-A	13:25:27.6	-43:01:08.9	CO	1.84	2.51	1	0.7
CO, OH in MHD shocks	IC443	06:17:42.5	+22:21:30.0	CO	1.84	2.51	40	3
	W28F	18:01:52.3	-23:19:25.0	CO	1.84	2.51	2	1
	W44 E/F	18:56:28.4	+01:29:55.0	CO	1.84	2.51	2	1
	3C391	18:49:22.3	-00:57:22.0	CO	1.84	2.51	2	1

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). "CO" refers to the J=10-9, 11-10 or 12-11 transition.

Freq. (THz) Species
1.37 p-H_2D^+
1.39 OD
1.461 [N II]
1.48 o-D_2H^+
1.84 OH
1.901 [C II]
2.51 OH