

SCIENCE UTILIZATION
POLICIES
OF THE
STRATOSPHERIC
OBSERVATORY FOR
INFRARED ASTRONOMY
(SOFIA)

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TABLE OF CONTENTS

STATEMENT OF PURPOSE	1
POLICY 1—SOFIA SCIENCE OPERATIONS PROFILE	2
POLICY 2—CATEGORIES OF SOFIA SCIENCE INSTRUMENTS	4
POLICY 3—CATEGORIES OF OBSERVING TIME	5
POLICY 4—ALLOCATION OF OBSERVING TIME	7
POLICY 5—PROTECTION AND USE OF GUARANTEED OBSERVING TIME	9
POLICY 6—DISTRIBUTION OF DATA, DATA RIGHTS, AND ACCESS TO ARCHIVAL DATA	10
POLICY 7—FUNDING OF DATA ANALYSIS	11
POLICY 8—DEPLOYMENTS	12
POLICY 9—INSTRUMENT AND TECHNOLOGY DEVELOPMENT	13
POLICY 10—NASA NEEDS FOR SUPPORT OF OTHER MISSIONS	14

STATEMENT OF PURPOSE

This document contains the policies that serve as the basic agreement between the SOFIA Program and the Science Mission Directorate at NASA on the scientific operation of SOFIA during normal operations. The primary goal of these policies is to maximize the scientific return from SOFIA and the public understanding of this science, subject to cost constraints. A secondary goal is to ensure fair access to the mission both for the astronomical community at large and for those who built it. A tertiary goal is to allow the SOFIA Program flexibility in the implementation of these policies.

The SOFIA Program during operations will be led by the SOFIA Program Manager, and will consist of two projects, the Science and Mission Operations Project and the Platform Project. The SOFIA Observatory is a joint endeavor between NASA and the German Science Agency (DLR), with 80% of the science flight time being awarded to NASA, and 20% of the science flight time being awarded to the DLR, as detailed in the Memorandum Of Understanding between NASA and the DLR dated December 11, 2006. These science policies herein apply only to the US portion of the SOFIA science time.

POLICY 1

SOFIA SCIENCE OPERATIONS PROFILE

For the purposes of these policies, SOFIA Science Normal Operations will begin when the observatory has been developed to the point where routine science operations are possible. The SOFIA Science Operations are divided into three phases: Early Science; Shared Purpose Operations; and Full Operations. During all of these periods, the scientific community will have an opportunity to get access to the observatory. Observing time will be allocated through a peer review of submitted proposals to the General Investigators (GI's)

Early Science — The period consists of the first science operations, and involves the science instrument teams, SOFIA Science Center (SC) personnel, and members of the general astronomical community. The SOFIA observatory is still in development and has much reduced scientific capabilities. The science policies in place in this period are not detailed in this document but are given elsewhere.

Shared Purpose Operations — It is highly desirable that high priority scientific observations with SOFIA will begin as early as technically feasible. To facilitate the double objectives of continued observatory development and timely initiation of high priority science observations, a Shared Purpose program will be conducted. This period will overlap and interleave with the conclusion of the initial SOFIA development phase and the beginning of the science program. The proper phasing of SOFIA development with science observations during this period is a scientific and operational decision which will be made by the Program Manager, in consultation with the SOFIA Project Scientist and the Science Center Director.

The Shared Purpose period begins with the observatory reaching the Limited Operations Capability (LOC) milestone and ends with the observatory reaching the Full Operations Capability (FOC) milestone. At the LOC milestone the efficiency, science flight rate and performance are all expected to be significantly lower than is ultimately expected from SOFIA. At LOC only a fraction of the first generation science instruments will be characterized, and not all of the observing modes within these instruments may be available. Science observations in the Shared Purpose period will be considered “shared risk,” in the sense that the observatory and sensitivity and efficiency will not be guaranteed or possibly even fully characterized. Selection of observing programs and communication of SOFIA scientific results to the scientific community and the public will proceed in the same fashion as planned for the Full Operations period. SOFIA observatory development and finishing the development and commissioning of all of the first generation science instruments will continue in parallel with the conduct of the Shared Purpose science observations, moving toward the FOC capabilities. Near the end of the Shared Purpose Operations phase, a decision will be made by NASA Headquarters on the timetable for release of the next Announcement of Opportunity for science instrument and technology development for SOFIA.

Full Operations — This phase begins at the FOC milestone and continues until the end of SOFIA's operational lifetime. At the FOC milestone the observatory performance requirements will have been fully verified and validated, although the flight rate will not reach the Level-1

requirement value for another three years. At the FOC milestone all of the first-generation science instruments will have been commissioned in all of their original operations modes. However, new instrument modes can be implemented as scientific needs evolve. Regular calls for proposals for new science instruments and technology development will occur during the Full Operations phase. Additional improvements to the observatory performance will take place throughout the Full Operations phase, taking advantage of the ready accessibility of an airborne observatory.

POLICY 2

CATEGORIES OF SOFIA SCIENCE INSTRUMENTS

Science instruments developed and operated for SOFIA by US teams will fall into one of three categories: Facility-class Science Instruments, Principal Investigator-class Instruments, and Special Purpose Principal Investigator-class Science Instruments. US Guest Investigators will have access to both Facility-class Science Instruments and Principal Investigator-class Instruments. The US Science Instruments will be solicited through an Announcement of Opportunity for instrumentation and technology development open to the general science community. Guest Investigator (GI) time on all instruments will be awarded through a peer review process.

INSTRUMENT CATEGORIES:

Facility-class Science Instrument (FSI) — A general purpose, reliable and robust instrument that provides state-of-the-art science performance at conclusion of commissioning. It is expected that this instrument will reside at the SC and will routinely be operated and maintained by designated SC FSI scientists in support of General Investigators (GI's), who will not be required to have extensive knowledge or experience in infrared instrumentation or observing techniques. The process of data acquisition, reduction, and calibration should be straightforward and transparent to the GI, with the assistance of the SC FSI scientist.

Principal Investigator-class Science Instrument (PSI) — A general purpose instrument that is developed and maintained at the state-of-the-art throughout its useful operating life. It is expected that this instrument will be operated by the Principal Investigator (PI) team members, both for their own research as well as for that of successful GI's. The interaction of the PI and GI teams is to be determined after proposal selections by mutual consensus for each GI proposal. Normally the instrument will reside at the PI's institution, where all maintenance and upgrades will be accomplished. The process of data acquisition, reduction, and calibration should be straightforward and transparent to the GI, requiring only a minimal level of assistance from the PI team.

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 FSI or PSI instruments. This instrument may incorporate technologies at the "edge-of-the-art" that would be too risky to include in a general purpose instrument. It is expected that the PI team will operate this instrument. GI's can only use a SSI instrument by partnering with the SSI instrument team, at their discretion. Normally the instrument will reside at the PI's institution, where all maintenance and upgrades will be accomplished.

POLICY 3

CATEGORIES OF OBSERVING TIME

Observing time is defined as time at flight altitude. Observing time will be allocated in three categories.

Guaranteed — Instrument Development Teams will be allocated guaranteed time to commission their instruments, and in the case of the Facility Science Instruments additional guaranteed time will be awarded as a reward for their efforts in developing and delivering the FSIs. The amount of guaranteed time allocated this way will be described in the Announcement of Opportunity for science instruments and technology development for the SOFIA program. In addition, a special agreement has been reached with the developers of the German FIFI-LS instrument that will allow general US community access to this instrument in return for Guaranteed Time determined by a formula described in the agreement “A Plan for Implementing the FIFI-LS Extended Observing Opportunity Program, SOF-1089.” The Guaranteed time allocated to the First Generation Instruments is summarized in Table 1 (see policy 4). Guaranteed time will not be peer-reviewed by the annual Time Allocation peer review committee. Protection and use of guaranteed time is described in Policy 5.

Discretionary — Discretionary time will be allocated by the Director of the SOFIA Observatory. Data obtained during Director’s discretionary time will not be subject to the proprietary period and will be made public immediately. Discretionary Time will not be peer reviewed by the annual allocation peer review committee and shall consist of the following types of observations:

- i. Targets of opportunity not allocated by the annual peer review. These could be allocated by a special peer review set up by the Director.
- ii. Special projects that the Director feels are important for the good of the observatory, such as time that allows effective and efficient use of scheduling of the telescope.
- iii. Observations of potentially high scientific impact but which were considered too risky to propose through the TAC process.

The allocation of Directors Discretionary time will be reviewed annually as part of the activities of the SOFIA Science Advisory Council that reports to both NASA and the science mission contractor.

General Investigator (GI) — Observing projects that do not satisfy the criteria for inclusion in the Guaranteed or Discretionary times will be called General Investigations. This time will be evaluated by peer review, with the final selection to be made by the Science Center Director, who will provide a list of the selections to the SOFIA Project Scientist. Observing time proposals for General Investigator time can be submitted by anyone, including members of instrument development teams. Proposals for the US allocation of the GI observing time in the Shared Purpose and Full Operations periods will be solicited through an open solicitation (excepting any limitations on German proposers specified in the Joint SOFIA Program Plan) issued by the Science Center Director. The SC will be responsible for organizing and conducting scientific and

technical peer reviews of submitted proposals. The selection process for observational programs using the German observing time will be the responsibility of the DLR.

Non-science Engineering Time — In addition to the categories of science time covered above, there is a fourth category of SOFIA flight time that is devoted to aircraft maintenance and observatory engineering upgrades. This includes observatory calibration and validation. This flight time is outside the scope of these policies. Data obtained during engineering time will not be subject to a proprietary period but will be made public immediately.

POLICY 4

ALLOCATION OF OBSERVING TIME

The SOFIA science observing time in the Shared Purpose and Full Operations periods will be shared between the US and Germany at a ratio of 80/20 US to German. In addition to the science observing time, time will be required for observatory upgrades. In the Shared Purpose period, it is anticipated that about 1/3 to 1/2 of the available time will be required for observatory upgrades with the remainder available for science. In full operations, it is anticipated that about 20% of the available time will be required for aircraft maintenance and observatory upgrades.

Within the US time allocation, the science observing time during the Shared Purpose and Full Operations periods will be divided among the categories defined in Policy 3 as given in Table 1. Duplicate Observations (e.g., observations of the same target, using the same observing mode with similar sensitivity) will not be allocated without explicit approval by the Science Center Director.

Table 1

Category	Absolute/Fraction of Observing Time
Instrument Guaranteed	<p>HIPO (SSI): 15 hours within two years of instrument commissioning (not including commissioning time)</p> <p>FLITECAM (FSI): 25 hours within two years of instrument commissioning (not including commissioning time)</p> <p>FLITECAM (FSI) + HIPO (SSI) combined use: 25 hours within two years of instrument commissioning (not including commissioning time)</p> <p>FORCAST (FSI) and HAWC (FSI): 50 hours each within two years of instrument commissioning (not including commissioning time)</p> <p>CASIMIR (PSI), EXES (PSI): 30 hours each,, including instrument commissioning time</p> <p>SAFIRE (PSI) 30 hours, including instrument commissioning time. In addition, SAFIRE is to receive 15 hours on HAWC to be taken out of the Director's Discretionary Time.</p> <p>FIFI-LS (under the Extended Observing Opportunity Program): One hour to SI team for every 5 hours awarded to US observers under the EOOP. This guaranteed time shall not exceed 40 hours per year.</p>
Science Center Director's Discretionary	7% per year
General Investigator	Remaining fraction of US time

POLICY 5

PROTECTION AND USE OF GUARANTEED OBSERVING TIME

Instrument Groups allocated Guaranteed observing time under Policy 3 are entitled to some protection for their proposed observing programs so that they will, in fact, be able to obtain SOFIA data from such programs before Guest Investigators obtain similar data on the same targets. With this goal in mind, the following procedure for holders of guaranteed time will be in force.

Each holder of Guaranteed Time for the upcoming observing period shall submit one proposal three months prior to the release of the Announcement of Opportunity. This proposal shall describe the specific scientific programs on specific targets for the upcoming period. The details of the proposal submission, content, and format will be developed by the SC. The targets selected by Guaranteed Time holders will be protected and these observations cannot be duplicated by General Investigators. Only specific scientific programs on specific targets will be protected. There will be no protection rights for entire classes of objects (e.g., quasars), nor for broad scientific programs (e.g., morphological classification of galaxies in all observable clusters of galaxies). However, Guaranteed Time holders may propose to use a portion of their time for "targets-of-opportunity," such as supernovae, novae, comets, etc. The complete list of protected programs will be circulated, as part of the Call for Proposals for that observing period, with the instructions to astronomers who wish to submit GI proposals; if the specific programs in this protected list have not been carried out when the guaranteed time has lapsed or been used for other programs, prospective General Investigators may propose to make these observations in response to future Calls for Proposals.

Proprietary data from all approved investigations as detailed in Policy 6 will not be released for public affairs purposes without prior concurrence of both the selected observers and of appropriate NASA Program personnel, as dictated by applicable NASA public affairs policy. However, it is extremely important that selected observers be cognizant of the great public information potential of their SOFIA data and that they work closely with the SC public information office to try to meet the public's right to information without compromising the science. Recognizing NASA's legitimate need for science images and other results that are appropriate for public outreach and public affairs, during shared purpose observations the availability of data and results for public outreach and public affairs may be taken into account when scheduling the observatory.

POLICY 6

DISTRIBUTION OF DATA, DATA RIGHTS, AND ACCESS TO ARCHIVAL DATA

All raw SOFIA PSI and FSI science data and mission housekeeping data will be archived, as will a summary description of all the data taken from every instrument. The data from supported observing modes for an FSI will be pipeline reduced by the SC and stored in the SOFIA archive. Raw data from PSI or SSI instruments will be reduced by the observer, but only the raw data and the summary mentioned above will be archived.

All archive data obtained through peer review processes will be proprietary for a validation period of one year. During this time only the PI, GIs, CoIs, and accredited SC staff can access the data. If major changes are required in calibration or in data processing software, this one-year proprietary period may be extended by the Science Center Director, who will decide whether changes are of such a nature that an extension is warranted. The proprietary period can be extended by the Science Center Director if dictated by compelling scientific requirements (e.g., extended astronomical programs which require a total data set before any reasonable scientific use can be made of any part of this set, etc). Each such extension must be justified in detail to ensure the productive and timely use of SOFIA data and each such extension must be proposed. Extensions beyond two years should be granted only in the most compelling cases and must be approved in each instance by the Science Center Director after review by the SOFIA Science Council.

After the proprietary period, the archive pipeline reduced FSI data and the raw PSI data will be available for scientific archival research by any investigator.

Data obtained through non-peer review processes (e.g. Director's discretionary time, engineering time, calibration time/validation time) will not be subject to a proprietary period and will be made public immediately.

The content of the SOFIA archive will be a valuable scientific resource and will be widely and conveniently available on an international basis starting during the Shared Purpose phase. Proposals for support for Archival Research will be solicited by the SOFIA Science Center and evaluated by peer review. These solicitations will coincide with those for General Investigations. Archival researchers selected through this process will be supported as described in Policy 7. However, non-proprietary SOFIA archive data can also be requested by scientists or the public without an attached request for analysis funding. Such requests must be honored without peer review.

POLICY 7

FUNDING OF DATA ANALYSIS

The SOFIA Project will provide funds to support the acquisition, calibration, analysis, and publication of SOFIA data by all categories of observers and archival researchers. In accordance with current NASA policy, this funding can be provided to US institutions only.

POLICY 8

DEPLOYMENTS

During the Full Operations phase, as a rule, a deployment will be scheduled to occur each year. The SOFIA Program will maintain a main deployment site in the Southern Hemisphere in a state such that it can efficiently support six weeks of operations. During this deployment, multiple flight series will be conducted using a variety of science instruments. In addition, SOFIA can be deployed to sites other than the Southern Hemisphere site for single-science instrument missions. Proposals for observing time during the Southern Hemisphere and single instrument deployments will be subject to the normal technical and peer review process.

POLICY 9

INSTRUMENT AND TECHNOLOGY DEVELOPMENT

New instrumentation and upgrades to existing Science Instruments are an important aspect of the SOFIA program. NASA Headquarters will be responsible for issuing Announcements of Opportunity for SOFIA Science Instrument and Technology Development and for organizing the technical and peer review process and selection. NASA Headquarters will also be responsible for selecting the funding vehicle and the organization responsible for oversight of Instrument and Technology Development. Since science should be the main driver of the Instrument and Technology Development, and in order to provide guidance to the Instrument and Technology Development program, the Science Center Director shall regularly organize a SOFIA Instrument and Technology workshop that will summarize the scientific priorities in this area and make those available to the NASA Program Scientist and the SOFIA Project Scientist.

Since science should be the major factor in a decision to remove SOFIA Facility-class Science Instruments, the following criteria, in order of precedence, will guide such decisions:

1. Unacceptably low scientific productivity
2. Restructuring of scientific priorities as defined by the NASA Strategic Plan.

Note: A FSI might be removed temporarily with the possibility of reflight in future observing periods for upgrades or to give other SI more flight opportunities. The Science Center Director shall report and make recommendations to the SMD Astrophysics Director on the status of each SOFIA FSI in his annual report or more frequently, as necessary. The SMD Astrophysics Director shall have final authority to decide on retirement or replacement of any SOFIA FSI.

POLICY 10

NASA NEEDS FOR SUPPORT OF OTHER MISSIONS

Under special circumstances, SOFIA observations of a particular target may be required to support another NASA program. All such requests must originate in the appropriate program office and require the approval of the SMD Astrophysics Director after consultation with the Science Center Director and the SOFIA Project Scientist. The requested observations shall be given special priority by the SC but be scheduled to minimize the impact on other observing programs. SOFIA time spent on such observations will not count against any time awarded to a SOFIA investigator, unless the SOFIA investigator was also planning on making these observations as part of a selected observing program, as described below.

If such observations of a particular target have already been included within an approved observing program, the observations will be developed in coordination with both the SOFIA observers and with the other NASA program team. The data will be made available simultaneously for use by both the other NASA program and by the approved SOFIA observers. Publication rights will be limited to the approved SOFIA observers alone.