# SOFIA Observation Scheduling and Flight Planning

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## 1 Introduction

SOFIA is an airborne observatory in which the telescope looks out of the port side of the aircraft. Thus, the azimuth of the object to be observed dictates the aircraft heading. Because the aircraft is moving, the observatory's longitude and latitude are changing constantly, unlike on ground-based observatories. After an observing night, SOFIA normally needs to return to the airport it started from since that is where services and support are located and the crew is stationed. These characteristics of SOFIA make scheduling of observations different from any other observatory.

This White Paper explains the flight planning process, from proposals over the yearly planning to the weather update for each flight plan. While scheduling and flight planning will be handled by the SOFIA SMO[1] staff, an understanding of the process and the restrictions inherent to airborne astronomy is useful to prospective proposers.

Before going into flight planning, the next section covers the peculiarities of airborne astronomy. Section 3 explains how SOFIA determines when to fly each instrument during the year/cycle. The scheduling of observations or flight planning is detailed in Sect. 4. That section also contains the timeline for the flight planning activities. This paper concludes with some general remarks on how the provided information is useful for observers.

# 2 Peculiarities of Airborne Observing

There are several peculiarities for scheduling observations arising from the fact that an observing plan for SOFIA translates into a flight plan. In addition to the need to return to the base after an observing flight, the flight plan also needs to avoid restricted air spaces. Another aeronautical issue, altitude, is linked to an important observational parameter. SOFIA is an airborne telescope in order to allow observations above most of the water vapor, i.e. above the tropopause. However, since the altitude of the tropopause changes geographically and with the seasons and as SOFIA climbs in altitude throughout a flight, the absorption due to the remaining amount of water vapor above SOFIA is constantly changing.

## 2.1 Heading Balance and Restrictions

Scheduling observations and creating an observing flight plan for SOFIA are one and the same thing as the targets dictate the aircraft heading. One of the main requirements for a flight plan is that SOFIA normally has to return to its base after an observing flight. The only exception may be when on deployment and during the ferry flight to or from the deployment location if used as an observing flight.

It is helpful to picture the observing legs as (slightly curved) vectors. The sum of all these vectors needs to be close to zero for each observing night. That means that the azimuths of the targets in one observing flight have to be selected from all directions

[1]SOFIA SMO – SOFIA Science Mission Operation

leading to a balanced heading distribution, guiding SOFIA back home at the end of the night.

Restricted airspaces pose additional problems. SOFIA cannot enter Mexican airspace, many Special Use Airspaces (SUAs, several large SUA exist around Palmdale), or costal warning areas. Figure 1 shows and explains SUAs, while the coastal warning areas appear only in the south-west corner of that map. The whole west coast has off-coast warning areas with only a few corridors to fly through. Canadian Airspace is accessible with at least four months advance notification. These access restrictions translate directly into observing restrictions. For example, it is not possible to observe a target in the north-east at the beginning of a flight as a south-east heading would take SOFIA into Mexican airspace, or a target in the south-west at the end of flight as a north-west course towards Palmdale would require SOFIA to be flying out of Mexican airspace. The costal warning areas usually force a flight to be either entirely over land or out over the Pacific. This results in SOFIA observing southern sources, e.g., the inner Galaxy, either mostly in the first half of the night over the Pacific at lower altitudes or in the second half of the night over land at higher altitudes.

## 2.2 Absorption by Water Vapor and the Altitude Profile

SOFIA is designed as an airborne observatory in order to conduct observations above most of the atmospheric water vapor, i.e. above the tropopause, since water vapor is an efficient absorber of infrared radiation. However, the altitude of the tropopause is not stable, changing both geographically and with the seasons. Furthermore, the altitude attainable is limited by SOFIA's total weight, which diminishes as fuel gets burned. A typical flight profile using conservative estimates follows a tiered profile:

- 35,000′ 30 min after take-off for a 10 hour flight,
- 39,000′ 8 hours before landing,
- 41,000′ 6 hours before landing, and
- 43,000′ 4 hours before landing.

Due to restrictions on how long a duty day can be for the flight and mission crew, the maximum flight length is 10 hours unless extra crew comes along. A flight can be shorter to allow SOFIA to climb to a higher initial altitude, if the science warrants it. Note that science observations start about 1 hour after take-off and end 30min before landing with the start of the descent. An altitude of 45,000′ can be reached 90 min before landing, but SOFIA does not climb that high routinely.

A higher altitude means less absorption by water vapor. Thus, it is desirable to always climb to an higher altitude as it becomes attainable to get less absorption. However, the change in absorption needs to be calibrated. Most instruments require an observation

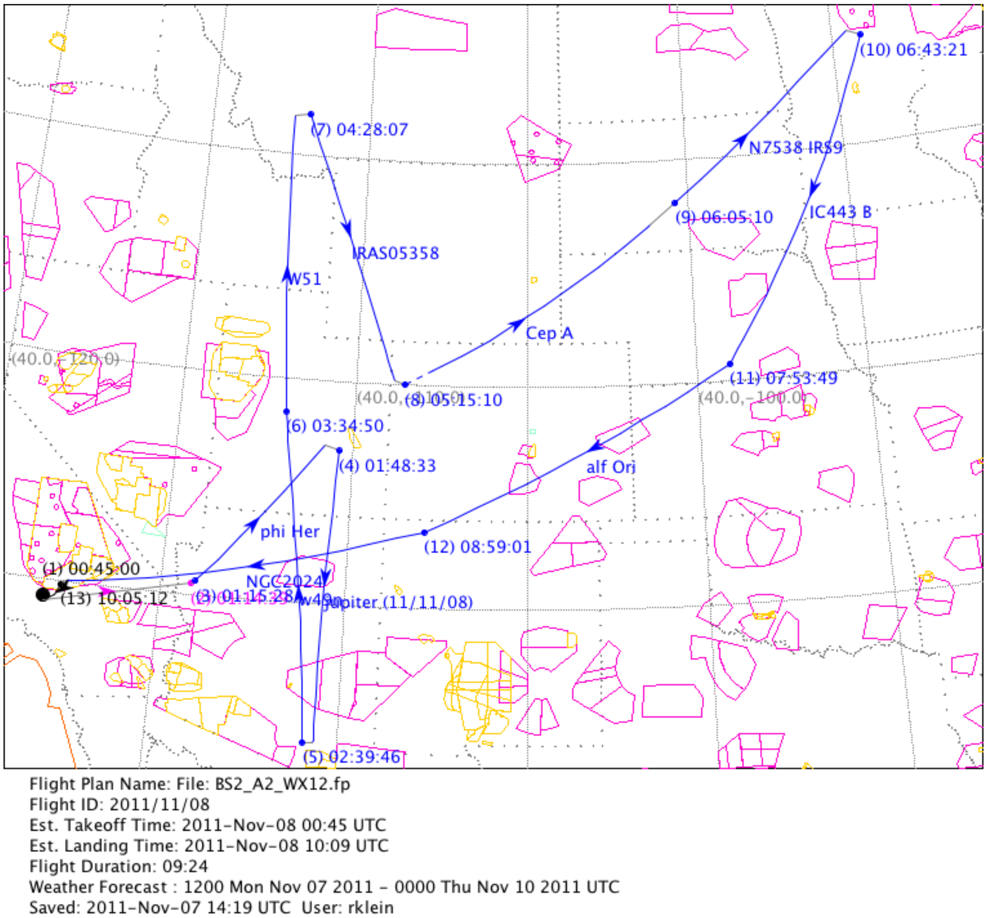


Figure 1: Example flight plan: This flight plan was flown on the night Nov 7/8, 2011. Blue lines are the observing legs with target names next to them. Black solid lines are "dead legs". Each turn has the leg number followed by the leg start time in UT. The yellow areas are restricted airspaces, most of which SOFIA may not enter. A notable exception is the large airspace in southern California belonging to the Edwards Air Force Base. The pink areas are other special use areas that SOFIA can overfly, with the exception of the larger ones located in Nevada. The orange line off the coast of California and Mexico indicates the forbidden coastal warning areas.

of a standard star for flux calibration at each flight altitude. A water vapor monitor, as yet uncommissioned, will report the changes in water vapor, thus alleviating the need for calibration at every flight altitude once the water vapor monitor has been fully commissioned and calibrated with each instrument.

## 2.3 Field Rotation and LOS Rewinds

The SOFIA telescope is essentially an alt-az[2]-mounted telescope, which means that the sky rotates in the field-of-view (FOV) of the telescope while tracking a celestial object. But there is an important difference to ground-based alt-az-mounted telescopes. Due to its spherical bearing, the SOFIA telescope can move freely in all three axes. This allows the telescope to be inertially stabilized so that it can move like an equatorial mounted telescope, i.e. the sky does not rotate in the FOV because the telescope rotates around the line-of-sight (LOS) axis. However, movement in the cross-elevation and LOS axes is restricted to $\pm 3^\circ$ (see Fig. 2). In practice, soft limits are generally placed at $\pm 1.5^\circ$ in order to accommodate aircraft motion arising from cross-winds, turbulence, and fine-scale course correction. For very fast rotators, the soft limit may be extended to $\pm 2^\circ$. When the LOS rotation reaches the limit, the observation has to be paused for the telescope to perform an LOS-rewind, during which it rotates back around the LOS axis towards the other side of the limit. After the LOS-rewind the position angle (PA) of the telescope's FOV has changed by the amount of the rewind. Effectively, the continuous field rotation of an alt-az-mounted telescope is "quantized" by the SOFIA telescope.

The frequency of LOS-rewinds and the PA of the telescope's FOV might play a role in planning observations, especially for slit spectroscopy. The frequency of LOS-rewinds depends on the target's location in the sky and the location of the aircraft. Southern targets tend to have low rotation rates[3] as the normal low rotation rate is further reduced by flying west, effectively slowing down local sidereal time (LST). However, targets to the north can have rotation rates of $0.5^\circ/\mathrm{min}$ and more, requiring an LOS rewind about every 5 min. The range of the rotation rate can be estimated for an observation, if necessary, but the exact rotation rate will only be known after the detailed flight planning. For the flight-planning timeline see Sect. 4.2. Similarly, the possible PAs of the telescopes's FOV can be estimated for any target, but the actual PA will only be known after detailed flight planning. *Note that neither the telescope nor most SOFIA instruments have a beam rotator to choose the instrument's focal plane position angle on the sky.* Thus, requesting a range of PAs for the telescope's FOV (which is possible) is like requesting a time constraint. The smaller the range and the faster the rotation, the harder it is to satisfy such a requirement.

[2]The term *altitude* can refer to two quantities. Within SOFIA it usually refers to the flight altitude while we use *elevation* to refer to the angular distance above the horizon. However, in *alt-az*, short for *altitude-azimuth*, *altitude* refers to the angular distance above the horizon.

[3]*Rotation rate* means here the rate of change of the PA of the telescope's FOV or equivalently the rate of change of the target's parallactic angle.

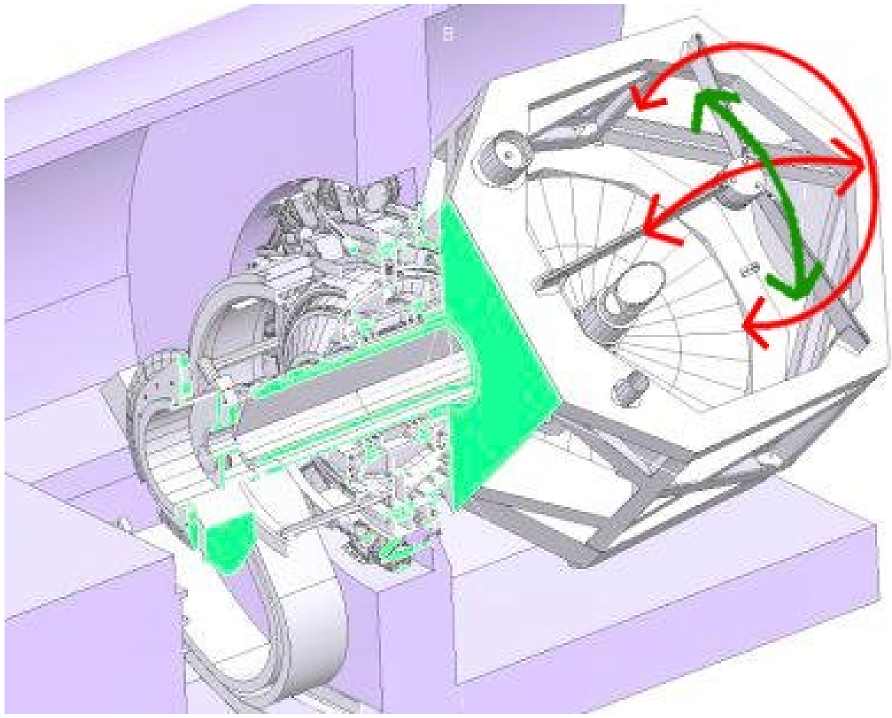

Figure 2: Cut-away view of the SOFIA telescope: The arrows show the three degrees of freedom of the telescope mount. The green and red arrows show the elevation and cross-elevation movement, respectively. The red circular arrow indicates the rotation around the line-of-sight. Actually, all rotations are around the center of the spherical bearing not around the telescope where the arrows are. The movements along the red arrows are limited to $\pm 3^\circ$. In practice, this movement is generally constrained to $\pm 1.5^\circ$ ($\pm 2^\circ$ for fast rotators) in order to prevent the telescope from hitting a limit due to slight heading changes and turbulence.

## 2.4 Elevation and other Operational Constraints

The un-vigneted elevation range of the telescope is from about $20^\circ$ to $60^\circ$. The exact range is slightly different for the head ring cameras[4] and the telescope itself. For observation scheduling purposes, the $60^\circ$ upper limit is a severe limitation as targets culminating above $60^\circ$ are inaccessible for several hours around their culmination. If a target culminates just above $60^\circ$, directing SOFIA to a higher or lower latitude helps significantly to increase the target's observability. However, observing a target that culminates above $70^\circ$ is difficult because the roughly 11 hours that the target spends above $20^\circ$ are split into two observing windows of only 3 hours. One of these windows may not or may only be partially available depending on when the target culminates during

[4]These are wide-field and the fine-field imagers, which are used for acquisition and guiding.

the night.

SOFIA is limited to observe during the night despite the far-infrared sky being about equally bright day or night. This is, in part, because SOFIA uses optical cameras for target acquisition and guiding, but also to avoid getting direct sunlight on the primary mirror, which might focus the sunlight at an unwanted spot on the fuselage.

Note that though SOFIA can take off before sunset, the telescope door can only be opened after the sun has set as viewed from the aircraft, which can be as much as 20 minutes later at 35,000 feet than sunset at sea level. After the telescope door has opened, the telescope gets initialized, calibrating its three axes on a star field. The initialization process can take up to 30 min and requires three moderately bright stars within the $5^\circ$ FOV of the wide-field imager.

During the early stages of development, there were a couple of instances in which the cavity door did not close, requiring that SOFIA land with the door open. Consequently, SOFIA is required to land 15 min before sunrise to ensure that there is time to land and taxi to the hanger before the sun rises, risking the exposure of the primary mirror to direct sunlight. As SOFIA matures and one can be sure that the door always closes, this restriction may be lifted.

# 3 The Cycle Schedule

Useful nomenclature:

**Science Flights –** Individual flights primarily devoted to obtaining astronomical science data.

**Science Flight Series –** Contiguous series of science flights, all with the same instrument.

**Science Flight Campaigns –** One or more Science Flight Series, beginning and ending with a non-science, engineering activity.

**Science Observing Cycles –** One or more of Flight Campaigns that are covered by a single science Call for Proposals.

## 3.1 The Proposal Selection

SOFIA uses a year-long cycle usually coinciding with the calendar year. The proposal call will normally be released in spring with a deadline in summer. After all observing proposals have been received, the Time Allocation Committee (TAC) meets to review the proposals. Based on the ranking, the observatory director assigns each proposal to one of three pools descriptively named “Must-do”, “Do-if-time”, and “Don’t-do”, aka declined proposals.

This section explains how the selected observations get scheduled, but from the above explanations it should already be clear that the scheduling is an interconnected problem. It is not possible to just schedule the top ranked proposals that are visible each month or so. That would be too stringent and would drive down the observing efficiency because the flight plans would be too inefficient. Disregarding the proposal ranking and allowing all proposals to be scheduled would allow very efficient flight plans and more observing hours, but the quality of the science would decline.

A trade-off between a large target pool and enforcing the proposal ranking needs to be achieved. The "Must-do" pool of targets must be smaller than the total available observing time. The "Must-do" and the "Do-if-time" target pools together should result in an *overallocation* of the available time, so that the Flight Planners have the flexibility to make the flight plans efficient.

The best of both worlds are proposals with a large target list from which the Flight Planners can select in order to optimize the flight plan efficiency. Survey proposals are just that. These programs should identify a large sample of targets and observations with a common scientific justification. The intent is that at least a minimal fraction of the targets, as defined in the proposal, in a given survey program will be observed. The Flight Planners are free to select targets from the sample as needed to make efficient flight plans.

Optimally, the total time awarded to all proposals should exceed the available time in the cycle by about one third, because a larger pool of observations will allow for more efficient observing schedules. About the same amount of time should be awarded to the "Must-do" and the "Do-if-time" proposals. This means that the "Must-do" proposals will fill about two thirds of the available time in the cycle, whereas only half of the time allocated for "Do-if-time" proposals will be utilized. Survey proposals should get ranked just like other proposals. If a survey proposal is selected as "Must-do", the minimal fraction gets scheduled. If it is selected as "Do-if-time", the minimal fraction is not guaranteed just as the completion of "Do-if-time" proposals are not guaranteed. If a survey has its minimal fraction scheduled, the remaining targets rank even below "Do-if-time" targets. That does not mean that these remaining targets never get scheduled. They only get scheduled if they are in a region of the sky where no non-survey targets are available.

## 3.2 Science Flight Series

The start and end dates of a Science Observing Cycle are fixed. The Science Flight Campaigns are mostly constrained by the aircraft maintenance and development schedules. Once the Science Flight Campaigns have been established, the Science Flight Series are defined. Generally there is only one instrument mounted to the telescope at any given time. Currently, the only exception is the HIPO and FLITECAM combination called FLIPO. Instrument changes take several days. The goal is to minimize down time due to instrument swaps while optimizing the ability to schedule the accepted observations for each instrument.

The Cycle Scheduler software tool, supports the planning of Science Flight Series including the determination of when to deploy to Christchurch, New Zealand, for a Southern Hemisphere campaign and with which instrument. The Cycle Scheduler randomly assigns instruments to the Campaigns, attempting to minimize the number of instrument changes during each. Each assignment gets evaluated for the heading balance on each flight, the availability of targets through the night, and the proposal ranking of all scheduled targets. The first two criteria ensure that the targets assigned to a flight can be combined to a flight plan. When necessary, the Cycle Scheduler also accounts for time constraints like occultations or observing constraints.

The Cycle Scheduler is used iteratively. The search is tried with different parameters to understand the resulting instrument schedule and to synthesize an instrument schedule satisfying all operational and programmatic constraints and priorities. At the start of the cycle the instrument schedule gets fixed and is not expected to change during the cycle. Targets of Opportunity, etc., can force a change.

By creating the instrument schedule, the Cycle Scheduler also creates a *de facto* observing schedule. These assignments are taken as the starting point for the detailed flight planning (Sect. 4). As planning commences, they will evolve, since the Cycle Scheduler does not create flight plans, but only an heuristic estimate for each flight's efficiency. Hence, it is unlikely for the dates originally assigned to an individual observation by the Cycle Scheduler to be maintained through the flight planning unless a target's visibility is confined to one series and it is a "Must-do" target.

# 4 Detailed Flight Planning

Detailed flight planning of an observation sequence and of the flight plans for a Flight Series starts about two and a half months before the beginning of a Flight Series. Section 4.2 details the timeline of the process, while the next section (4.1) describes the construction and editing of a series of flight plans.

## 4.1 A Jigsaw Puzzle with Changing Tiles

Creating flight plans for a Flight Series is like a jigsaw puzzle. Each observation, characterized by the target coordinates and the duration, corresponds to a ground track on the map. One can imagine these tracks as puzzle pieces. Their length is set by the duration. The exact shape and orientation depends on the time of the observation and the location of the aircraft. A flight plan is constructed by stringing these puzzle pieces/tracks together. The goal is to lead the aircraft back to the airport after a 10 hour flight. But beware, the puzzle pieces change their shape. Mostly the heading direction changes with time and position. Additionally, the curvature of the track changes over time. The availability of each puzzle piece/target also depends on time and location. There is no "correct solution" to the puzzle, but the Flight Planner has to find a solution that tries to maximize the observing efficiency while respecting the proposal ranking.

The challenge of flight planning a Flight Series is to take all the puzzle pieces that could be observable during a Flight Series and assign them to flights in the series and arrange them in an order that results in flyable flight plans that lead back to the origin. The assignments generated by the Cycle Scheduler are a good starting point, but to achieve a high efficiency throughout the series, highly ranked targets may need to be moved between flights and "Do-if-time" targets may get switched in and out. This is why the Cycle Scheduler assignments, which exist already at the beginning a cycle, are poor indicators of when or whether an observation is actually carried out.

Observations are defined by the observers through Astronomical Observing Requests (AORs). Often there are multiple short AORs for one object or a small region,[5] especially with the instruments for which one AOR is needed per filter set. For flight planning purposes, AORs from one proposal targeting the same area are combined into Observing Blocks. These Observing Blocks might be several hours long either because of the combination of AORs as mentioned above or simply because a long integration time is requested. However, SOFIA cannot stay on a single object for more than a few hours in most situations. If an Observing Block is long it may be split into several legs distributed over several flights. Long observations of targets that rise above $60^\circ$ also have been split into two legs and observed on one flight, the first leg while the target rises and the second while it sets. To prevent Flight Planners from splitting an observation into legs that are too short, observers can specify minimum leg duration per AOR. Note that legs shorter than one hour are not usually split. Specifying a minimum leg duration longer than half of the total AOR duration effectively disallows splitting. (See also Fig. 3 and Sect. 6.)

To make the puzzle pieces fit, the Flight Planners may also take the liberty to adjust the observing leg durations. Modifications to the duration of observing legs are inevitable once the weather updates are made (see 4.2), often resulting in changes to leg duration of $\pm 5$ min. But also, during the initial detailed flight planning, deviations of up to $\pm 20\%$ of the requested time may be required to ensure a high efficiency of the flight plans and fair scheduling during a Flight Series. Larger deviations have been necessary but are discouraged and need special approval from the Observatory Director.

## 4.2 Timeline

At least five different groups are involved in preparing a Flight Series. These include the Flight Planners, the Observatory Director, Science Operations (SciOps), Mission Operations (MOPS), and the Flight Crew, each with a different responsibility and focus.

[5] A small region here means about $1^\circ$ in size. SOFIA can fly a steady heading while moving the telescope around in that small area.

The flight plans have to be coordinated with and reviewed by each of these parties. A timeline has been established so that all parties can integrate the reviews into their schedules. Below, the generic timeline is laid out. The timeline is referenced to the day of the first flight of a series, denoted "**T**".

### The Flight Planning Timeline

**T-2 1/2 months (10 weeks):** Flight Series planning starts. The instrument schedule and flight dates are fixed. The observation details are in the SOFIA Data Cycle System (DCS) as AORs.

**T-10wk to T-8wk:** Flight Planners lay out detailed flight plans for the series.

**T-8wk to T-7wk:** The Observatory Director reviews the Flight Series plan to ensure that the TAC recommendations are met.

**T-7 weeks:** The Observatory Director approves the "Initial Series Plan" and it is released to SciOps, MOPS, and the Flight Crew.
The Initial Series Plan contains flight plans with detailed science observations for all flights in the series. While it is released to everyone, this release is primarily for a review by SciOps.

**T-7wk to T-5wk:** SciOps reviews the Initial Series Plan to ensure that it meets instrument constraints and fulfills target and calibrator requirements.

**T-5 weeks:** SciOps review completed.

**T-5wk to T-4wk:** Flight Planners update the Initial Series Plan with SciOps feedback.

**T-4 weeks:** The "Post-Science Series Plan" approved by SciOps is released.
The Post-Science Series Plan includes the instruments, science targets, and calibrators for the flight series set. It cannot be changed after this time.
This package, already approved by SciOps, will be reviewed by MOPS for flight and schedule constraints, etc.

**T-4wk to T-3wk:** MOPS reviews the Series Plan. MOPS together with SciOps start detailed preparations for the observing flights.

**T-3 weeks:** MOPS review completed.

**T-3wk to T-2wk:** Flight Planners update the Post-Science Series Plan with MOPS feedback.

**T-2 weeks:** The "Post-MOPS Series Plan" approved by MOPS is released. The Post-MOPS Series Plan includes the finalized flight dates. Any Canadian overflight or other international airspace entries are defined and cannot change after this time.

**T-2wk to T-1wk:** Schedule reserve.

During the first 9 of the 10 weeks leading up to the Science Flight Series, the individual flights plans in the entire Flight Series Plan were worked on simultaneously. During the final week, however, the flight plans are prepared individually. The take-off time for each flight is now denoted with a "**t**".

**t-7 days:** The "Initial Flight Plan" is released, and it is delivered to the Flight Crew. The Initial Flight Plan has set-up targets defined and cannot be changed after this time. The only changes allowed after the Initial Flight Plan is released are in response to the weather forecast or to unforeseen flight constraints.

**t-7d to t-3d:** Flight Crew reviews the Initial Flight Plan and works with Flight Planners to make adjustments.

**t-36h:** The weather forecast for the flight day becomes available. Flight Planners update the Initial Flight Plan accordingly.
The "36hWX Flight Plan" is released. Flight Planners deliver the 36hWX Flight Plan to the Flight Crew using the weather forecast from 12:00 UT (04:00 PST) of the day before the flight. The 36hWX Flight Plan has all flight legs defined, and sets the day-of-flight schedule. Only changes due to an updated weather forecast are allowed after this time.

**t-12h:** The "12hWX Flight Plan" is released. This flight plan is updated using the weather forecast from 12:00 UT (04:00 PST) on the day of the flight. It will be filed by the Flight Crew with air traffic control and then flown accordingly.

The Flight Planning Timeline may look long and drawn out. One might think that such a long lead time for planning makes SOFIA an inflexible observatory. On the contrary, the relative long planning timeline ensures good resource management and that SOFIA is well prepared to execute normal operations. Thus, when the need arises to respond to unforeseen events like Targets of Opportunity, weather or other operational requirements, SOFIA has the resources available and is prepared to do so.

# 5 In-flight Re-plans

In-flight, the Flight Planner supports the Mission Director and the Flight Deck to stay on the flight plan. The Flight Planner monitors the position of SOFIA relative to the planned position during the flight. He or she is supported by software that updates the remaining portion of the flight plan from the current location and time. The effect of being a couple minutes early or late on flight legs accumulates over the remainder of the flight and becomes apparent through the predicted track. In coordination with the Flight Deck, the Flight Planner advises the Mission Director on the remaining time on the current leg, including the possibility of extending or shortening flight legs to correct any spatial or temporal deviation from the plan. The margins are 10 to 20 nautical miles off track depending on air trafic control and a couple of minutes mismatch in time.

The Flight Planner will conduct more extensive re-planning in-flight, when a situation makes it impossible to continue the original plan. Such events may include being rerouted by air traffic control, bypassing storms, or attempting to recoup the loss of science due to a brief, unforeseen observatory failure on an absolutely required leg. The Flight Planner and the Mission Director will then coordinate with the Science Team to determine which changes are necessary and which legs can be kept. The relative priorities for each leg within a flight are marked up in the flight plan beforehand to help with such the decisions. The goal is usually to retain as much of the original flight plan as possible, because this is what the Science Team and the Telescope Operators have prepared for. It is not possible to add completely new observations to replace legs in the original flight plan. The Flight Planner edits the flight plan accordingly and communicates it to the Flight Deck. Then the pilots request permission to deviate from the original flight plan and communicate the new waypoints to air traffic control. If the request for the new route is granted, the re-plan can be executed.

# 6 Concluding Remarks

While it is certainly interesting for SOFIA users to learn how observations are scheduled and flights are planned, one may ask if there a benefit for the user? Yes, there is. Flight planning starts with the proposals, as they provide the Flight Planners with the "puzzle pieces". A constant challenge in flight planning is to balance the headings during a flight so that SOFIA can return to the home base. For obvious reasons the inner Galaxy is a region for which a lot of observing time is requested. Depending on the time of the year this requires observing legs flying south-west, west, or north-west, but never east. Consequently, Flight Planners often need targets that take SOFIA eastwards. Targets north of $45°$ and visible while the inner Galaxy is observable are very helpful. Such targets from "Must-do" proposals have a good chance of getting even more time than requested. Such targets from "Do-if-time" proposal are likely to be observed whereas "Do-if-time" targets in oversubscribed regions likely won't. Similarly in the winter, Orion is likely to be oversubscribed.

The connection between AORs and flight legs and the possibility of splitting into shorter observing segments were discussed in Section 4.1. Figure 3 shows the distribution of leg durations during the Basic Science phase in 2011. While the distribution of the shorter leg durations (less than $\sim 1.5\,\mathrm{h}$) was determined by the distribution of such requests, the distribution of the longer legs was determined by the necessity for SOFIA to make a turn. The distribution shows that legs longer than 2hrs are possible but very rare. There were not many requests for such long legs, but it is also very likely for such long observing requests to be split up into several legs.

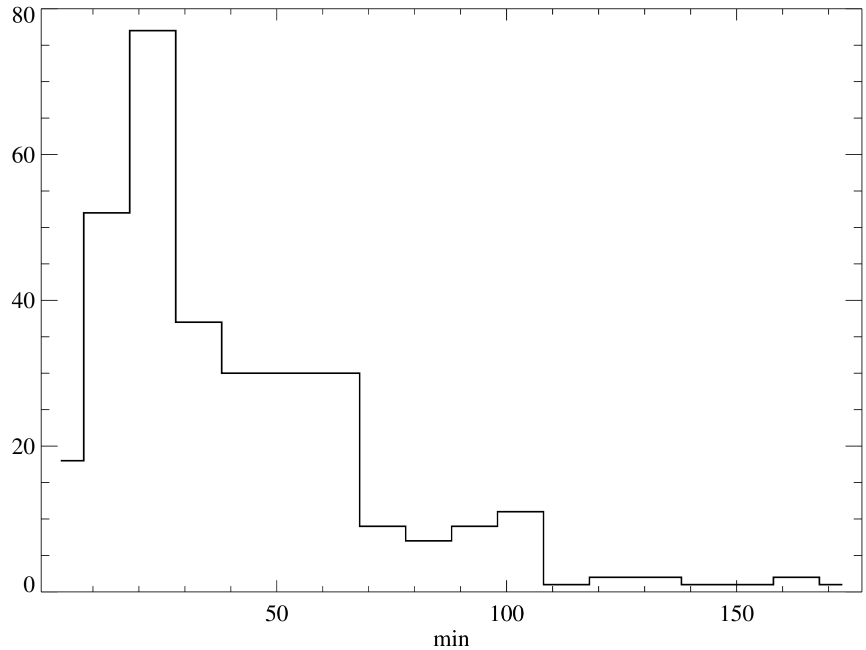


Figure 3: Distribution of leg durations during Early Science (2010)

Scheduling observations or flight planning is a unique problem for SOFIA as an airborne observatory. A well distributed source pool is key for efficient flight plans. A good preparation is key to efficient operations. SOFIA tries to achieve both by using the policies and procedures detailed in this paper.