

# SOFIA's Vision for the Future

Harold Yorke  
Director, SOFIA  
Science Mission Operations

September 4, 2019

Astronomy Picture of the Day: 19 June 2019

NASA, SOFIA, Hubble



# Disclaimer

---

The content of this presentation is based on Harold Yorke's view of the SOFIA world. It has not been endorsed by NASA. Some of the ideas presented here will require NASA concurrence.

I apologize in advance for any inaccuracies in this interim report.

# SOFIA's Recent Reviews

- At the end of FY18, the Senior Review efforts concluded and transitioned into two major program reviews:
  1. **SOMER** (SOFIA Operations and Maintenance Efficiency Review)
  2. **FMR** (SOFIA 5-Year Flagship Mission Review); USRA was tasked by NASA to lead the FMR Proposal
- SOMER submitted report to NASA-HQ in February; SOFIA program received summary on April 23
- After FMR proposal submission March 22, SOFIA program responded to 50+ RFIs from FMR panel; SMO\* Director briefed FMR panel on SOFIA instrumentation
- FMR panel conducted site visit at SOFIA Science Center on April 24-26. It included interviews with USRA personnel across most functional areas.
- FMR Panel oral debrief May 31. Final written FMR report received June 7.
- **The SOFIA Program is now undergoing an OIG review (August 20-21 kick-off)**

\*SMO = *Science Missions Operations (USRA prime contractor)*

# SOMER Executive Summary

---

Based upon an analysis of identified issues, the SOMER has made specific recommendations for improvement in three major areas:

- Management
- Operations
- Workforce

Recommendations that might effect science in **RED**

# SOMER Executive Summary: Management

---

1. Transition SOFIA aircraft operations away from an integrated astrophysics program into an existing independent aircraft management model – such as SMD’s Airborne Science Program (ASP) – in order to leverage aircraft operations expertise.
2. Consider issuing a Request for Information (RFI) on the feasibility of a Government-Owned Contractor-Operated (GOCO) mode of operations.
3. Re-establish firm operational metrics and regularly measure SOFIA performance against them.

# SOMER Executive Summary: Operations

4. Reduce flight profiles to 8 hour flights, improving safety posture, dispatch rate, scheduling flexibility and increasing the percentage of aircraft time at high-value altitudes.
5. Schedule 6 flights per week, which would directly correlate to an increased number of total flights per year.
6. Adjust aircrew mission briefing, pre-flight, and post-flight duty periods to shorten the overall crew duty day, improving crew turn-around times and maximizing maintenance touch-time.
7. Manage the number of instrument changes to allow for more aggressive aircraft scheduling.
8. Dedicate assigned aircrew to a primary SOFIA role (limit to two total aircraft qualifications of similar category on a not-to-interfere basis) which would decrease scheduling complexity and reduce the overall pilot training requirements, both in time and cost.
9. Incorporate exchange aircrew support from DLR to improve operational diversity and add unique experience/thought processes.

# SOMER Executive Summary: Workforce

---

10. Reduce/reassign full-time O&M workforce in specified areas (such as engineering, inspection, technicians, flight safety and aircrew) decreasing extraneous program costs.

# NASA HQ Response to SOMER Recommendations

---

- Based on SOMER Recommendations...
- NASA HQ directed a transition from a single integrated program into three separate projects (platform, science, new instrumentation)
  - Platform Project to be run by SMD's Airborne Science Program (ASP) out of NASA Armstrong
  - Science Project to be run out of NASA Ames
  - New Instrumentation Project to be run out of NASA Ames (HIRMES)



# The FMR Panel endorsed in the FMR proposal...



- SOFIA's science vision
- SOFIA's staff: "professional, dedicated, enthusiastic, motivated, talented, cohesive"
- SMO's growing emphasis on large programs and Legacy Programs
- SMO's plan to extend Southern Hemisphere deployments
- SMO's plan to make data pipelines public
- SMO's plan to streamline operations by automation
- SMO's plan to reduce the number of instruments and instrument modes offered in a Cycle
- SMO's plan to explore joint calls for proposals with selected partner observatories to increase scientific impact

# The FMR Executive Summary

- “Bold vision and transformative change are needed to take SOFIA to the next level and strengthen its role as a general-purpose flagship-class observatory that takes full advantage of its observational capabilities.”
- “More science would result by focusing efforts on extracting the latent science potential of existing instruments and developing data archive tools than from development of new instruments beyond those already underway (e.g., HIRMES).”

# FMR Recommendations

1. Nurture a science-driven culture within the mission.
2. Embrace change. Identify and implement operational approaches that relieve staff stress, simplify operations, promote innovation, and increase science return.
3. Emphasize completion of high priority science programs.
4. Emphasize collection of high quality data to increase scientific productivity and simplify post-observation data processing.
5. Maximize observing time at stratospheric altitudes (typically above 40,000 feet) to get above water vapor and exploit SOFIA's unique observational capabilities.
6. Fly more southern hemisphere flights to increase scientific productivity.
7. Transfer data products into the archive quickly and engage users in quality assessments.
8. Adopt the SOMER recommendation to split aircraft operations from telescope/science operations
9. Invoke HIRMES cost and schedule control (now), and complete it in a timely manner, or else cancel it.
10. Focus on science with current instruments (and HIRMES, if developed), not on post-HIRMES instrument development.

# SMO Post-FMR Plans

*The SMO has carefully considered the FMR report and embraces the spirit of its recommendations.*

*The SMO is eager to work with NASA and drive the needed changes to improve scientific output and impact and increase operational efficiencies via automation.*

- The Project leadership (NASA and the SMO) conduct weekly strategic meetings (since June) to prepare a plan to address and implement the FMR recommendations.
- The SMO is leading this effort. Tiger Teams formed to define/implement initiatives.
- Some initiatives are contingent on the FY20 and outyear budgets and concurrence from the NASA Ames Center leadership.
- Many initiatives, however, will be implemented immediately with the goal of completing the full implementation by the end of 2019 Calendar Year
- The SMO is undergoing a reorganization; new roles and responsibilities for senior staff

# SOFIA Science Goals (adapted from FMR proposal)

- **Birth of Stars and Planets:** Determine the role of magnetic fields, radiation, and turbulence in star and planet formation.
- **Origins of Life:** Investigate the cosmic synthesis of molecules and solid particles in protoplanetary disks and star-forming cores necessary to create and sustain life.
- **Physics of the Distant Universe:** Calibrate high-redshift galaxies by detailed examination of nearby analogs.
- **Evolution of Planetary Systems:** Infer the physical sizes, atmospheric structures, and chemical compositions of planets, comets, and asteroids.

# FY20-24 Operational Initiatives

Id	Fy20-21 Key Initiatives *Contingent upon increased budget	FMR #	Complete
A	Hire staff scientists: Guarantee 75/25 project support/research time*	1,2,6,7	FY20-21
B	Hire 3-4 Post-Docs: To increase research activities within SMO*	1,2	FY20
C	Implement Archival Research Program complementary to ADAP	3	FY20-22
D	Optimize Proposal Selection: legacy vs regular programs	1,3,4,6,10	FY20
E	Collaboration with Other Observatories: Joint Calls for Proposals	2	FY20-22
F	GO Communication: Track project progress and provide SMO support as needed	3,7	FY20-21
G	Improve Automation of SMO functions	2,7	FY20-21
H	Improve Data Access: Transition to IRSA; provide Pipelines and User tools*	4,7	FY21
I	Redefine Mission Operations activities: Take advantage of improved automation	2,6	FY20
J	Community and Public Outreach Strategy	2	FY20
K	Optimize Observatory Modes and Instrument Suite	10	FY20-21

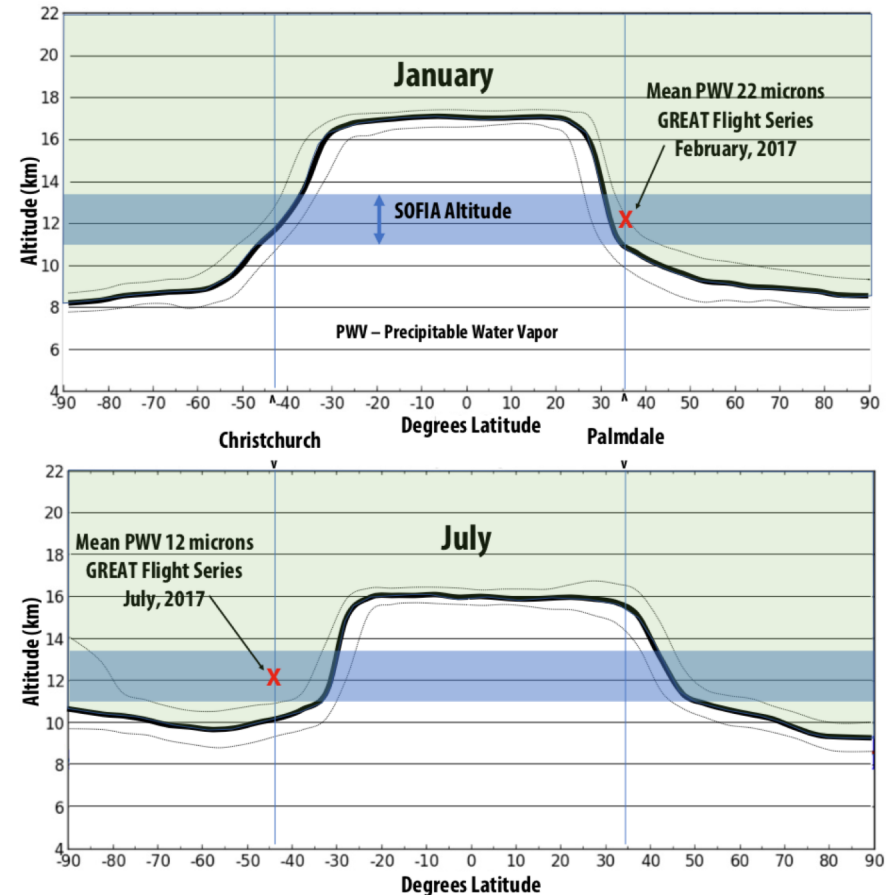
## FMR Recommendation #5:

### Pros & Cons of weekly 5x8-hour flights versus 4x10-hour flights

- Because of climbs, telescope setup, turns, and descents (~2 hours), an 8-hour flight means 6 hours on sky; 10-hour flight means 8 hours on sky
- Pros of 5x8-hour vs. 4x10-hour flights
  - Get to higher altitude quicker => lower water vapor & better observing conditions
  - Shorter workdays for flying personnel (10 hours versus 12 hours)
  - Two additional hours to fix problem(s) recognized on previous flight
- Cons of 5x8-hour vs. 4x10-hour flights
  - Maintenance model transitions from LUMP (*low utilization maintenance plan*)
  - Increased staffing: Ground crew works 6-day weeks; additional flying personnel
  - Lower dispatch rate (currently >80%; modeling indicates ~75% in future)
  - Shorter flights => shorter integration times => more flights/target => possible higher probability of incomplete projects
  - In New Zealand, tropopause is below 39,000 ft => less high quality observing time

# Test Case for 5x8-hour flights

- Short “surge” for a one week test after Stuttgart deployment
  - USRA flying staff volunteered for back-to-back flights
  - USRA ground personnel agreed to work overtime for this test week
  - NASA and contractor maintenance ground personnel will be increased for test week
- Although possible for a one week test, continuous operations at 5x8-hour weekly cadence will require staffing up
- Based on test results, SMO will conduct modeling of continuous operations at 5x8-hour and make recommendations to NASA





# Adding internet capability

- “Add broadband internet capability – broader participation by staff and community / reduced demand on staff to fly”
- The SMO strongly endorses adding in-flight internet capability
  - Improves participation of GOs in science-based decision making
  - Allows (limited) uploading of additional material from astronomical databases
- The SMO strongly recommends keeping instrument scientist on board
  - Even in stable conditions on ground (e.g. SOFIA Science Center), internet is not 100% reliable
  - Instrument scientist must often makes quick decision based on quick-look data
  - Losing 5 minutes per flight corresponds to equivalent loss of 2 flights/year

# Program activities underway

- Tiger Teams created for above-mentioned initiatives
- Added new science role – Associate Director for Research: Jim Jackson
  - The new AD responsible for Call for Proposal, Post-Doc mentorship, improve SOFIA research productivity, focus on science centered outreach
- Reduce and consolidate other AD roles
- New post-doc and staff scientist positions: requisitions/ads
- Prepare for the TAC meeting and Cycle 8 selection
  - Define Cycle 8 evaluation guidelines consistent with new paradigm
- Conduct a 5-flight week in Cycle 7
  - Use results and modeling to refine optimization for high quality science
- Cycle 9 Call for Proposals
  - Reduce instrument modes and instruments offered