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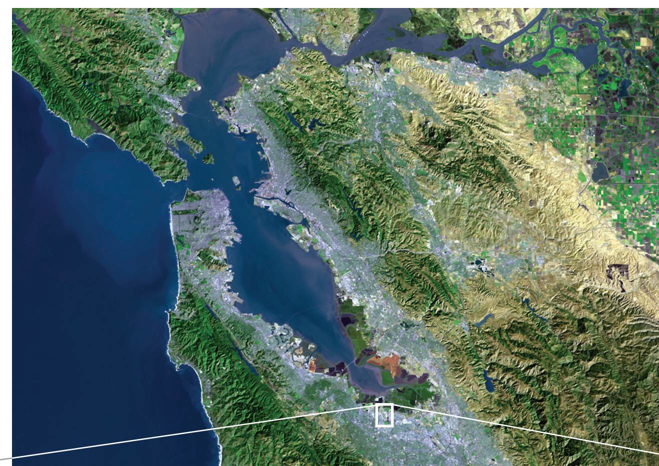
The SOFIA Science and Mission Operations Center

Hangar N211 at NASA Ames is Home of Airborne Astronomy

Next year, the modified 747SP that is the Stratospheric Observatory For Infrared Astronomy will fly from Waco, Texas to Moffett Federal Airfield and the NASA Ames Research Center in California's Santa Clara Valley. There, SOFIA will roll into its permanent new home: Hangar N211, the *SOFIA Science and Mission Operations Center*. Over the last few years, as the aircraft has undergone extensive modifications that allow it to now accommodate a 2.5-meter telescope in a vibration-isolated cavity that opens to the heavens, the building that will house the aircraft and all associated operations has been going through its own substantial alterations. In N211, the SOFIA aircraft will be virtually surrounded by the people who make the missions happen – scientists, engineers, flight crews, mechanics, education and outreach specialists, and database experts. The building also houses laboratories for readying and checking out instruments, facilities for stripping and coating the telescope's primary mirror, flight operations rooms where missions are planned, and education areas for students and teachers discovering airborne astronomy.



Above: Moffett Federal Airfield and the NASA Ames Research Center. SOFIA's new home, Hangar N211 is highlighted. Dominating the landscape is Hangar One, built for the massive Navy airship USS Macon. Highway 101, connecting San Francisco and San Jose, cuts through right of photo. Water at upper left is a southernmost fringe of the San Francisco Bay. At left is a front view of N211.

— Continued inside —

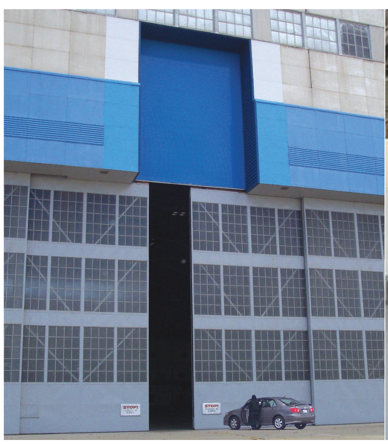
Inside

Roughly 60,000 square feet of wide-open hangar space is stripping and coating facilities, metal and machine shops,

In short, the *SSMOC* is a massive, multifaceted, state-of-the-art facility that will soon house not only the SOFIA aircraft but every major component the project requires to meet a rigorous schedule of planned missions with an array of different instruments and celestial targets.

Built in 1945 to house cutting-edge and experimental aircraft being tested in the wind tunnels of what was then NACA's burgeoning Ames Aeronautical Laboratory, Hangar N211 has long hosted many unusual aircraft and the people associated with them (see page 11 for more history on the hangar). The entire structure has a footprint of about 80,000 square feet, or almost two acres. Roughly 60,000 square feet of wide-open hangar space is surrounded on three sides by three floors of lab space, mirror stripping and coating facilities, metal and machine shops, mechanical rooms, offices, and conference rooms.

The hangar area itself is a huge expanse of grey concrete floor bordered on three sides by white walls rising up to a massive network of girder framework supporting the building's domed roof. Prominent and strikingly new is the elevated walkway stretching from the second floor of the hangar's south wall out to where the port door of the aircraft will be when it's parked. Although this skywalk will be the main route for boarding the plane, it



Tail cut out above the massive doors allows the 747SP's 65-foot high vertical stabilizer to enter the hangar. It is one of several major investments by NASA to tailor N211 for SOFIA.

The skywalk will afford access to the plane's port side; next to it (and also new) are two high-bay rooms for mirror stripping and mirror coating. Yellow lines in foreground mark the center taxi line for the aircraft.

Red pipes of N211's new fire suppression system rise at the hangar's back wall to branch out to several key locations throughout the hangar.

was designed by SOFIA Project Scientist **Jackie Davidson** for bringing aboard heavy equipment such as observing instruments to be mounted to the telescope. Along the under side of the skywalk are several pipes that bring electrical power, water and compressed air to the plane. Three rectangles on the hangar floor mark where the concrete has been reinforced to handle the prolonged weight of the parked aircraft, which will be the biggest, heaviest plane ever rolled into N211. Planned but not yet built is a retractable nose dock, a scaffold-type structure that will be rolled up to and surround the front of the plane and linked to the skywalk to allow outside access to the nose and cockpit. Instruments will be wheeled on special carts via the skywalk, across the nose dock, and into the plane.

Three new rooms form an outcrop from the hangar's south wall between the hangar doors and the new walkway: the Preflight Integration Facility (see page 10), the Mirror Stripping Room and the Mirror Coating Room (see page 6).

Along the hangar's back and side walls, windows provide labs, offices and conference rooms with views into the hangar. Rising up the back wall is a

surrounded on three sides by three floors of lab space, mirror mechanical rooms, offices, and conference rooms.

network of bright red pipes that constitute the fire suppression system (built expressly for SOFIA). An elevator near the southeast corner of the hangar is another upgrade to the building installed for SOFIA; it will be used for bringing instruments and other equipment to the second floor to be brought aboard the aircraft via the walkway. The elevator will also provide the disabled with access to upper floor offices and education and public outreach areas.

The second floor is mostly comprised of offices for SOFIA staff scientists and engineers, but includes a small recreation area for guest investigators, who will typically spend a total of two to three weeks at the SSMOC. (A ping-pong table was recently procured for this room).

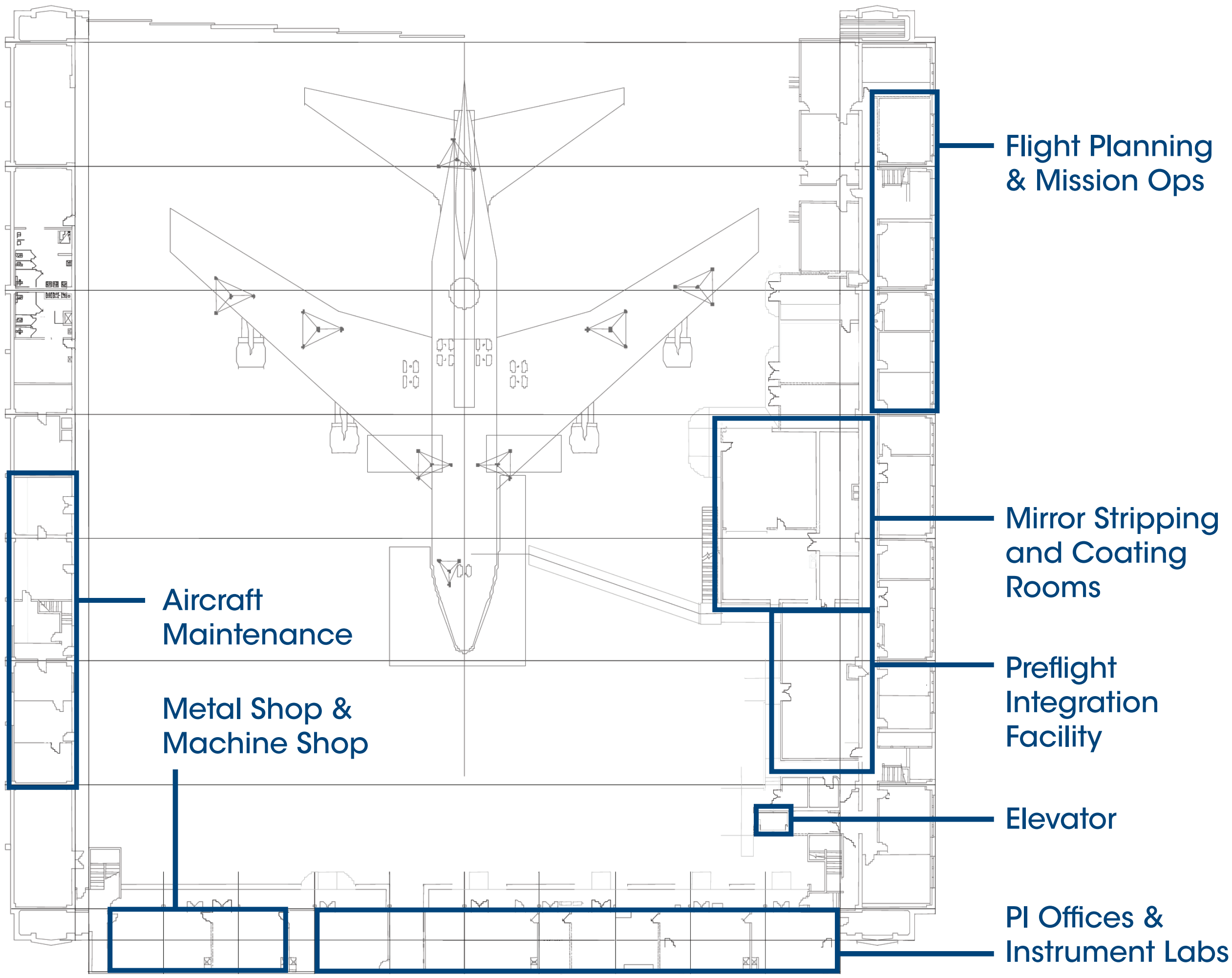
In the front (east side) of the hangar area are the massive gray hangar doors that telescope out from the sides. Much of the light in the hangar is from the windows that comprise most of the doors' area. Above where the doors meet, in the center of the section of wall between the roof and the massive opening at the front of the hangar, a rectangular section of the wall has been cutout to make room for the tail of the SOFIA 747SP. The cutout has its own rolling shutter-type door (newly painted "SOFIA blue"). The hangar opens onto a large concrete flight line

The SSMOC (N211) viewed from the flight line. (Annex to the right of the main hangar houses local law enforcement aircraft.)

area bordered on the left by two smaller hangars and on the far side by the airfield's west taxiway. SOFIA Chief Scientist **Eric Becklin**, whose office on the second floor is filled with diagrams and blue prints pertaining to the building and its improvements, is very happy with the SSMOC. "It's all the space we need," says Becklin. "We now have 8 scientists here. Once we start operations, we'll have about 15. Plus we'll constantly have scientists visiting the SSMOC – people here to observe, their collaborators, and also scientists who might be considering proposing for observing time, who want to just come out and sit in on some flights." Like the rest of the staff at the SSMOC, Becklin is eager to start flying. "We've had a huge amount of work to do here while they've been working on the plane down in Waco (Texas)," says Becklin. "We're not quite done yet but we are getting close to being ready for operations. We really can't wait for it to get here. We want to start flying."

Eric Becklin
SOFIA Chief Scientist

Floor Plan (1st Floor)



SOFIA's Understudy for a Day

In June of 1999, the NASA Shuttle Carrier 747-100 was pulled into N211 as far as its tail height allowed (this was prior to N211's tail cut-out) for a fit-to-function check. With the same wingspan and landing gear footprint as the SOFIA 747SP, the 747-100 was useful in gauging the physical parameters of the SOFIA aircraft in the SSMOC. It was also used for checking access on Moffett's main ramp and fuel pit areas.

SSMOC

Why Moffett Field?

SOFIA will normally fly out of Moffett Federal Airfield in Northern California's Santa Clara Valley. Moffett Field is operated by the NASA Ames Research Center, which adjoins the airfield. This location fits well with SOFIA's mission for a number of reasons, many related to observing conditions. Moffett's climate, latitude, and proximity to the sea all make it an attractive base for infrared observing flights.

Latitude: At 37 deg. north, Moffett is arguably the perfect latitude for SOFIA's base. "This location allows easy access to the higher latitudes, so SOFIA can get north of the rising troposphere in the summer," says **Allan Meyer**, SOFIA Associate Scientist. "And yet we're far enough south to allow flights for observing the galactic center. It's pretty much ideal for our mission."

Water Vapor: The location typically has low atmospheric water vapor levels. In the mid-90s, satellite data was used to plot the seasonal zenith water vapor overburden – the amount of precipitable water vapor above a given altitudes. At 41,000 feet above Moffett Field, the result ranged from 4.1 to 5.2 microns – favorable numbers that are comparable to the best available anywhere in the continental United States. Other U.S. locations to the East and especially in the southern states have sustained periods during summer when water vapor levels exceed 10 microns; Moffett does not.

Weather: The area also has a comparatively low incidence of very high clouds. East of the Rockies, summer thunderstorms frequently create extensive cirrus clouds even above 41,000 feet. Moffett has mild ground temperatures, relatively low average annual ground humidity, and low winds and dust – all of which negate the need for environmental control of the hangar (a costly measure that would be necessary in a desert or high-humidity locale). The region has few thunderstorms and no icing conditions, both of which can hurt on-time take-off rates.

Traffic: Moffett Field has a light amount of air traffic. SOFIA's departures and landings will be virtually unaffected by other aircraft – an enormous benefit. "The airfield is well equipped to service the SOFIA observatory and centrally located to other nearby airports with long runways stressed for 747 aircraft," says **Tom Speer**, SOFIA's Manager for Aircraft Operations.

The Sea: Moffett's proximity to the coast means SOFIA can quickly get over the Pacific, where the air is usually more calm and air traffic is relatively light. And being based at sea level means SOFIA can begin flights at a higher take-off weight; this means more fuel and so more observing time.

NASA Ames: While SOFIA will fly out of Moffett Airfield, the flying observatory itself and the SSMOC are part of NASA Ames, where the SOFIA concept was born. SOFIA's predecessor, a modified C-141

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SSMOC

Mirror Stripping and

Newly Built Facilities for Maintaining SOFIA's Massive Primary Mirror

Two adjoining new rooms in N211 built just for SOFIA—the mirror coating room and the mirror stripping room—form an expanse of new white wall that juts out a few feet into the south side of the hangar area between the skywalk and the hangar doors. These rooms are where the telescope's primary mirror will be periodically stripped of its aluminum coating, cleaned, and recoated with a precise, uniform layer of aluminum. **Pat Waddell**, Associate Director of SOFIA for Mission Operations and Support, has overseen the design and construction of these critical additions to N211, which he describes as "akin to head-of-state surgical facilities."

The process begins with a large, wheeled, quasi-robot looking device called the PMA (for Primary Mirror Assembly) Cart—"sort of a giant rotisserie drive with a box frame," is the way Waddell describes it—which is rolled out onto the hangar floor through a garage door at one end of the room. The cart, controlled by an operator walking with it, is rolled up to the port side of the SOFIA aircraft, beneath the cavity door. Next, a mobile hydraulic crane lifts the entire primary mirror assembly—880 kg of polished glass bonded to 200 kg of carbon fiber reinforced plastic framing, the whole thing about the size of a sports car. The crane lowers it with the mirror

Left: Pat Waddell next to the mirror coating tank, an evacuation chamber where SOFIA's primary mirror will periodically get a fresh coating of aluminum.

Right: The top of the PMA cart, which transports and maneuvers the primary mirror for stripping and re-coating. Yellow apparatus above the cart is two-axis crane that moves the mirror assembly into and out of the mirror coating tank.

facing the horizon onto the PMA cart's square top frame, as three male-female connection joints are aligned. The cart and its precious load are then rolled into the mirror stripping room, where the frame is wrapped to shield it from several chemical solutions that will first remove the existing aluminum coating and then clean the mirror surface.

After the mirror is stripped and cleaned, the cart is rolled a few feet through another garage door-like opening into the mirror coating room. There, the entire upper "rotisserie" section of the PMA cart (holding the mirror assembly) is rotated 90 deg. to orient the mirror to a face-down position, and a two-axis crane built into this high-bay room slowly raises the mirror and its carbon fiber cell straight up and then a few feet over so that it is above a huge, stainless steel vacuum tank.

The tank, nearly 5 meters tall and 4 meters in diameter and resembling a giant pressure cooker, is primarily an evacuation chamber. The mirror is lowered face-down into the tank to rest on outcrops near the tank's top, allowing just enough room for the chamber's top (essentially a giant pot lid weighing several tons) to be lowered into place by the crane and secured atop the chamber. Next, a positive displacement pump partially evacuates the chamber, and virtually all water vapor and gases are removed. The high level of evacuation required

Coating Rooms

Posts along electrically conductive rings at bottom of coating tank. Tungsten filaments stretched across these posts will be heated to incandescence until aluminum strands tied along the filaments evaporate.

1 of 63 6-inch tungsten filaments being attached to conductive posts.

Tiny strands of aluminum tied to the filaments; they will evaporate and coat everything in the tank, including the mirror.

(< 10-6 Torr) is achieved by two 20-inch cryopumps, which capture and trap the remaining gas molecules. The entire evacuation process takes about 8 hours.

The next step is coating the mirror with a new layer of aluminum. At the bottom of the tank, 63 separate 6-inch tungsten filaments are stretched across two concentric, electrically conductive rails. Carefully twisted around each filament are 10 short strands of aluminum (picture a silver twist tie). (The painstaking but crucial task of gently twisting some 600 strands of aluminum at regular increments along the length of the filaments will go to SOFIA interns.) The placement and amount of the aluminum will determine the thickness and consistency of the coating; the SOFIA mirror coating system is designed for < 3% non-uniformity. As a low-voltage current is passed through the filaments, they heat up, become incandescent, and finally reach a temperature (650˚ C, or 1200˚ F) that melts the aluminum. The current is maintained at this level briefly—just long enough for the liquid aluminum to "wet" the filament—then is rapidly increased to heat the filament enough to vaporize the aluminum. In the vacuum of the chamber, over the next 10 to 20 seconds, the evaporating aluminum travels everywhere and coats everything—including the mirror—with a layer of aluminum 150 nm thick—about 1/500th of a human hair. (The rest of the telescope assembly is shielded, and the walls of the chamber itself simply get coated repeatedly, without ill effect.)

Getting the PMA back into the SOFIA aircraft is generally a straight reversal: the 2-axis crane out of the tank, the shielding removed, the PMA cart out to the plane, the hangar crane into the open cavity.

The mirror coating facility has already been successfully tested using small mirrors placed at the expected position of the primary mirror. The facilities will get their first true workout in 2006, when SOFIA arrives at the SSMOC to complete flight testing that will precede operations. The primary mirror will require cleaning and coating upon its arrival. Because the first time this task is done, many support components will be tested for the first time in close proximity to the primary mirror, each step of the process will be carefully tracked, monitored and recorded, with an eye on eventually maximizing the efficiency of the process. Pat Waddell expects the first time to take about one full month.

Once SOFIA starts flying on a regular basis, the mirror will be stripped and recoated regularly, perhaps as often as every 6 months. But the cost in loss of observing time and added risk to the precious optic is such that plans are in place for developing highly effective cleaning processes that may increase the time between these serious operations to longer than one year. "What we'll always be working towards is less cleaning and more flying," says Waddell.

Why Moffett Field?

Continued from page 5

named the Kuiper Airborne Observatory, flew from Moffett/Ames for 20 years. It was Ames scientists and engineers – most of them KAO veterans – who conceived of SOFIA and initiated planning and design of the immensely complex project. After USRA was selected to develop and operate the flying observatory, some of the same Ames scientists and engineers long associated with the project became part of the USRA team and continued to work on SOFIA with USRA.

Warren Hall, Ames' Assistant Director for Aviation, ran the Airborne Science Program from 1985–2002, during which he logged "about a million hours on the KAO," he jokes. Hall is bullish about Moffett Field and its advantages in regard to the flying observatory. "SOFIA will live right off of the airfield, so you couldn't have better access," says Hall. "We've got generally mild weather, not the extremes you get in a place like the desert or the far south. It doesn't hit 100 degrees here." Hall also cites the proximity of water. "We're right at the end of the bay, so it was usually easy enough [for the KAO] to come in right over the water when returning in the early morning hours, and that's neighbor-friendly." Something else attractive for the SOFIA program about the location of Moffett Field and Ames: "We've got proximity to some excellent universities with experience in airborne astronomy through the KAO, and being in Silicon Valley gives us easy access to experts in electronics and data systems."

"But probably most important," says Hall, "is that this is really the home of airborne astronomy. The key people are here at Ames."

The SOFIA Team at Ames

Scientists, engineers, technicians, and other experts preparing for the arrival of the SOFIA aircraft.

From left to right, bottom to top, Back row: Ted Brown, Jürgen Wolf, Eric Wang, Mike Crawford, Jonathan Adams, Alex Cowles, Franziska Harms, Elizabeth Moore, Maureen Savage, Fran Nelbach, Toshiya Ueta, Bill Vacca, Nancy McKown, Neill Callis, Jason Brown, Patrick Waddell, Göran Sandell, Eric Becklin. Front row: Darlene Mendoza, Vinh Nguyen, Hilary Smith, Richard Bacher, Sean Casey, Siri Limmongkol, Allan Meyer, Dana Backman, Jackie Davidson.

Not pictured: David Black, Stefan Brüggenwirth, Ken Diggs, Michael Gross, Lan Lin, Brandon Maus, Ralph Shuping, Tom Speer, Will Willoughby, Leslie Proudfit, Rodger Belisle, Charlene Daley, Deanna Gearhart, Diana Martinez, Bernadette Pagan, Bree Holmbe

SSMOC

Germans at the SSMOC

SOFIA is a partnership between NASA and the DLR (German Aerospace Center). In November 2004, the DLR selected the University of Stuttgart to host the German SOFIA Institute (Deutsches SOFIA-Institut, or DSI), which now coordinates all German participation in SOFIA, including (once operations begin) Germany's 20% share of SOFIA observing time. Two German members of the SOFIA team are now on assignment to the SSMOC, working with the rest of the team toward First Light.

Franziska Harms is a University of Stuttgart student attaining her Ph.D. in aerospace engineering and space systems – mostly through her work on the SOFIA program. Harms, who earlier this year was awarded an Amelia Earhart Fellowship (an award from Zonta International to women pursuing graduate degrees in aerospace-related sciences and engineering), is focused on the telescope pointing system, working with a system of three imagers and three fiber optic gyroscopes that together keep the telescope pointed where it should be. "I'm excited about being a small part of SOFIA, and the new things it will find out about the universe," she said. Harms is halfway through a three-year stint with SOFIA.

Franziska Harms
Ph.D. Student, University of Stuttgart

Jürgen Wolf, DSI-SOFIA Senior Scientist, flew on the KAO roughly 20 times from 1985 to 1987 while he was a postdoc at Ames working on infrared detectors. Wolf later worked on ESA's Infrared Space Observatory, and has been with the SOFIA program

Jürgen Wolf
DSI-SOFIA Senior Scientist

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The Aircraft: Update

The 747SP SOFIA aircraft continued its steady progress at the Waco, Texas aircraft modification facility of SOFIA team member L3 Communications Integrated Systems. Initial flight testing is now planned for Winter 2005-06 and the aircraft will arrive at the SSMOC in 2006. Some recent developments:

Landing Gear Checked Out—In February, SOFIA underwent successful testing of its landing gear (photo, right). The testing consisted of jacking up the entire aircraft at five key points high enough to swing down and lock into place each component of the landing gear: right- and left-hand main body gear, right- and left-hand wing gear, and the nose gear.

Final Cavity Door Elements Installed—The final, main elements of SOFIA's cavity door—the aperture (which moves with the telescope) and the lower flexible door (which moves up and down as needed to minimize the size of the opening depending on the viewing angle of the telescope)—were successfully installed in May. The upper rigid door, the third main door element, was successfully installed in December 2004. The cavity door has been one of the biggest challenges to the SOFIA team's engineers. The hole from which the telescope looks out is 19 feet high by 14 feet wide, and the door must be able to open and close while flying in the stratosphere at SOFIA's cruising speed of 598 mph.

FORCAST Tested at Palomar—One of SOFIA's First Light Instruments made its first sky observations attached to the Palomar Observatory's 200-inch telescope. FORCAST—Faint Object InfraRed Camera for the SOFIA Telescope—is a mid-IR camera, one of SOFIA's facility-class instruments. FORCAST's PI is Terry Herter of Cornell.

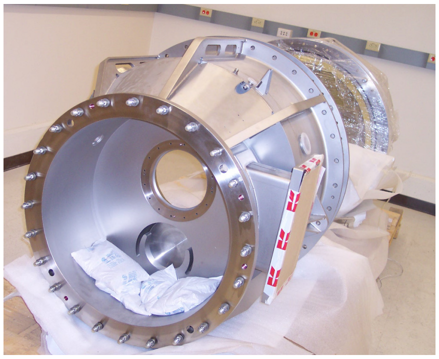
Part 145 Certification—In April, USRA was presented with the FAA Part 145 Repair Station Certification. This provides approval by the FAA for USRA to manage/provide guidance on the maintenance work for the SOFIA aircraft at the SSMOC.

SSMOC

Preflight Integration Facility

SOFIA Instruments Will be Checked Out on Full-Scale Telescope Mockup

Another room added to Hangar N211 specifically for the SOFIA program is the Preflight Integration Facility, where SOFIA observing instruments will be checked out prior to being brought onto the aircraft. Here, guest investigator instruments and facility-class instruments are attached to a full-scale mockup of the flange at the user end of the SOFIA telescope to ensure that the coupling and operation go smoothly. Instruments are physically connected to this flange, which is precisely identical to the actual telescope. (The mock-up was made by Keyser-Threde—the German company that manufactured the section of the telescope that interfaces with the instruments—for the DLR.) Instruments will not only be connected to the mock-up, but also to software identical to that which controls the telescope in the aircraft. A series of tests will be conducted to ensure that the instrument can correctly control the telescope.



Observing Instruments bound for SOFIA will be attached to this exact replica of the telescope flange and checked out for compatibiility.

Eventually, the PIF will house a complete, end-to-end simulation of the SOFIA telescope and all associated controls. For this end-to-end testing, special "hot sources" in the PIF will be used to simulate stars.

The point of all the testing and tweaking is to lessen time spent attaching new instruments to the actual telescope and refining compatibility between the two. "Actual time on the plane is precious," says Pat Waddell. "No instruments will get to the plane without coming through here. This aircraft is going to have a very demanding flight schedule, so we have to absolutely minimize time spent connecting instruments and checking out software. Time spent on the ground is not time spent observing."

Pat Waddell
Associate Director for Mission Operations and Support

Jürgen Wolf, DSI-SOFIA Senior Scientist, agrees: "SOFIA is going to reach it's flight goals through the preflight processes and the labs. The systems on the ground are almost as critical as the systems in the air." The PIF will have one full-scale mock-up permanently installed, and another that SOFIA will take on deployments to places like Christchurch, New Zealand, to perform the same function.

SOFIA E/PO Will Place Educators "Right on the Plane."

Once SOFIA goes operational, the program's already aggressive education and public outreach program will ramp up significantly, through the SOFIA *Airborne Ambassadors* program. "We're going to put about 200 educators each year right on the plane during observing flights," says Dana Backman, Associate Director for Education/Public Outreach. Backman is himself an infrared astronomer and a veteran of the Kuiper Airborne Observatory. "Educators will receive training prior to the flights, and then will work right alongside scientists engaged in infrared observing in the stratosphere," Backman says. Educators will take their experiences back to their classrooms and communities and become part of a national network.

Airborne Ambassadors is just one component of SOFIA's multifaceted E/PO program, which is carried out by a partnership between the SETI Institute and the Astronomical Society of the Pacific.

Dana Backman
Associate Director for Education/Public Outreach

60 Years of Quarter

Since 1945, N211 Has Been Housing Aircraft at Technology's Forefront

Hangar N211 was built in 1945 at Moffett Field, then officially the U.S. Naval Air Station Sunnyvale, California. Established in 1932 as a home for the massive Navy airship Akron, Moffett Field was selected in 1939 (by a committee headed by Charles Lindbergh) to host a second NACA major aeronautical research facility (the Langley Memorial Aeronautical Laboratory began in 1917). The facility was later named after Joseph Ames, a pioneer in aerodynamics who, as NACA Chairman in the 30s, urged NACA members to prepare for America's entry into WWII. Along with its full-scale wind tunnels, the Ames Aeronautical Laboratory built hangars like N211. All are dwarfed by Hangar One – built for the short-lived Akron – which dominates the skyline for miles.

Over the next several decades, N211 was used for many experimental aircraft, including early helicopters and tilt-rotors.

Jack Boyd, a USRA employee who serves as Senior Advisor for History at NASA Ames, has been at Moffett Field since 1947, when he was an aeronautical research engineer. Boyd specialized in supersonic aerodynamics, studying the characteristics of fighter and bomber aircraft in wind tunnels, and later focused on the aerodynamic properties of reentry vehicles. Boyd is well acquainted with N211. "The hangar itself is sturdy, and it hasn't changed much since 1945," says Boyd, who was named an AIAA Fellow in 2003. "What's exciting about it is the many kinds of experimental and scientific aircraft that rolled through its doors over the past 60 years and called it home. SOFIA is the latest, and certainly the biggest, in a line of aircraft that have included the Kuiper, ER-2, most experimental tilt-rotors, and many rotorcraft."

Some of the Aircraft Housed in N211 Since 1945:

- F-86
- Fairchild F-24
- Hiller Rotorcycle (1963)
- Douglas XBT2D-1 Skyraider (1946)
- Canadian-built VZ-9AV (VTOL) "flying saucer" (1959)
- YC-134A STOL (1959)
- NC130-B (1962)
- Convair Model 48 STOL (1967)
- Bell X-14A (VTOL) (1964)
- Bell XV-3 VTOL
- Ryan XV-5B VTOL
- North American YF-93
- North American F-100A
- F9F-A Cougar
- North American FJ-3 Fury
- Lockheed P-38
- Douglas F4D-1 Skyray
- Boeing QSRA
- YAV-8B V/STOL Systems Research Aircraft (VSRA)
- U-2
- ER-2
- DC-8

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Germans at the SSMOC

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since 1999. His home institution is the DLR Institute of Space Sensor Technology and Planetary Exploration in Berlin.

Although Wolf looks back on the Kuiper with a type of bittersweet nostalgia that seems common among KAO veterans, he is focused ahead. "The KAO was not a small aircraft but the observing team only had 3 or 4 seats on the plane," says Wolf. "We spent many hours strapped into these small seats. It was like a long flight in coach class. In SOFIA, we have tables and work areas. SOFIA is more like business class."

His research interest is primarily in far infrared detectors but Wolf is involved in an array of efforts to complete SOFIA's ground support facilities in time for arrival of the aircraft. He is enthusiastic about what the SSMOC has to offer. "The Kuiper (program) had one lab," says Wolf. "We have here two PI labs and one facilities instrument lab. We can have three instruments preparing for flight while one is flying."

"When SOFIA becomes operational," says Eric Becklin, SOFIA Chief Scientist, "we'll have a total of about 15 Germans here – 3 scientists and the rest engineers, technicians, and students like Franziska." Becklin, whose title will change to Observatory Director once the program becomes operational, adds that a German scientist (not yet named) will serve as SOFIA Deputy Director as soon as observing flights begin.

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