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SOFIA

STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY

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SOFIA will be a three meter class telescope operating in a Boeing 747 astronomers routine access to infrared wavelengths unavailable from the ground, and with the means to observe transient astronomical events from anywhere in the world. The concept is based on 15 years of experience with NASA's Kuiper Airborne Observatory (KAO), which SOFIA will replace in the mid 1990's. SOFIA's wavelength range covers nearly four decades of the electromagnetic spectrum: from the visible, throughout the infrared and submillimeter, to the microwave region. Relative to the KAO, SOFIA will be roughly ten times more sensitive for compact sources, enabling observations of fainter objects and measurements at higher spectral resolution. Also, it will have three times the angular resolving power for wavelengths greater than 30 microns, permitting more detailed imaging at far infrared wavelengths.

The infrared spectral regime encompasses a multitude of rich and varied physical processes and is uniquely suited for study of the cosmic birth on all scales. SOFIA's high spectral and spatial resolution will exploit and extend the scientific legacy left by IRAS (the Infrared Astronomical Satellite) and will complement the enormous sensitivity for imaging and moderate resolution spectroscopy to be furnished by SIRTF, the Space Infrared Telescope Facility. Questions that SOFIA users would address include:

* Interstellar cloud dynamics and star formation in our galaxy: Why and how do galactic clouds form stars? How important are magnetic fields and rotation in this process?

* Proto-planetary disks and planet formation in nearby star systems: How common are solar-systems? Under what conditions are they created?

* Origin and evolution of biogenic materials in the interstellar medium and in proto-planetary disks: What environments are hospitable to pre-biotic molecules and compounds?

* Comets, planet atmospheres and rings in our solar system: How did our solar-system evolve? What was the composition of the solar nebula?

* Star formation, dynamics and chemical content of other galaxies: How different are other galaxies? Why do some exhibit extraordinarily large infrared luminosities? What is the origin of this luminosity?

* The dynamic activity in the center of our own galaxy: What powers the highly luminous phenomena hidden at the center of the Milky Way - a compact star cluster or a black hole? Is this region similar to the "Active Galactic Nuclei" seen in some other galaxies?

SOFIA is currently being studied jointly by NASA and the German Science Ministry (BMFT). NASA would provide and modify the aircraft, and West Germany would develop the telescope assembly. As can be seen from Figure 1, the SOFIA telescope is much larger relative to the B747 than the KAO telescope is to the Lockheed C-141. This means that the new telescope requires considerably more sophisticated technology.

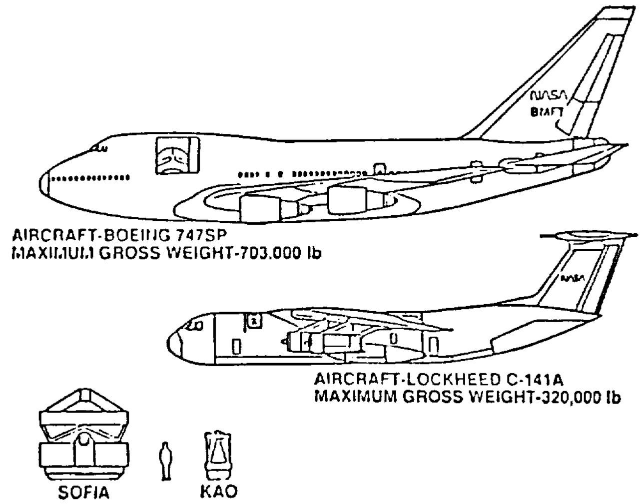

Figure 1: Comparison of SOFIA and KAO.

Nevertheless the SOFIA telescope concept, shown in Figure 2, borrows heavily from the KAO heritage. The optical system is supported on vibration isolators and an air bearing, and is expected to achieve sub-arcsecond pointing stability, as does the similar KAO design. Light weight is achieved by use of a carbon fiber structure and a thin meniscus mirror. The telescope operates in an open port cavity, while the experimenter has continuous access to his focal plane instrument.

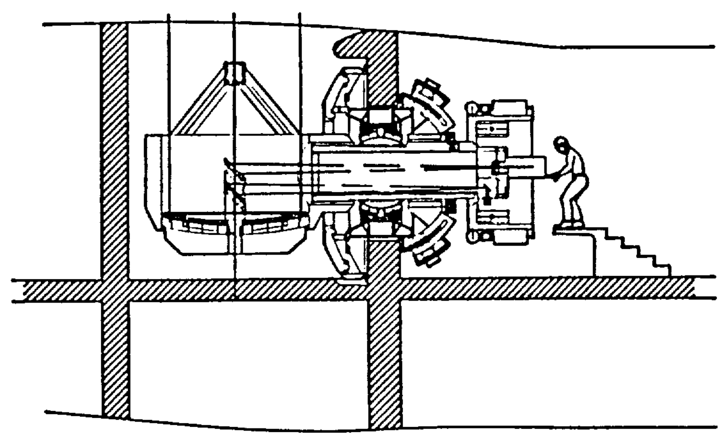

Figure 2: SOFIA Telescope Concept

NASA will operate SOFIA with support from the BMFT as an international facility for astronomy throughout an estimated 20 year lifetime. It will provide 120, 8 hour flight opportunities per year for approximately 40 principal investigator teams, selected by annual peer review.

Evolution of state-of-the-art focal plane instrumentation is a key aspect of the SOFIA concept. Roughly half of the investigator teams will provide the observatory with a wide variety of specialized instruments including array cameras, polarimeters, and several types of spectrometers. Major improvements can be expected in both conventional infrared detectors and heterodyne receivers which will extend the scientific productivity of SOFIA. Far infrared detector array technology, although currently in a primitive state, has excellent potential for airborne astronomy applications. It is iortant to note that the relatively high backgrounds may imply considerably different requirements on detector systems than for space-based cryogenic telescopes. In particular, higher dark currents can often be tolerated, but high quantum efficiencies are extremely desireable.

It is clear that SOFIA, as a unique astronomical observatory, as an educational facility for the science community, and as a stimulus for the development of new focal plane instrument technologies, will have a major influence on astronomy well into the next century.