Infrared Astronomy, From Eight Miles Up

By JOHN McNICHOLAS
Sentinel Staff Writer

NASA 714 thundered down the runway at Moffett Field one night last week and roared aloft, heading east into the dark.

In the cargo hold of the huge C141 Starlifter, experimenters sat before banks of control panels, data-gathering and recording instruments and video displays, waiting for the plane to gain altitude.

Half an hour later, at 41,000 feet, a fuselage door to a compartment ahead of the left wing rolled open, unshrouding a 36-inch infrared telescope which had been cooling in nitrogen.

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Eight miles above the empty, moonless deserts of Nevada, the Kuiper Flying Observatory turned its unblinking eye to the stars.

In the cockpit, the flight crew — two test pilots and a flight engineer from NASA — sat in the darkened cockpit, their shadowed profiles dimly lit by the glowing instrument panels. They kept track of the plane's functions as it settled on autopilot into the first leg of a computer-generated course that would zig and zag some 3,000 miles over four states and the Pacific Ocean, following the tracks of the stars through the skies.

Aft, in the flourescent-lit, uninsulated hold, the thundering engines and 500 mile-per-hour wind outside made normal conversation impossible. The seven-person team of collaborators from UCSC and NASA-Ames Research Center talked laconically through headset intercoms, and began their experiment.

Flying that night were UCSC Professor and Lick Observatory Astronomer David Rank and his undergraduate assistant Diane Wooden; the NASA-Ames contingent of the team comprised Fred Witteborn, John Goebel, and former UCSC graduate students Harriet Dinerstein, her husband David Lester and Allan Meyer.

The team was on its third flight to search the banks and shoals of deep space for infrared clues to the galaxy's makeup and evolution, clues which may lie in the gaseous "ashes" of the exploding stars called supernovae and in the dust among the stars.

UCSC's David Rank, left, and Fred Witteborn of NASA fill a spectroscope

In one of the two separate experiments under way, the team would probe carbon- and oxygen-rich stars, seeking answers about a characteristic and unexplained infrared "signature" of the dust found in space.

The effect cannot be reproduced in terrestrial labs. Correlating its presence with certain stars might help explain its origin.

The other experiment focused on areas of ionized hydrogen gas, — tenuous clouds in which bright, hot young stars are imbedded. The team was to measure the regions for the abundance of argon, produced in massive supernova explosions.

The difference between argon abundances in the galaxy's dense and active center and in its cooler, spiral arms could tell about the system's evolution: whether it it evolved unevenly as it coalesced from a shpere of dust into a spinning disc filled with stars.

Abundances are thought to be higher in the galactic center, where there have been a greater number of supernovae.

Rank say he and the team suspect previous calculations of argon abundances, done with sparse observational data, may be incorrect.

Using a spectrograph he developed, supercooled with liquid helium to increase its sensitivity and eliminate "noise" generated by the heat of the instrument itself, they hope to correct these measurements.

"Using infrared and optical devices, observers haven't been able to see all the argon," Rank said. "With these techniques, we can see it all.

"It's sort of like looking back in time. It will tell you what happened, the same way looking at fossils will."

But in this case, the "fossils" are infrared waves, generated at their sources 10,000 to 20,000 years ago and only now reaching earth from deep space.

Before the 1960s, such precise observations were impossible. Water vapor in the earth's atmosphere absorbs up to 95 percent of the infrared radiation reaching earth.

But in 1965, the late University of Arizona astronomer Gerard P. Kuiper began observing infrared phenomena through a 12-inch telescope bolted to the floor of a Convair 990 jet used by NASA for planetary observations. In the stratosphere, above nearly all the water vapor, clarity jumped almost 100 percent.

Since then, the Airborne Astronomy Program has carried astronomers and their increasingly sophisticated equipment into the stratosphere to probe the universe.

A Learjet was first outfitted with a 12-inch telescope. Then, in 1975, NASA bought the C141 from Lockheed, which had been using it as a demonstration model.

With considerable structural modificationto the plane, a 36-inch Cassegrain-type relflector telescope was installed.

Its lens is open to the thin, cold air during flight, and spoilers deflect the airflow across the opening.

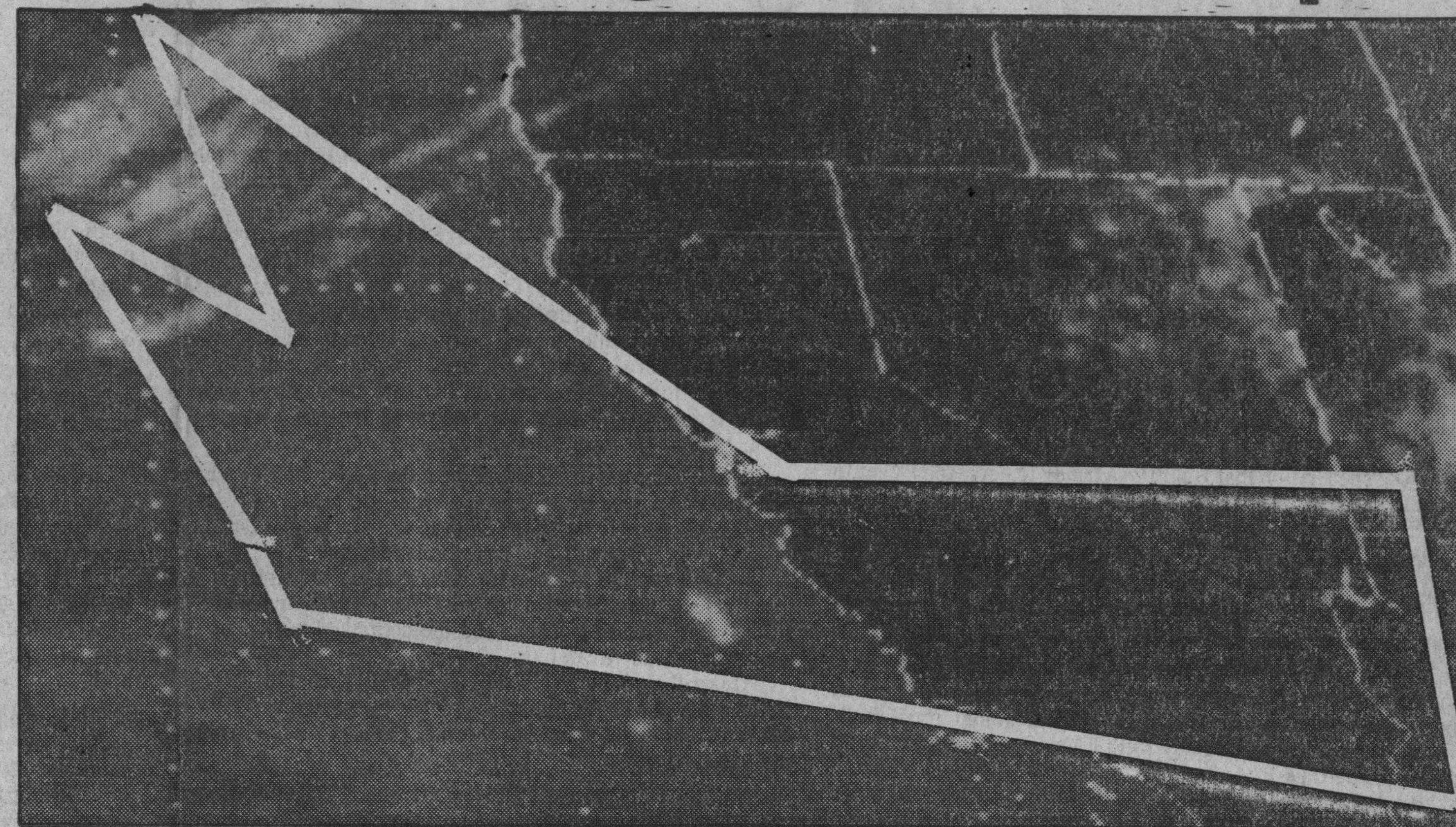
The telescope rides on a 16-inch bearing lubricated by compressed air and so frictionless the telescope's 6,000 pounds can be moved by a fingertip; its precision gyroscopes and a digital tracking system are controlled from consoles within the plane.

Its limited elevation — from 35 to 85 degrees — means the plane must fly perpendicular to any observed object, and flight plans are figured down to the second to allow maximum viewing time.

Each experiment may require up to six $40,000 flights. Astronomers from all over the country have completed 400 research flights, their projects carefully screened by a NASA committee in Washington, D.C.

They have returned with startling and new information about the universe, far and near.

Among the discoveries are the rings of Uranus; an internal heat source in Neptune; water in the atmosphere of Jupiter and sulphuric acid in the clouds of Venus, and galaxies invisible to the eye but more luminous in the infrared wavelengths than all the stars in the Milky Way



An approximation of the Kuiper Airborne Observatory's 3,000-mile, 7½- hour flight.

A high-flying U2 was recently added to the program's stable of planes.

NASA-Ames and UCSC recently signed an agreement to collaborate on research and to develop and test new ground-based optical and infrared facilites, instrumentation and technology.

As the plane flew on last week, the team worked with practiced precision.

Allan Meyer, who earned his master's degree from UCSC in 1974 and now works for NASA-Ames, searched the images projected on his screens. With little hesitation, he picked the object the team was to observe out of the carpet of stars on the screen.

"Allan is the best I've ever worked with," said NASA team leader Witteborn. Rank agreed, saying, "He has an incredible spatial imagination."

Witteborn occasionally "moved the star"— adjusted the telescope to keep its radiation pouring through the center of the telescope and into the "doer," Rank's spectroscope.

There, it was converted into electronic information and sent into the group's computer and recording equipment.

Dinerstein, Lester, Goebel and Wooden kept the logs and ran the computer, and the two members of the plane's crew — the mission director and telescope operator — ensured that everything worked correctly, smoothly and safely.

Safety is a major factor in a plane "unremittingly unforgiving of carelessness," in the words of a safety film all passengers must view before flying.

A spilled cup of coffee could cause a fire in the tons of electronic gear, and at 41,000 feet, a pressurization failure could render everyone unconcious in 30 seconds.

Everyone aboard is fitted with an oxygen mask and instructed in its use. Those who fly between 41,000 and 45,000 feet, the plane's peak altitude, must train in a decompression chamber.

There were no problems last week, and as the night wore on, it became clear the mission was a success. The clipped commands and non-committal information passing over the intercom occasionally reflected something near satisfaction:

"Bring the retical up some; let's have it for 60.... OK, x equals 1.9, y equals 9.9...integrating...Are we really in the right place? Yeah, what makes you think we're not?...switch beams... I like it, I like it...We've got an argon line. It's a big bruiser."

When the plane touched down back at Moffett at 4:30 in the morning, the weary team's work had only begun. They will spend months with the rich trove of data, evaluating it and testing hypotheses.

"We have found already," Rank said, "the way abundances were measured was not right. We've been able to do a better job.

"What does it all mean? You never know what it all means until you're done with it. But oftentimes in the process, something happens. That's what you wait for."

NASA test pilots Bob Innis and Jim Martin discuss flight pattern.

Photos By
Bill Lovejoy

UCSC's David Rank, left, and Fred Witteborn of NASA fill a spectroscope with helium.

NASA committee in Washington, D.C.

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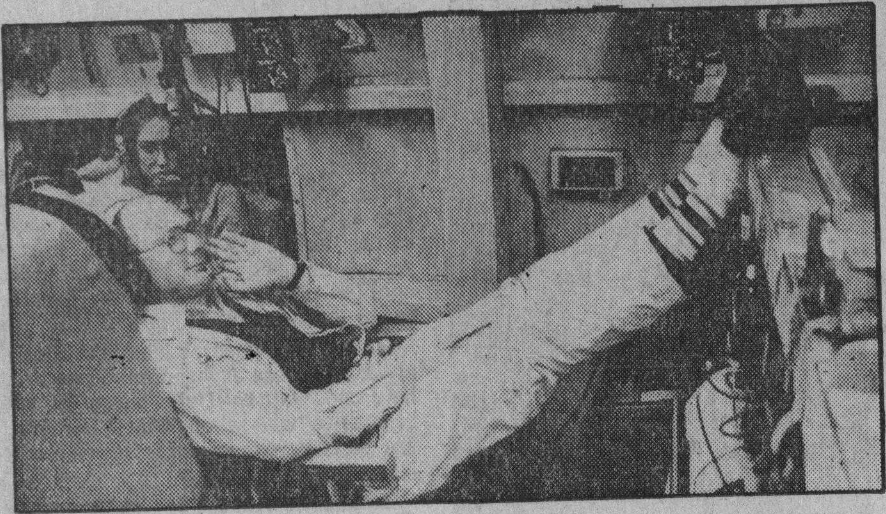

Diane Wooden and John Goebel log data in the late hours.