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THE THREE T-SHIRTS: The current, founding, and predecessor directors of the Harvard-Smithsonian Center for Astrophysics, respectively, Irwin Shapiro (left), George Field (right), and Fred Whipple (center), help celebrate the CfA's Silver Anniversary by hoisting the 1990s equivalents of institutional banners at the 25th Birthday Bash in the Perkin Courtyard October 7. (Photo by Jon Chase, Harvard News Office)

"FIRST LIGHT" IS A WAKE-UP CALL AS THE SM ARRAY GETS A FRINGE ON TOP

Everybody knows his bedtime is exactly 11 pm--on the dot, without exception--every night. So why was Jim Moran bugging Irwin Shapiro at 10:59 pm, Friday, October 23?

Moran, calling from the Submillimeter Array site in Westford, assured Irwin that he would be pleased by this late-night disruption of his usual routine. And, indeed, he was--for Moran was calling to report that he and about eight other members of the SMA Project had just succeeded in obtaining "fringes" on the planet Saturn with the two prototype antennas at Haystack.

Needless to say, Irwin was excited by that call. However, when sleep finally came, it was sound and serene: The SMA interferometer was going to work!

Indeed, at the start of the very first attempt to observe an astronomical source, the initial two elements of the planned eight-antenna Submillimeter Array (SMA) now under construction by SAO

and Taiwan's Institute of Astronomy and Astrophysics had gotten strong and stable "fringes" from an astronomical object, with a very high signal-to-noise ratio, thus achieving the submillimeter-wave equivalent of "first light" for this unique instrument.

"Fringes" are the name of the game in interferometry and refer to the distinctive patterns produced by the simultaneous receipt and combination of radio signals from two separate telescopes, in this case, two 6-meter-diameter antennas now operating in a Massachusetts hay field but slated for later installation near the top of the Mauna Kea volcano in Hawaii.

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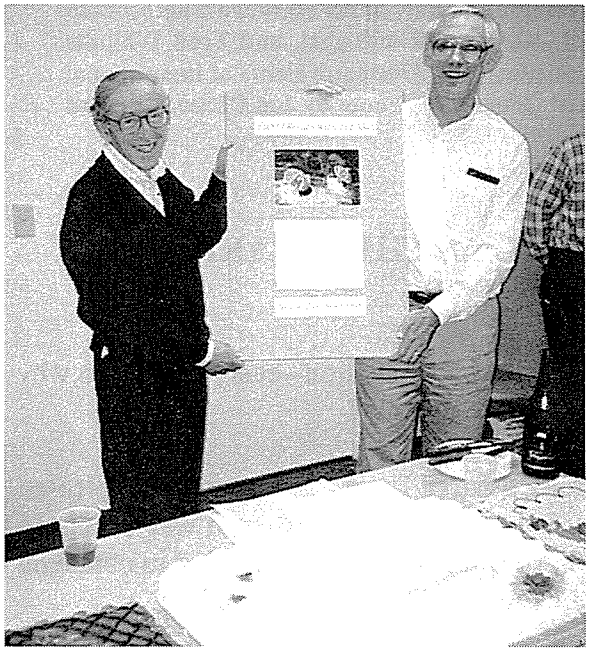
Two days later, in a more detailed report for the technical types who had been intently monitoring the "SMA Weekly Calendar" for positive news about this major SAO initiative, Moran described the operations at Haystack the night he kept Irwin Shapiro from early retirement:

"By late last Friday afternoon all the IF/LO equipment was in place and checked out for the initial phase stability tests on the monochromatic 230 GHz beacon. At first there was some difficulty in locking the vector voltmeter to the beacon signal at the IF frequency of 1GHz. This problem was overcome by passing the received signals first through the holography IF system which had narrow band filters at 21 MHZ.



Irwin Shapiro (left) and his late-night caller Jim Moran display the giant "first fringes card" displayed at the impromptu party held October 28 to celebrate that historic technical achievement. Notice that the celebratory cake seems to be decorated in a wavelength visible only to submillimeter detectors! (Photo by Jim Cornell)

"With the vector voltmeter locked up, one of the secondary mirrors was moved through a range of several millimeters to check the phase scale. With the secondary in a fixed position, the phase drifted slowly, about 20 degrees over a period of 10 minutes. Changes of up to about 10 degrees were seen on time scales as short as 30 seconds. With the drift removed, the rms phase deviation over 10 minutes was about 4-5 degrees...The assembled crew were rather impressed with this level of phase stability on the very first test. (To place this result in perspective, the initial electronic stability specification of the VLA, circa 1980, was 1 degree rms of phase fluctuation per Gigahertz...)

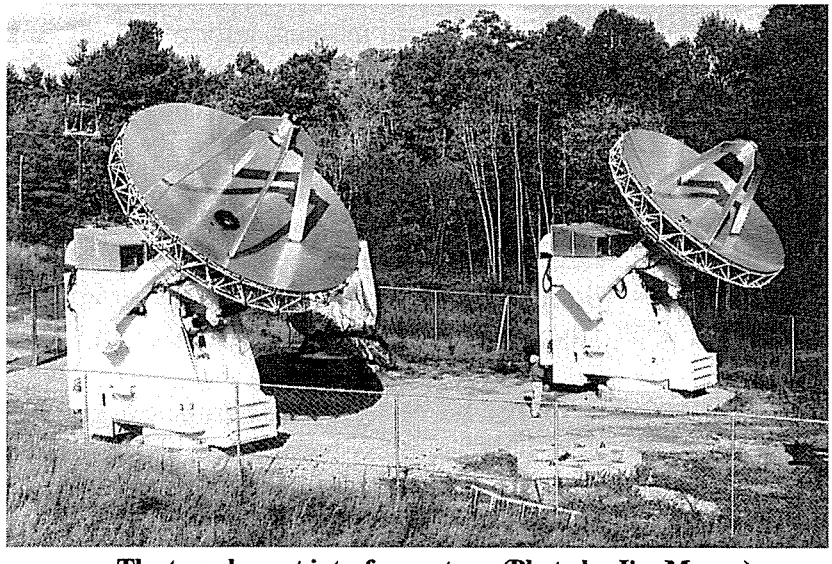
"Emboldened by the phase stability results, the crew turned the interferometer towards Jupiter with the IF signals feeding the 100 MHZ bandwidth analog correlator. Alas, by the time

all was ready, Jupiter was an hour past transit and well out of the delay window (10 nanoseconds). Undeterred, the crew decided to try for Saturn, which was 90 minutes from transit.

"Amazingly, obvious fringes appeared immediately on the chart recorder. The fringe rate was exactly as expected, 0.75 Hz, and the `sausage' pattern in the fringes caused by interaction of the two sidebands separated by 10 GHz was clearly evident. A quick check showed that the fringes were about the amplitude to be expected when the source transited, about 0.5 percent of the system noise.

"How could this be when Saturn was so far from transit? After some head scratching, it was realized that no special care had been taken to equalize the fiber-optic cable that run from the two antennas. Fringes 90 minutes before transit implied a relative delay of about 16 nanoseconds. (A check on Saturday confirmed that the relative cable lengths were different by 5 meters.) There must be some moral about the early bird getting lucky!

The assembled crew (Todd Hunger, Charles Katz, Jim Moran, Nimesh Patel, Masao Saito, William Snow, Sridharan Tirupati, and Ken Young), along with Paul Ouellette, celebrated with pizza and a stash of Rabbit Run Sauvignon Blanc left over from the SMA Advisory Committee meeting."



The two-element interferometer. (Photo by Jim Moran)