NATIONAL RADIO ASTRONOMY OBSERVATORY
TUCSON, ARIZONA

March 3, 1982

25 METER MILLIMETER WAVE TELESCOPE
MEMO No. 149

MEMORANDUM

TO: M. S. Roberts

FROM: M. A. Gordon

SUBJECT: The millimeter-wave plans of the University of Arizona

As you know, Charles Lada and Bobby Ulich have enthusiastically pressed Steward Observatory to enter radio astronomy. Here's a report of their progress to date. Their activities involve 2 separate instruments and primarily the sub-millimeter wavelength region.

I. Multiple-Mirror Telescope:

This array of six mirrors has been designed to operate as a phased system in the IR but has only recently been tested-- in the following experiment at 870 microns.

In February, Paul Goldsmith and Neal Erickson of UMass brought their 870-micron mixer to the MMT for a joint experiment with Lada and Ulich. The scientific objective was to obtain line profiles of the 3-2 CO emission from nebulae known to have asymmetric gas flows of high velocities

The MMT performed very well. The beam consisted of a main lobe with 24 sidelobes, with the power ratio of the main beam to the first sidelobe of about 3:1, exactly as expected from this kind of interferometer. Forty percent of the power lies in the main lobe. The full width at half-power of the main lobe was 25 arc seconds (corresponding to the MMT composite diameter of 8.5 m), and the geometrical collecting area is equivalent to a 4.5-m single mirror. The pointing accuracy was about 1 arc second-- a good accounting of Inductosyn shaft-angle encoders, an excellent support structure, and Ulich's analytical abilities.

Bobby told me that there were only small problems with standing waves, and these occurred only during daytime. (The spectra I saw were completely free of these effects). But, to avoid all problems in the future, he will build a beam-combiner operating only in one circular polarization so that reflections (being in the orthogonal mode) cannot pass into the receiver.

Because of this success, the MMT is planning to make sub-millimeter observations on a regularly scheduled basis--as the receiver is available.

II. The MPI-UAz Sub-Millimeter Telescope

This project is continuing as planned. You may recall that the MPI has a few million DM allocated for construction of a small sub-millimeter telescope. However Europe lacks a suitable site and operating money. Hence, the arrangement with the University of Arizona.

The plan is for the MPI to order a telescope mount from Krupp-MAN for a telescope of sufficient diameter to meet the existing budget. Pete Mezger is hoping for a 10-m diameter, but will accept a smaller diameter if necessary.

The design for the surface plates mimics one which the NRAO found unsuitable for the 25-m. The Optical Sciences department of the UAz has produced and sent to West Germany a pyrex mold accurate to at least 1 micron. In Germany, the aircraft manufacturer Dornier is now in the process of making carbon fiber plates from that mold. The main difference between the NRAO (Harris Corporation) experiment and Dornier approach is that Dornier plans to use aluminum honeycomb between the carbon fiber layers, rather than the nylon honeycomb we used. They are certain that the inelastic properties of the "dead-soft" aluminum will allow an accurate conformation to the mold. Charlie Lada told me that, although the thermal problem has been discussed, Dornier feels that even here there may be advantages to using an aluminum core.

The UAz people have an alternative plan for a surface if the carbon fiber plates fail to materialize: a 10-m borosilicate mirror. Evidently the University of Texas is designing a 7-m monolithic telescope. Also, the UAz is making plans for a second and larger version of the MMT. The plan is to have the Optical Sciences department at the UAz slump and polish honeycomb mirrors, under the direction of Mr. Robert Parks (Optical Sciences) and Prof. Roger Angel (Steward). They need to construct an oven for this process. Roger hopes to build an oven large enough to handle

a 10-m mirror. As a trial, he will make a 10-m mirror which probably won't be good enough for the optical telescopes, but will be fine enough (1 micron) for a sub-millimeter telescope.

The sub-millimeter telescope will be constructed on Mt. Lemmon within the old airforce radar station (the very site ruled out by an NRAO external committee because of the political problems of building a radio telescope in a nest of transmitters). The dome design is a low-cost box, which will open either electrically or hydraulically.

Although it is too soon to know whether Dornier will be successful in their carbon-fiber plates, the University of Arizona appears to be committed to expanding their astronomy program to include radio observations.

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