25 Meter Millimeter Wave Telescope
Memo #107

NATIONAL RADIO ASTRONOMY OBSERVATORY

Charlottesville, Virginia

May 10, 1978

MEMORANDUM

TO: 25-m Telescope Design Group

FROM: W-Y. Wong

SUBJECT: Operating Limits of the 25-m Telescope

The 25-m telescope is designed for the wavelength λ = 1.2 mm with
the astrodome in closed position. The design goal is to maintain the sur-
face error, or the deviation from the best-fit paraboloid, within a limit
of 0.075 mm rms, and the pointing error kept within 1.2 arcsec. These
values are derived from the combination of errors induced by gravity
effects, thermal effects, fabrication tolerance and measuring inaccuracy.
Vigorous analyses indicated that these design goals are indeed possible
to achieve with the help of the optimization program for the gravity
effects, and the protective enclosure for the elimination of wind effects,
plus an air circulating system for the reduction of temperature gradient
on the back-up structure. This design concept is intended to maintain
the instrument's accuracy throughout the 24-hr period to a reasonable
extent, so that the observers can use this telescope as a 250-GHz instru-
ment under reasonable weather conditions.

The instrument will become more powerful on calm windless evenings,
when temperature difference on the back-up structure becomes small, the
hourly fluctuation of temperature stabilized, and the astrodome window
in an opened position. Observations could be done without the attenua-
tion of radome material, hence producing higher aperture efficiency.
Mark Gordon's 5/1/78 memo states that the telescope operate only in
modest wind with astrodome door open is erroneous. He also stated that
this telescope should be operational with the astrodome open in winds up
to 50 mps (80 km/hr) or higher. This implies some fundamental changes
of requirement in the telescope design.

The wind pointing error of the present telescope design is 3.2
arcsec rms in 30 km/hr wind. Prorated it to a wind speed of 80 km/hr,
the pointing error is 23 arcsec. In order to reduce the structural de-
flection so that the wind pointing is reduced from 23 arcsec to 1 arcsec
is not an easy task. It required not only strengthening the structural
members, but also required a basic geometric change of the back-up and
tower structure. This new design will be massive and stiff.

How successful to change the design in order to fulfill this kind of wind pointing requirement is very uncertain. It is not practical to stiffen up the structure without considering other problems such as servo, thermal and even cost. How does the homology optimization work on a massive structure of new geometry is not possible to predict. It will take six months to one year to produce an acceptable homologous design.

In case we do have an acceptable new design, that the pointing under 80 km/hr wind is about 1 arcsec, then the need of the astrodome no longer exists. An insulating envelope for the structures with some air circulation which is sufficient and economical. Thermal problems on the surface plates will be greatly reduced by using thermally stable material such as carbon fiber epoxy. The difficulty in dealing with the astrodome's design problem of high wind will also be eliminated.

But it is unlikely that we will succeed to produce such designs. Unless we are willing to compromise the telescope time loss due to wind in order to save the cost of the astrodome, this approach is not recommended.

NATIONAL RADIO ASTRONOMY OBSERVATORY

TUCSON, ARIZONA

May 1, 1978

To: 25-m Telescope Structural Group

From: M. A. Gordon

Subject: Operating limits for the 25-m telescope

During discussions with Buck, I learned that the 25-m telescope may have been designed to operate only in modest winds with the astro-dome door open. I'm certain that the astronomers will want to use the 25-m telescope with the astrodome open in winds up to 50 mph or higher. We should design both astrodome and telescope to meet these conditions, if possible. The limitation of 15 mph at the 36-ft telescope sharply reduces observing effectiveness and causes great unhappiness among our users.