National Radio Astronomy Observatory

Charlottesville, Virginia

To: 25-m Telescope Design Committee   August 6, 1976

25 Meter-Millimeter Wave Telescope Memo #48

From: W-Y Wong

Subject: Wind Pointing Error

The pointing error due to wind effect on the 25-m was investigated in a greater detail using the JPL wind tunnel test data (internal memorandum CP-4 — Load Distributions on the surface of paraboloidal reflector antenna). Assuming the telescope is not protected by dome or astrodome structure with 30 Km/h wind and five telescope positions, the pointing is estimated to be 19 arc-sec. peak, 9 arc-sec. rms. The wind pointing with the present design is too large for short wavelength observation if the structure is not protected by any enclosure. It is intended to limit the overall pointing error of this design including wind, thermal and servo to less than a tenth of the beam width at $\lambda 1.2mm$ or 1.2 arc sec.

The wind pointing of the telescope is a combination of beam displacements caused by various mechanical deflections of telescope under wind gust. With the present geometry and optic, the beam displacements $\Delta\theta$ and the mechanical deflections $\Delta\alpha$ are having the following relations:

(a) The best fitting paraboloid $\Delta\alpha_1$(rad.): $\Delta\theta_1 = 1.8 \, \Delta\alpha_1$ (rad.).

(b) Tilt of the cassegrain mirror $\Delta\alpha_2$ (rad.): $\Delta\theta_2 = 0.101 \, \Delta\alpha_2$ (rad.).

(c) Lateral displacement of the cassegrain mirror $\Delta\alpha_3$(mm): $\Delta\theta_3 = -7.02 \times 10^{-6} \, \Delta\alpha_3$ (rad.).

(d) Rotation of mounting tower $\Delta\alpha_4$ (rad.): $\Delta\theta_4 = 1.8 \, \Delta\alpha_4$ (rad.).

The lateral displacement of the phase center and the tilt of the foundation were not taken into consideration due to their relatively small magnitudes. The following table shows the beam displacement contributed by each individual mechanical component:

Wind Pitch Angle with $0°$ Yaw Angle	Individual Contribution of Pointing Error				Summation
	(a)	(b)	(c)	(d)	(sec.)
(degree)	(sec.)				
$0°$	+0.7	0.0	0.0	+3.1	+3.8
$60°$	+18.6	+1.9	-4.0	+2.2	+18.7
$90°$	-6.5	+2.2	-4.0	+0.7	-7.6
$120°$	-0.7	+1.9	-4.0	+1.3	-1.5
$180°$	+2.2	0.0	0.0	+2.0	+4.2

RMS   9.4 arc-sec.

For comparison, the wind pointing of two other telescopes of similar size, but different in design and in performance, are listed below:

30Km/h wind	VLA-25-m	mm Wave-25m	DSS-13-26m
Max. tilt of the best fit	21 sec.	10 sec.	
Max. tilt of the beam	28 sec.	19 sec.	36 sec.*
rms of beam displacement	14 sec.	9 sec.	18 sec.*

*Prorated from data given in "Performance of DSS 13 26-m Antenna at X-Band" by A.J. Freiley, JPL Deep Space Network Program Report 42-30.

WYW/jlt