12 METER MILLIMETER WAVE TELESCOPE
MEMO No. 207

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From: John W. Findlay

The situation at present is roughly that we have a telescope with a performance approximately half as good (in RMS) as the measurement system suggests. The reflector seems to be nicely axially--symmetric. We have already started on a program to improve both our knowledge and also the telescope. Let me note here what we are already doing and what we intend to do.

Task #1 Study the Circumferential Figure of the Reflector.

We have done this roughly with a sensor on the surface. On December 13 I measured 24 edge balls using the N III on the "yellow peril". The telescope was rotated; I put a sine curve through the numbers and got the following:

Best fit sine curve is

$$992 \times \sin(\theta_i + 139°) \qquad (1)$$

(Amplitude in μm corresponds to an azimuth axis tilt of 34 arc seconds. θ_i is the azimuth angle in reflector coordinates of the i th radius).

Table 1 below gives the edge-ball departures from this curve and also the differences (in the sense new-old) of these edge-ball heights since our four sets of observations made on September 23-28, 1982. I should note that these earlier measurements showed an agreement of about 20 μm (1σ) from run to run.

Table 1 Edge Ball Heights (December-September)

Edge ball #	Elevation September 23-28	Elevation December 15	Difference
52	-23 μm	- 12 μm	11 μm
46	-20	- 33	- 13
40	7	7	0
37	- 1	32	33
30	-24	- 71	- 47
25	7	- 24	- 31
19	-22	- 16	6
13	9	- 41	- 50
9	7	- 16	- 23
4	- 1	31	32
143	0	25	25
137	18	22	4
131	-32	-119	- 87
125	26	- 55	- 81
116	20	- 14	- 34
107	10	65	55
102	-31	- 14	17
97	1	- 9	- 10
92	- 8	- 82	- 74
88	9	- 48	- 57
83	30	47	17
79	21	- 45	- 66
69	- 6	- 60	- 54
60	- 9	101	110

We should note that the December 15 measures failed to close by 60 μm and I have taken this slope out in the table.

We also note several differences $>|50|$ μm. These are probably too big to be measurement errors.

I tested the measurement for astigmatism and found none to the ±20 μm level.

If we accept these larger differences as real there are two possible explanations:

(a) The edge of the telescope has changed shape.

(b) The azimuth bearing has roughness in it.

(b) is certainly possible. 110 μm at the edge is an angle of only about 4 arc seconds. But (a) also is possible, and we must test for it. So we shall re-measure all the 139 balls visible to us from the center.

To do this we must replace the N III in the center and make an observer's platform. I shall talk to Paul--we may not need to replace the original platform.

We need an "edge-ball extender". I have sent a sketch to S.S. and JMP. When we use this we shall work only slowly. How do we get it into place without rotating the telescope (to avoid (b) above)?

I have measuring plans to counteract the slow measuring speed.

I assume each one of you prefers the N III to using the mercury level of Pierre.

Once we know the edge-ball heights our next attempt at setting will tell us the reflector figure.

Task #2 Check all sources of radial measurement error.

1. Remeasure the Reference Jig

This is in hand two ways. We have set up the N III so that the overall elevation (center to edge) can be measured. We tested stepping briefly and have decided we need a larger-range inclinometer and an improved stepping bar. JMP has already started on these.

The second way (also mainly in JMP's hands) is to base all measurements on lengths referred to the H-P interferometer. This is being repaired and we hope we can keep it longer.

2. Small Checks

(a) We plan to run MEASURE into the PDP-11/40; this assumes JMP's look at hardware is OK. Thus we shall be forced to check all sensor calibrations--particularly #6 which may be doubtful.

(b) When we next re-set, let us set radius #45 which (by chance) never got set. I excluded it from the maps but J. C. Maxwell includes it in his work!

3. Any other suggestions?

I hope JMP can proceed with 2(a) above. It will speed up the measuring data. I plan to keep my programs SETTING and MATING in the Apple II for the present. MEASURE is basically a raw-data writing task and if needed I shall be happy to help with the program.