National Radio Astronomy Observatory
Tucson, Arizona

March 13, 1989

MEMORANDUM

To: D. A. Chase, T. Folkers, R. W. Freund, D. T. Emerson, and J. M. Payne

From: P. R. Jewell PRJ

Subject: Pointing Hysteresis

I have appended a EMail messages form Bob Martin relating some findings on a serious pointing hysteresis problem. I have confirmed with Tom Folkers that this effect really is happening. The problem may be worse if you brake the telescope and drive it around manually, then remeasure. Nevertheless, the problem seems to happen at some level even under conditions of smooth tracking. For example, if you measure the position of a star at 45° elevation, then drive the telescope to either the zenith or the horizon, then return to the star, the pointing is typically off by 6-7" in each coordinate compared with the initial measurement. For the data I have examined, the hysteresis loops appear to be 8-9" in azimuth and 6-7" in elevation.

What could be causing this? I would appreciate it if everyone would spend a little time thinking about possible causes. One obvious possibility is that something is loose. On the next Maintenance Day I would like for Bob to check the encoder/shaft couplings and for Dennis and Stan look about the telescope structure for anything that could be loose (e.g., feedleg mounts, guy wire tension, hub mountings). Remember that this effect was seen with the optical telescope, so things that effect only the radio beam (mirrors, etc.) are not relevant.

From: TUCVAX::RMARTIN 13-MAR-1989 00:41
To: PJEWELL,RMARTIN
Subj: 12m (mis)pointing

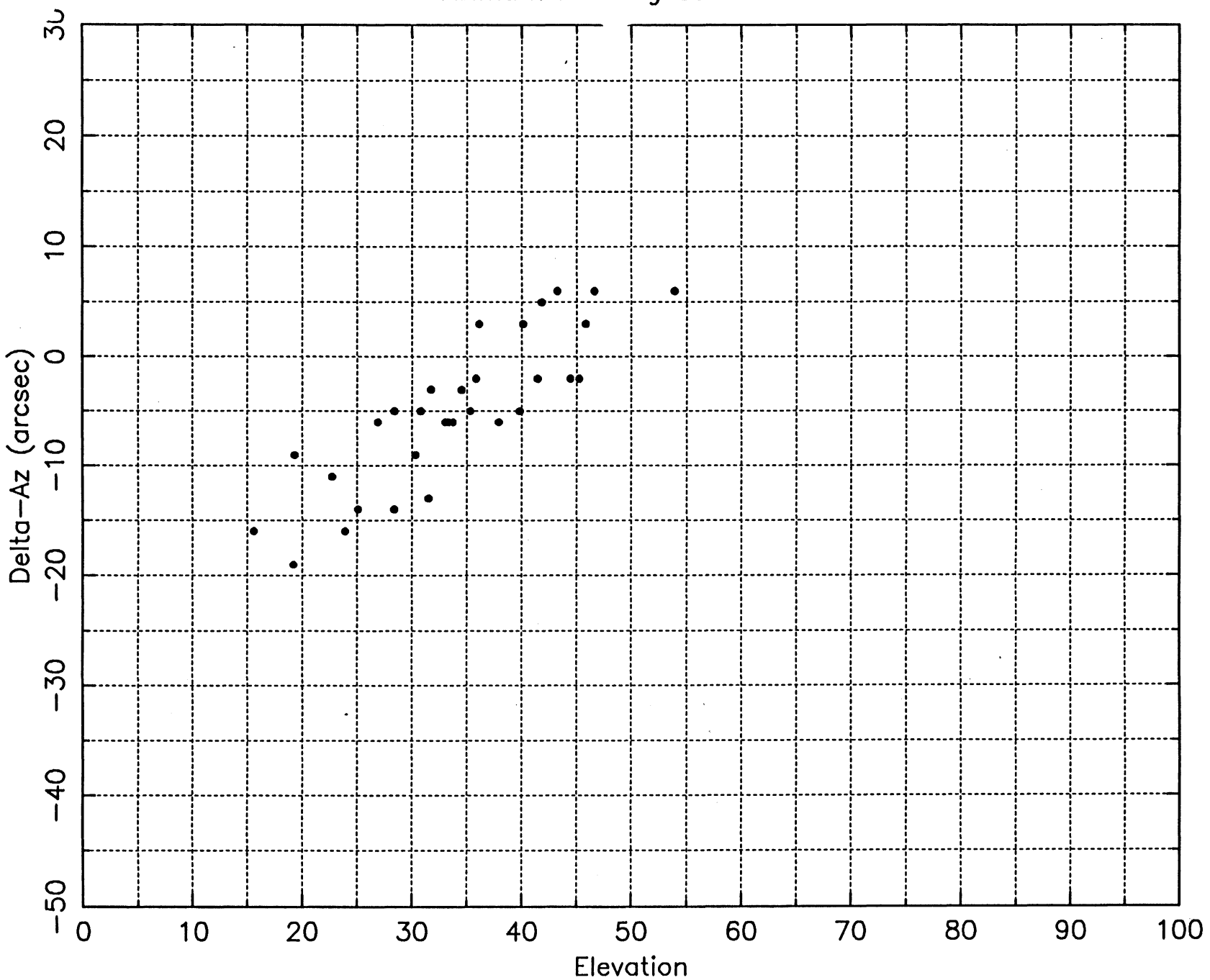
Yo.....Herrn Doktor Oberteleskopehofrat!

We spent most of today trying to understand the pointing problems, and we believe that we have run up against some serious problems. A long session with the optical pointing system this evening showed the following problems. If we do a pointing set on a group of sources such that we go from source to source in ascending elevation and then immediately repeat this in reverse order, we get hysteresis curves in the delta az and delta el versus elev plots. The magnitude of this effect is up to 20" at some elevations (40 degree elevation). A second test is to point on a star and then drive off the source by about 10 degrees in any direction. When we return to the star, the pointing is right on. Now if we do the same test but drive to the zenith and back, the pointing changes by about 10" in each coordinate. Going to 15 degree elevation and back will pop back at least one of the coordinates to the original value. We can try to shake the telescope to test if it is the mounting of the optical telescope, but it appears that this is a real telescope effect. The conclusio is that there is a pointing error of up to 1 beam at 345 GHz which depends on where the telescope drives from before tracking the source. You will appreciate that this makes life in the fast lane of NRAO submm astronomy a bit rough.....

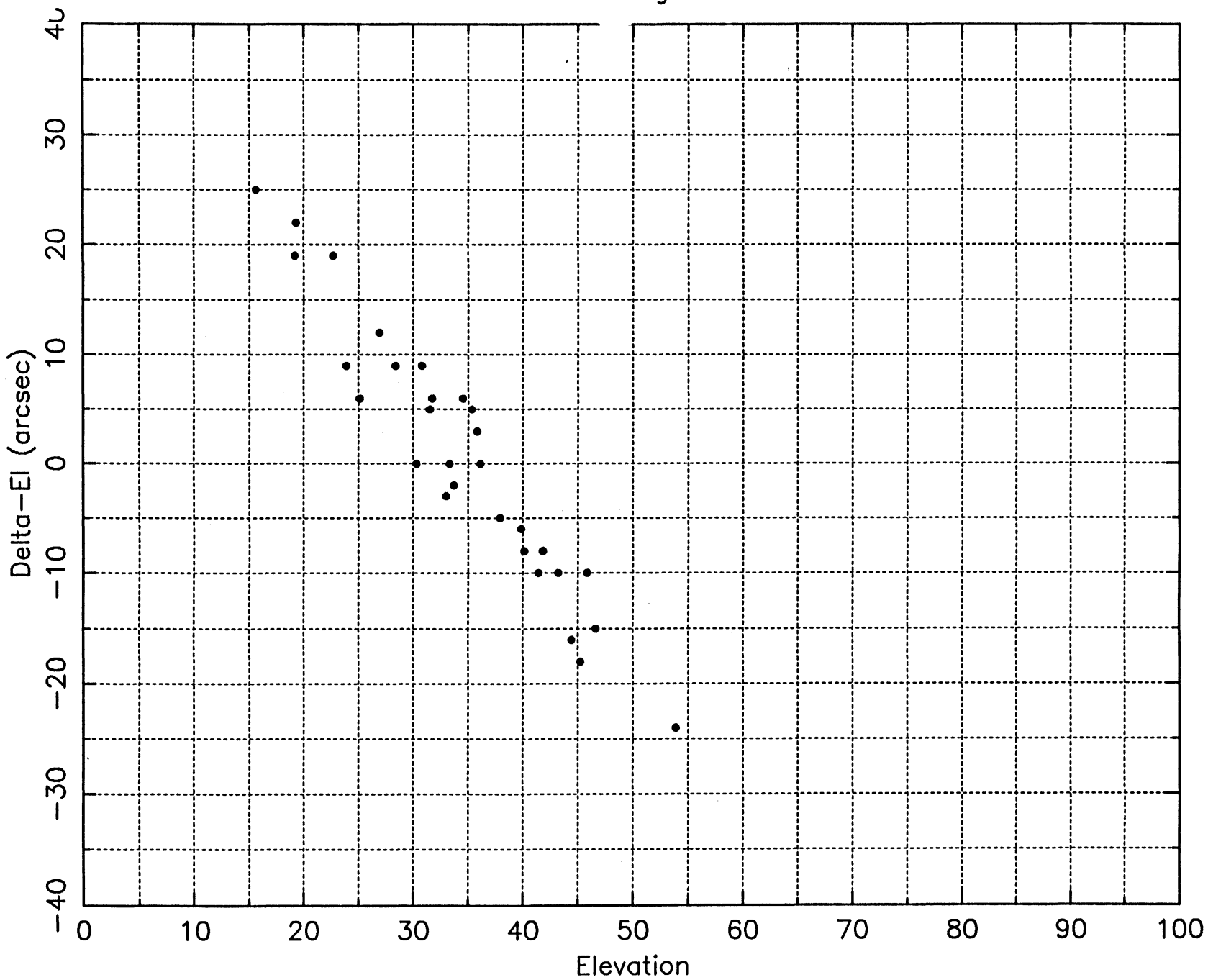
We are now (midnight) trying to repeat some of these tests with pointing at 3 mm, since we don't have any sources at 345 GHz and the weather is bad. Repeated FORTH (Frightening ORgnization of Telescope Handling) crashes have limited our efficiency.....We have hints of this effect in the 345 GHz pointing data.
I tried to call you earlier this evening, but you are obviously prepared for our infamous abuse - your phone was busy.

You might give Tom F. a call about this in the morning; he was extremely helpful in giving us a hand with this long after his shift was over. I'll talk with you in the morning; I promise not to bite (in the first 1 minute). Our resident Tong gang member was explaining today how the Aztecs used to remove peoples hearts when they were unhappy with them.....

Bob M.



NETOBS 13-MAR-1989 13:00


Elevation P ng Corrections
Delta-El (arcsec)
40
30
20
10
0
-10
-20
-30
-40
0
10
20
30
40
50
60
70
80
90
100
Elevation
NETOBS
13-MAR-1989 13:01

1	P0500-26M5	3	13	89	0.00000	OPT	0	219.600	19.300	-9.0	22.0	0	0.0	0.0	0.00	3:53	0.0
2	S0503-22M3	3	13	89	0.00000	OPT	0	221.700	22.700	-11.0	19.0	0	0.0	0.0	0.00	3:54	0.0
3	S0526-20M3	3	13	89	0.00000	OPT	0	218.300	26.900	-6.0	12.0	0	0.0	0.0	0.00	3:55	0.0
4	P0510-16M3	3	13	89	0.00000	OPT	0	224.700	28.400	-5.0	9.0	0	0.0	0.0	0.00	3:56	0.0
5	S0517-13M4	3	13	89	0.00000	OPT	0	225.500	31.700	-3.0	6.0	0	0.0	0.0	0.00	3:56	0.0
6	S0510-12M5	3	13	89	0.00000	OPT	0	227.200	30.800	-5.0	9.0	0	0.0	0.0	0.00	3:57	0.0
7	P0512-08M0	3	13	89	0.00000	OPT	0	230.800	34.500	-3.0	6.0	0	0.0	0.0	0.00	3:58	0.0
8	S0521-07M4	3	13	89	0.00000	OPT	0	229.100	36.100	3.0	0.0	0	0.0	0.0	0.00	3:59	0.0
9	S0515-06M4	3	13	89	0.00000	OPT	0	231.500	35.800	-2.0	3.0	0	0.0	0.0	0.00	3:59	0.0
10	S0505-05M3	3	13	89	0.00000	OPT	0	235.200	35.300	-5.0	5.0	0	0.0	0.0	0.00	3:59	0.0
11	P0521-02M3	3	13	89	0.00000	OPT	0	233.900	40.100	3.0	-8.0	0	0.0	0.0	0.00	4: 0	0.0
12	P0527-01M5	3	13	89	0.00000	OPT	0	233.900	41.800	5.0	-8.0	0	0.0	0.0	0.00	4: 0	0.0
13	S0529-00M3	3	13	89	0.00000	OPT	0	234.800	43.200	6.0	-10.0	0	0.0	0.0	0.00	4: 0	0.0
14	A0528+05M4	3	13	89	0.00000	OPT	0	241.200	46.600	6.0	-15.0	0	0.0	0.0	0.00	4: 2	0.0
15	P0522+06M2	3	13	89	0.00000	OPT	0	243.000	45.800	3.0	-10.0	0	0.0	0.0	0.00	4: 2	0.0
16	P0529+18M4	3	13	89	0.00000	OPT	0	257.500	53.900	6.0	-24.0	0	0.0	0.0	0.00	4: 4	0.0
17	P0522+06M2	3	13	89	0.00000	OPT	0	244.600	44.400	-2.0	-16.0	0	0.0	0.0	0.00	4: 9	0.0
18	A0528+05M4	3	13	89	0.00000	OPT	0	243.000	45.200	-2.0	-18.0	0	0.0	0.0	0.00	4:10	0.0
19	S0529-00M3	3	13	89	0.00000	OPT	0	237.400	41.400	-2.0	-10.0	0	0.0	0.0	0.00	4:11	0.0
20	P0527-01M5	3	13	89	0.00000	OPT	0	236.600	39.800	-5.0	-6.0	0	0.0	0.0	0.00	4:12	0.0
21	P0521-02M3	3	13	89	0.00000	OPT	0	236.700	37.900	-6.0	-5.0	0	0.0	0.0	0.00	4:12	0.0
22	S0505-05M3	3	13	89	0.00000	OPT	0	238.000	33.000	-6.0	-3.0	0	0.0	0.0	0.00	4:13	0.0
23	S0515-06M4	3	13	89	0.00000	OPT	0	234.600	33.300	-6.0	0.0	0	0.0	0.0	0.00	4:13	0.0
24	S0521-07M4	3	13	89	0.00000	OPT	0	232.500	33.700	-6.0	-2.0	0	0.0	0.0	0.00	4:14	0.0
25	P0506-08M4	3	13	89	0.00000	OPT	0	235.100	30.300	-9.0	0.0	0	0.0	0.0	0.00	4:15	0.0
26	P0512-08M0	3	13	89	0.00000	OPT	0	234.500	31.500	-13.0	5.0	0	0.0	0.0	0.00	4:15	0.0
27	P0509-11M5	3	13	89	0.00000	OPT	0	232.200	28.400	-14.0	9.0	0	0.0	0.0	0.00	4:16	0.0
28	P0510-16M3	3	13	89	0.00000	OPT	0	229.000	25.100	-14.0	6.0	0	0.0	0.0	0.00	4:17	0.0
29	S0526-20M3	3	13	89	0.00000	OPT	0	222.800	23.900	-16.0	9.0	0	0.0	0.0	0.00	4:17	0.0
30	S0503-22M3	3	13	89	0.00000	OPT	0	226.200	19.200	-19.0	19.0	0	0.0	0.0	0.00	4:18	0.0
31	P0500-26M5	3	13	89	0.00000	OPT	0	224.300	15.600	-16.0	25.0	0	0.0	0.0	0.00	4:19	0.0

$\Delta = 26^m$