NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO

VLA Test Memorandum No. 117

POINTING RUN - FEBRUARY 15-16, 1977

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Two twelve-hour periods of identical pointing runs were made on February 15-16 to check the consistency of the telescope pointing. Three sources, 3C84, 3C120 and 3C273 were observed in pointing mode at C and K-Bands.

1. Day to Day Pointing Consistency

Pointing observations were made for 3 sources at C and K-Band for telescope #2. The sources and frequencies were interleaved. A comparison of the two days are shown in Figure 1.

The difference in pointing between the two days appears to be a function of time with excursions of ~18" over several hours. This behavior is independent of the source (i.e., position in the sky) and frequency. The scatter about a smooth curve is $\smile \pm 4$".

Pointing observations of two days for telescope #6 at C-Band only are shown in Figure 2. In this plot we have shown the individual source observations. The scatter is larger here than for telescope #2; however, there is a systematic difference of ~12" in azimuth between the two days. No significant source dependence is suggested.

2. Frequency Dependence of the Pointing

The pointing offset between C and K-Bands were measured for telescope #2 and #1. It is expected the offsets should be constant. Results are given in Figure 3.

For telescope #2 the pointing offsets are reasonably constant over the two days with a scatter of ~8". For telescope #1, however, the C to K elevation offsets systematically changes by ~40" over ten hours. The change does not appear to be significantly source dependent but is temporal in nature. The difference is mainly caused by C-Band change in the elevation pointing. Unfortunately, telescope #1 operated on only one day. The azimuth behavior is quite good on telescope #1.

3. Beam Offsets Between Right and Left Circular Polarizing

The beam offsets were calibrated for several antennas and frequencies and are given below.

(R-L) POINTING POSITIONS (ARC-MIN)

	C-BAND						K-BAND			
	Elev.			Azim.			Elev.		Azim.	
Tel	#1	#2	#6	#1	#2	#6	#1	#2	#1	#2
Offset	-0.19	-0.23	-0.25	-0.53	-0.50	-0.52	-0.01	0.00	-0.11	-0.10
	±0.02	±0.02	±0.04	±0.02	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01

As expected, the offsets are nonvariable and scale roughly with wavelength.

4. Tentative Conclusions

With this limited data it is clear that the antenna pointing behaves in a variety of ways.

a) In telescope #2 and #6 there are temporal variations of azimuth and elevation of ~18" on a time scale of several hours to a day. Larger variations over longer duration are possible. These variations seem to be independent of frequency for telescope #2.

b) The elevation offset in pointing between two frequencies varied by ~40" over 10 hours for telescope #1. This offset change was temporal in nature and seems to be unrelated to detailed subreflector motion or position in sky. However, such an effect plays havoc with the determination of collimation differences between frequencies. The collimation differences between C and K for telescope #2 and azimuth #1 was well behaved, i.e., constant with a scatter of ±10".

c) The Right-Left point difference is very stable and

virtually identical for each telescope. It does not scale precisely with observing wavelength.

These results suggest that most of the pointing problem is temporal in nature and may be related to heating effects on dish and subreflector, encoder drifts..... Detailed subreflector motion errors do not appear to be important.

5. Half-Power Beam-widths

The beam-width at K-Band is anomalous for antenna #1. The following table shows the derived half-power width.

HALF-POWER BEAM-WIDTHS (ARC-MIN)

Telescope	Freq.	Elev. Width	Azim. Width
1	C	8.9	9.3
1	K	1.4!	1.9
2	C	9.1	9.0
2	K	1.9	1.9
6	C	9.2	9.2

6. K-Band Elevation Dependence

Baseline 2-4 shows a well-defined gain - elevation dependence. Observations of two days were combined with three sources each scaled inversely by their flux density ratio. This plot is shown in Figure 4. The scatter about a mean line is ~5%. The dependence shows a marked decrease for elevations less than 25%, a peak sensitivity at 40^{o} - 50^{o} elevation and a moderate drop towards zenith. The drop off at low elevation is about equal to q≈10% atmospheric attenuation $(1+q \sec z)/(1+q)$.

Baseline 2-1 shows a much poorer gain - elevation dependence. This is anticipated by the strange K-Band beam shape for telescope 1 discussed in Section 5. There is an azimuth dependence of the "gain - elevation" behavior.

Correction for system temperature changes have not been investigated.

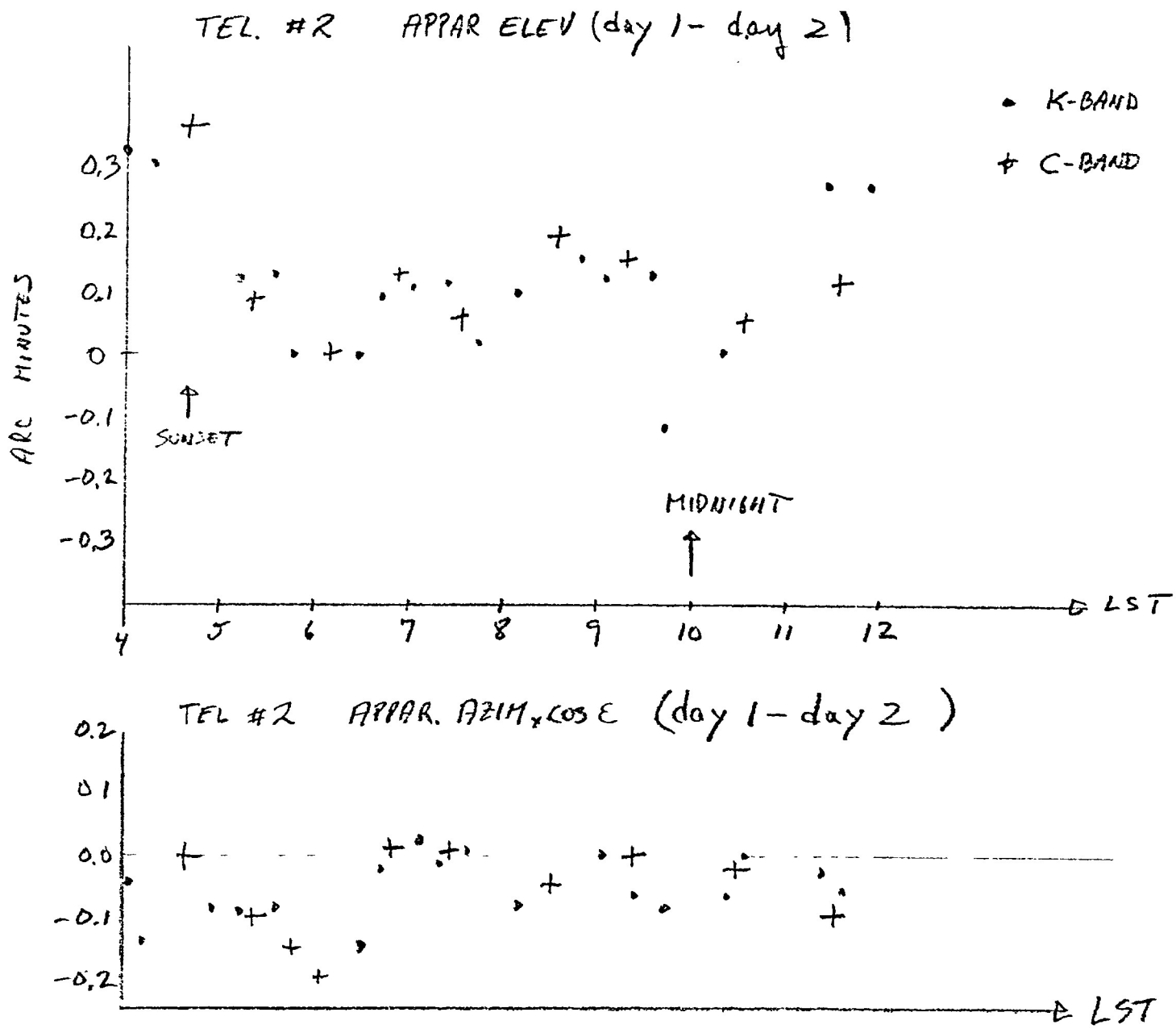
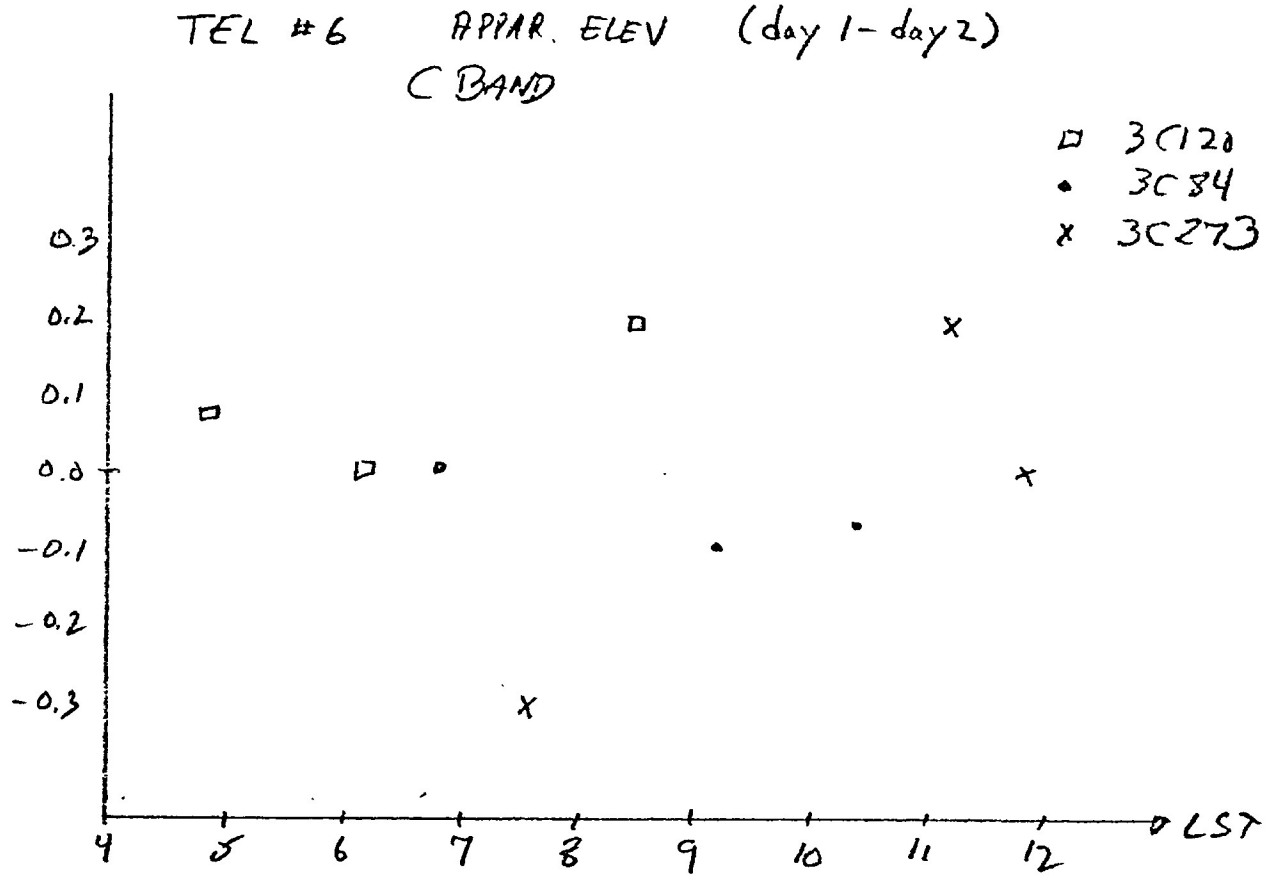

TEL. #2 APPAR ELEV (day 1 - day 2)
K-BAND
C-BAND
ARC MINUTES
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
SUNSET
MIDNIGHT
LST
4
5
6
7
8
9
10
11
12
TEL #2 APPAR. AZIM x cos ε (day 1 - day 2)
0.2
0.1
0.0
-0.1
-0.2
LST

Fig. 1


TEL #6 APPAR. ELEV (day 1 - day 2)
C BAND
3C120
3C84
3C273
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
4
5
6
7
8
9
10
11
12
LST

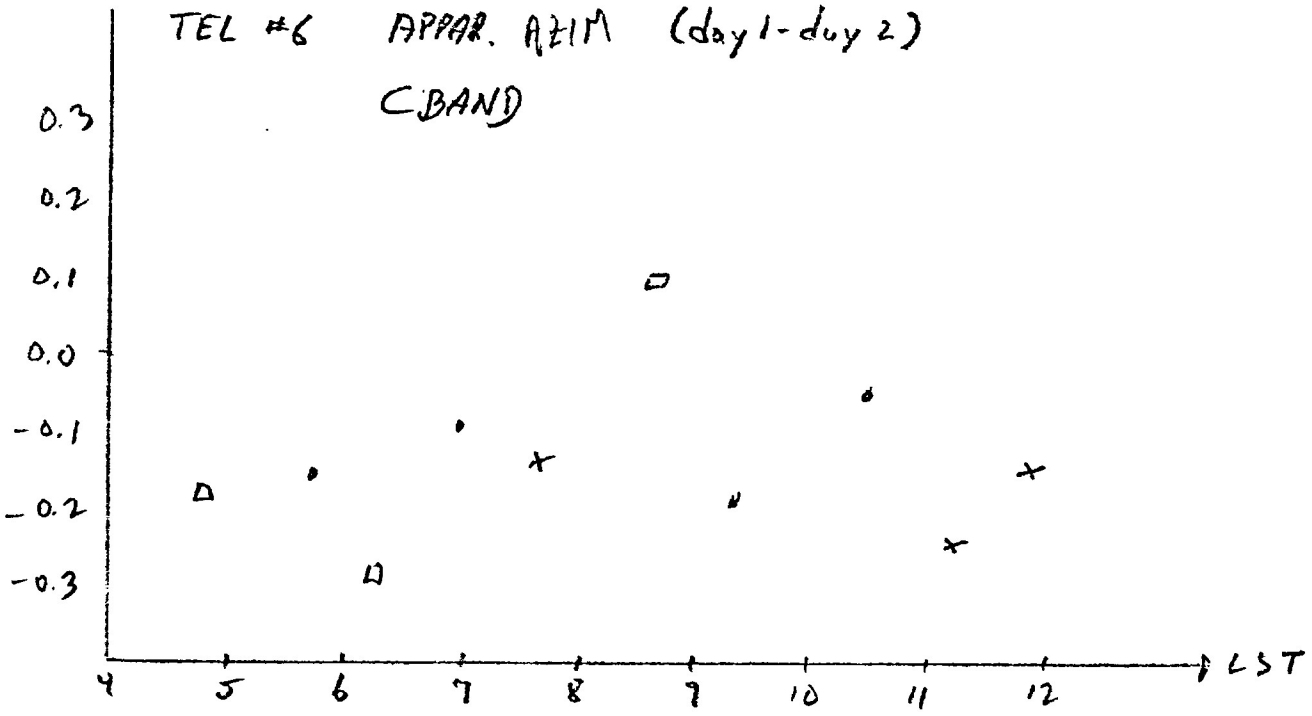

TEL #6 APPAR. AZIM (day 1 - day 2)
C BAND
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
4
5
6
7
8
9
10
11
12
LST

Fig 2

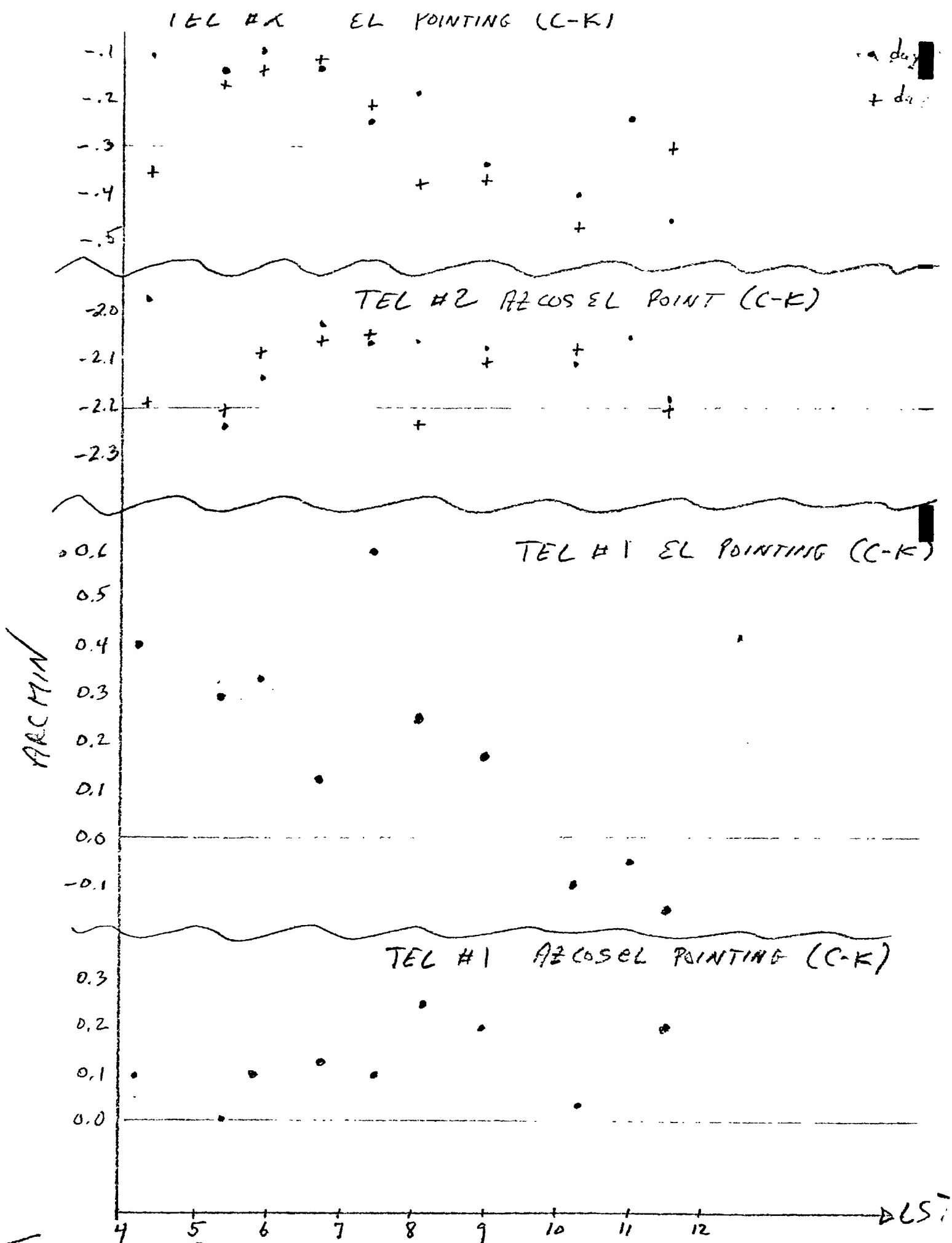

TEL #2 EL POINTING (C-K)
-.1
-.2
-.3
-.4
-.5
TEL #2 AZ COS EL POINT (C-K)
-2.0
-2.1
-2.2
-2.3
TEL #1 EL POINTING (C-K)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
ARCMIN
TEL #1 AZ COSEL POINTING (C-K)
0.3
0.2
0.1
0.0
4
5
6
7
8
9
10
11
12
LST

FIGURE 3

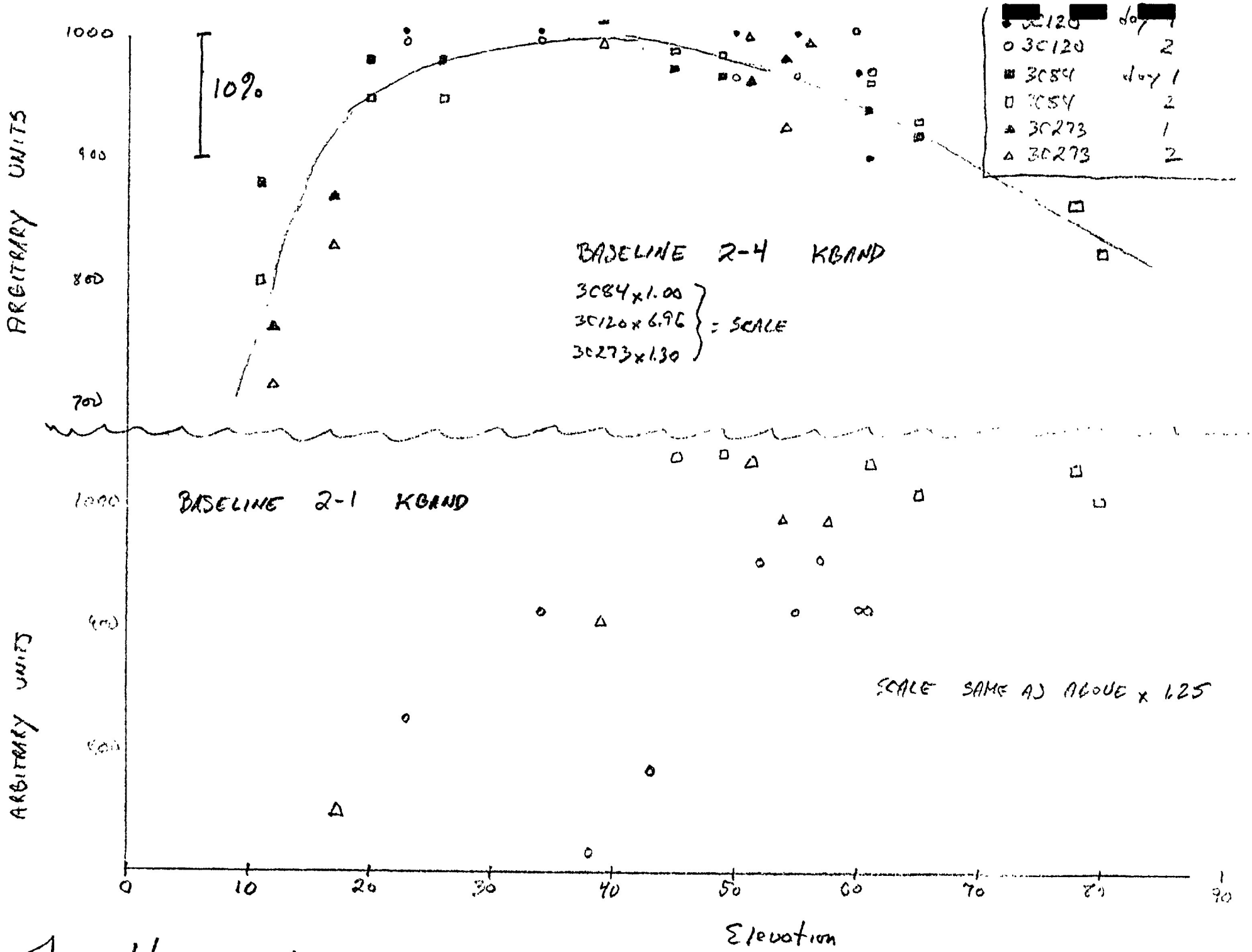

1000
900
800
700
ARBITRARY UNITS
10%
3C120 day 1
3C120 2
3C84 day 1
3C84 2
3C273 1
3C273 2
BASELINE 2-4 KBAND
3C84 x 1.00
3C120 x 6.96
3C273 x 1.30
= SCALE
BASELINE 2-1 KBAND
SCALE SAME AS ABOVE x 1.25
ARBITRARY UNITS
0
10
20
30
40
50
60
70
80
90
Elevation

Fig 4