VLBA TEST MEMO NO. 32

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April 14, 1992

To: VLBA Test Memo Series
From: Craig Walker
Subject: Los Alamos Phase Cal Variations

The attached memo from Arthur Neill and Alan Rogers describes periodic variations that they have noticed in the phase cal measurements at Los Alamos in a CDP R&D observation. Durga Bagri has been studying phase cal vs time lately and has seen similar effects at more than one site including LA. The phase variations scale with first LO frequency at 4 and 13 cm (this is rather different than the ratio of RF frequencies). They do not scale with IF frequency. This suggests that the variations are in the first LO. The variations are not seen in the 500 MHz round trip phase measurements but are very well correlated with the temperature of the C rack in the maser room which also shows cyclic variations. These characteristics effectively isolate the problem to the 500 MHz LO transmitter signal. Not all sites show the effect at same level (Los Alamos seems worst out of LA, PT, FD) and the module in the test rack at the AOC is not very temperature sensitive so final diagnosis awaits tests at one of the affected stations and/or more tests in the lab.

f:\randd\la_pcal.rpt

April 8, 1992

To: Craig Walker
From: Arthur Niell and Alan Rogers

Subject: Los Alamos phasecal phase variations

After the correltaion of an experiment a set of summary plots of delay (both singleband and multiband), rate, and phasecal phase (difference in phase between highest and lowest frequency) are generated to assess the quality of the data and to look for problems. In the summary plots for the CDP R&D92-2 experiment (DOY 35-36) a quasi-periodic variation in the difference of phase between the highest and lowest X-band frequencies is quite apparent with a timescale of about 40 minutes (see figure 1). This was one of the first time a new program called *aedit* has been used for plotting the diagnostics, and the higher resolution of the plotting allowed the variation to be easily seen. I looked back through previous R&D experiments and the variation is there as far back as 1991 June, although the the magnitude may have been smaller then.

Figures 2 through 5 display the phase cal phases and phase differences for all channels of X- and S-band for a three hour period beginning about eight hours into the experiment.

Figure 2: X-band phasecal phases for Los Alamos for the five frequencies common to Los Alamos and Mojave (Mojave lost one track for this experiment).

Figure 3: difference of phasecal phase between other BBCs and the lowest X-band frequency. The three higher curves correspond to differences between upper and lower sideband BBCs, while the lowest curve is for the difference between two upper sideband BBCs.

Figure 4: Same as figure 2 except for S-band.

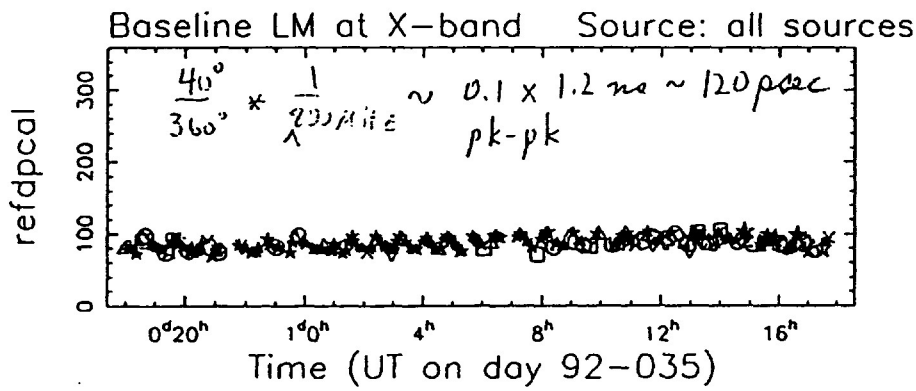
Figure 5: Same as figure 3 except for S-band. Also, the difference between the two highest frequencies is also shown since it represents the smallest difference in baseband frequencies.

At X-band the peak-to-peak phase variation with time is $\sim 150°$ in all five frequency channels (figure 2), and there is clearly a difference in the magnitude of the variation of about 20° between BBCs connected to different LOs (figure 3). Thus, it appears that the largest effect is due to differential change in the two X-band LOs. However, there is also a smaller effect that shows up for the frequencies with a common LO, such as the 8352-8212 difference.

At S-band the phase change with time is $\sim 40°$ (figure 4); the variation in the differenced phases (figure 5) is only about 5°, peak-to-peak, but for the times when the phases are largest, the largest frequency separation has the largest phase change. Since all frequencies have a common LO, this variation is similar to that seen for the X-band with common LO. Since the common LO differences scale with frequency, they are delay-like; however, they are also approximately monotonic with BBC frequency.

Although these variations are probably compensating for equivalent changes in the observed group delays, it is valuable to reduce their magnitude in order to be able to recognize and diagnose other problems which these may obscure. All of the total and differential phases at S- and X-band are in phase which suggests a common source. The cyclic behavior is suggestive of a temperature effect. Is a record of the temperatures in the vertex and control rooms kept?

Let us know if there is something else we should look for.



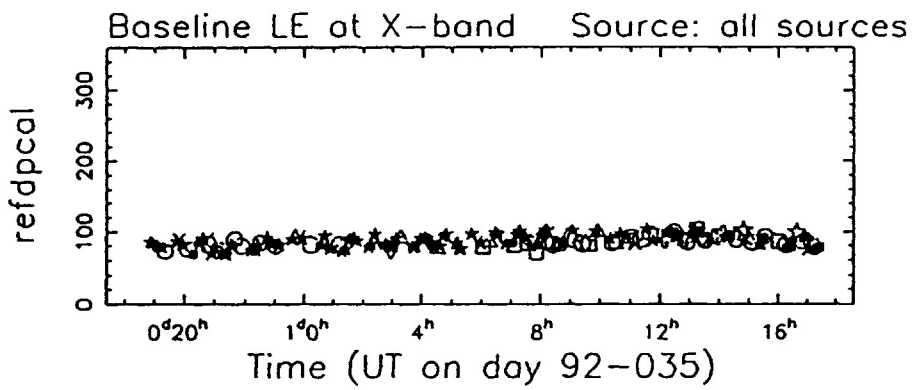


figure 1

both are $\phi^{pcal}_{8932} - \phi^{pcal}_{8212}$

for Los Alamos, but ~~first~~ for scans on different baselines

L = Los Alamos
M = Mojave
E = Westford

X-band phase cal phase at Los Alamos

R&D 92-2

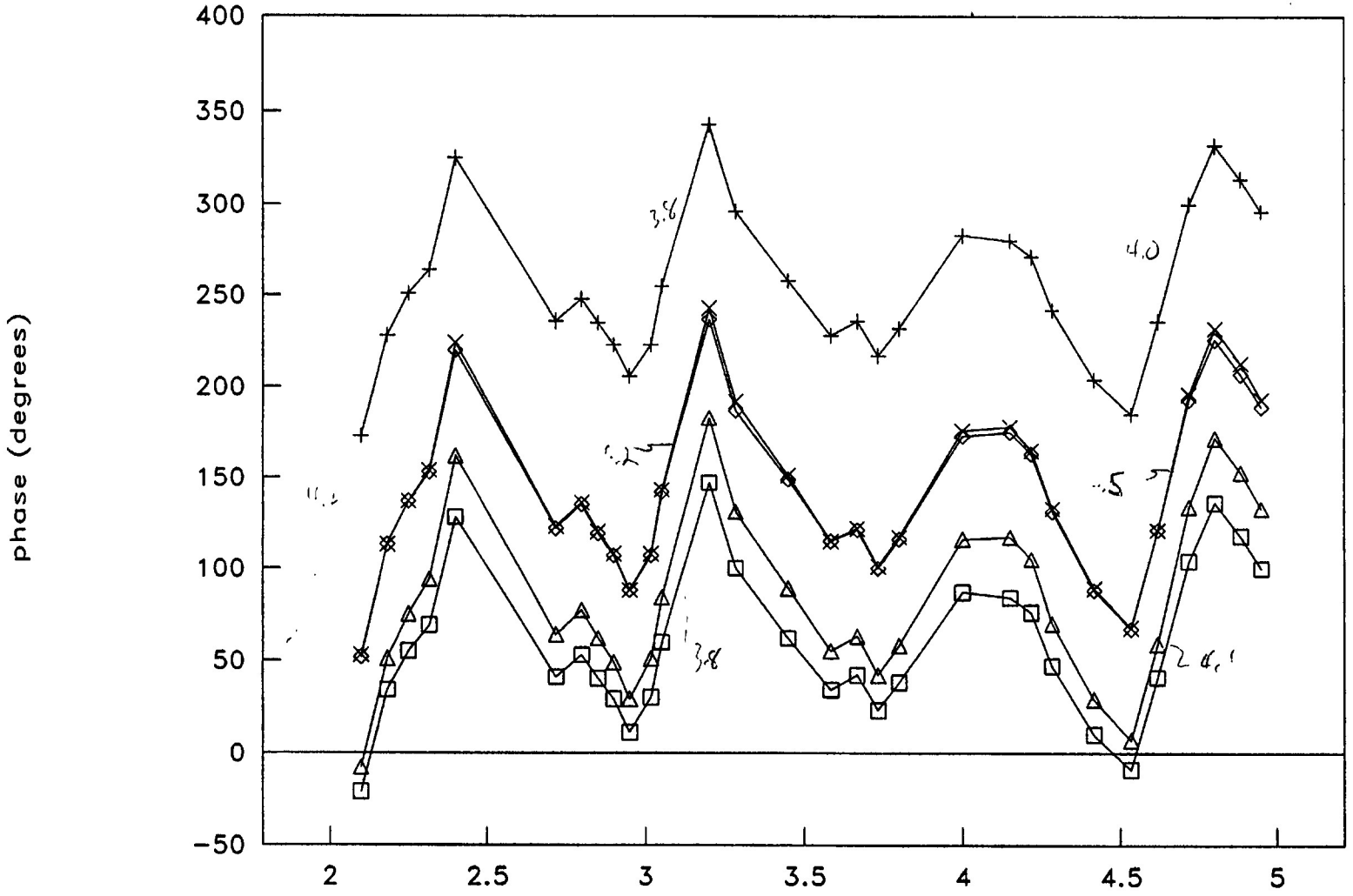
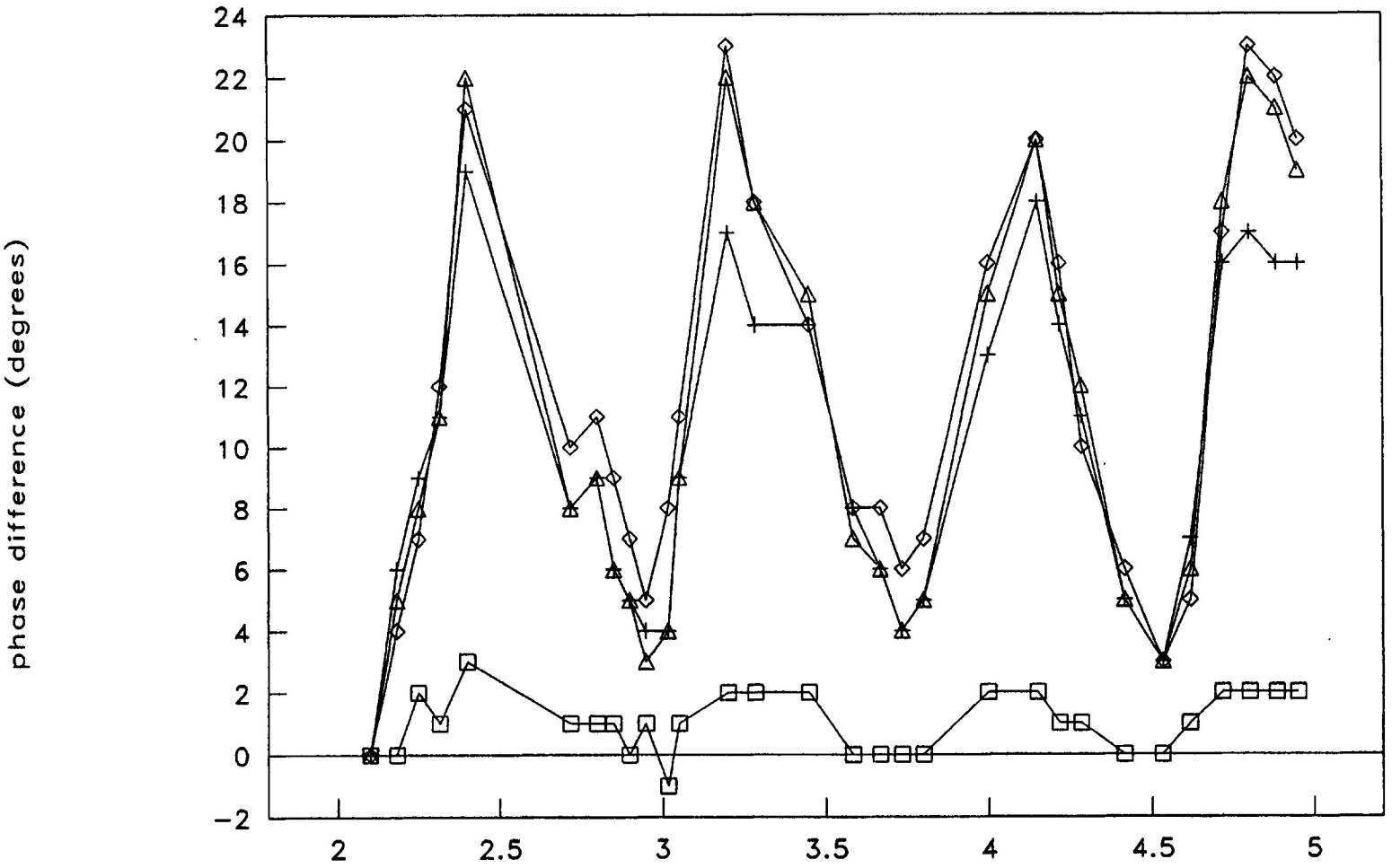


Figure 2

X-band phase cal phase at Los Alamos

R&D 92-2



U-U L-U L-U L-U

140 520 700 720

Figure

S-band phase cal phase at Los Alamos

R&D 92-2

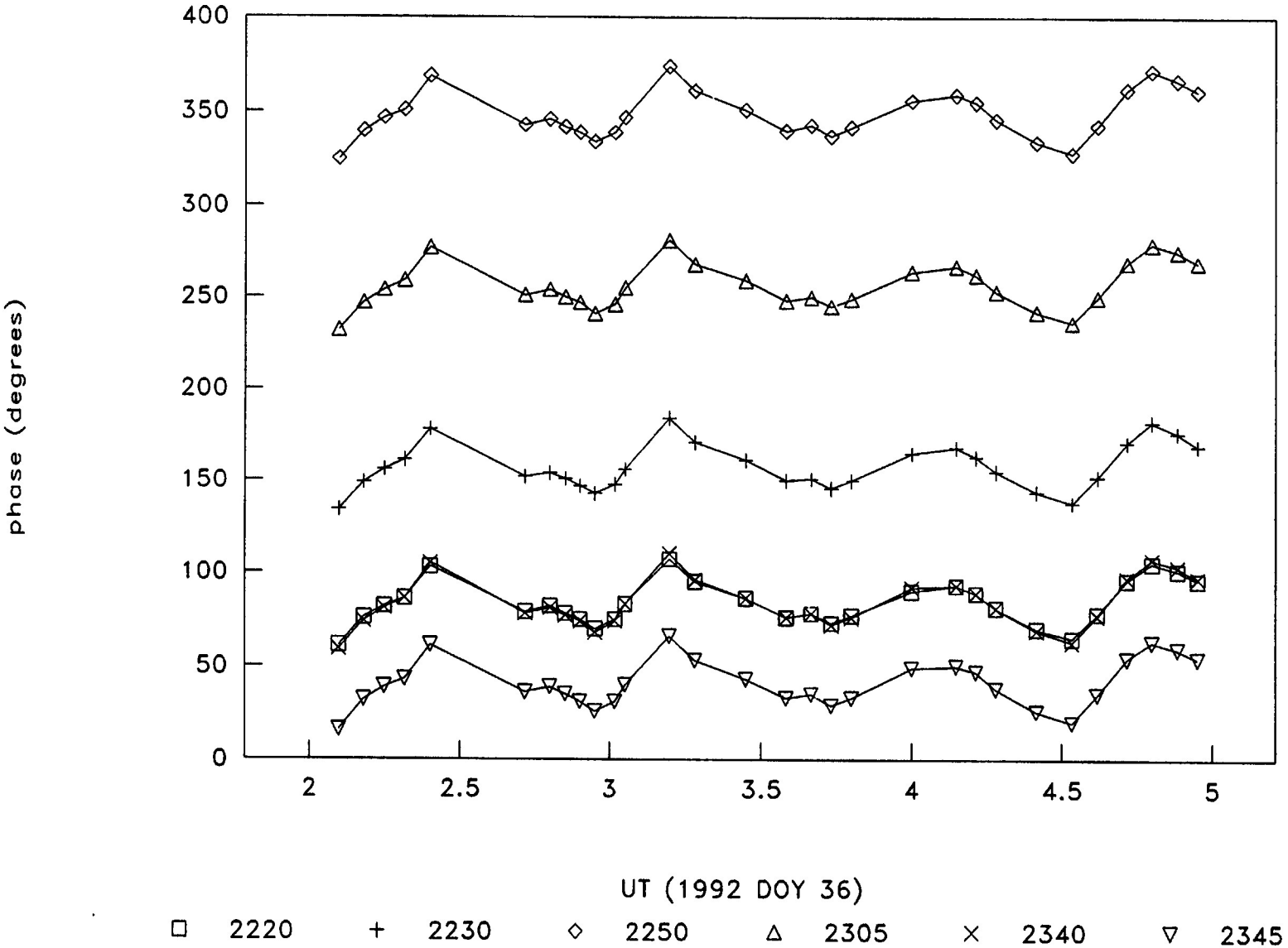


figure 4

S-band pcal phase diff at Los Alamos

R&D 92-2

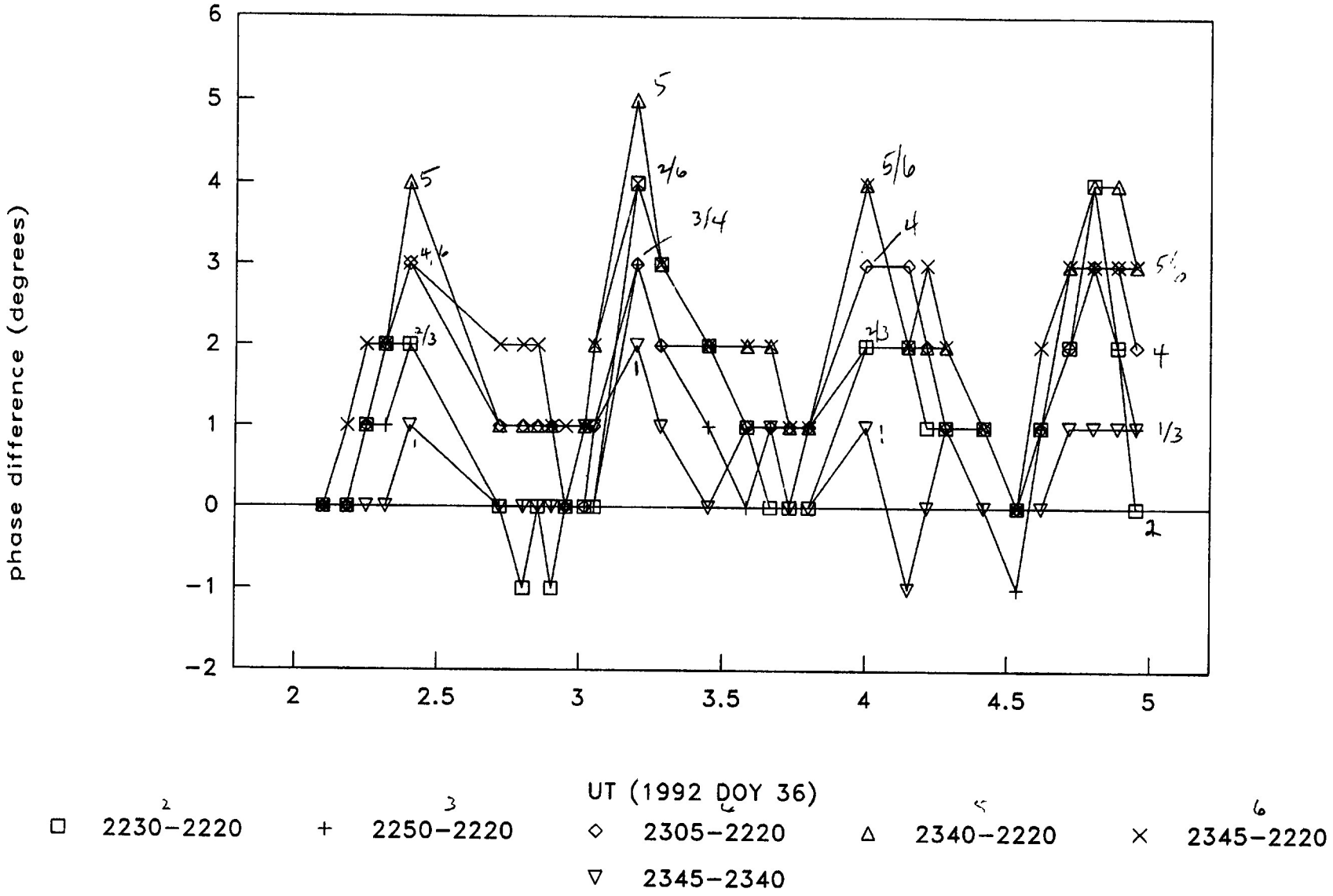


figure 5