REPORT ON REASONS FOR PHASE JUMPS SEEN IN THE LOCAL OSCILLATOR

1.0 Introduction:

Controlled experiments were conducted last week in the E-lab at Pune to study the reasons for phase jump seen at C9 by Pramesh. This write-up is punched into my PC as I analyse the data collected and ideas form in my mind and hence may not be very friendly to others. You are welcome to ask any clarifications.

2.0 Description:

A GPIB+ADC data acquisition program was written by Som and me, which acquires five different types of data each second; averages 10 data points and records the same in a file with extension ".RAW". Details of any **ABRUPT CHANGES** noticed as recording is in progress is written in another file with extension ".STA". The name of both the files is defined by the user. The data collected are from:

(a) HP Vector Voltmeter 8508A Channel B/ Channel A power through GPIB. Signal connected to Channel A is Marconi 2031 Signal Generator at 600 MHz, +10 dBm power running on an external referance of 5 MHz ["E-lab(Pune) Frequency Referance"]. Signal connected to Channel B is 600 MHz First LO synthesised using MCM2.
Abrupt change is defined to have occured if the average of B/A power exceeds the default by > +-0.01 dB. When this happens, the default gets updated to current value. The change occurs when First LO goes out of lock by just a few 10s of Hz for 10 seconds/ Slow drift in power levels of A or B by +- 0.01 dB.

(b) HP Vector Voltmeter 8508A (Channel A - Channel B) phase. Signals are as in (a) above.
Two levels of **Abrupt change** are defined:
Drift, if the phase goes beyond 10 degrees from default.
Jump, if the phase goes beyond 11 degrees from default.
When a Jump or Drift takes place, the default gets updated to current value.
When Jump gets asserted, the condition is similar to what Pramesh noted at C9. Assertion of Drift is not serious.

(c) Tektronix Oscilloscope 2465, to monitor temperature at any point through GPIB. For the data acquired, the temperature was measured in the D48 PIU mounted in the A33 rack at E-lab, above the LOSDS unit.
Preliminary measurements with the temperature probe taped on top of the T-8 table in E-lab showed similar behaviour as explained later in the analysis.
The Oscilloscope is ALSO used to manually record the drift in the 1 MHz signals. The scope is triggered using 1 MHz from the LO Referance Master. 1 MHz TTL level signal, regenerated in A09 system of LOR located in A33 rack is given to Channel 1. 1 MHz ECL level signal in LOSDS chassis is fed to Channel 2. Scope is set to delayed time base mode. Drifts of the order of +- 25 nS can be recorded with an accuracy of 0.25 nS.

(d) HP Vector Voltmeter 8405A Channel B/ Channel A power through ADC. Signal connected to Channel A is 105 MHz from E-lab LO Referance Master. Signal to channel B is 105 MHz regenerated in A09 ABR system located in A33 rack.

(e) HP vector voltmeter 8405A, (Channel A - channel B) phase, through GPIB. Signals are as in (d) above. Calibration is 0.0273 counts/ degree phase.

3.0 Recording done:
The results of the recording done from 16:40 hrs on 11/02/95 to 06:45 hrs on 12/02/95 are analysed in this report.

4.0 Results and Interpretation:

4.1 Temperature:
Plot enclosed as Figure 1. Varied from 30.7 to 29 degrees. Cyclic change after about 23:00 hrs. Attributed to the air condititioner turning OFF and ON. Till 23:00 hrs, compressor was ALWAYS ON because E-lab temperature was HIGHER than outside.

4.2 105 MHz phase:
Plot enclosed as Figure 2. X-scale is same as in 4.1. Cyclic changes, attributable to temperature clearly seen. Phase changes by ~ 0.225 degree/ deg. C. Conclusion: Changes seen are more likely due to temperature effects on cable linking "CEB" and "ABR" as the PIUs of LOR are fully sealed.

4.3 600 MHz phase:
Plot enclosed as Figure 3 for the full period. Figure 4 is expanded from Figure 3 to see from 21:56 to 22:30 on 11/02/95
Kink marked A in Figure 3 does not have a ready explanation. Unlocking of LO around 22:15 hrs for about 5 minutes can be seen in Figure 4. This has happended when the temperature is between 29.9 and 30.1 deg. C. The effective "jump" of 80 deg in phase before and after event B does not have a ready explanation. Events C to I are jumps of ~102 degrees, which is explained by earlier hypothesis of JUMP at 600 MHz == [FRAC (600/105)] * 360 degrees. Clear correlation between temperature and jumps C to I. For eight cycles in temperature, there are only 3.5 cycles of phase jumps.
The time of occurance and the signature resembles the observations at C9 by Pramesh to a high order of similarity.

4.4 600 MHz power ratio:
Plot enclosed as Figure 5 for the whole period. The signature is more of slow drift than out-of-lock, indicating that the jitter was of a small magnitude for the recording to register.

4.5 STA file:
The STA file for the recording is enclosed as Table 1.
Columns 2 gives the Occurance Number and 4, the default value for comparison after the time as in Column 1 for 2.0(a) described above. The statistics agree with inferance in 4.4

Columns 2, 3 and 5 are to be read together with the time for statistics of phase, as described in 2.0(b) above. Ststistics agree with inferance in 4.3.

4.6 Drift at 1 MHz:
Following is extracted from the Lab record book:

Date	Time	LOR delay	LOS delay	Remarks
11-02-95	17:10	0	0	Arbitarary start
	19:17	-0.75 nS	-1.75 nS	
	20:16	-0.75 nS	-1.50 nS	
	22:11	-2.25 nS	-4.00 nS	
12-2-95	05:45	-5.75 nS	-11.00 nS	
	06:15	-5.50 nS	-12.50 nS	
	06:56	-6.00 nS	-13.00 nS	
	07:29	-6.50 nS	-14.00 nS	
	07:57	-5.75 nS	-10.75 nS	
	08:10	-6.50 nS	-14.50 nS	
	09:27	-7.25 nS	-15.00 nS	
	11:25	-7.50 nS	-15.50 nS	
	14:09	-6.00 nS	-11.75 nS	
	15:28	-1.00 nS	-9.50 nS	

The inferance is: There are two independant variations, first in LOR which is primarily due to cable linking "CEB" and "ABR" and the second, due to inadequate thermal transfer in D48 PIU of LOS.

5.0 Conclusion:
The exercise has helped in in-depth understanding of the system.

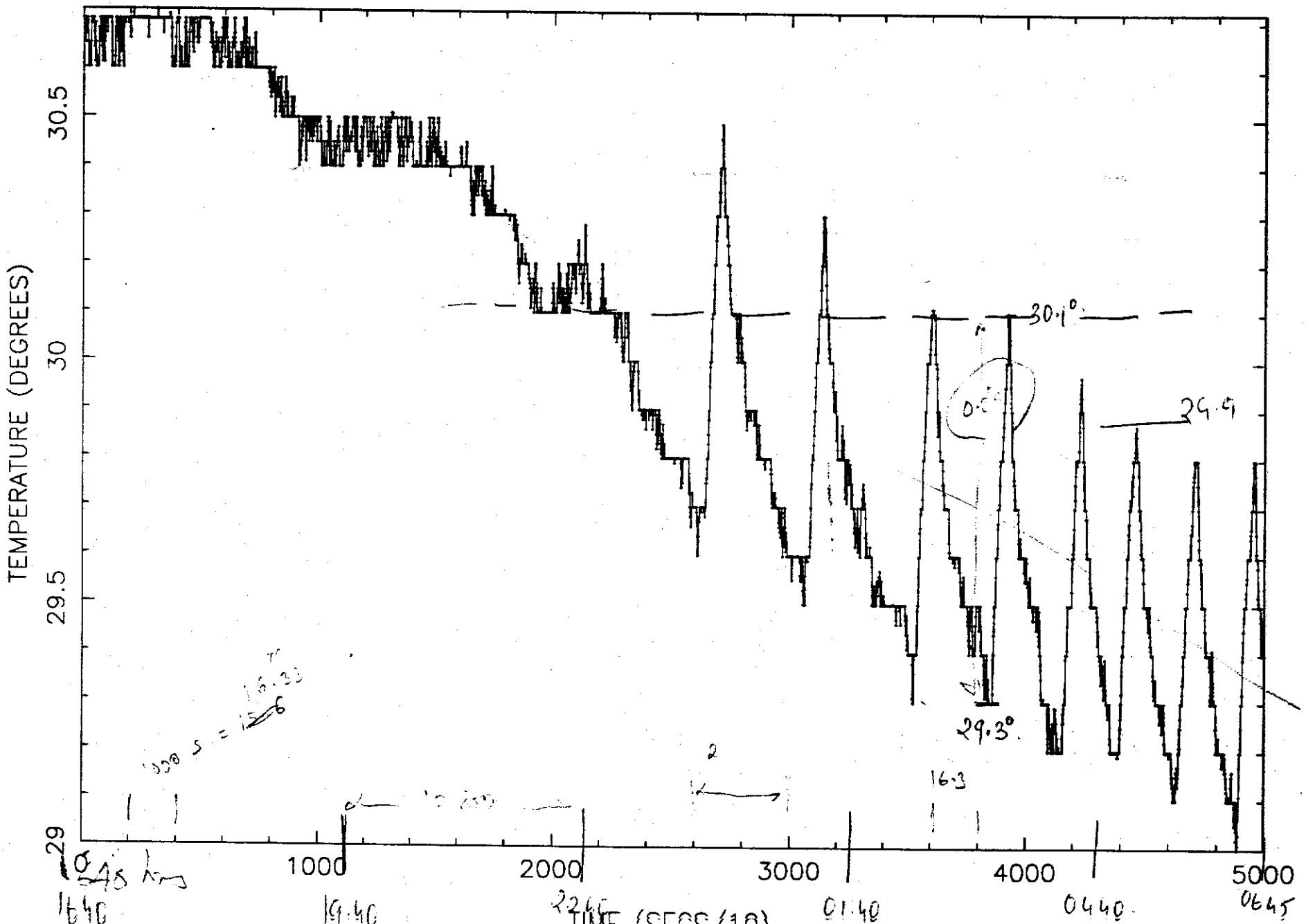
The LOR system with in the PIUs seems to be quite robust.
The ABR rack must not be left open during observation. Reliable working of the split air conditioner at each antenna is extremely important and essential. The cables which are exposed at each antenna will need a ThermoZip or similar covering.
Inadequate thermal transfer in D48 PIU of LOS will improve with the final chassis having Chomerics thermal sheet and heat sink fins. At present, the PCB is exposed in an open chassis. The fan tray is located with one sub-rack gap.
It appears that the LOR round-trip measurement must have a sensitivity of around 0.1 degree (resolution of 0.01 degrees).

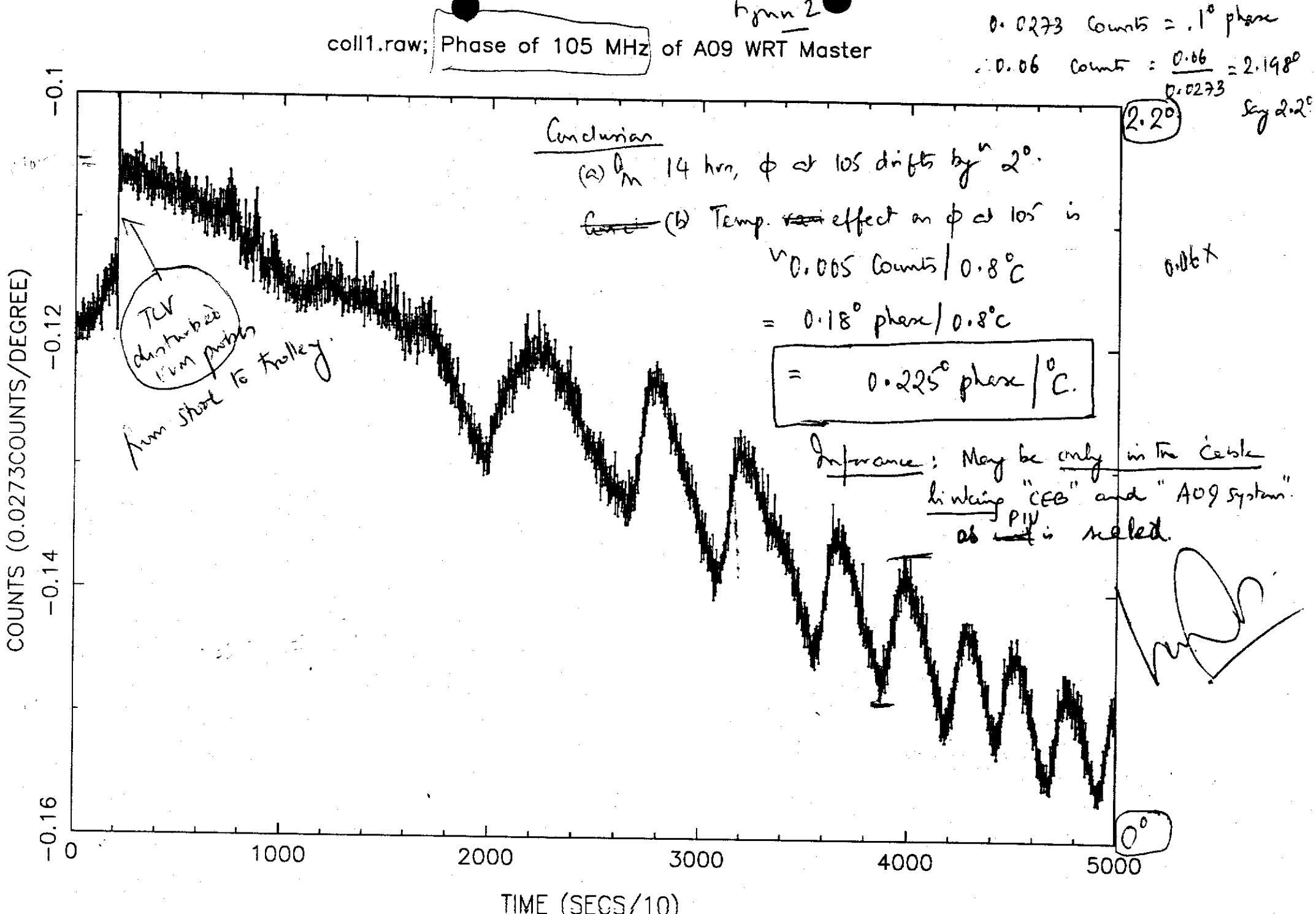
6.0 Concluding remarks:
The recording is continuing now and will be stopped on 13/2/95 09:00 hrs, unless Prof. GS/ SAK/ Sarmaji suggest additional expts I might have missed.
Program will be updated to include delay into automatic acquisition.
Expt. will be re-run after a few weeks when the final D48 PIU is available.

Plots of data collected from 06:55 hrs of 12/2/95 to 08:50 hrs of 13/2/95 are enclosed as figures 6 to 10 with out any analysis.

Figure 1.

coll1.raw TEMPERATURE AT SPACE ABOVE SDS UNIT



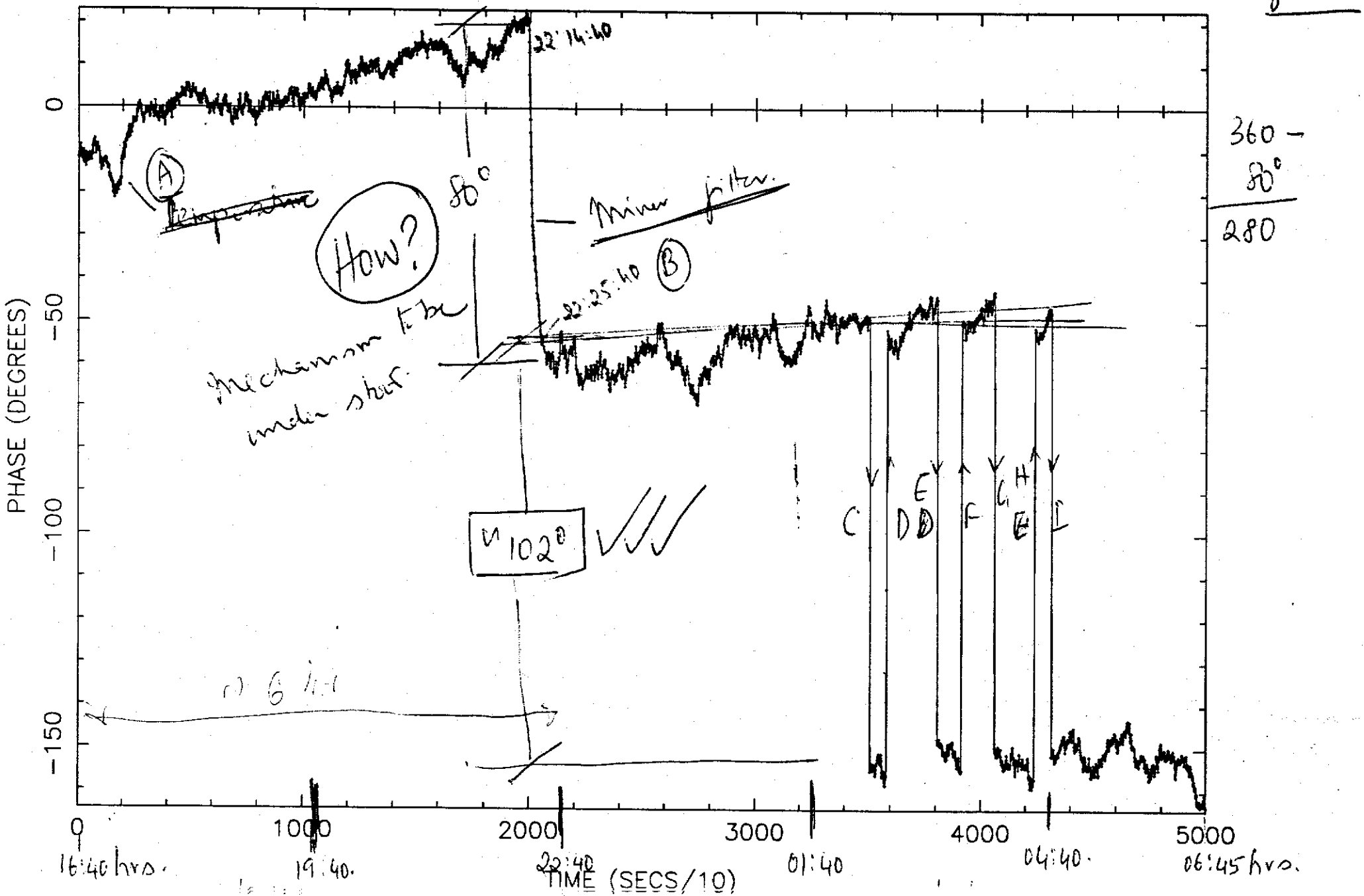

coll1.raw; Phase of 105 MHz of A09 WRT Master
COUNTS (0.0273COUNTS/DEGREE)
TIME (SECS/10)
-0.1
-0.12
-0.14
-0.16
0
1000
2000
3000
4000
5000
TCV disturbed from probes
Arm short to trolley
Conclusion
(a) In 14 hrs, φ at 105 drifts by ~ 2°.
(b) Temp. effect on φ at 105 is
~ 0.005 Counts / 0.8°C
= 0.18° phase / 0.8°C
= 0.225° phase / °C.
Inference: May be only in the cable linking "CEB" and "A09 system" as PIV is sealed.
0.0273 Counts = .1° phase
∴ 0.06 Counts = 0.06 / 0.0273 = 2.198°
Say 2.2°
2.20
0.0b X
0°

605 MHz

coll1.raw Phase of Marconi vs. MCM2 11-02-95 16:40 to 12-02-95 06:45

Mauro.

figure 3



coll1.raw Phase of Marconi vs. MCM2 yy-02-95 pp:qq to zz-02-95 rr:ss

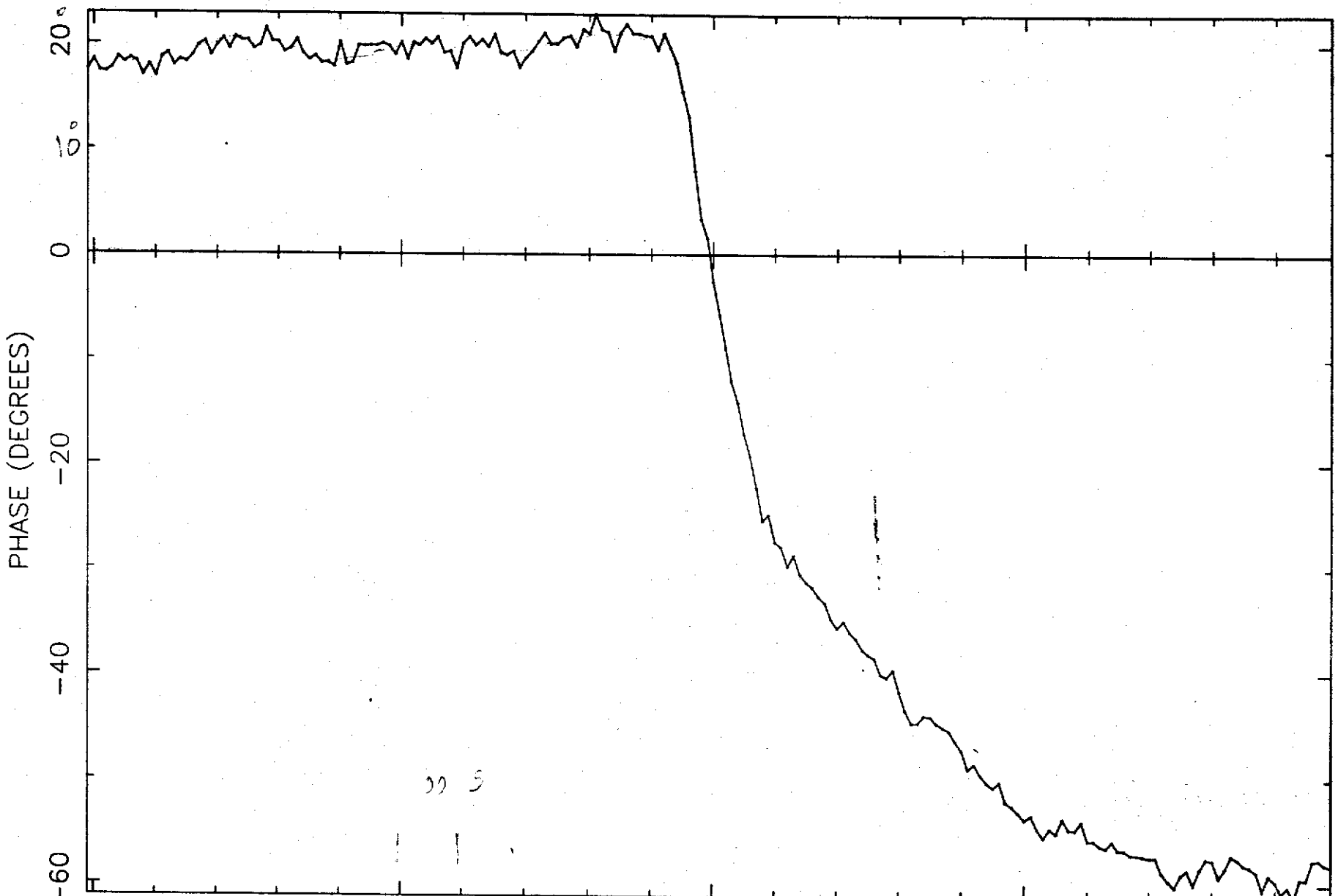


Figure 5.

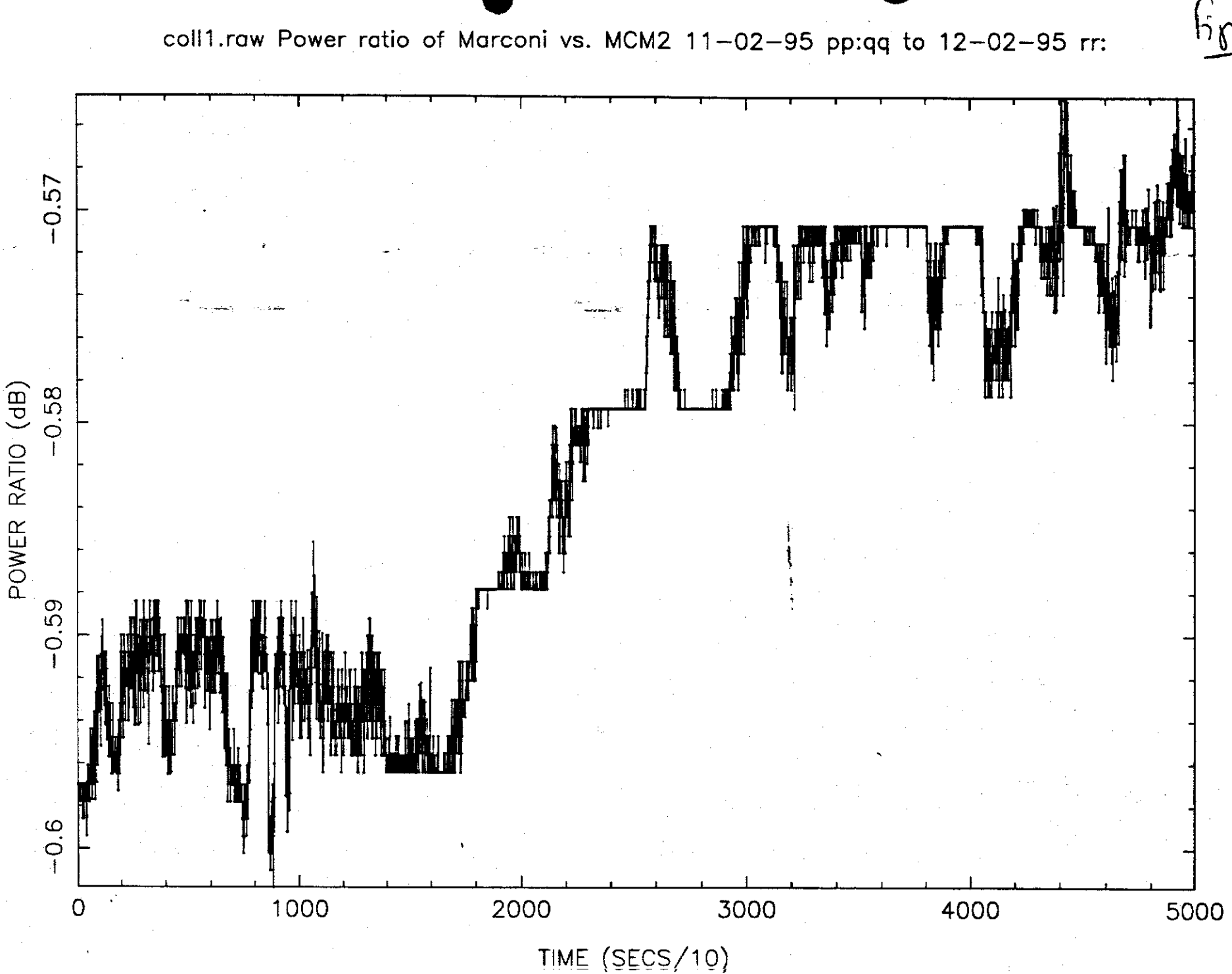

coll1.raw Power ratio of Marconi vs. MCM2 11-02-95 pp:qq to 12-02-95 rr:
POWER RATIO (dB)
-0.57
-0.58
-0.59
-0.6
0
1000
2000
3000
4000
5000
TIME (SECS/10)

Table 1

STATISTICS OF DATA ACQUIRED ON 02-11-1995
FROM 16:40:20
NAME OF FILE HAVING DATA coll1.RAW

TIME	AJUMP	PJUMP	PDRIFT	AJUMPVAL	PJUMPVAL	
16:40:20	0.0000	0.0000	0.0000	-0.5970	-11.4800	
17:06:20	0.0000	0.0000	1.0000	-0.5970	-20.2530	
17:15:40	0.0000	0.0000	2.0000	-0.5970	-10.1468	
17:25:50	0.0000	0.0000	3.0000	-0.5970	-0.1128	
19:39:00	1.0000	0.0000	3.0000	-0.5856	-0.1128	
19:46:10	2.0000	0.0000	3.0000	-0.5964	-0.1128	
19:59:30	2.0000	0.0000	4.0000	-0.5964	9.9859	
22:01:30	2.0000	0.0000	5.0000	-0.5964	20.2180	
22:01:40	3.0000	0.0000	5.0000	-0.5861	20.2180	
22:14:40	3.0000	1.0000	5.0000	-0.5861	7.9933	
22:15:10	3.0000	1.0000	6.0000	-0.5861	-2.5763	
22:15:50	3.0000	2.0000	6.0000	-0.5861	-14.1330	
22:16:30	3.0000	3.0000	6.0000	-0.5861	-25.4100	
22:18:30	3.0000	3.0000	7.0000	-0.5861	-35.6090	
22:21:40	3.0000	3.0000	8.0000	-0.5861	-46.3040	
22:25:40	3.0000	3.0000	9.0000	-0.5861	-56.4430	
23:14:00	3.0000	3.0000	10.0000	-0.5861	-66.4440	
23:33:00	3.0000	3.0000	11.0000	-0.5861	-55.7150	
23:48:10	4.0000	3.0000	11.0000	-0.5759	-55.7150	
00:13:10	4.0000	3.0000	12.0000	-0.5759	-65.7960	
00:33:40	4.0000	3.0000	13.0000	-0.5759	-55.5310	
01:54:30	4.0000	3.0000	14.0000	-0.5759	-44.6940	
02:26:50	4.0000	4.0000	14.0000	-0.5759	-102.6160	
02:27:00	4.0000	5.0000	14.0000	-0.5759	-155.2000	
02:39:00	4.0000	6.0000	14.0000	-0.5759	-112.5830	
02:39:10	4.0000	7.0000	14.0000	-0.5759	-51.7550	
03:16:10	4.0000	8.0000	14.0000	-0.5759	-75.5560	
03:16:20	4.0000	9.0000	14.0000	-0.5759	-148.7000	
03:34:10	4.0000	10.0000	14.0000	-0.5759	-71.0350	
03:34:20	4.0000	11.0000	14.0000	-0.5759	-50.2720	
03:58:40	4.0000	12.0000	14.0000	-0.5759	-65.2620	
03:58:50	4.0000	13.0000	14.0000	-0.5759	-148.4600	
04:25:10	4.0000	13.0000	15.0000	-0.5759	-159.0700	
04:28:10	4.0000	14.0000	15.0000	-0.5759	-93.8070	
04:28:20	4.0000	15.0000	15.0000	-0.5759	-51.9540	
04:40:50	4.0000	16.0000	15.0000	-0.5759	-109.7860	
04:41:00	4.0000	17.0000	15.0000	-0.5759	-151.5300	
04:56:30	5.0000	17.0000	15.0000	-0.5647	-151.5300	
05:23:10	6.0000	17.0000	15.0000	-0.5747	-151.5300	
06:22:10	7.0000	17.0000	15.0000	-0.5646	-151.5300	
06:28:40	7.0000	17.0000	16.0000	-0.5646	-161.7800	

IGNORE

drift

IGNORE

IGNORE

IGNORE

IGNORE

IGNORE

IGNORE

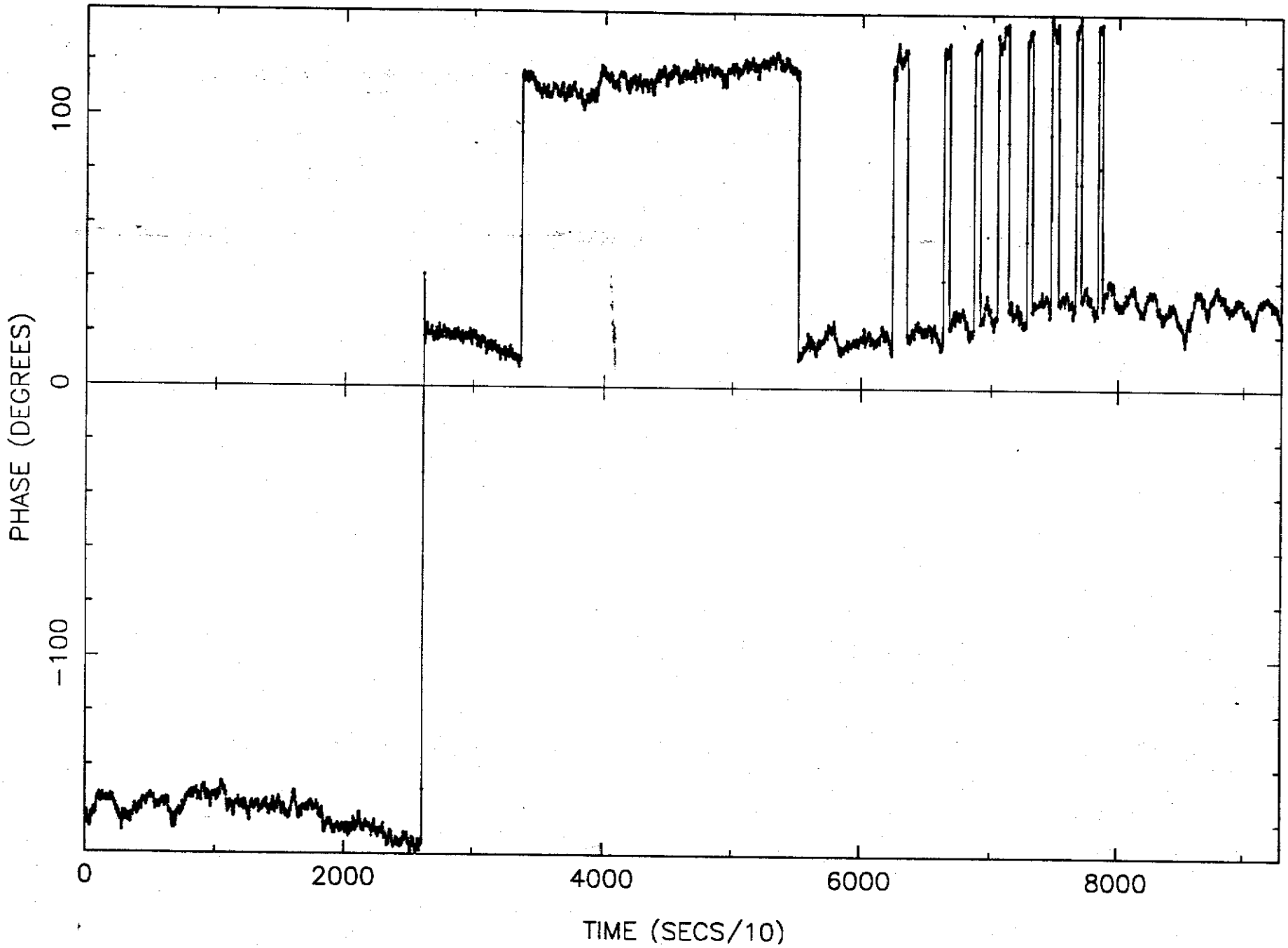
-155 -51 /194

-445-155 : -111

IGNORE: avg value has points from both ends and is not valid

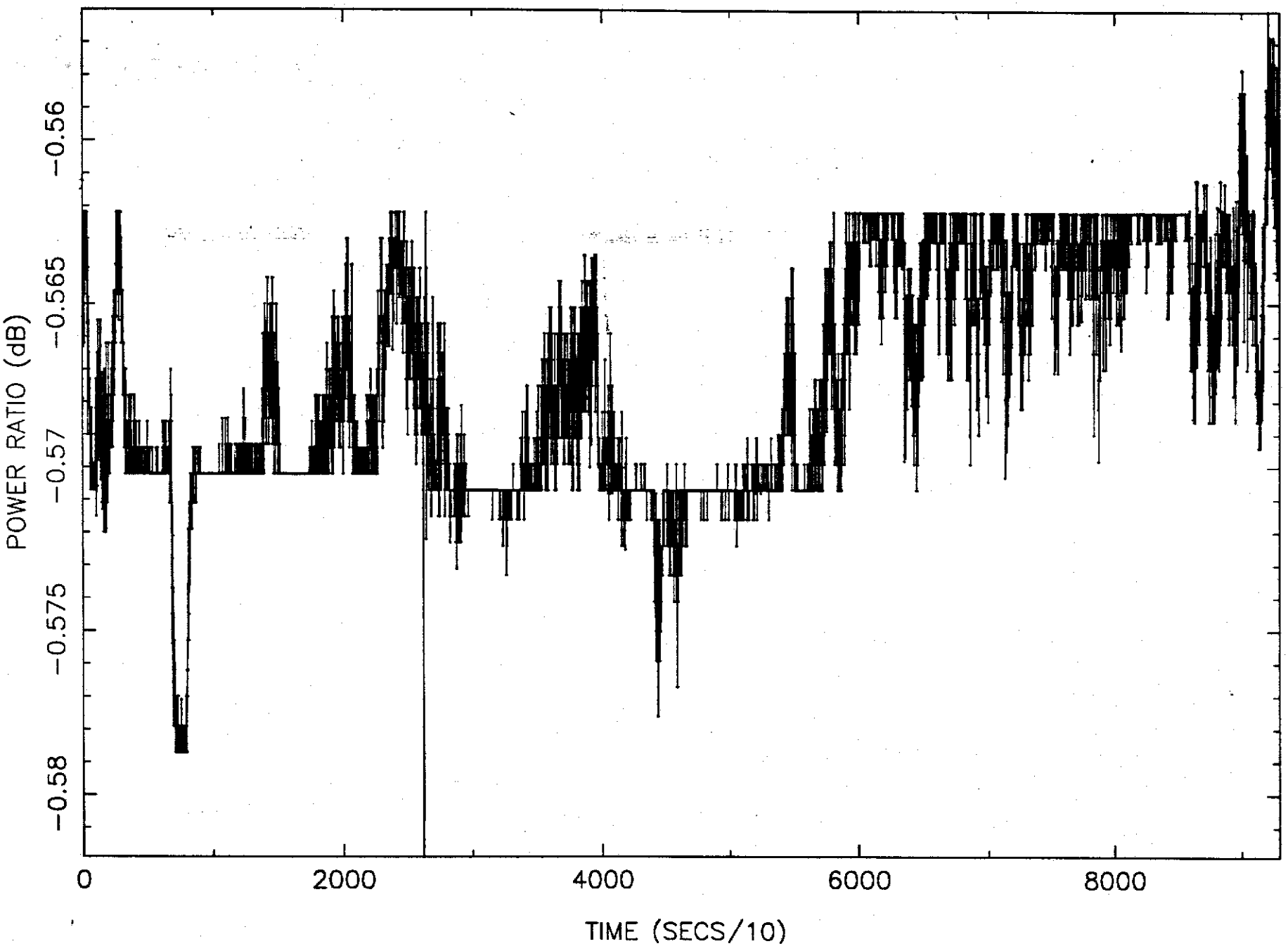
coll2.raw Phase of Marconi vs. MCM2 12-02-95 06:55 to 13-02-95 08:50

Figure 6

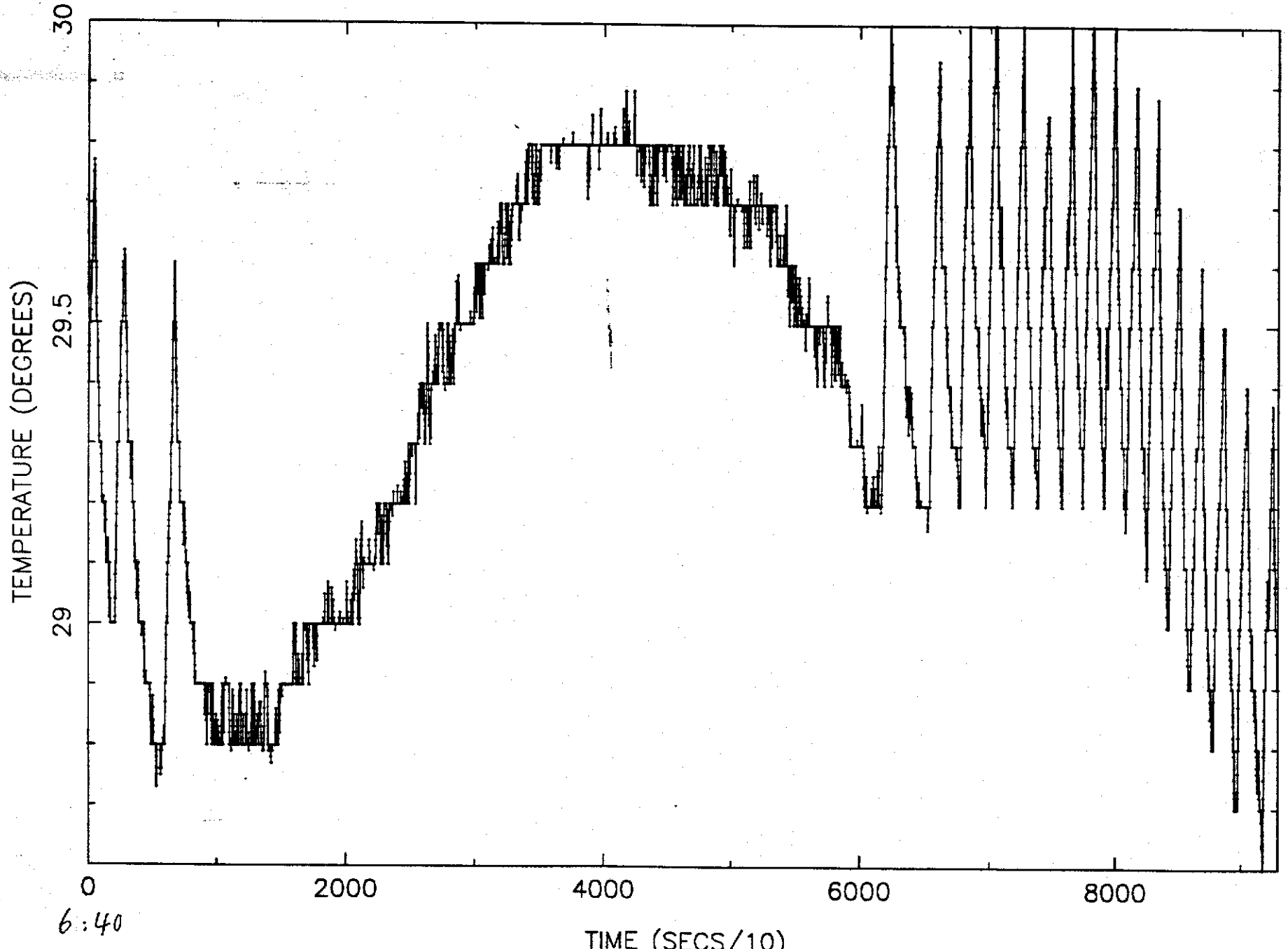


coll2.raw Power of Marconi vs. MCM2 12-02-95 06:55 to 13-02-95 08:50

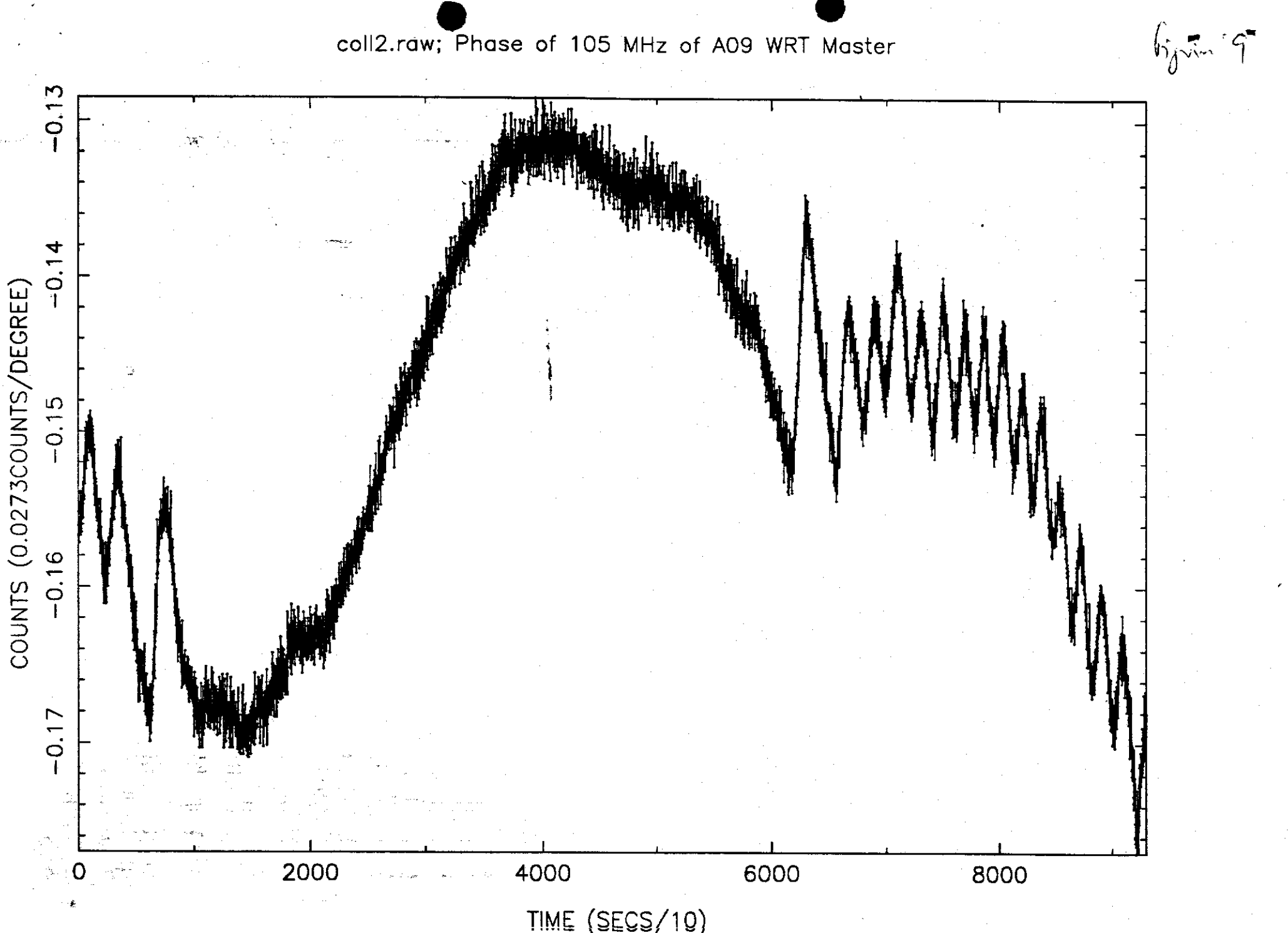
Figure 7



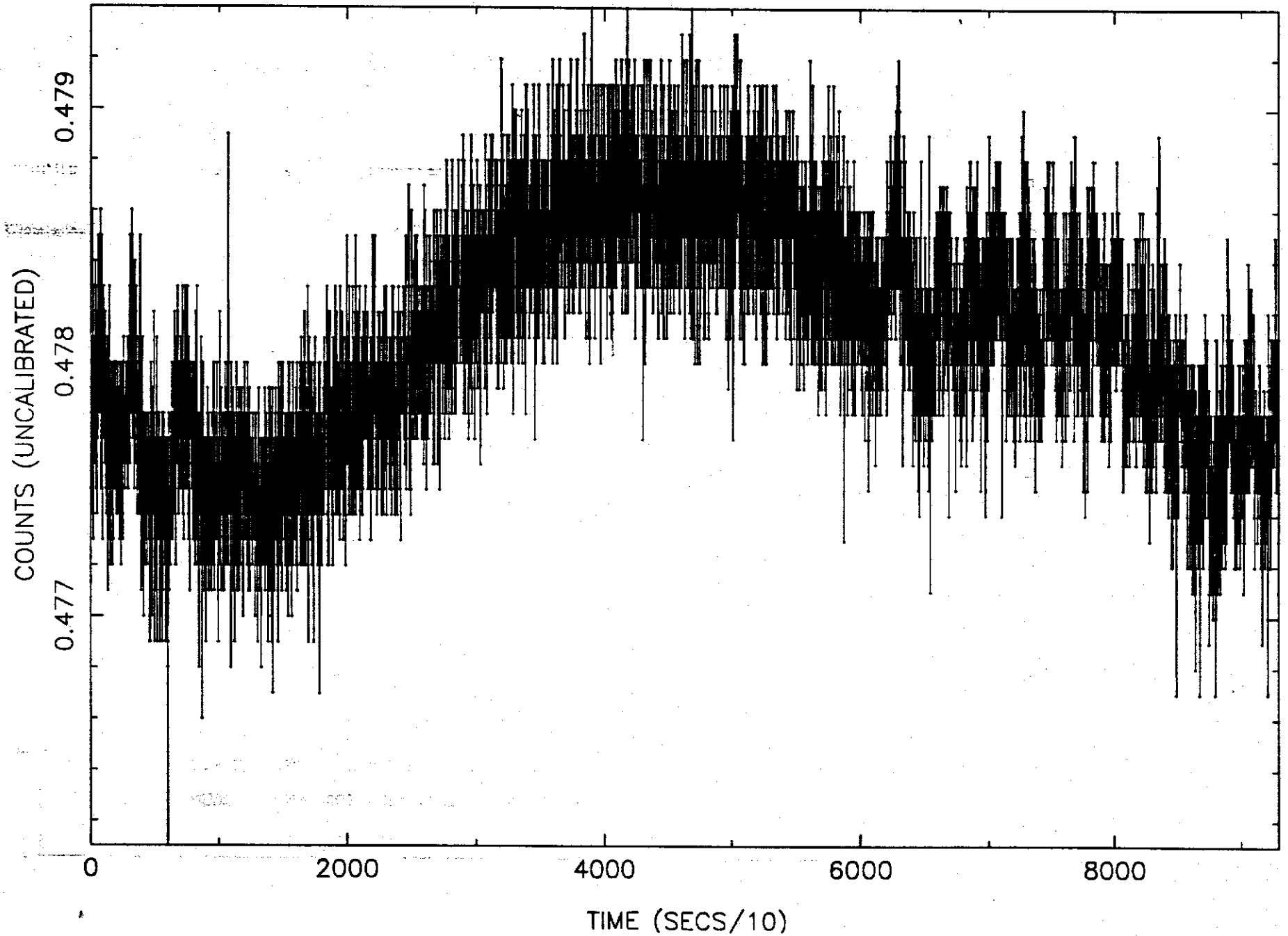
coll2.raw TEMPERATURE AT SPACE ABOVE SDS CHASSIS IN D48-105



6:40


coll2.raw; Phase of 105 MHz of A09 WRT Master
COUNTS (0.0273COUNTS/DEGREE)
-0.13
-0.14
-0.15
-0.16
-0.17
0
2000
4000
6000
8000
TIME (SECS/10)

coll2.raw; Power ratio of 105 MHz of A09 WRT Master



[Error: timeout; OffendingCommand: timeout]%%