NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

VLBA Antenna Memo Series No.24

St. Croix Maintenance Visit, January 15 - 20, 2000 - Trip Report

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January 30, 2000

Attachments: Wheel Worksheet, Gain Curves

During the St. Croix maintenance visit in June 1999, the Azimuth #1 Drive wheel was popping and had pitted races in both bearings. A maintenance team consisting of T. Frost, R. Gutierrez, R. Molina, J. Rodriguez, P. Sanchez and J. Thunborg was dispatched to St. Croix to change the wheel. The wheel change, along with several other tasks, was accomplished. The site techs J. Williams and H. Winchel also worked toward the completion of the scheduled tasks.

A new wheel assembly with a heat-treated 4340 steel axle (Drawing D52502MO25, Revision D) was installed on the antenna. After the wheel was aligned the antenna was used for 2 days and then the alignment was re-measured. Below are the results from this final measurement.

	Measured	**Specified**
Conic radius	300.121"	300" +/- ¼
Coupling	0.001" TIR	Not Specified
Axle Vertical Slope	93° 27' 05"	93° 26' 23" +/- 1.4'
Axle Horizontal error	10"	< 1.4'

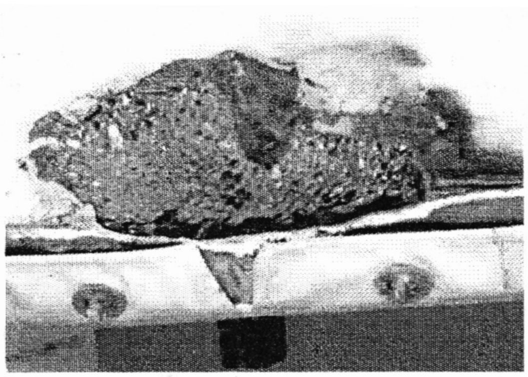
Servo tests indicated that the new wheel assembly had no measurable impact on servo performance.

Several other tasks accomplished by the maintenance team are listed below.

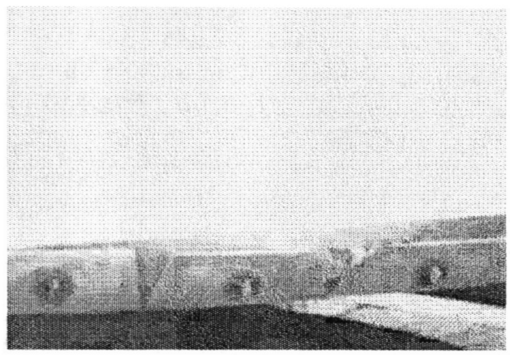
1. The FRM subreflector was moved. Repositioning the subreflector improved the antenna performance somewhat but it has still not recovered to its pre 1995 status. See attached for plots generated by Vivek Dhawan. Current theory is that there may something loose in the FRM. This will be checked using digital dial indicators on the next visit to St. Croix.
2. A rusted stair tread was replaced.
3. Several rusted feed bolts were replaced
4. An elevation counterweight measurement was performed indicating that the telescope is currently 60,000 ft-lbs dish heavy.
5. The FRM hardstops were replaced with chemical resistant ones. The hard stops that were replaced during the July Tiger Team were already showing signs of softening.
6. The FRM cable track was replaced with Gore track.
7. The FRM cables and J boxes were replaced with new ones. The original J-boxes were almost completely rusted through.

8. The rusted angle brackets that hold the gearbox flow indicators were replaced with brackets made from stainless steel.
9. The guy rod cotter keys were replaced.
10. The FRM second screw sensor was replaced.
11. The FRM turnbuckles were replaced with rust resistant brass.
12. A crack in the diesel generator radiator was soldered.
13. Installed guard rail at the antenna apex (see change order #119)
14. The FRM torque requirement was measured. The FRM required 17 lbs of force at the barrel to rotate.
15. A small platform was installed to facilitate installation of the stow pin.
16. The servo motor J-boxes were replaced with stainless steel ones.

The 6 by 10-inch gash shown below was found on the edge of the subreflector. Bondo was used to repair the Subreflector. However, a reflective surface was not installed over the Bondo. The systems engineers who understand these sorts of things should consider the effect of this repair on antenna performance. The cause of the gash is not currently known.



Before



After

A visual inspection of the paint on the antenna showed that the painters are beginning to get ahead of the corrosion. The painters have been concentrating on the backup structure and the major structural members. These areas showed very little rust. However, additional painting is needed on the secondary parts of the structure. We should continue painting the antenna during maintenance periods with emphasis placed on the most severely rusted areas like the undersides of the elevation platforms.

1/20/00

WHEEL ALIGNMENT (Antenna Center Calculation)
Equal distance method

Procedure: Set up theodolite 3 to 5 feet away from axle. Rotate antenna until the meausurement point is 100 inches from theodolite and record ACU and theodolite(az and el) readings. Rotate in opposite direction untill measuring point is 100 inches on other side of theodolite. Record ACU and Theodolite readings. Measure and record distance from wheel center to measuurement point.

Worksheet:

Wheel # 1 AZ DRIVE, HEAT TREATED AXLE

Set distance (d) 200

Theo1 Elevation	91 34 50	Theo1 el degrees	91.58
Theo1 Azimuth	0, 0, 16	Theo1 az degrees	.00444
Theo2 Azimuth	85. 02 08	Theo2 az degrees	85.03555
ACU1 Azimuth	92.7675	Thoedolite difference	85.0311
ACU2 Azimuth	41.775	ACU difference	50.9925
Offset	13.75	R	
		Radius	300.121
		ACU_center	67.271

EXAMPLE

$d := 100 \cdot in$	Distance from Theodolite to measuring point (~100 inches)
$Theo\_el := 92.6599 \cdot deg$	Elevation angle of theodolite (either side)
$Theo1 := 100 \cdot deg$	First Theodolite Reading
$Theo2 := 196.2289 \cdot deg$	Second Theodolite Reading
$ACU1 := 180 \cdot deg$	First ACU Reading
$ACU2 := 207.1904 \cdot deg$	Second ACU Reading
$Offset := 16.375 \cdot in$	Distance from measuring point to wheel center

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$Theo\_hor := Theo2 - Theo1 \qquad Theo\_hor = 96.229 \cdot deg$

$ACU := ACU2 - ACU1 \qquad ACU = 27.19 \cdot deg$

199.9239 .67579

$$R := d \cdot \sin(Theo\_el) \cdot \frac{\sin\left(\frac{Theo\_hor}{2}\right)}{\sin\left(\frac{ACU}{2}\right)} \qquad R = 316.377 \cdot in$$

.43045 = 313.871

$Radius := R - Offset \qquad Radius = 300.002 \cdot in$

$$ACU\_center := ACU1 - \frac{ACU}{2} \qquad ACU\_center = 166.405 \cdot deg$$

Horizontal

~~42 30 52~~

~~42 31 ..~~

~~42 31 12~~

Horizontal

42 31 12 center

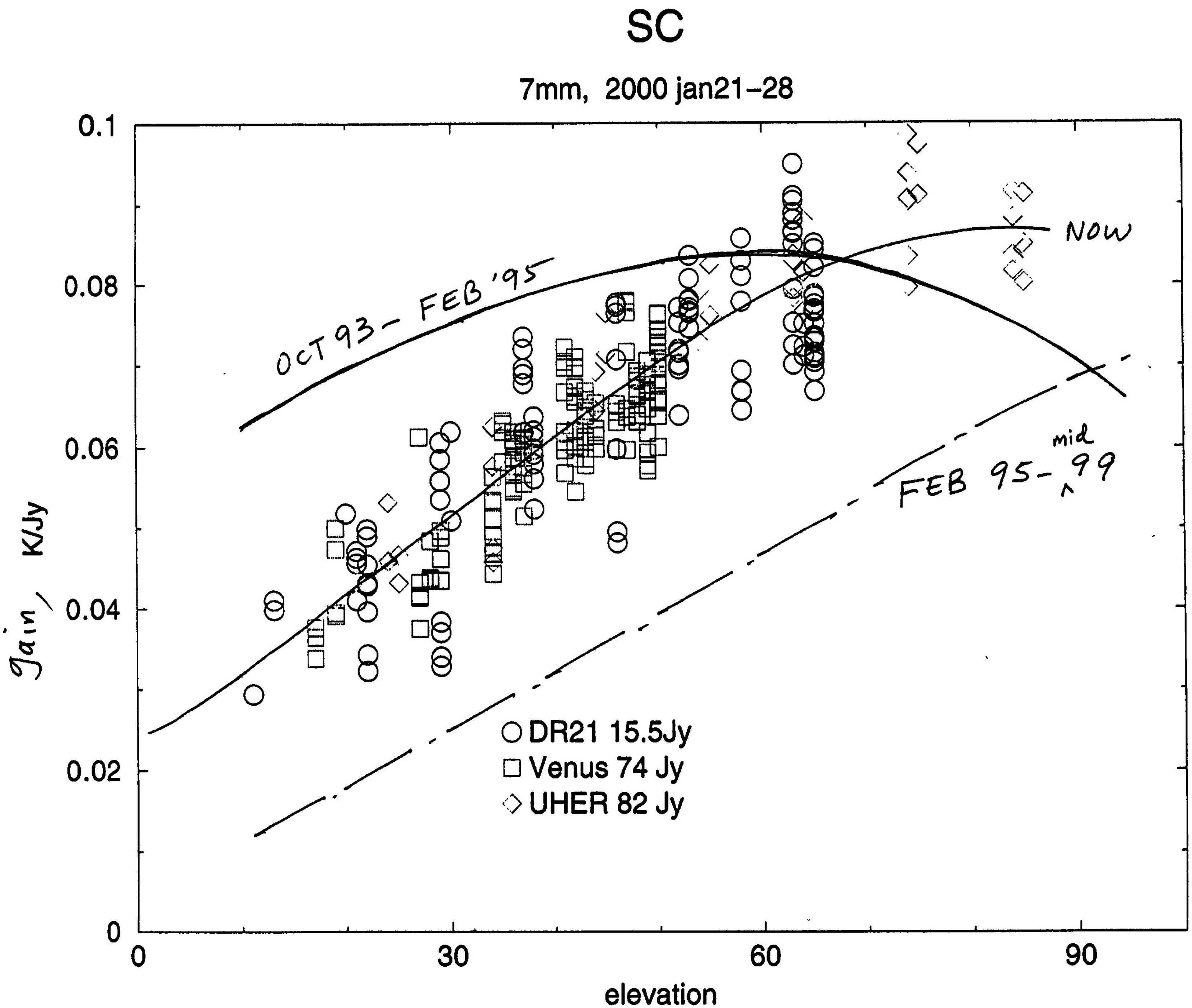
42 31 02 meas

ERROR 10"

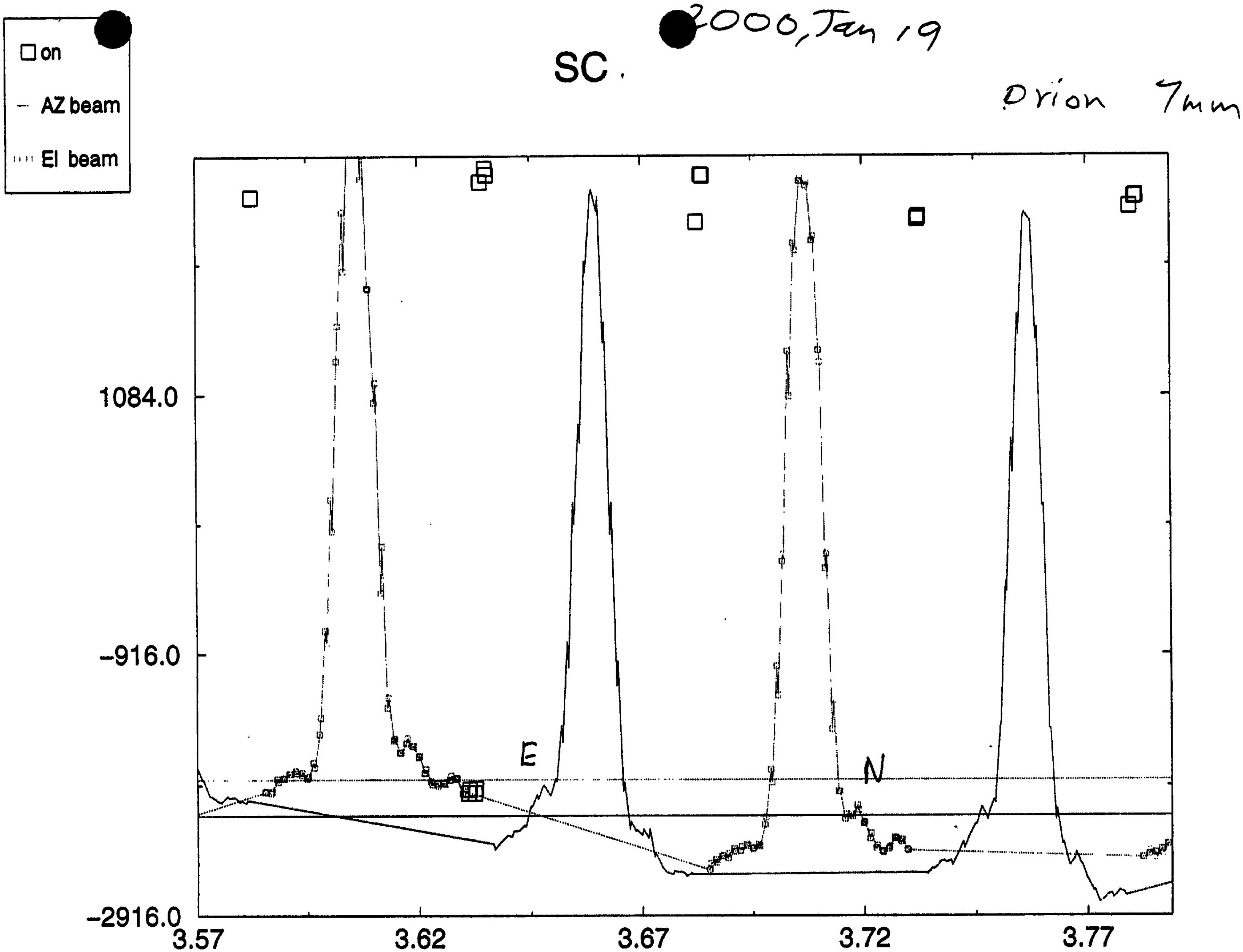
269	59	60
266	32	10
	27	50
3		

VERTICAL

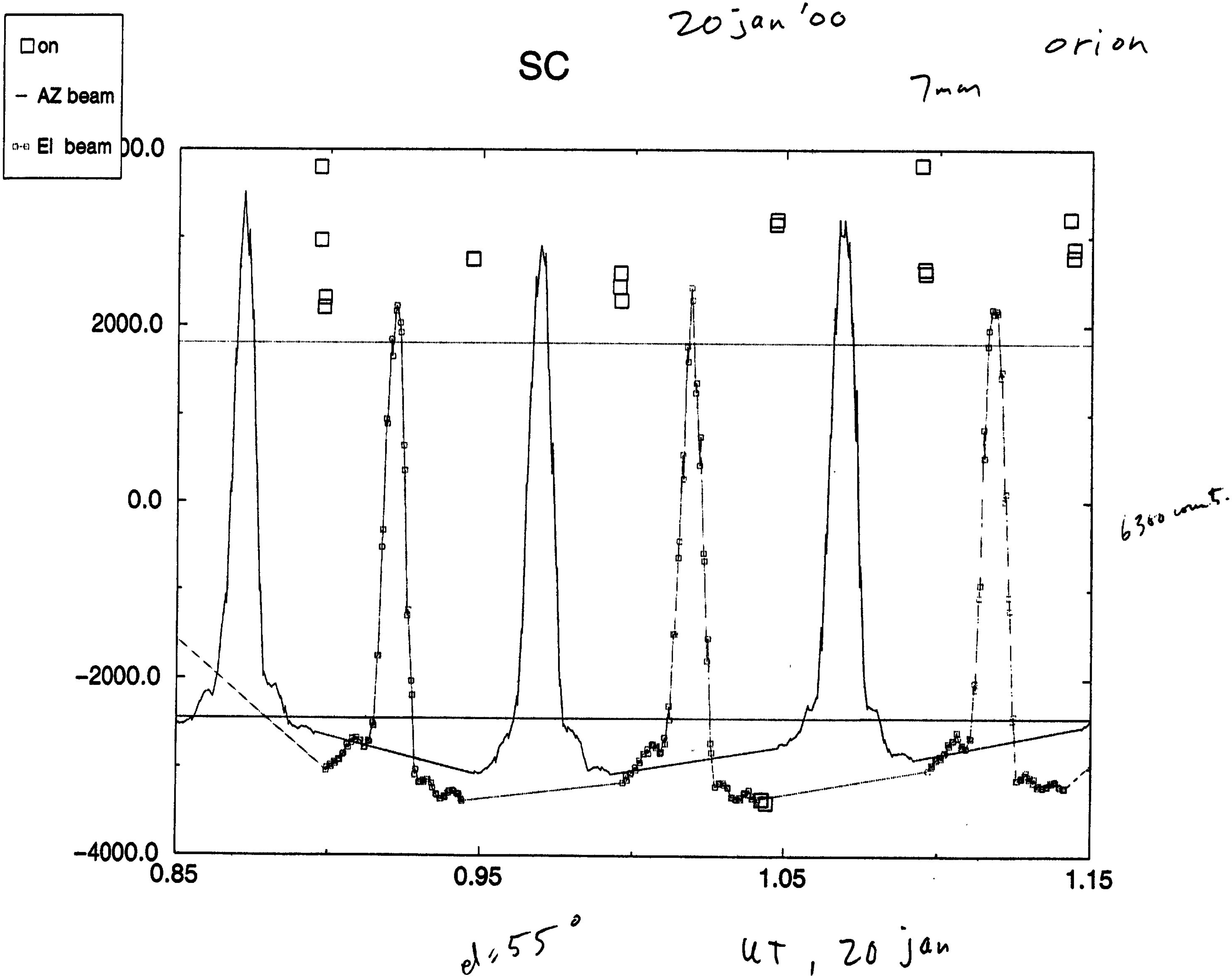
set point	93	26	2:
	93	26	21
flip	3	27	50
AVE	3	27	05



SC
7mm, 2000 jan21-28
Gain, K/Jy
elevation
0.1
0.08
0.06
0.04
0.02
0
0
30
60
90
OCT 93 - FEB '95
NOW
FEB 95 - mid 99
DR21 15.5Jy
Venus 74 Jy
UHER 82 Jy



2000, Jan 19
SC.
Orion 7mm
on
AZ beam
El beam
1084.0
-916.0
-2916.0
3.57
3.62
3.67
3.72
3.77
E
N



on
AZ beam
El beam
SC
20 jan '00
orion
7mm
2000.0
0.0
-2000.0
-4000.0
0.85
0.95
1.05
1.15
6300 counts..
el ≈ 55°
UT, 20 jan