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Setting-up of TT60 for the run 17-20 December 1976

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On 23rd October a 200 GeV slow extracted proton beam was directed for the first time towards the West Hall onto the targets T1, T3, T5 (see Commissioning Report No. 32). Since then the part of TT60 which includes the branches 61, 62, 63, 64, 65 and the splitter system has been set up several times and much experience has been gained. On 19th November a 200 GeV fast extracted beam was sent through switch 1 and branches 66 and 67 onto target T7 (for the RF separated secondary beam S3) and on 10th December a 400 GeV fast extracted beam through switches 1, 2 and 3 and through branch 69 onto target T11 (for the narrow band neutrino beam). During the run of 10th December, for the first time all five targets T1, T3, T5, T7 and T11 were receiving protons at the same time. (Branch 68, which can run alternatively to branch 69 and which feeds the target T9 for the wide-band neutrino beam, will be commissioned early in 1977.) A schematic layout of the TT60 beam line complex is shown in Fig. 1; more details can be seen on drawing 8033.1.9.M.

This report gives results of the setting-up for the run of 17th to 20th December during which all targets were again receiving protons.

SPS cycle and extraction

The SPS ran with the composite cycle No. 8 which has a 1 sec flat top at 200 GeV and a 60 msec flat top at 400 GeV. Three extractions were made: a 3-5 μsec long fast extraction (FE1), a slow extraction of about 800 msec spill length (SE) at 200 GeV and a fast extraction of about 20 μsec length at 400 GeV (FE2). The FE1 was for target T7, SE for T1, T3, T5 and FE2 for T11.

The SPS accelerated about 3.5×10^{12} protons and the intensities of the different extractions were as follows:

FE1 : $1-2 \times 10^{11}$

SE : about 1×10^{12}

FE2 : 0.5 to 2.5×10^{12}

When a reduced intensity was required for FE2 the kick length was reduced and the remaining fraction of the circulating beam was dumped internally.

The emittance of the extracted beams was as follows: (measured with the 3 BSG monitors in part 61 of TT60)

FE1 : $\varepsilon_H = 0.15\pi$ mm mrad
$\varepsilon_V = 0.13\pi$ mm mrad
(Only one measurement was done at the beginning of the run; the emittance reduced later during the run.)

SE : $\varepsilon_H = 0.2 - 0.3\pi$ mm mrad
$\varepsilon_V = 0.07 - 0.17\pi$ mm mrad

FE2 : $\varepsilon_H = 0.08 - 0.12\pi$ mm mrad
$\varepsilon_V = 0.08 - 0.09\pi$ mm mrad

Operation of beam switches

The operation of the beam switches is illustrated in Fig. 2 where the pulse shape of the three switches and the pulsed parts of TT60 are shown, together with the SPS main magnet cycle. The minimum rise or decay time of switch 1 is about 120 msec, this means that at least 120 msec are lost for the spill length of the SE if both extractions FE1 and SE are done during the 200 GeV flat top. It is therefore envisaged for future runs to use the whole 200 GeV flat top for SE and to do the FE1 immediately after the end of the flat top when the main magnet cycle is already rising again. The switches and the pulsed part of TT60 will then have to be operated as shown on Fig. 3.

Beam splitting

During the previous runs the beam had always been split symmetrically, giving equal intensity to targets T3 and T5. For this run an asymmetric split was requested with the following approximate shearing ratio : T1/T3/T5 $\approx$ 0.3/0.1/0.6. This was achieved in blowing up the beam to about 4σ = 80 mm and displacing its centre at the MSSA by about 15 mm upwards. The result is shown in Fig. 4.

Target focusing

The focusing of the proton beam onto the targets is tested by measuring the beam profiles with miniscanners which are positioned 1 m upstream from the target centre for T1, T3, T5 and 3.3 m upstream for T11.

The results are shown in Figs. 5 to 9. The beam profiles are as expected. The large background measured at T3 comes from the two upstream targets T1 and T5.

Conclusions

Once set up the TT60 beam lines are very stable and need no readjustments for long periods.

With the available powerful beam steering programs, the setting-up and the adjustment of the beams is done rather quickly. The beam optics is well in hand. Although the parameters of the extracted beams (both emittance and ellipse parameters) are still varying from run to run and even during one run the available file base for quadrupole settings allows to compensate for that and to cope with the present requirements for beam splitting and target focusing.

The splitter system operates well and shows the expected flexibility. More work has to be done on intensity measurements (mainly calibrations) to measure the losses on the splitter system with good precision.

The operation of TT60 is at present supplemented by surveillance programs which monitor the switch status of all power supplies (pulsed and d.c.) and the beam positions at the targets. More thought will still be given to this matter.

Reported by : E. Weisse

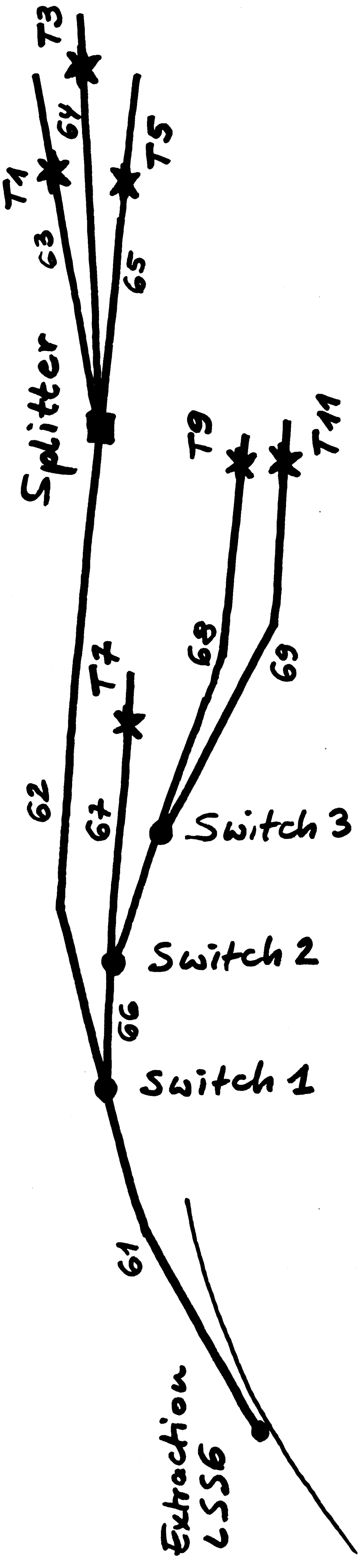

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Fig. 1 Schematic layout of beam lines in TT60

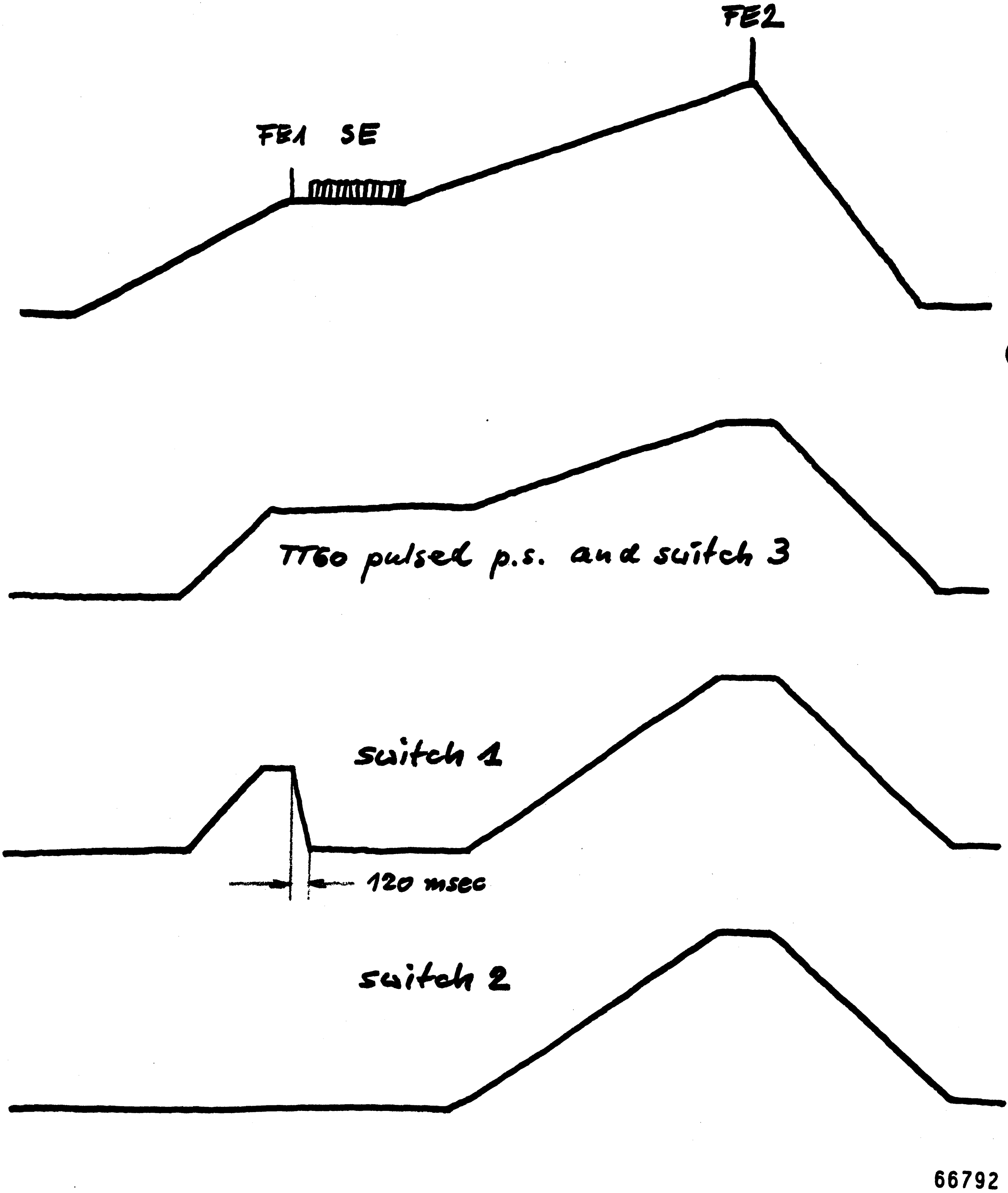


Fig. 2 Operation of beam switches for sequence FE1, SE, FE2.

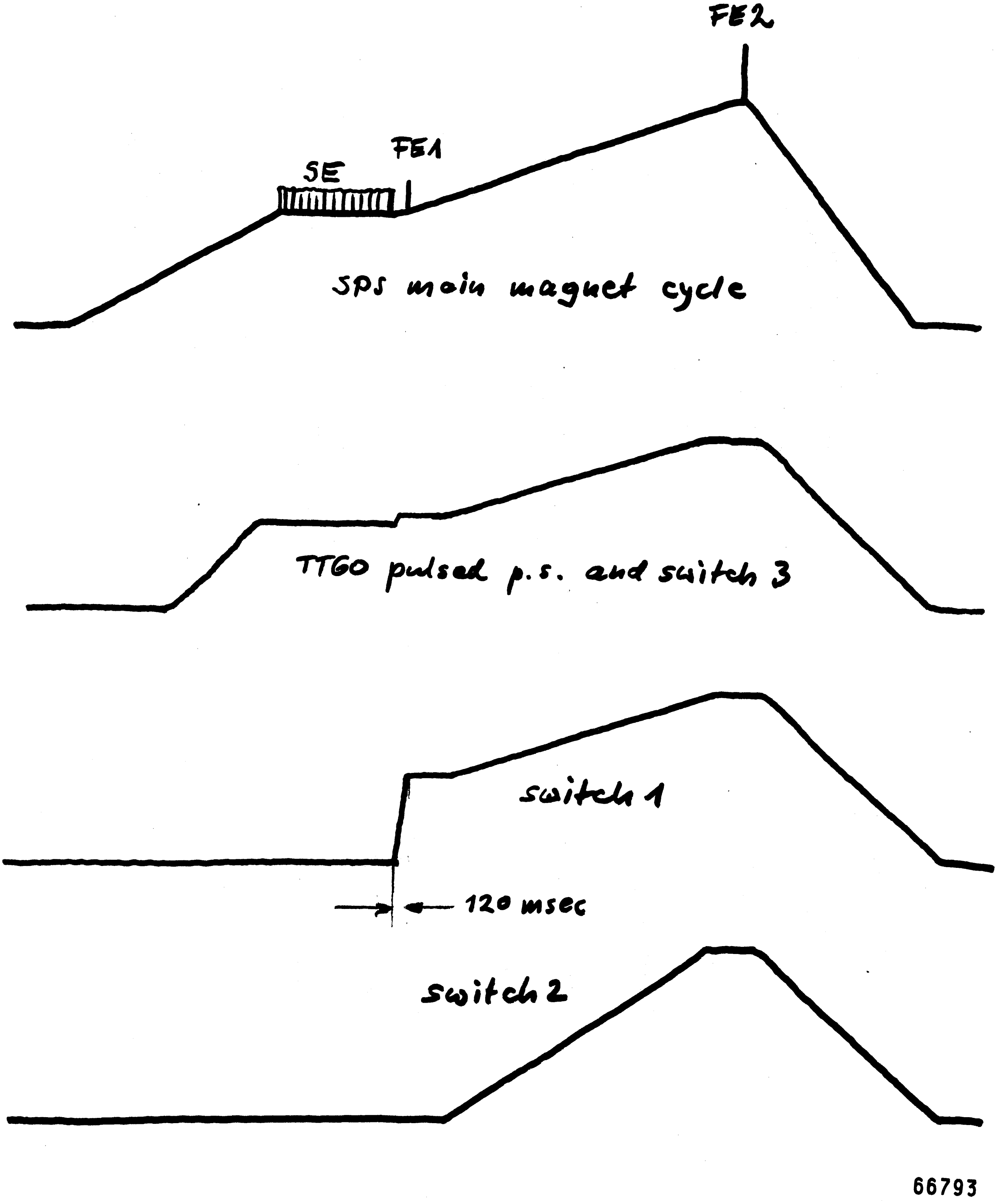
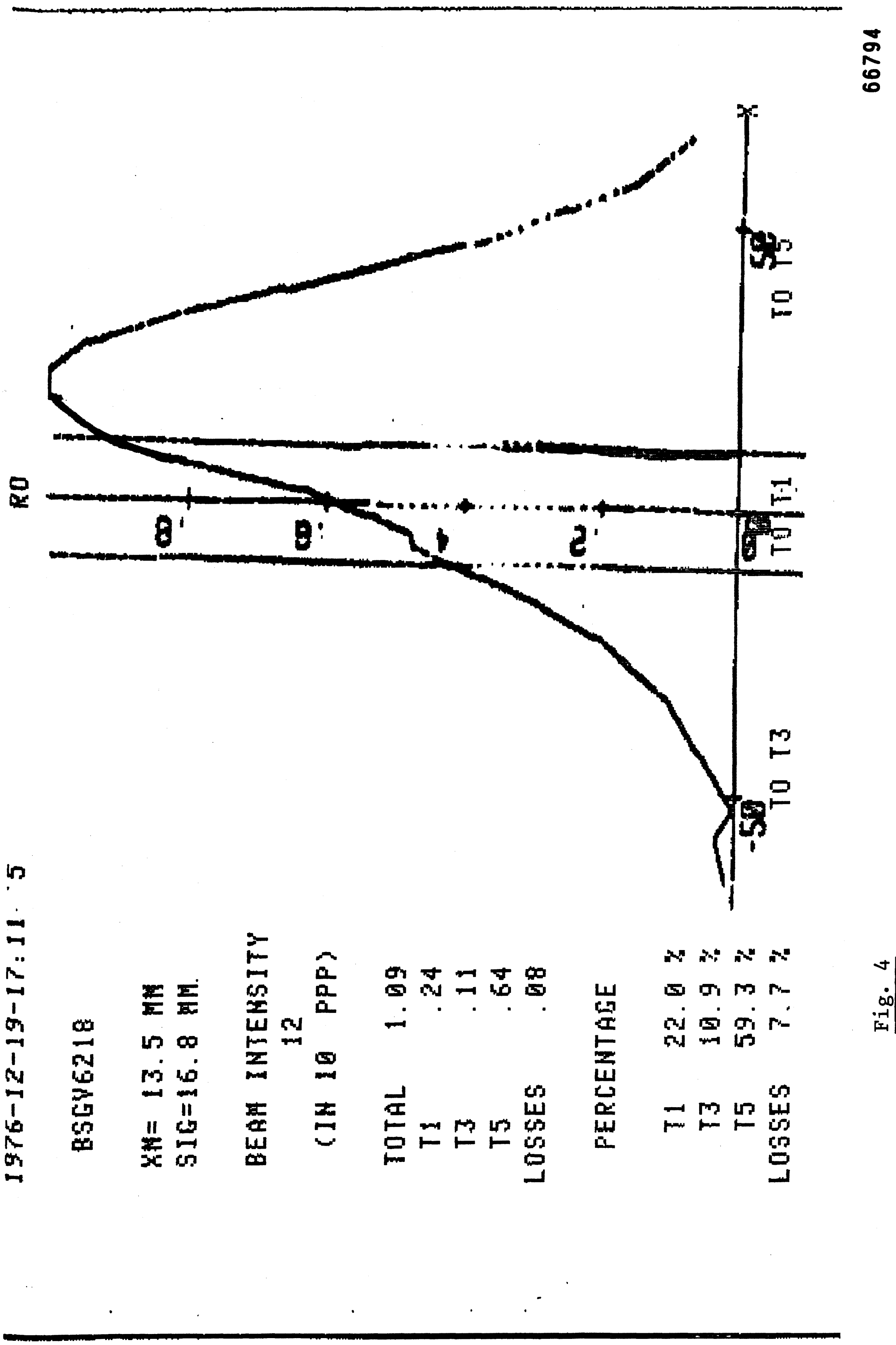


Fig. 3 Operation of beam switches for sequence SE, FE1, FE2.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RO
.8
.6
.4
.2
-50
50
TO T3
TO T1
TO T5
X
1976-12-19-17:11 5
BSGV6218
XM= 13.5 MM
SIG=16.8 MM
BEAM INTENSITY
12
(IN 10 PPP)
TOTAL 1.09
T1 .24
T3 .11
T5 .64
LOSSES .08
PERCENTAGE
T1 22.0 %
T3 10.9 %
T5 59.3 %
LOSSES 7.7 %

Fig. 4

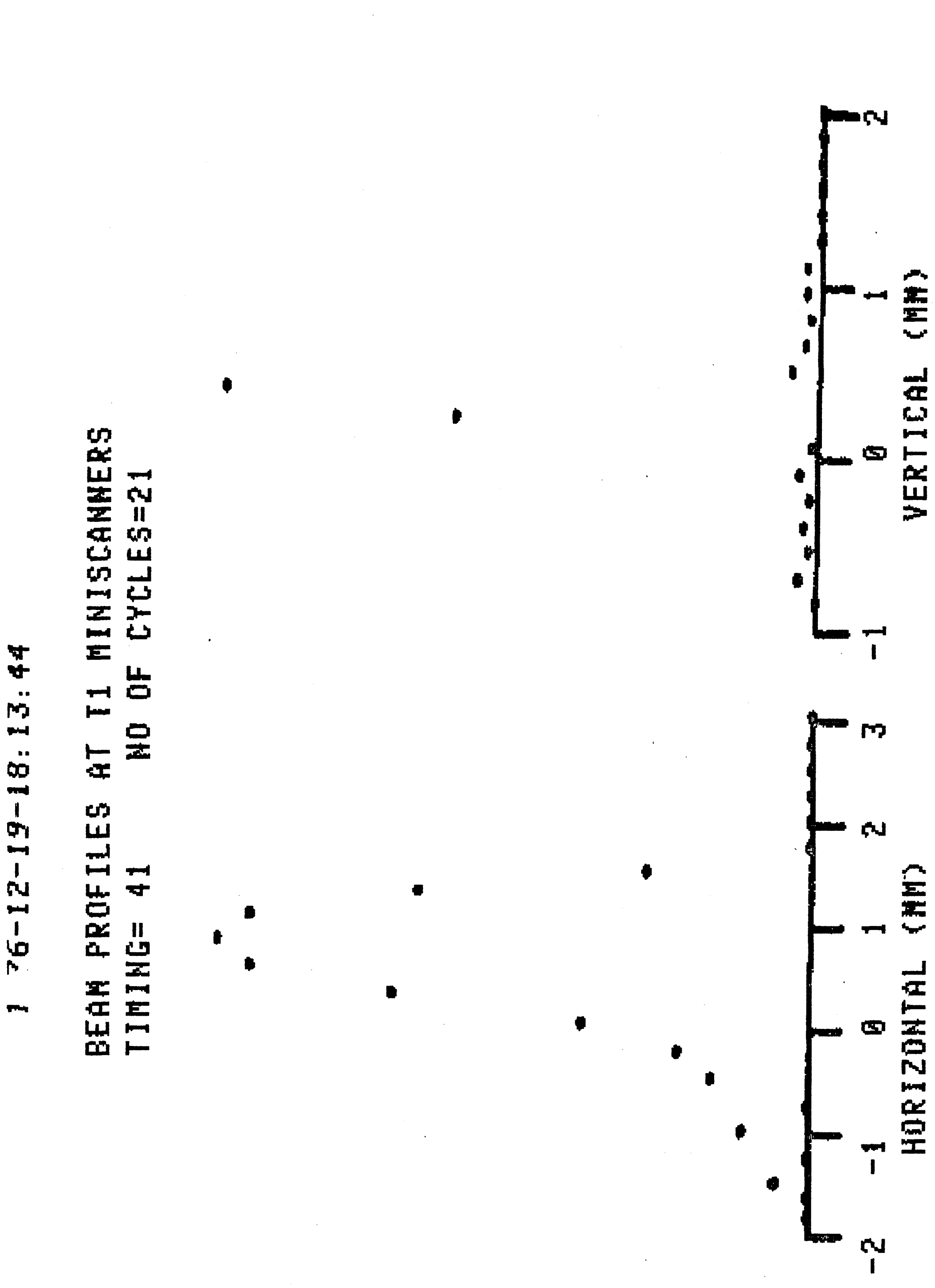
1 76-12-19-18:13:44
BEAM PROFILES AT T1 MINISCANNERS
TIMING= 41
NO OF CYCLES=21
-2
-1
0
1
2
3
HORIZONTAL (MM)
-1
0
1
2
VERTICAL (MM)

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Fig. 5

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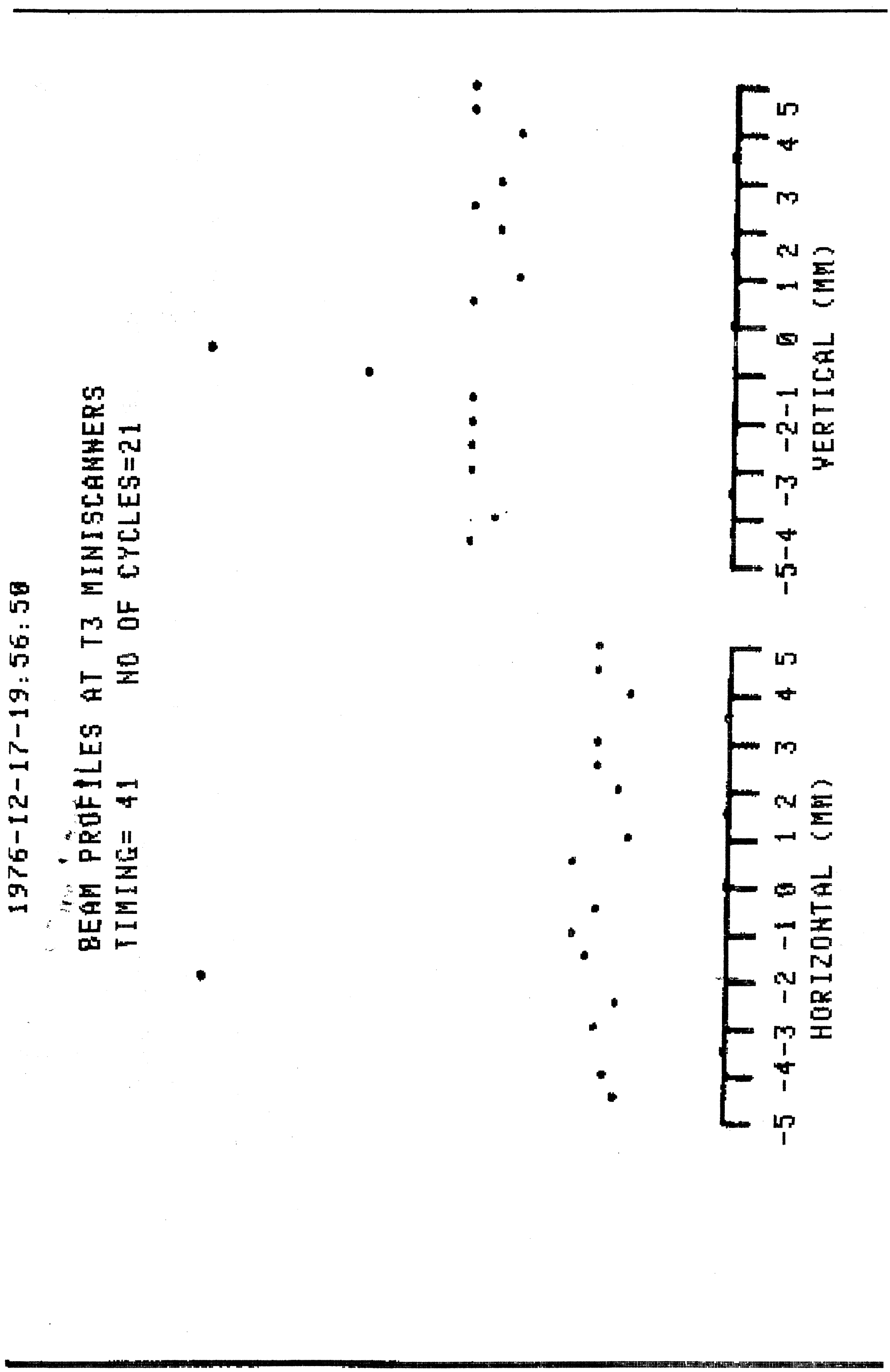
1976-12-17-19:56:50
BEAM PROFILES AT T3 MINISCANNERS
TIMING= 41
NO OF CYCLES=21
-5 -4 -3 -2 -1 0 1 2 3 4 5
HORIZONTAL (MM)
-5 -4 -3 -2 -1 0 1 2 3 4 5
VERTICAL (MM)

Fig. 6

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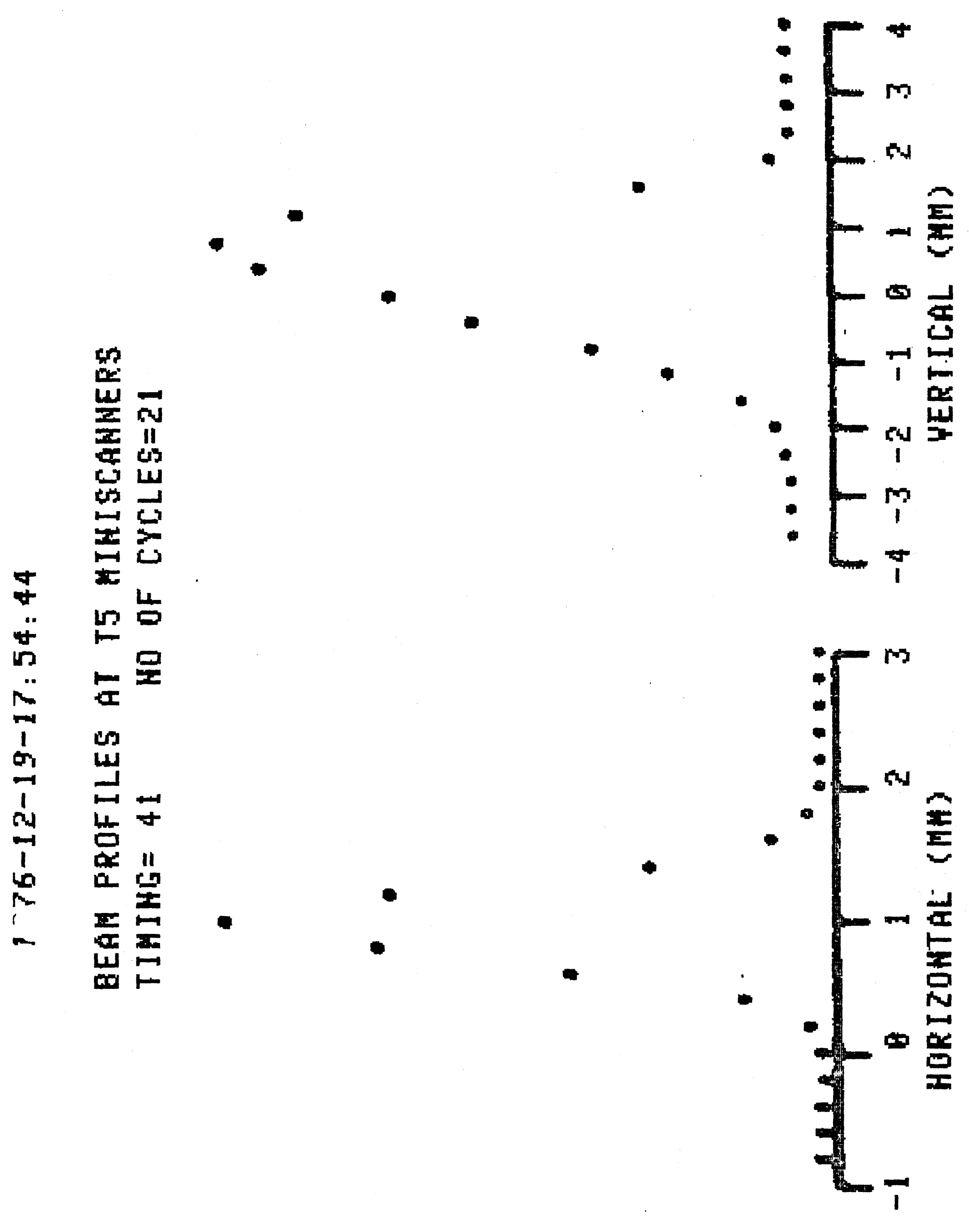
1?76-12-19-17:54:44
BEAM PROFILES AT T5 MINISCANNERS
TIMING= 41   NO OF CYCLES=21
-1 0 1 2 3
HORIZONTAL (MM)
-4 -3 -2 -1 0 1 2 3 4
VERTICAL (MM)

Fig. 7

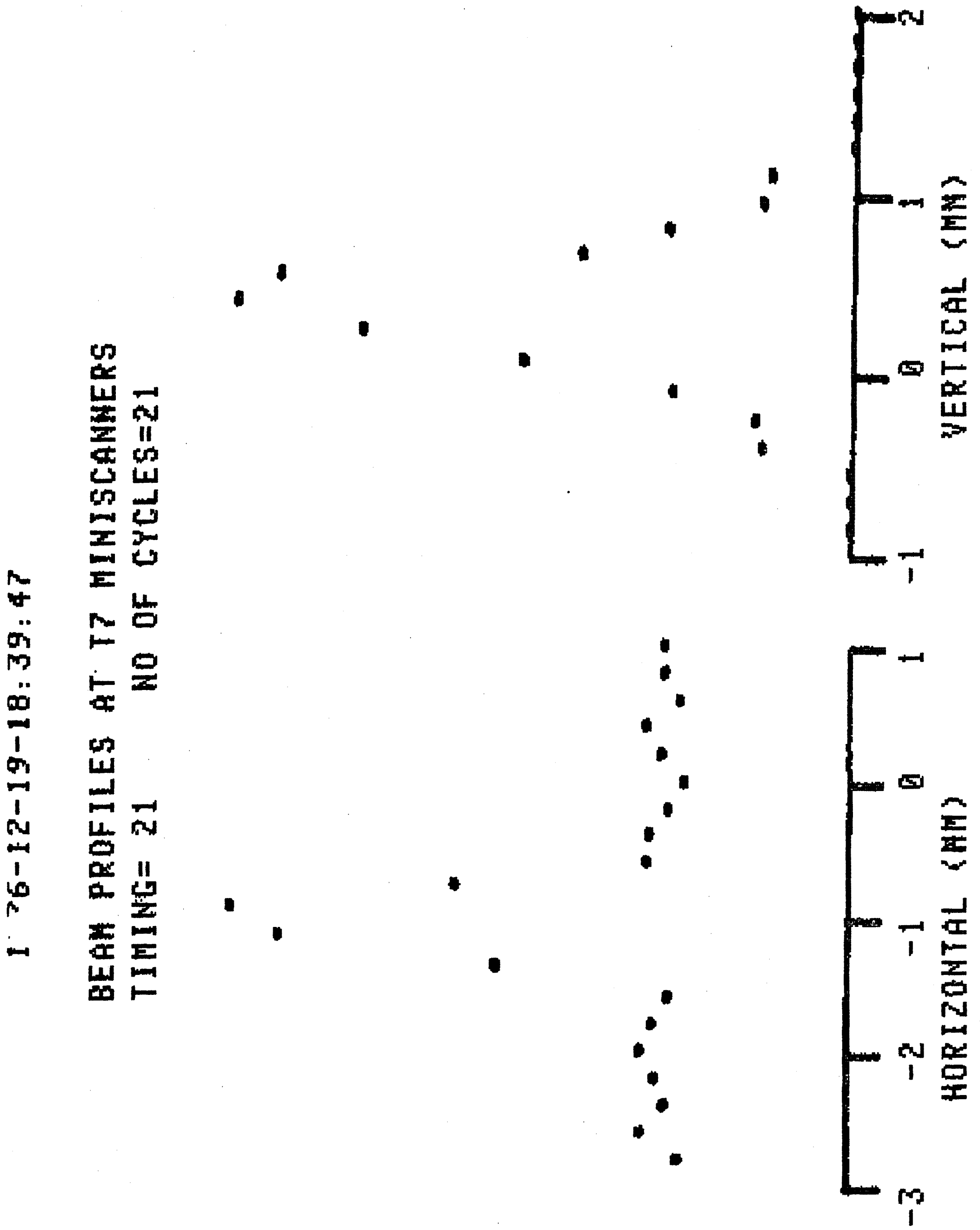
76-12-19-18:39:47
BEAM PROFILES AT T7 MINISCANNERS
TIMING= 21 NO OF CYCLES=21
HORIZONTAL (MM)
-3 -2 -1 0 1
VERTICAL (MM)
-1 0 1 2

Fig. 8

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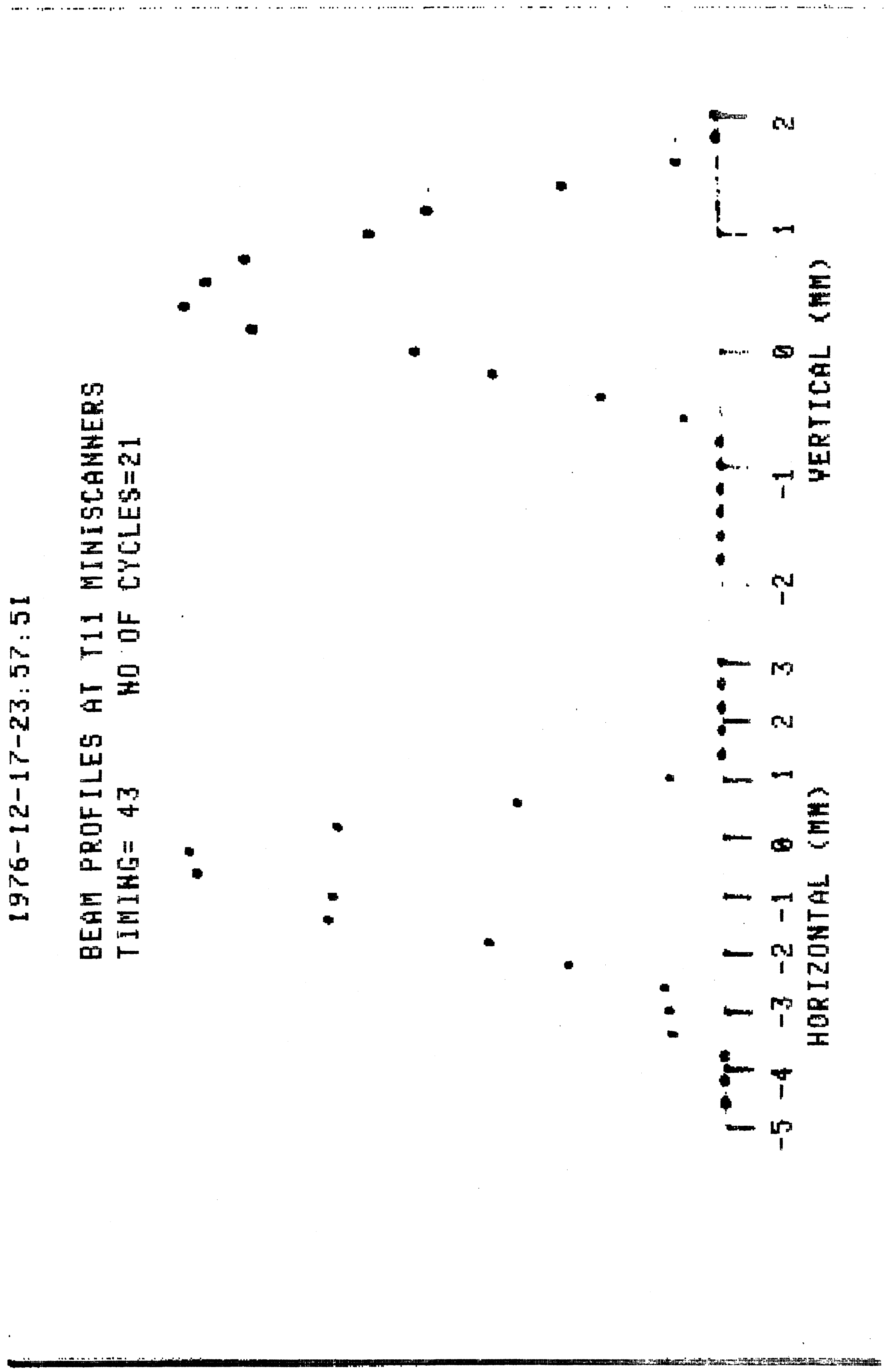

Fig. 9