MPS/BR Note/75-3
15.1.1975

EXAMINATION OF T-K2's PERFORMANCES

Report of two MD's :

27th November (08.00 - 10.00) - Participants : L. Magnani, C. Metzger, D. Williams, D. Zanaschi.

21st December (08.00 - 12.00) - Participants : L. Guerrero, J.F. Labeye, L. Magnani, C. Metzger, A. Smith, D. Williams.

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This examination was needed because the first bunch of ring two is incorrectly recombined in the vertical plane. It appears that the initial part of T-K2's deflection is unsatisfactory.

To explore the first half of the T-K2 flat-top by means of beam two, T-K2's timing was changed every 10 ns in the range of more than one RF period. The vertical shifts of the bunches were observed on the position pick-up T-U4.

Due to some trouble and our inexperience in such manipulations, measurements made during the first MD are not complete (see fig. 3). The purpose of the second study is to confirm the previous results and extend the measurement range. In this note, only results of the second MD are fully explained and reported.

To improve the bandwidth measurements were made in the TIK room (362) as well as the MCR. The bandwidth of the observation system and the oscilloscope for the present results is about 35 MHz enabling useful resolution to 10 nanoseconds.

The oscilloscope triggering was from bunch No. 1 via the Σ channel from TU-4. By means of a delay, the 11th bunch is always shown at 3,2 divisions from the left of the screen and there was no observable jitter of the Σ trace. The amplitude of the Σ signal however, did change slightly from one cycle to the next.

The sensitivity of the display in microradians per millivolt can be determined from photographs 1 and 2. For this, bunches 12 to 16 have been measured and the result is 3,5 microradians/millivolt or 0.175 milliradians/division.

After the photographs 1 to 10 had been taken, a dipole was trimmed to improve the definition and photographs 11 to 28 only have been analyzed. To avoid the disturbance arising from bunch No. 10 when the kicker timing was advanced more than 40 ns, ring 4 was not accelerated. This is evident in photographs 19 to 28.

The maximum delay of the kicker timing was 30 ns and for deriving the kicker waveform this is taken as "time zero". The results have been evaluated by measuring the peak deflection of each bunch and its change as the kicker timing was advanced in steps of 10 ns. The value of Σ has been assumed constant from bunch to bunch and cycle to cycle. The resulting curve, which represents the beam deflection and hence the kicker's flux is shown in Fig. 1. The curve is similar to the results obtained in the MCR, Fig. 2 and the previous results, Fig. 3. The initial peaks shown in these curves are similar to the results shown by the kicker acquisition system. The final displacement of bunch 15 occurs because the timing has been advanced so much that bunch 15 sees the start of T2K1's field.

The additional bandwidth does allow more detailed examination of bunch shapes and certain qualitative observations can be made : - sometimes bunches 11 to 14 pass the pick-up with a skew, i.e. not concentrically. In photograph No. 1 the front of the first bunch is well centred but the part that passes after Σ max is over deflected. Many similar observations can be made even as far along as bunch 14 photographs 3 to 6 show the front of the bunch "under-deflected" and the tail "over-deflected". This could suggest a very high ripple in a kicker's field, but the present measurements of TK2 do not reveal this. A more detailed analysis would require simultaneous acquisition of Σ and Δ information and if this is obtained by oscilloscope/photographic technique much time and care would be necessary.

The purpose of the examination has been fulfilled and it can be seen that the final rise time of the field is slower than desirable and the overshoot is approximately 7% instead of 2%.

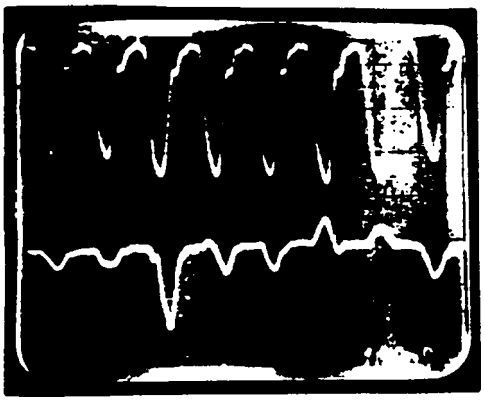
A secondary problem that arises from these tests and the need to improve the flux waveform is the need for a more direct method of determining the shape of the kicker flux. The accuracy of the "average" value used by the acquisition system is not in question. But the ringing seen on the plateau of the waveform is clearly not seen by the protons and therefore it is a false signal. This is receiving attention as a separate problem.

C. Metzger D. Williams

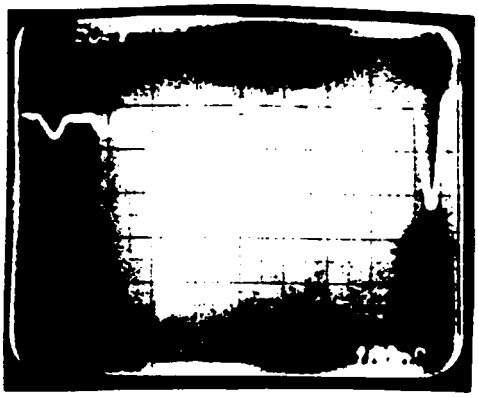
Distribution

Participants
BPC
E. Brouzet
O. Barbalat
G. Nassibian
A. Plunser
K.H. Reich

All horizontal scales are:-
100 nS/div.

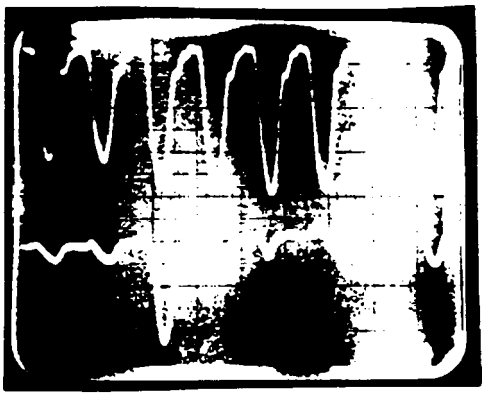


1. Σ 500 mV/div Δ 50 mV/div.
DEFLECTION TK2 6.184 milli Radians

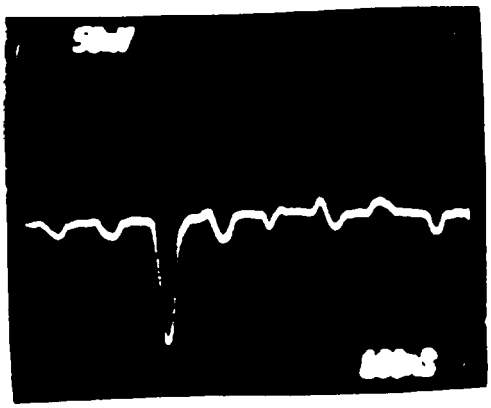


2. Δ 50 mV/div DEF. 7,1 mRadians

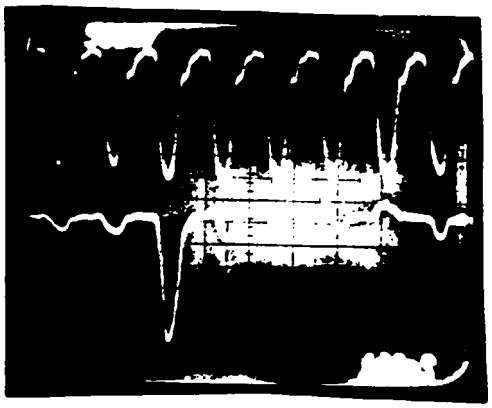
3. Δ 50 mV t = -10 nS



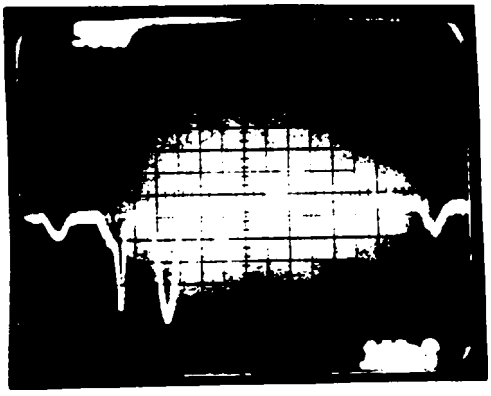
4. As 3 with Σ 500 mV/div



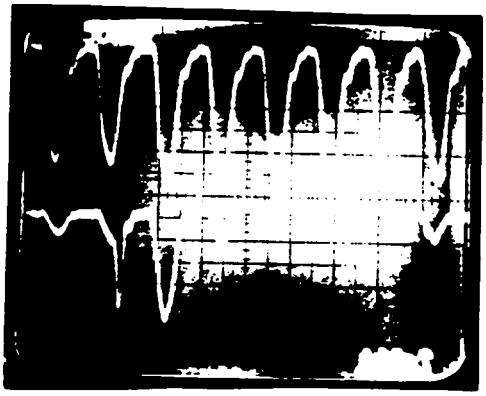
5. Δ 50 mV/div t = -20 nS



6. As 5 with Σ = 500 mV/div



7. Δ 50 mV/div t = -30 nS

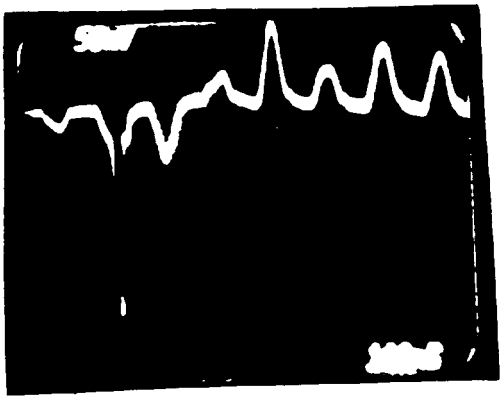


8. As 7 with Σ = 500 mV/div

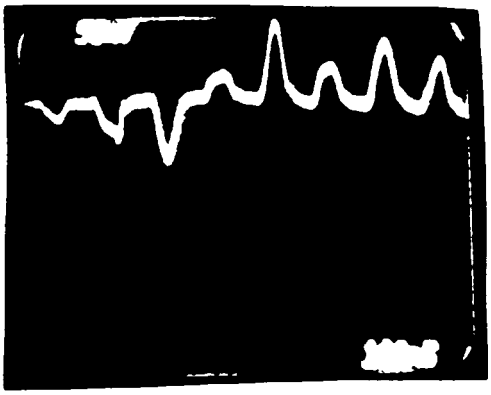
9. Δ 50 mV/div. t = -40 mS

9' AS 9. SHOWS AMPLITUDE CHANGE

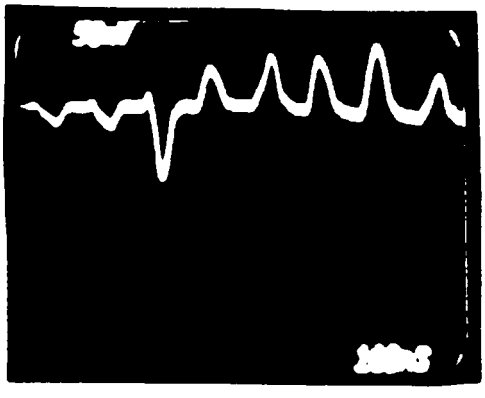
10. Δ 100 mV/div t = -50 mS



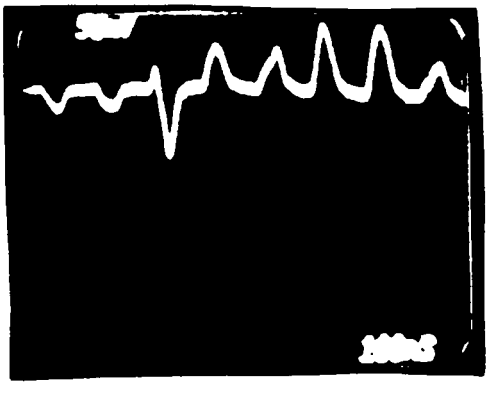
11. t = -40 mS. Δ 50 mV/div



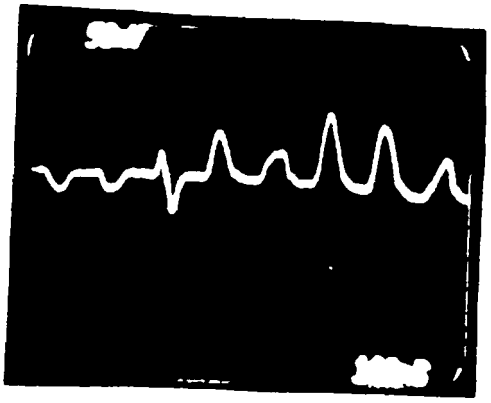
12. t = -30 mS. Δ 50 mV/div



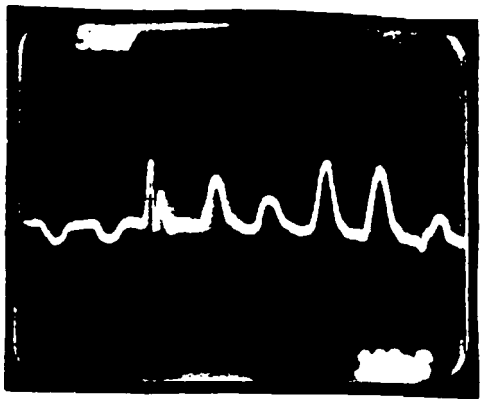
13. t = -20 mS. Δ 50 mV/div



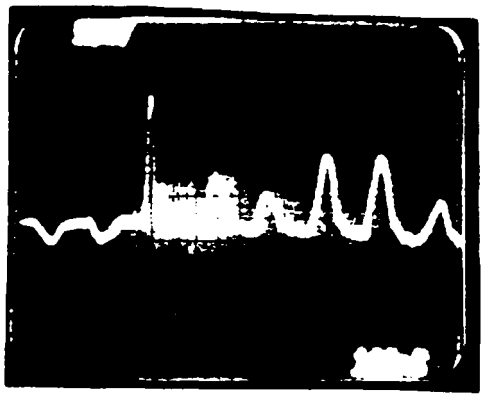
14. t = -10 mS. Δ 50 mV/div



15. t_0 = 0 nS Δ: 50 mV/div

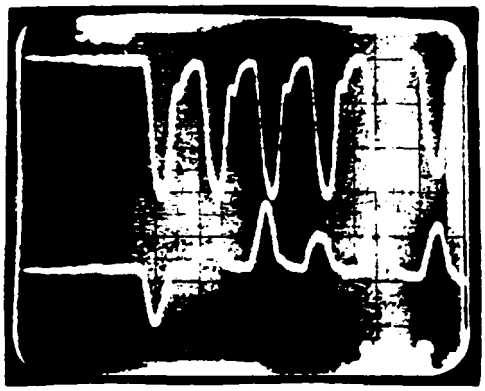


16. t = +10 nS Δ: 50 mV/div

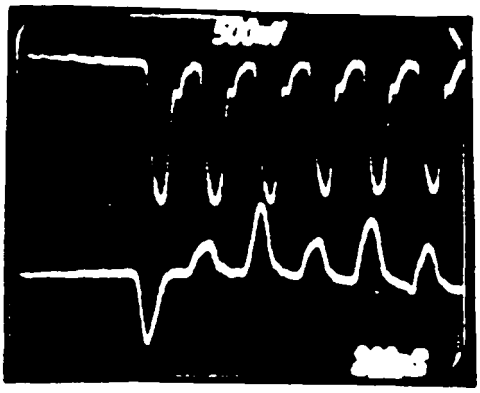


17. t = +20 nS Δ: 50 mV/div

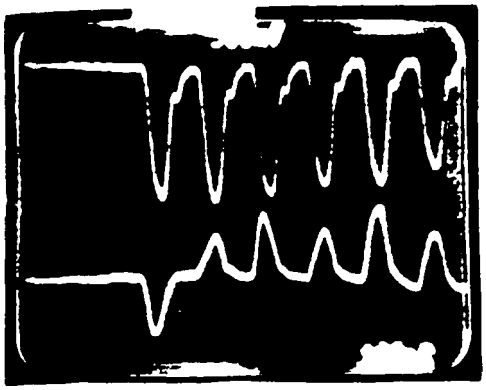
18. t = +30 nS Δ: 200 mV/div



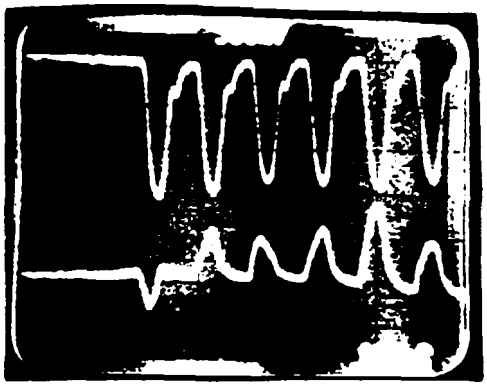
19. t = -40 nS Δ: 50 mV/div



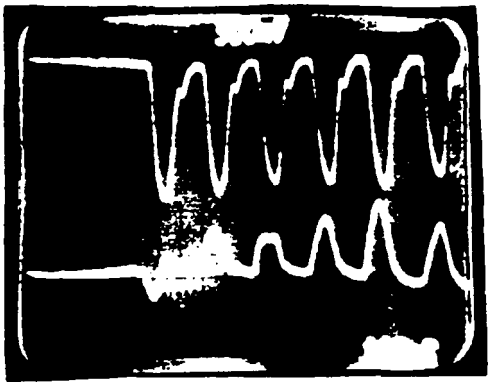
20. t = -50 nS Δ 50 mV/div



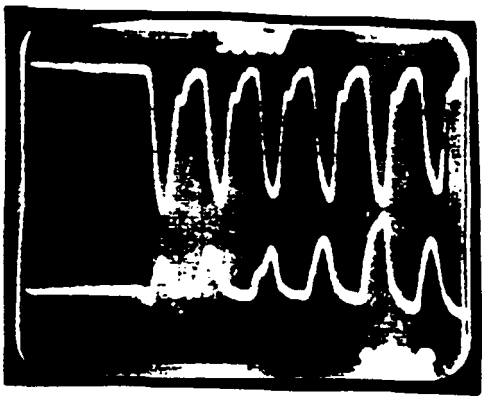
21. t = -60 nS Δ: 50 mV/div



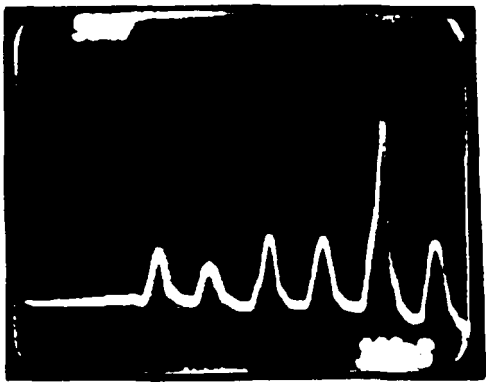
22. t = -70 nS Δ: 50 mV/div



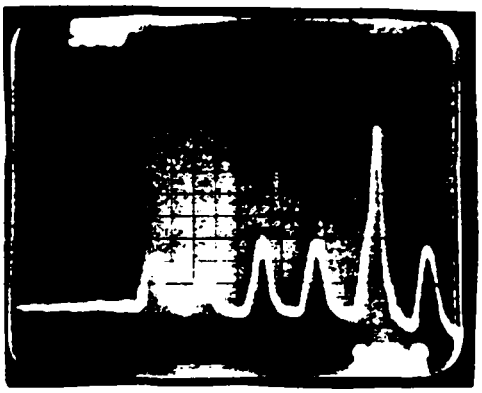
23. $t = -80$ mS Δ 50 mV/div



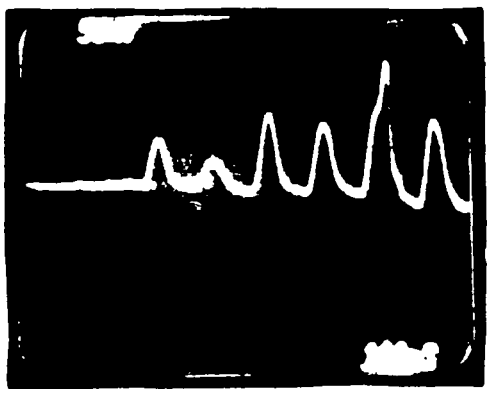
24. $t = -90$ mS Δ 50 mV/div



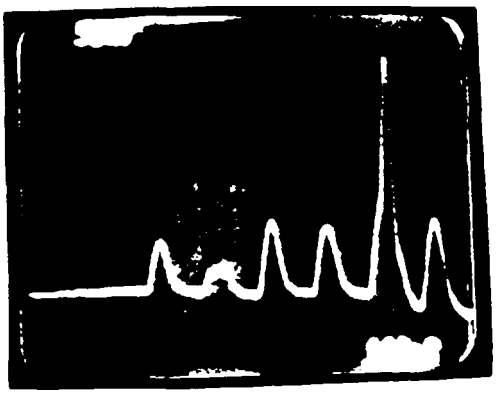
25. $t = -100$ mS Δ 50 mV/div



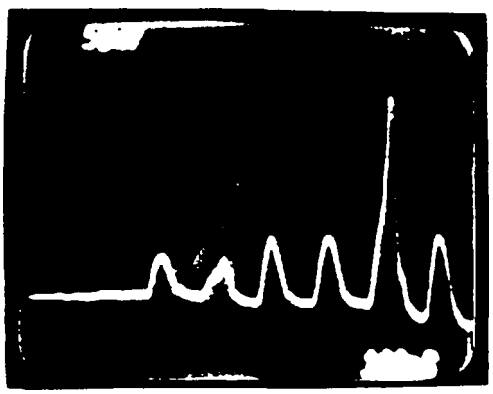
26. $t = -110$ mS Δ 50 mV/div



27. $t = -120$ mS Δ 50 mV/div



27.1 AS 27. AMPLITUDE CHANGE



28. $t = -130$ mS Δ 50 mV/...

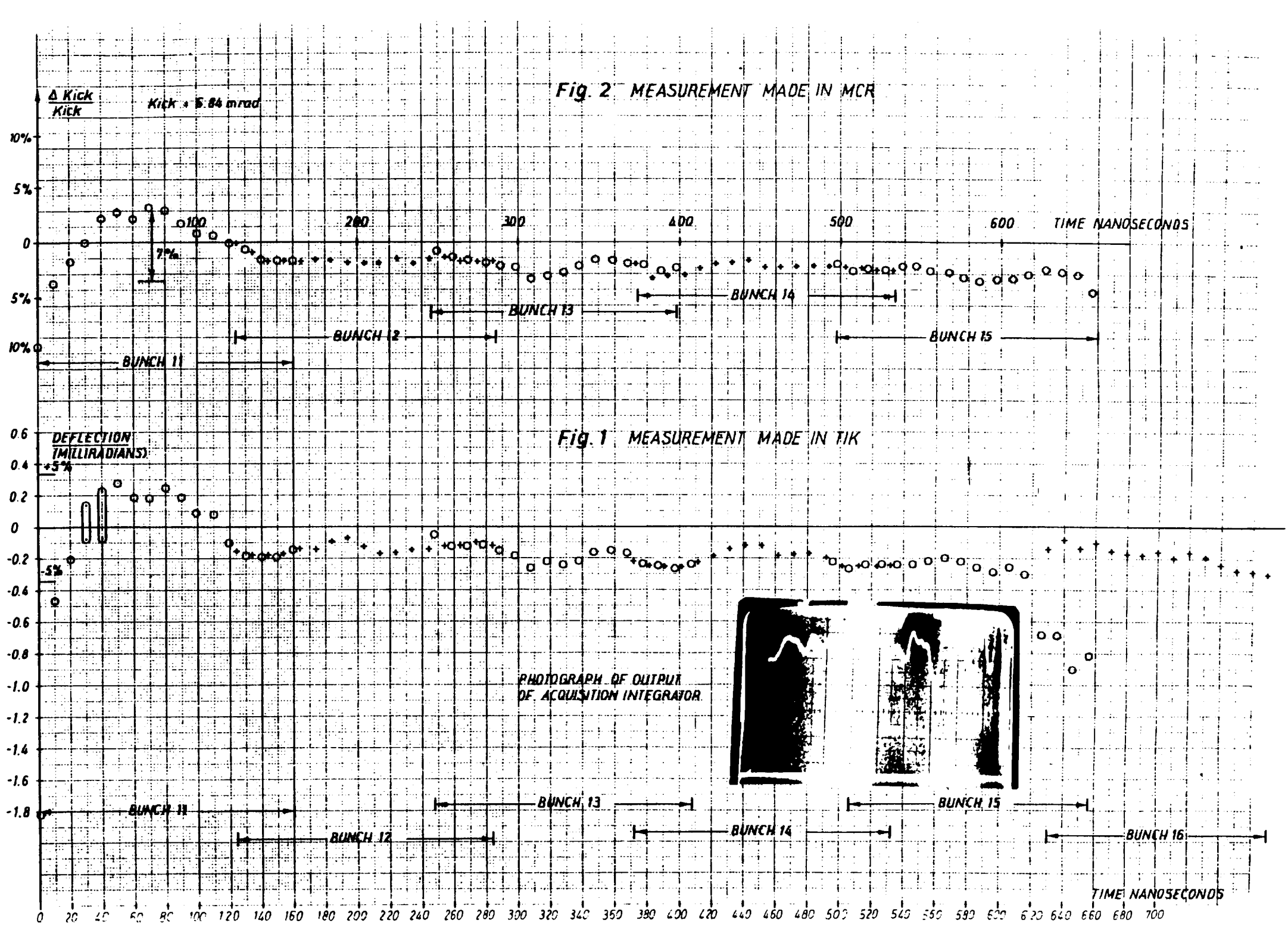
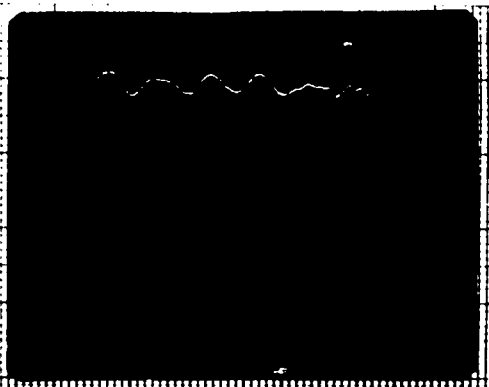


Fig. 2 MEASUREMENT MADE IN MCR
Δ Kick / Kick
Kick = 5.84 mrad
10%
5%
0
5%
10%
7%
100
200
300
400
500
600
TIME NANOSECONDS
BUNCH 11
BUNCH 12
BUNCH 13
BUNCH 14
BUNCH 15
Fig. 1 MEASUREMENT MADE IN TIK
DEFLECTION (MILLIRADIANS)
+5%
-5%
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
-1.6
-1.8
PHOTOGRAPH OF OUTPUT OF ACQUISITION INTEGRATOR
BUNCH 11
BUNCH 12
BUNCH 13
BUNCH 14
BUNCH 15
BUNCH 16
TIME NANOSECONDS
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700

Fig. 3



DEFLECTION
d MILLIRADIANS

+10%
+0.6
+0.4
+0.2
BASE
0.65mR
-0.2
-0.4
-0.6
-10%
-0.8
-1.0
-1.2
-1.4

BUNCH 11
BUNCH 12
BUNCH 13
BUNCH 14
BUNCH 15

TIME NANOSECONDS

0 20 40 60 80 100 150 200 250 300 350 400 450 500