CALIBRATION OF MONITORS IN THE FAST AND SLOW EJECTED BEAMS

The measurements reported in this note were performed during a part time of the Machine Development at :

A. 14.9.66 : Fast ejection (F.E.) into the u_3 channel
5 bunches at 16 GeV/c (see NOTE MPS/CO 29.9.66)

B. 28/29.10.66: Fast ejection into the e_2 channel
5 bunches at 16.7 GeV/c

C. 8.10.66 : Slow ejection (S.E.) and fast slow ejection (F.S.E.) into the e_2 and e_{2s} channel at 15.0 GeV/c

The layout of the monitor is sketched in Fig. 1. The following monitors were used :

1) F.E.: current transformers I and II

2) S.E.: current transformer III

3) Secondary emission chamber (S.E.C.)

4) Insulated plate (Al 1 mm thickness and 30° inclined) for charge measurements

5) Target m_6 (Cu : 2 x 1 x 150 mm) for charge measurements

6) Foils placed at the position of the u_3 and m_6 target and behind S.E.C.

Both F.E. current transformers were compared with the foil measurements. The calibration of the S.E.C. and of the charge measurements is based on the independent measurements of the induced activity in foils and on both the F.E. current transformers. The linearity of the F.E. transformer was checked by varying the number of protons/burst. All measurements with the S.E. current transformer (III) were in disagreement with all other monitor calibrated with the F.E. transformer and foils except for the highest intensity with S.E. (20 m.s) or F.S.E.. Therefore the calibration is based on the F.E. current

transformer and the induced activity for S.E.

1. COMPARISON BETWEEN THE TWO ABSOLUTE MEASUREMENTS

(Current transformer and induced activity) :

TABLE 1

RUN	ACT.	FOIL/TRANSF. I	FOIL/TRANSF. 2
A	Na^{24} (γ)	0.87	0.84
B	Na^{24} (γ)	0.90	0.90
B	F^{18} (β)	1.01	0.93
MEAN		0.93	0.92

The statistical accuracy of the foil measurements in Table 1 is estimated to 1-2 o/o. The statistical error for the measurement, using the F.E. current transformer is less than 2 o/o.

2. CALIBRATION OF S.E.C.

In Table 2 the calibration factor C is given, where $N_p = C\, N_{SEC}$, N_p = number of ejected protons and N_{SEC} reading on the S.E.C. scaler (in unit 0.1 mV for Ampl. 1/ 52 nF). The value for C obtained by the F.E. current transformer is a mean value of 25 measurements during run A and B over a range of 4 to 11 x 10^{11} protons/burst ejected (see Fig. 2).

TABLE 2

Monitor	Calibration factor C without correction of S.E.C.	Calibration factor C with background
FOILS (S.E.)	$4.14 \cdot 10^8$	$4.28 \cdot 10^8$
FOILS (F.E.)	$3.87 \cdot 10^8$	$4.19 \cdot 10^8$
TRANSFO (F.E.)	$4.01 \cdot 10^8$	$4.31 \cdot 10^8$
MEAN VALUE	$4.01 \cdot 10^8$	$4.26 \cdot 10^8$

In Table 2 the ratio $C = N_{TRAFO}/N_{SEC}$ during the foil exposure is omitted, since the ratio with the foil in the beam is different from all other measurements and suggest an effect due to the disturbed beam.

The constant noise of the SEC circuit amounts to less than 5 o/o for $2 \cdot 10^{11}$ proton/burst.

3. CALIBRATION OF THE PLATE

The charge measurement on the plate was found to be linear with respect to the F.E. transformer and SEC (Fig. 2 and 3), the calibration is given with

$$N_p = (0.464\ N_{CH} - 2.77) \cdot 10^9 \qquad N_{CH} \text{ in mV}$$

or roughly (neglecting the background)

220 mV = 10^{11} protons

(with amplificiation 10 and a capacity of 50 nF (49 nF) + 24 nF (cable). The accuracy estimated is 5 - 10 o/o.

4. CALIBRATION OF THE CHARGE MEASUREMENT AT m_6 TARGET

The cross-section of the target m_6 is 2 x 1 mm^2. The beam distribution as measured with foils using S.E. is shown in Fig. 4. 15 to 18 o/o of the total beam crossed the area of 2 x 1 mm^2. This results in

8.4 volts = 10^{11} protons

crossing 2 x 1 mm^2 of target m_6 (150 mm) with amplification 10 and a capacity of 100 nF (109 nF) + 34 nF (cable). The accuracy of this calibration is estimated to $\pm$ 20 o/o.

5. CONCLUSIONS

The result of a comparison between the monitors is shown in Fig. 2a, b and 3a, for fast and slow ejection.

a) The absolute values given by the F.E. current transformer and the foil measurements agree within 7.5 o/o, where the larger value results from the current transformer. The cross-sections used for the induced activity are known with an accuracy of only $\pm$ 5 o/o to $\pm$ 7 o/o. Therefore one cannot expect a better accuracy using the activation method for comparison.

b) The S.E. current transformer is not yet a reliable monitor for the slow ejection. Improvements and further studies have to be envisaged.

c) Charge measurements and S.E.C. have proved to be useful monitors for F.E. and S.E. Both monitors increase linearly with increasing intensity. It should be tried to reduce the noise. The background for S.E.C. is constant and for $4 \cdot 10^{10}$ protons per burst in the order of 10 o/o.

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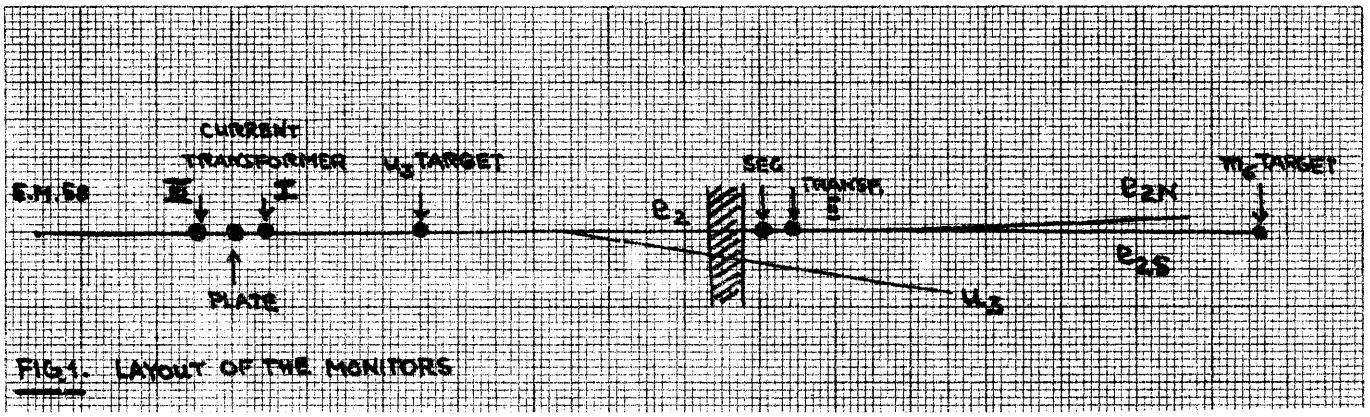


FIG 1. LAYOUT OF THE MONITORS

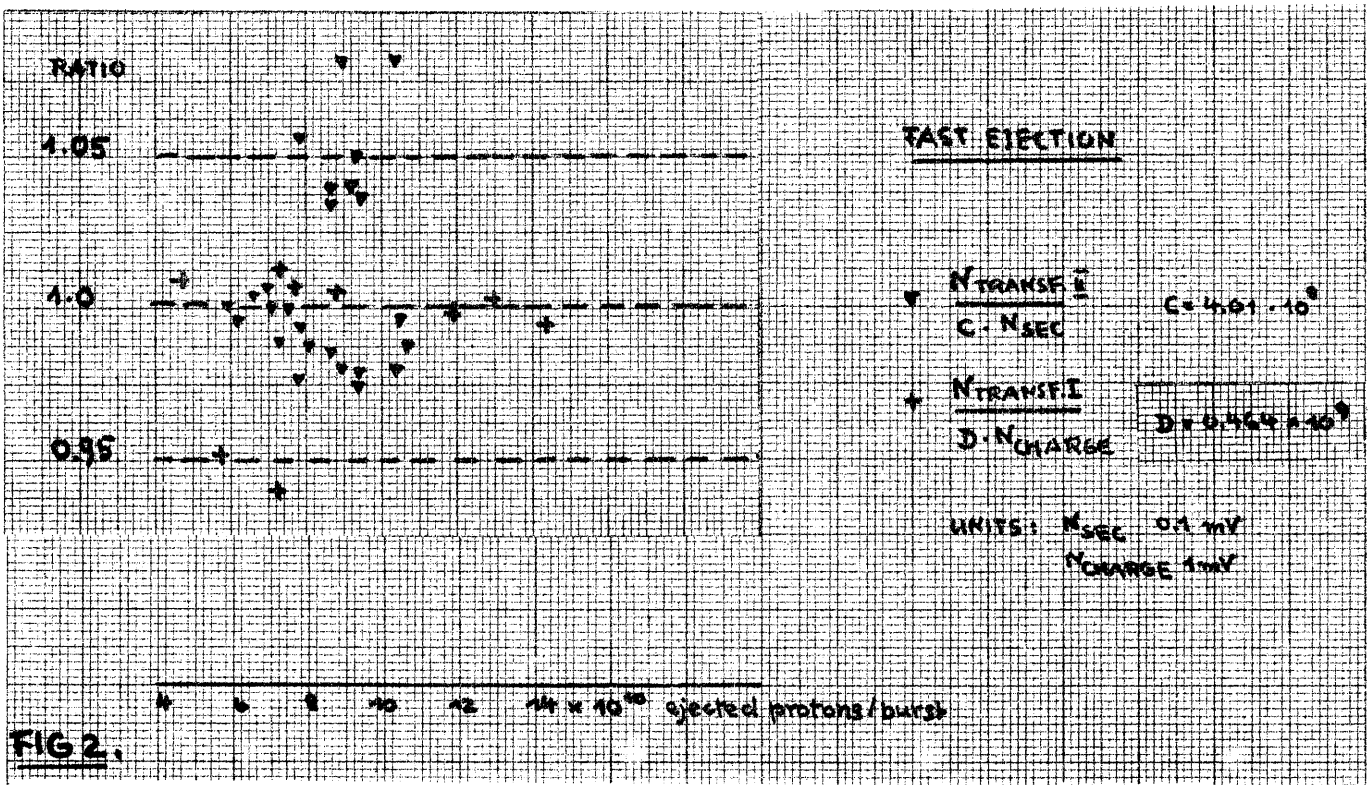


FIG 2.

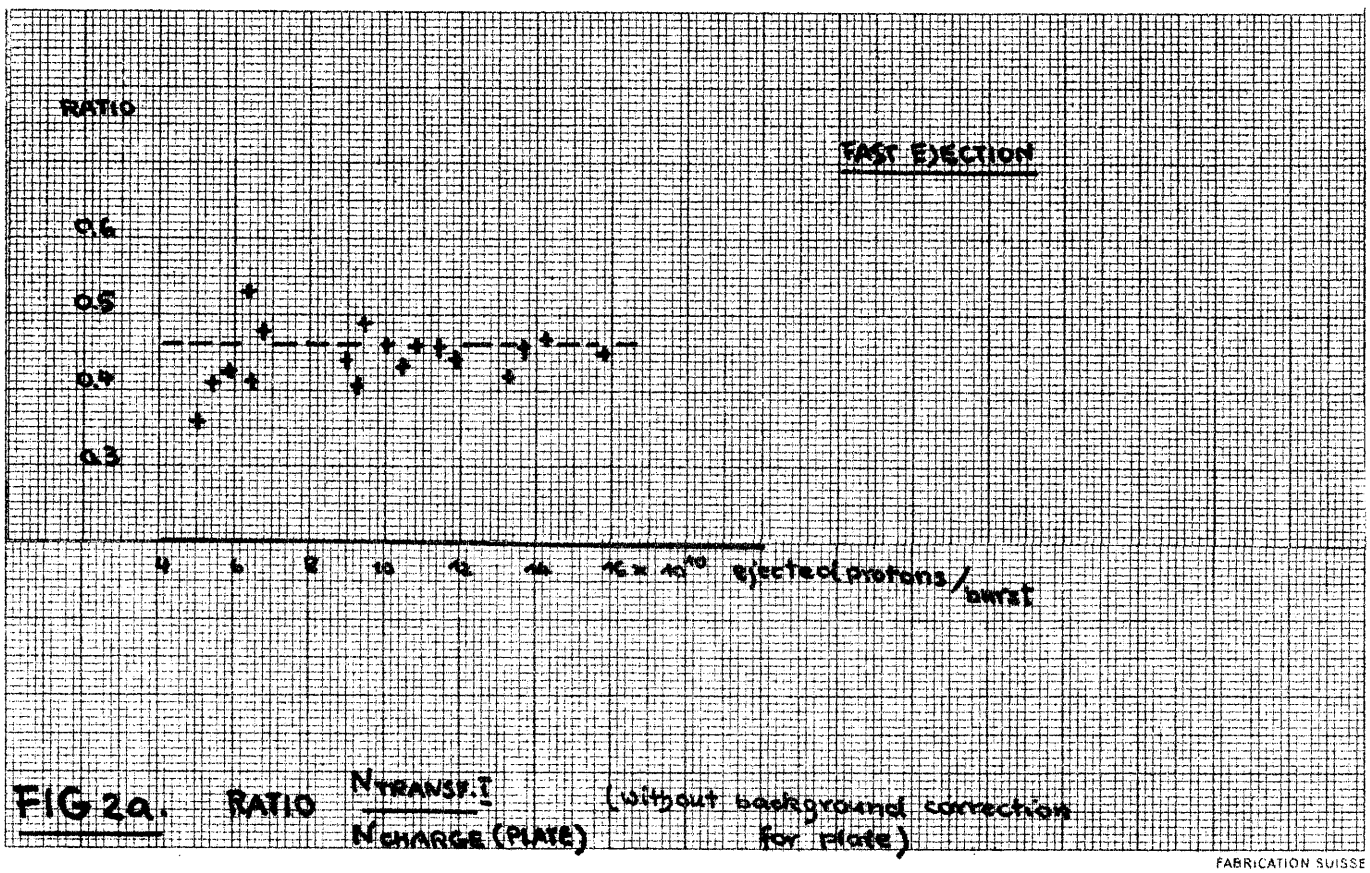
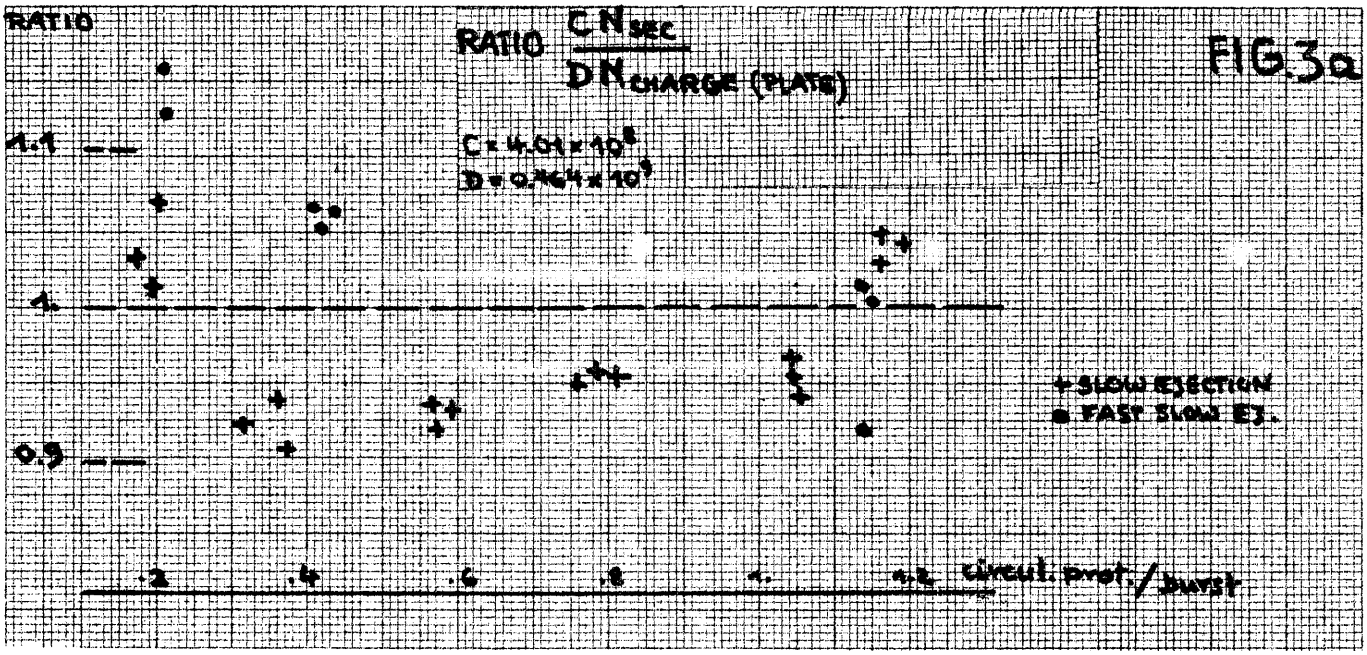


FIG 2a. RATIO $\frac{N_{TRANSF.I}}{N_{CHARGE\ (PLATE)}}$ (without background correction for plate)


RATIO
RATIO $\frac{C\,N_{SEC}}{D\,N_{CHARGE\ (PLATE)}}$
FIG. 3a
C = 4.01 x 10^8
D = 0.464 x 10^8
1.1
1.
0.9
+ SLOW EJECTION
● FAST SLOW EJ.
.2
.4
.6
.8
1.
1.2
circul. prot. / burst

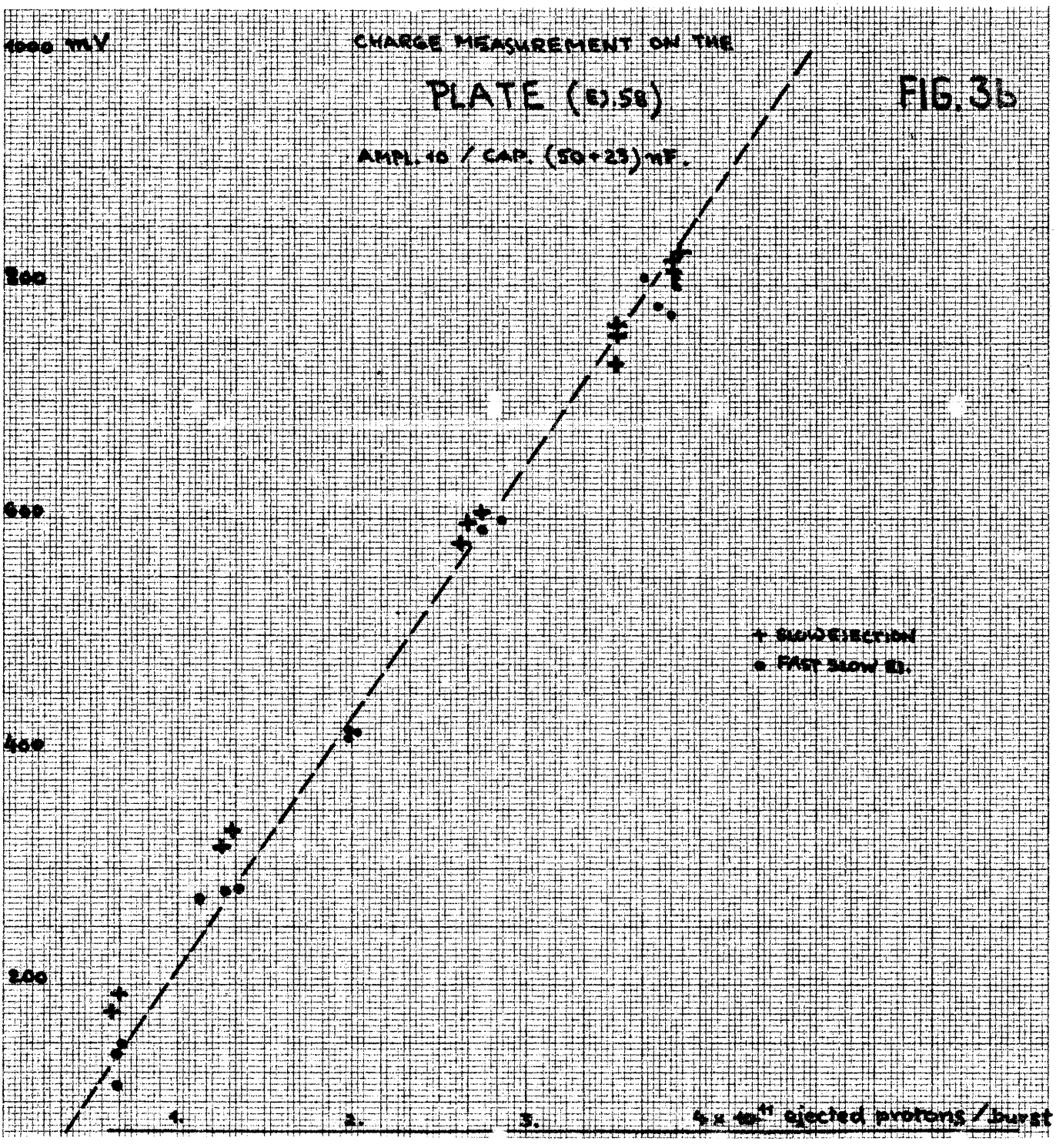

1000 mV
CHARGE MEASUREMENT ON THE
PLATE (E).58)
FIG. 3b
AMPL. 10 / CAP. (50+23) nF.
800
600
400
200
+ SLOW EJECTION
● FAST SLOW EJ.
1.
2.
3.
4 x 10^11 ejected protons / burst

FIG. 4

BEAM DISTRIBUTION AT THE m_6-TARGET

(SLOW EJECTION)

8.10.66

MEASURED WITH INDUCED ACTIVITY IN STRIPS OF 1 mm.