PS/LP Note 94-45
9/10/1994

The CTFRun No. 2 1994

Results and Comments

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1. General

Start : 5/07/94
End : 25/08/94

Modifications in respect to Run 1 (see: PS/LP/Note 94-30 (Tech))

Beamline : - the collimator of the BPM beam line removed

- for calibrating the UMA's with a Faraday Cup (FC) the quadrupole triplet behind LAS was removed from 15 to 19/08 then,
- QDN415 replaced for type QL2 - water cooled and QFN620 for a QL1

RF-network : KLY97 feeding LAS
KLY98 feeding gun and booster - see fig. 1

Laser: relay imaging and spatial filtering as installed improved spot size

Pulse train generator : a pulse doubler in front of the existing two generators permits to create a train of 48 pulses or two closely spaced pulses

UMA signal attenuated by a factor 10; announced ranges :
high gain: 1nC to 20nC
low gain: 20nC to 200nC

2. Objectives of the run

- Test if with the higher accelerating gradient in LAS a better beam for 30 GHz power by TRS is obtained
- Calibrate the UMA's with the FC
- Bunch length measurements
- Transverse beam emittance measurements
- Experiments with two laser pulses in one rf bucket
- Beam for testing the BPM's and a Beam Position and Intensity Monitor - a prototype made at the Uppsala University.

3. Beam momenta

To get with the new rf power distribution the same field levels in the gun and booster as at run 1 we took as reference the signal BL1 = 2.5 V (Booster Loop 1) and this for MDK98 PFN at 32.7 kV.

Using the spectrometer and the calibration for BHZ385 of 0.518 MeV/c A,
momentum gun: 4.0 MeV/c Fig. 2 Logbook p. 165
momentum gun + booster : 11.0 MeV/c p. 98

With the KLY97 set at a power level of around PKI97 = 30 MW ,this for MDK97 PFN at 36.0 kV, for BHZ430 the calibration of 2.698MeV/c A,
momentum behind LAS : 82.0 MeV/c for low charge.

Gradient: 17.3 MV/m

During run 1 we had: 59.6 MeV/c

During run 2 we had twice the power into LAS and thus expect: 81 MeV/c.

4. More 30 GHz power generated by TRS

At first the 24 bunch train had been adjusted for intra bunch spacing and position on the photocathode.

Several optics were tried. Finally we run best with the large solenoid on LAS off and with SNF350/380 at 47/50 A and QDN410/QFN415/QDN420 at -5.75/ 48.1/ - 8.2 A (QFN415 type QL2).

Our main goal of the CTF was attained: p. 153

- 30 GHz power from TRS 60 MW (peak) with
- Peak electric field 110 MV/m
- Average electric field 79 MV/m

and in CAS
- Peak electric field 103 MV/m
- Average electric field 73 MV/m

We do not have a simultaneous reading of the 30 GHz and the UMA's.

A representative set of UMA-readings is :

- UMA375 67.5 nC or 2.8 nC per bunch
- UMA385 69.3 nC or 2.9 nC pb
- UMA406 68.0 nC or 2.8 nC pb
- UMA455 53.4 nC or 2.2 nC pb

For a charge of 68 nC the 60 MW is generated if the bunch length is 12 ps FWHH and thus close to our measurement (see ch. 6).

5. Comparison UMA - FC

During the previous run we had found that the digital readout of the UMA saturates and therefore an attenuator was put in.

At low charges the UMA agreed well with the FC put in the spectrometer line of BHZ350 and of BHZ430.For high charges, due to the momentum spread, the beam becomes to wide to enter fully the cup.

As it is essential to know the charge in the bunch train up to 100 nC at least, we removed the triplet behind LAS to have the FC on the straight beam line. From fig.3,4 and 5 we see that the UMA digital readout agrees with the FC reading.

For single bunches the agreement is less good for charges above 4 nC. We believe that this is caused by bunch blow-up as the FC is reading less with increasing charge (Fig. 6).

6. Bunch length measurements with TCM's and streakcamera

The laser pulse width measured with the streakcamera is 8.0 ps FWHH at 262 nm.

So far, the bunch length was found to be 10 ps or more. By filtering the light coming from the TCM's such that the red spectrum goes to the camera only, the bunch length becomes shorter.

Results: fig. 6, 7 and 8. These results now agree better with the simulations. But, what in the optics of the TCM's is causing this pulse lengthening?

Note that the dip in the curve on fig. 8 was found earlier already.

7. Transverse bunch emittance

The programme conceived by M. Comunian is still under development but a first result was obtained: the norm.rms.emittance in x for a 2.8 nC bunch is 39 mm.mrad.

The transverse bunch profile is measured with TCM445T and the current in QDN420 varied. One emittance measurement takes about 10 minutes.

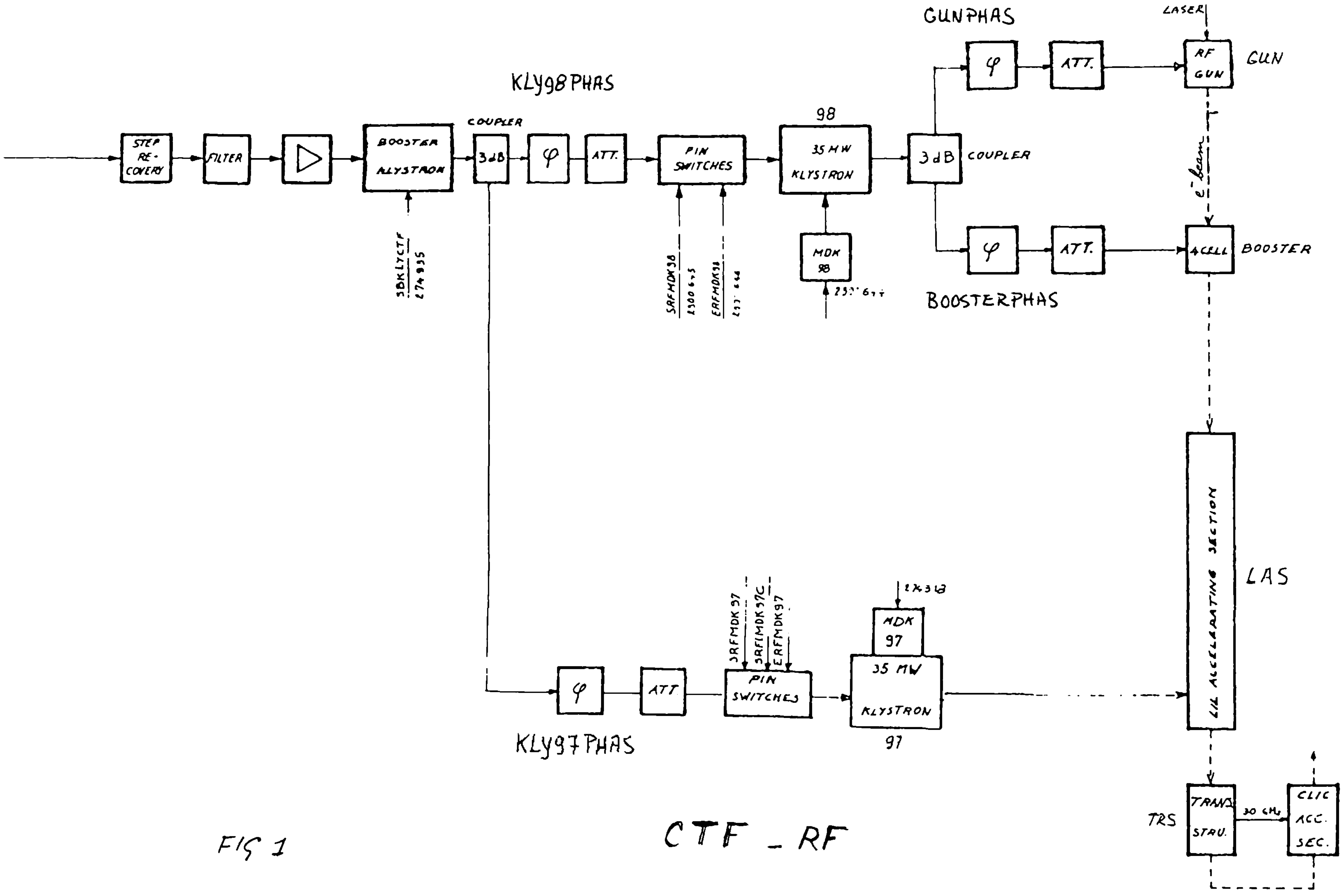
8. Two bunches in one rf bucket

With a splitter and an optical delay two laser pulses are made with a spacing which can be adjusted from a few ps to 333 ps. This permits to make a long bunch and to study the beam dynamics in the gun. The bunch spacing varies with the rf phase at the laser pulse arrival. See fig. 10 and 11.

9. Testing beam position monitors

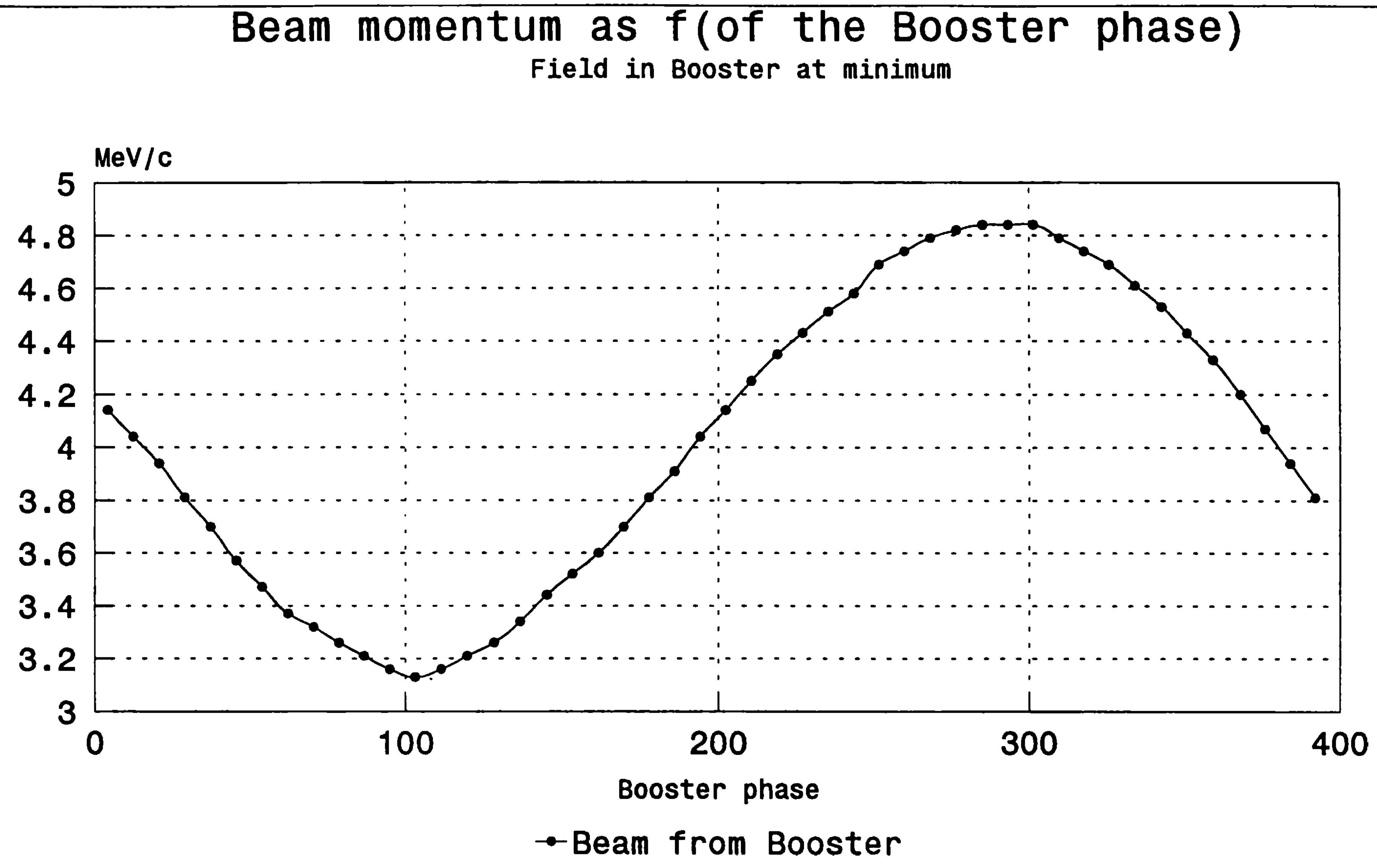
The CLIC - BPM test, results fig. 12, showed that the beam position had in the vertical plane a maximum jitter of $\pm 17\ 10^{-6}$ m.

A prototype BPM made by the Uppsala University was installed behind the UMA406. The signal could not be used due to strong oscillations. These oscillations were attributed to wakefields created by the bunch.


STEP RE-COVERY
FILTER
BOOSTER KLYSTRON
SBKLYCTF
COUPLER
3dB
KLY98PHAS
φ
ATT.
PIN SWITCHES
SRFMDK98
ERFMDK98
98
35 MW KLYSTRON
MDK 98
3dB
COUPLER
GUNPHAS
φ
ATT.
LASER
RF GUN
GUN
e⁻beam
BOOSTERPHAS
φ
ATT.
4CELL
BOOSTER
LIL ACCELERATING SECTION
LAS
KLY97PHAS
φ
ATT
SRFMDK97
SRFIMDK97C
ERFMDK97
PIN SWITCHES
MDK 97
35 MW KLYSTRON
97
TRS
TRANS. STRU.
30 GHz
CLIC ACC. SEC.

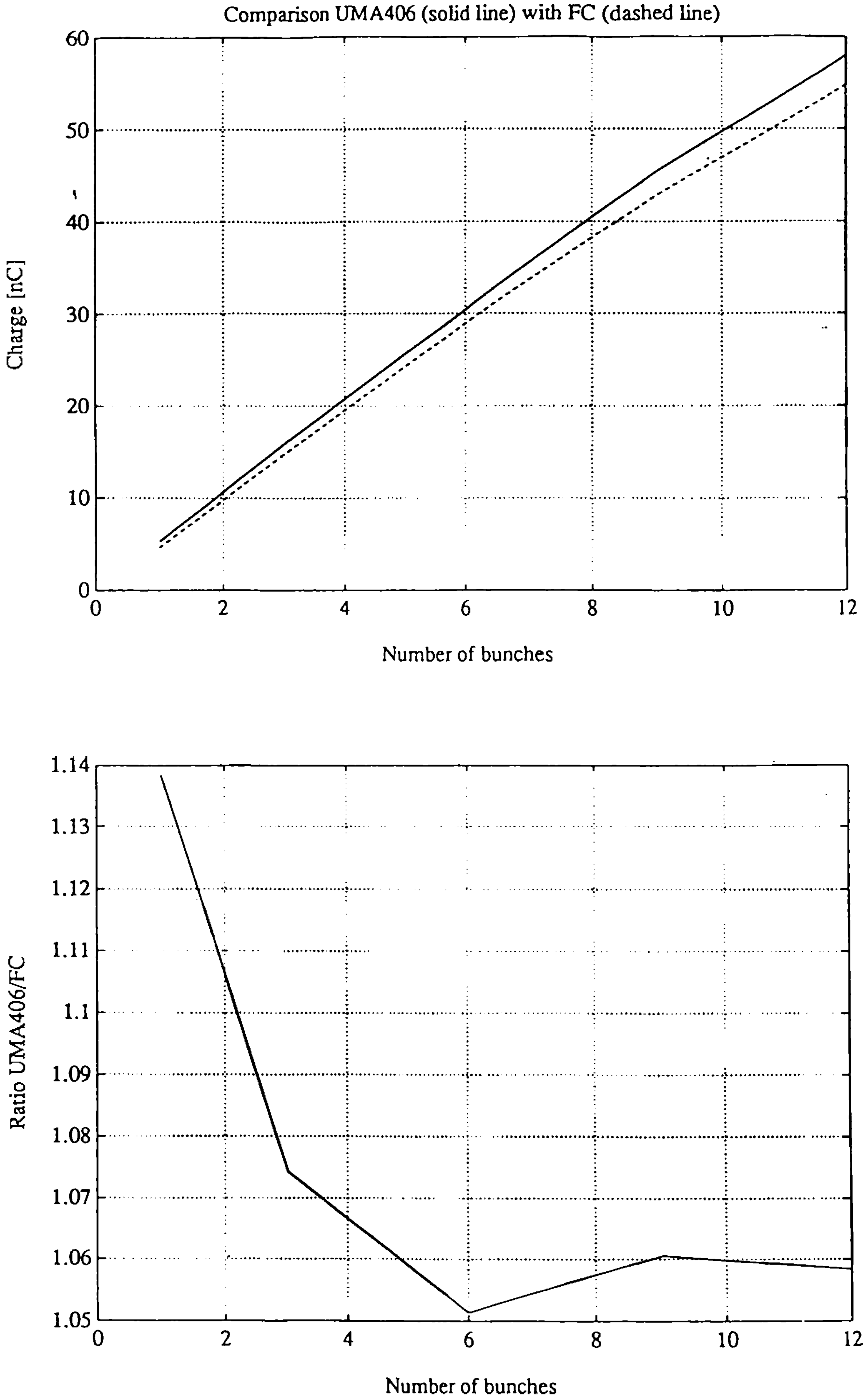
CTF - RF

FIG 1

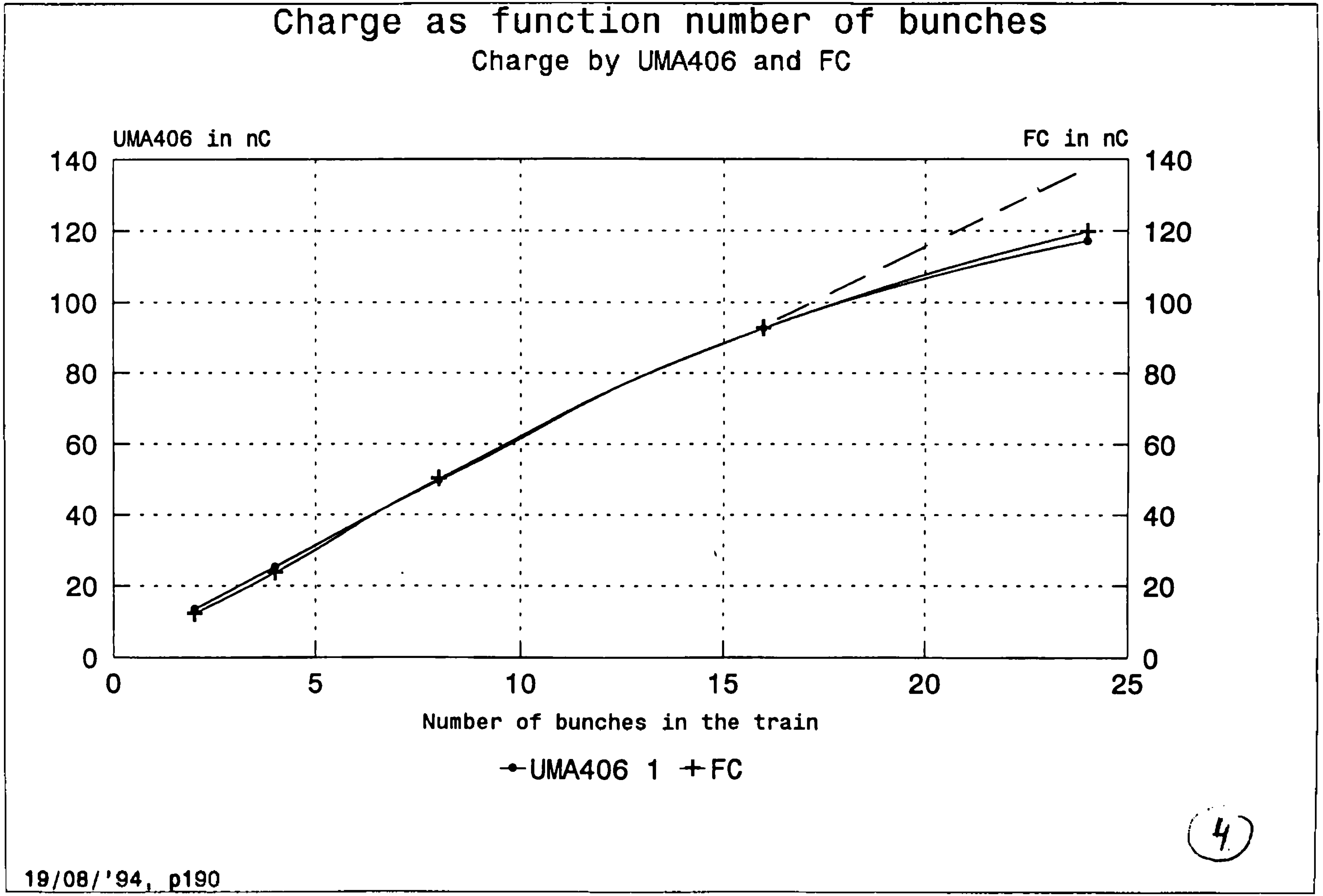


On 9/08/'94, page 165/166
Two times bunch no.1; 11.2 nC p.b.
Gun beam is at 4.0 MeV/c

Fig 2



Comparison UMA406 (solid line) with FC (dashed line)
Charge [nC]
Number of bunches
Ratio UMA406/FC
Number of bunches



Charge as function number of bunches
Charge by UMA406 and FC
UMA406 in nC
FC in nC
140
120
100
80
60
40
20
0
0
5
10
15
20
25
Number of bunches in the train
UMA406 1
FC
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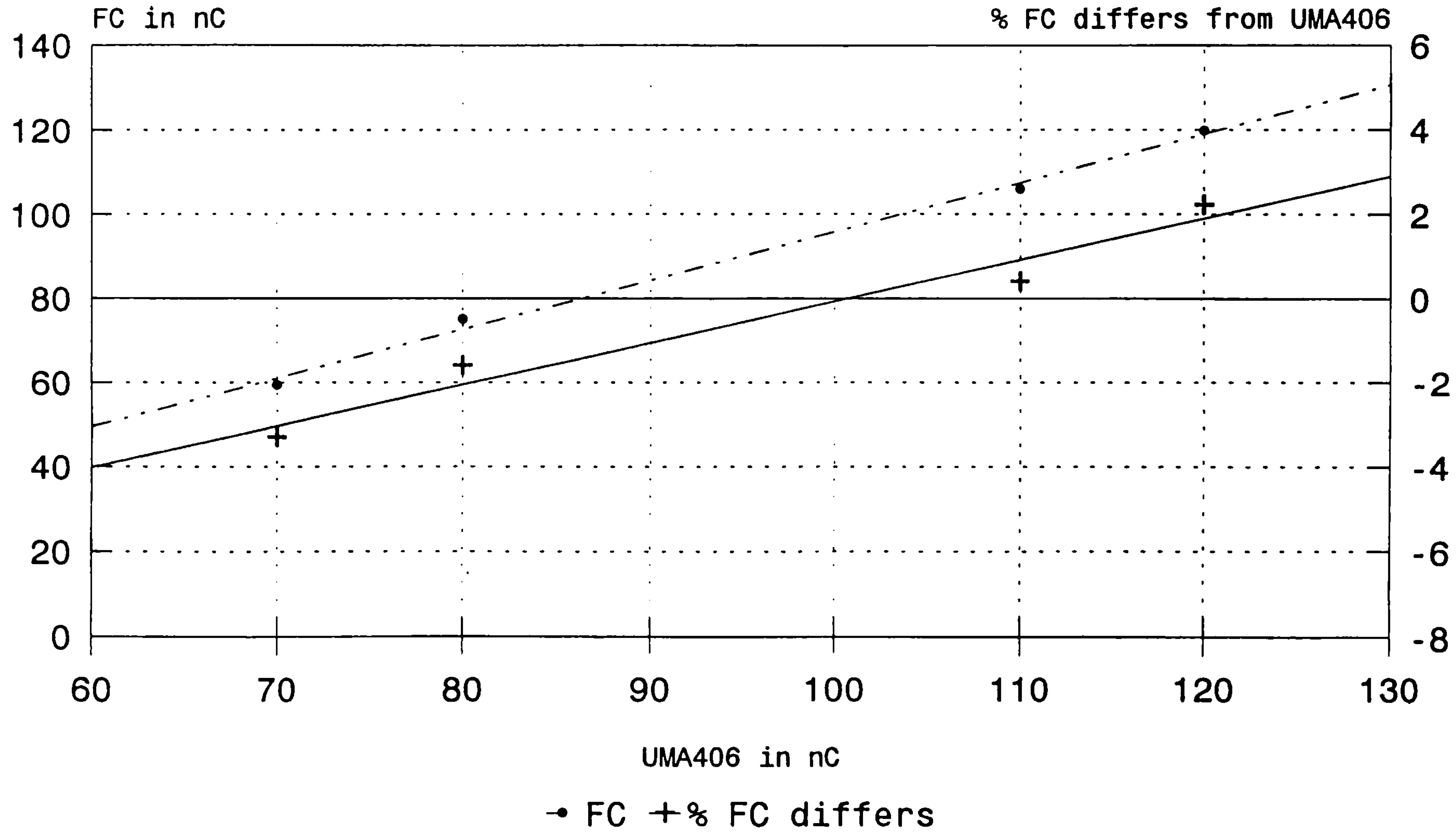
4

Charge by UMA406 and FC

Train of 24 bunches



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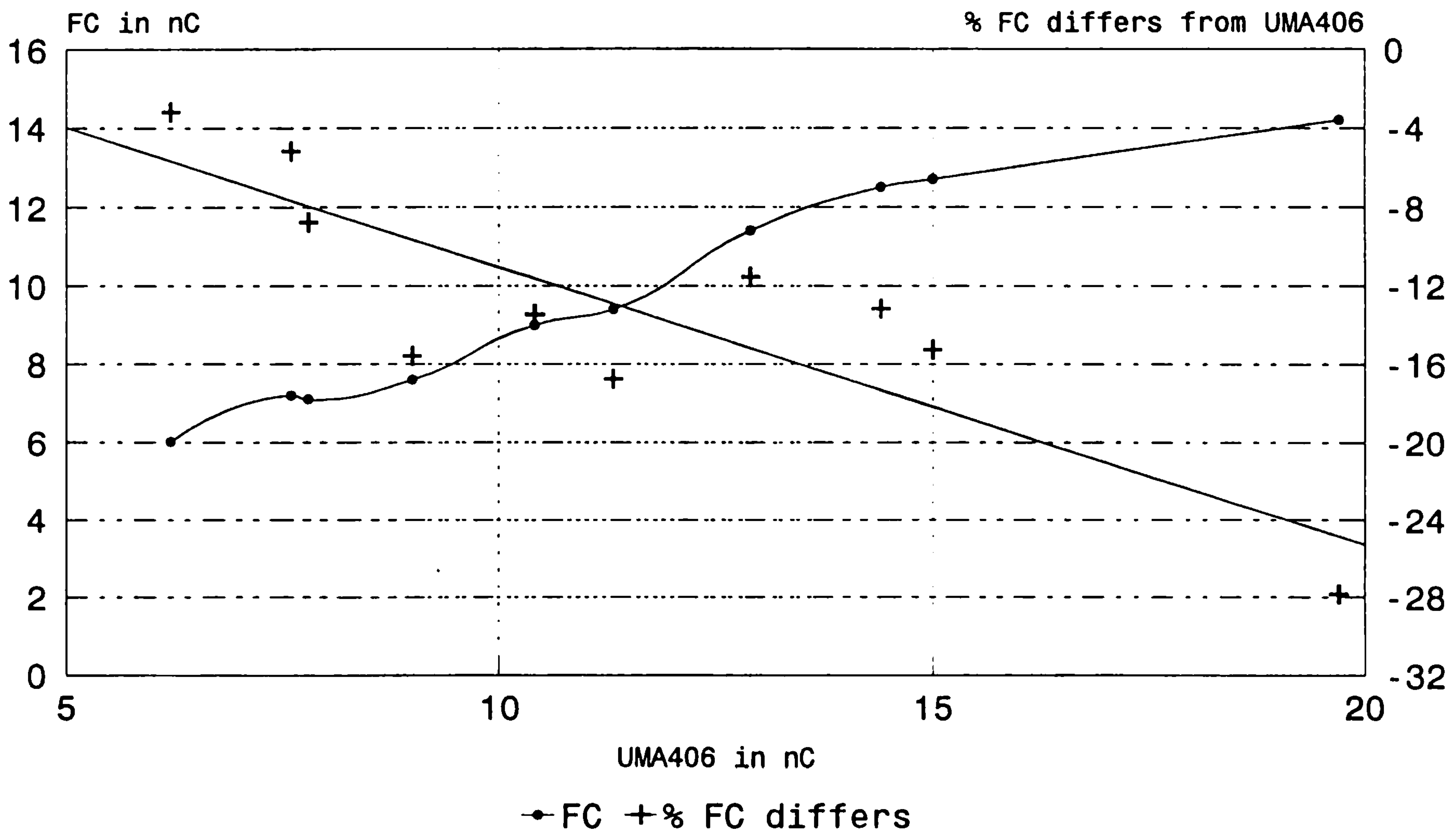
Charge in single bunch

For different optics



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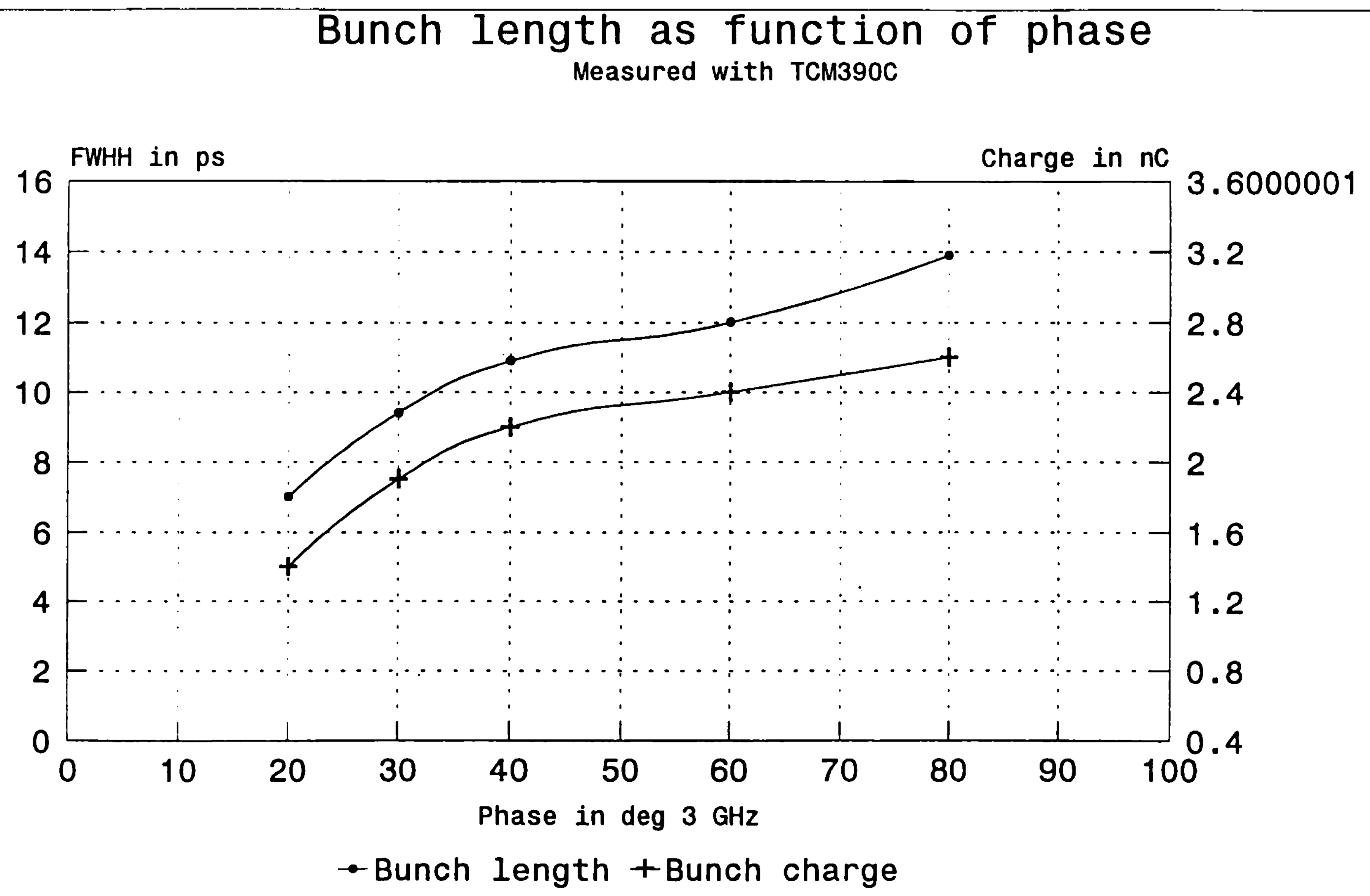
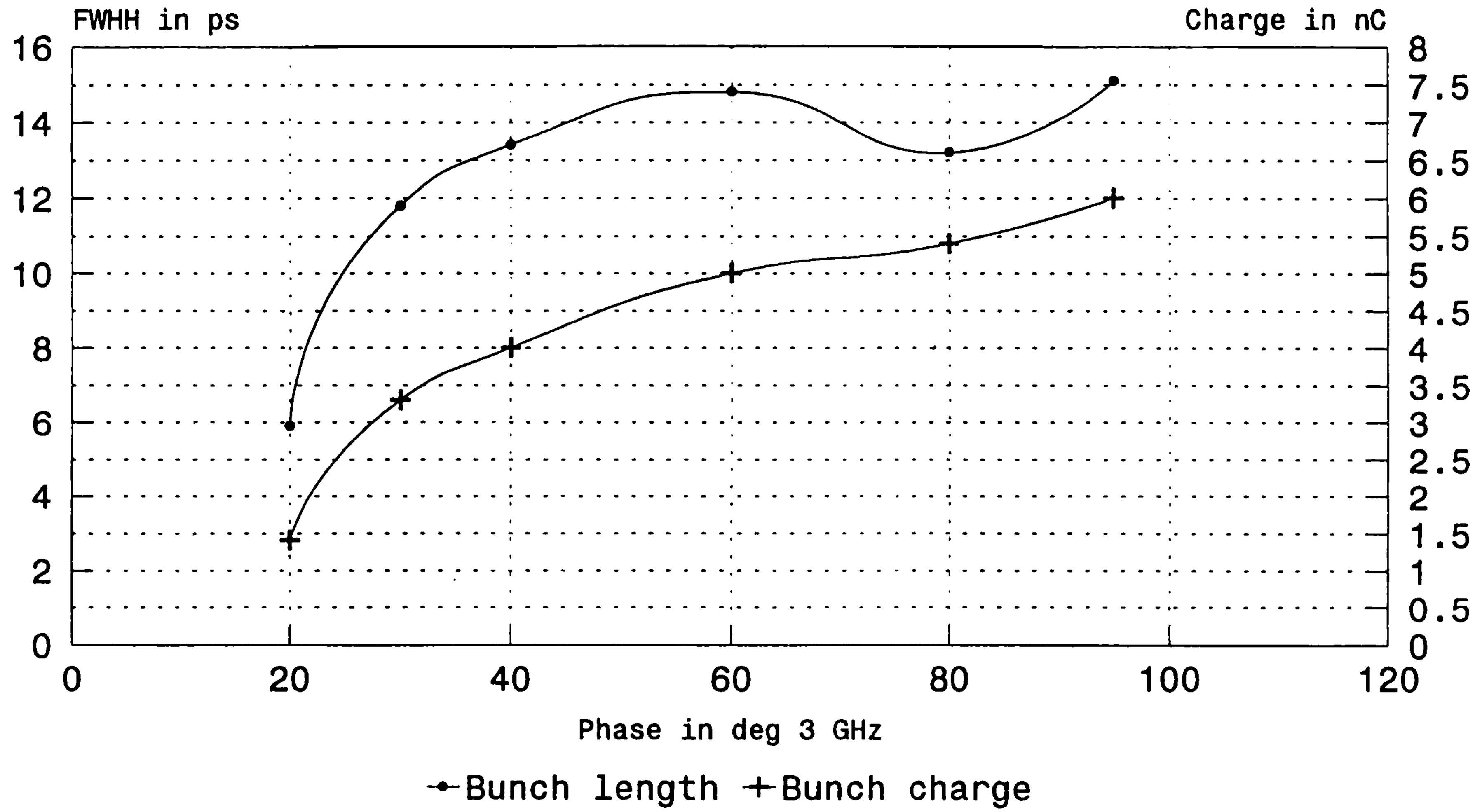


On 9/08/'94, page 170.
Phases are relative

(7)

Bunch length as function of phase

Measured with TCM390C

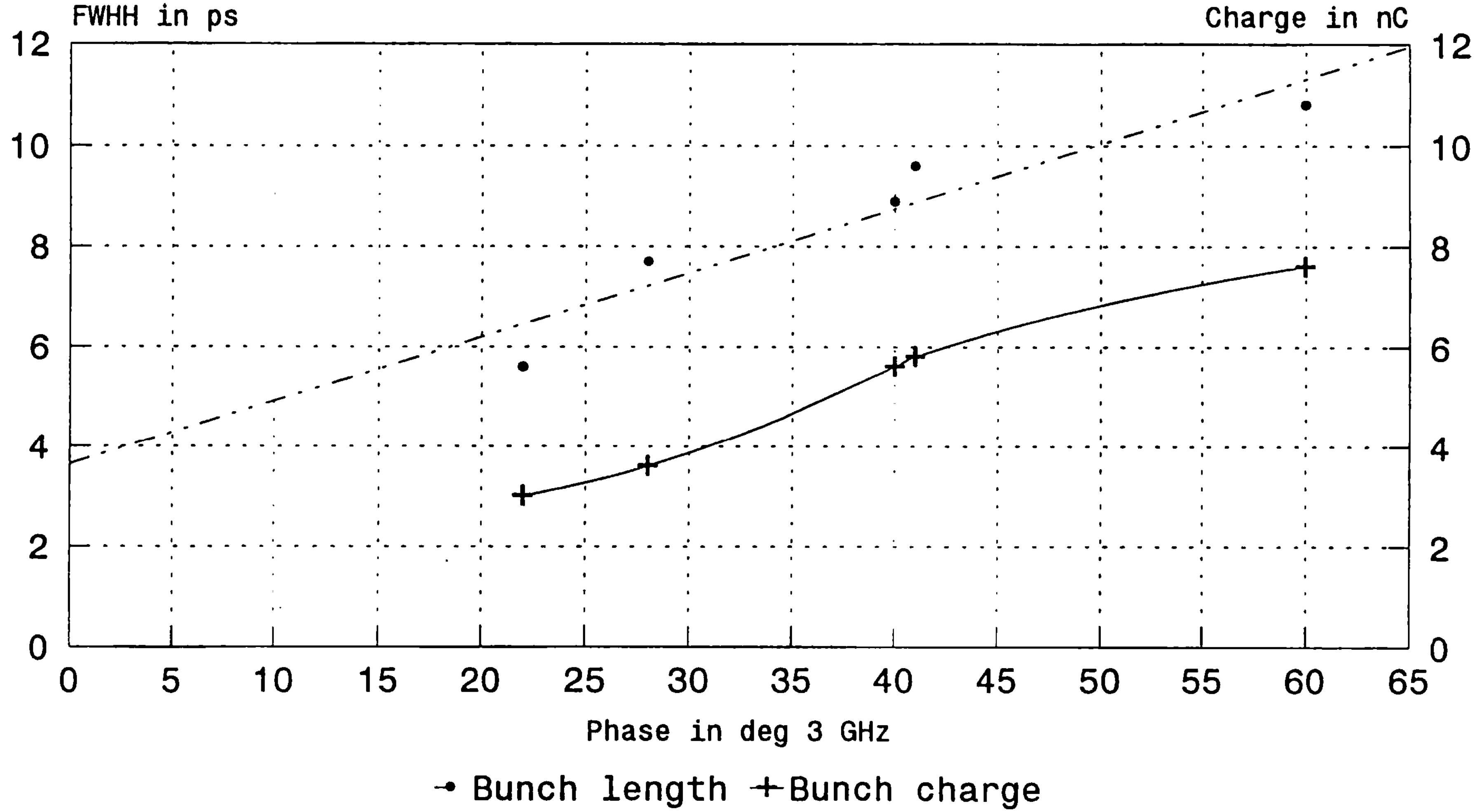


On 9/08/'94, page 170
Phases are relative

(8)

Bunch length as function of phase

Measured with TCM445T



On 9/08/'94, page 172
Phases are relative

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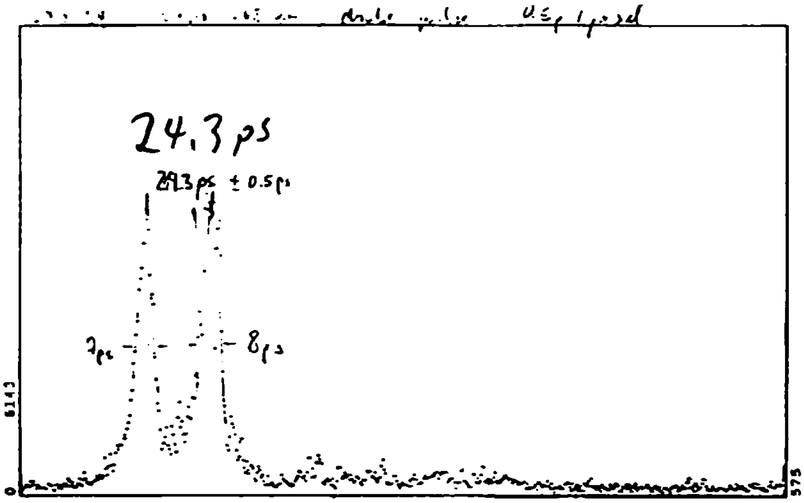
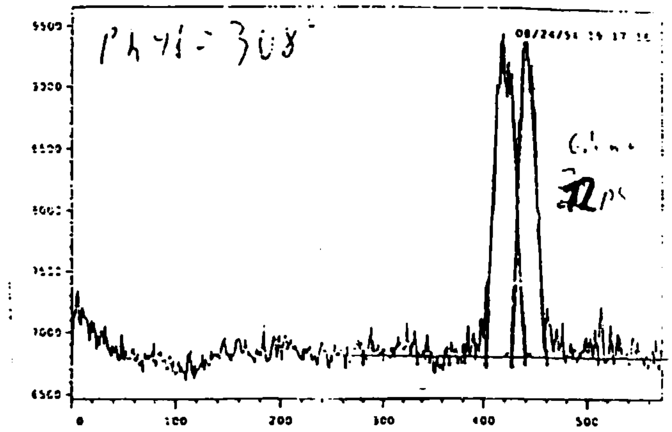
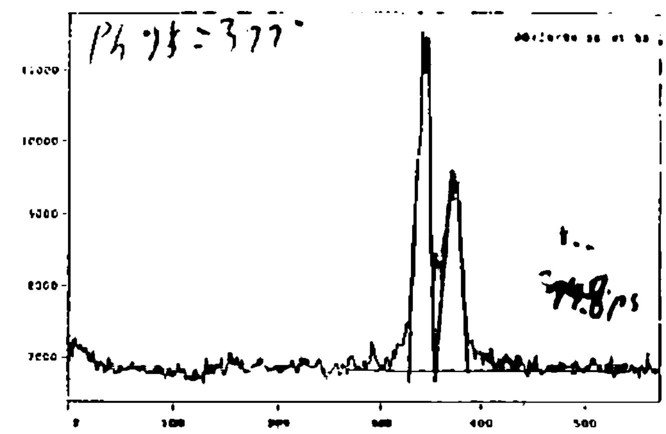
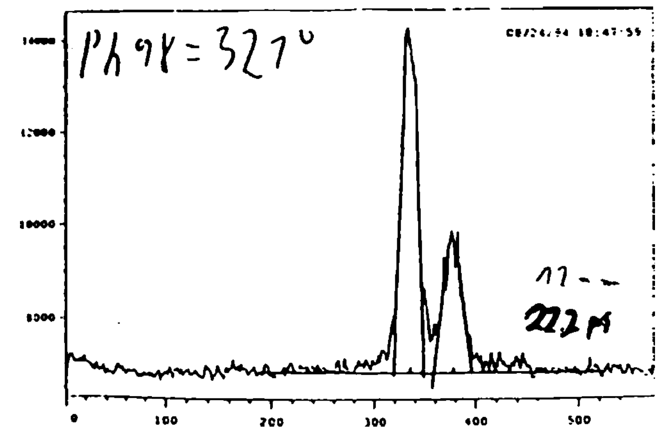
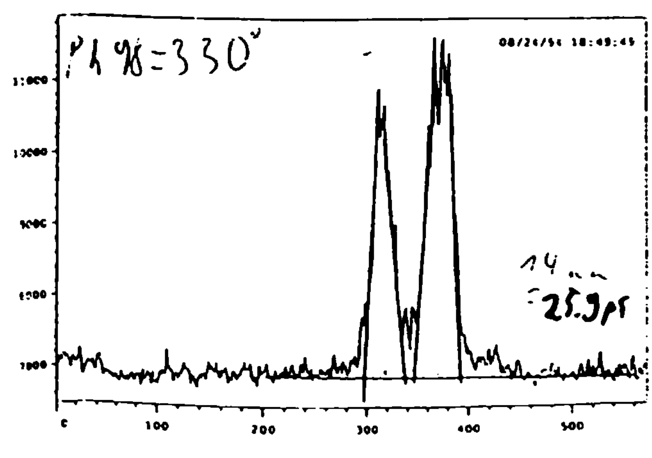
Laser on Streak Camera TCM 390C



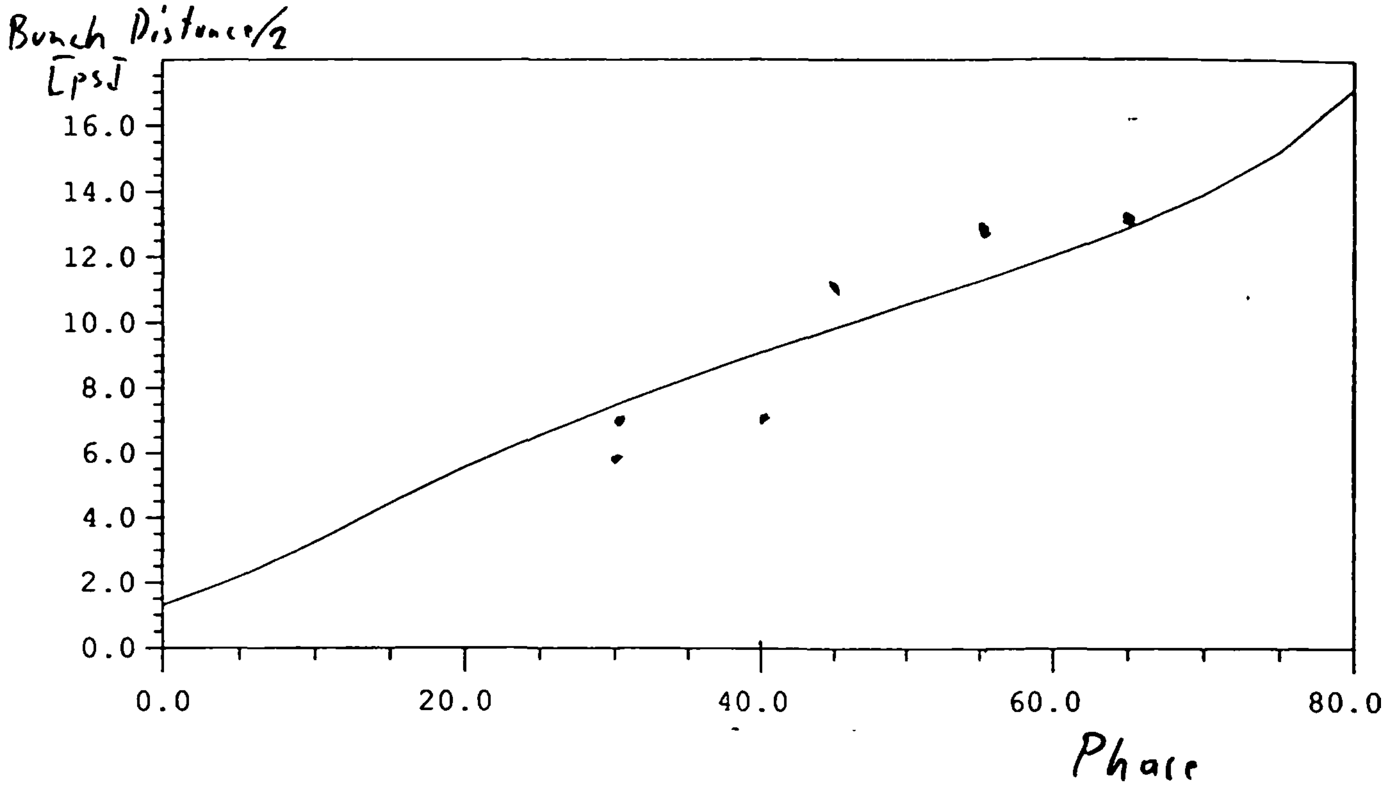








Comparison Measurement/CTFSIM



LINE : FROM CTFSIM.

DOTS : MEASURED, see fig 10

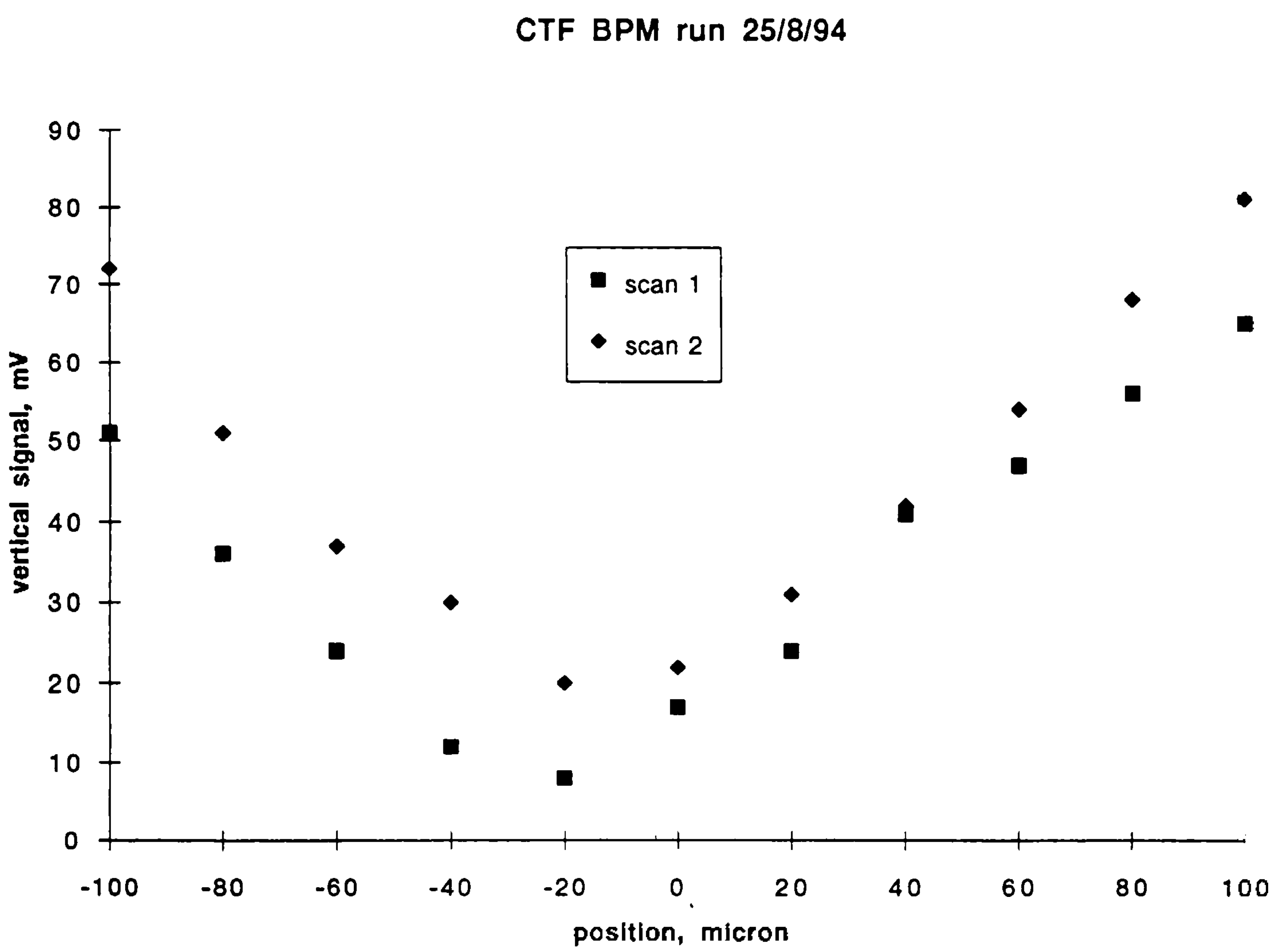

CTF BPM run 25/8/94
scan 1
scan 2
vertical signal, mV
0
10
20
30
40
50
60
70
80
90
-100
-80
-60
-40
-20
0
20
40
60
80
100
position, micron

Fig 12.

Distribution:

Autin B.	PS
Bossart R.	PS
Braun H.	PS
Brouet M.	AT
Chautard F.	PS
Chevallay E.	PS
Comunian M.	PS
Corsini Roberto	PS
Delahaye J.-P.	PS
Fischer Claude	SL
Garoby, R.	PS
Geissler K.K.	AT
Godot J.-Cl.	PS
Guignard G.	SL
Hübner K.	DG
Hutchins S.	PS
Jensen E.	PS
Johnson C. D.	PS
Kamber I.	PS
Koziol, H.	PS
Kugler H.	PS
Le Gras M	PS
Madsen J.H.B.	PS
Metral G.	PS
Michailichenko A.	PS
Millich A.	SL
Pearce P.	PS
Potier J.-P.	PS
Riche A.J.	PS
Riege Hans	AT
Rinolfi L.	PS
Rossat G.	PS
Schnell W.	Bât. 584
Schreiber S.	AT
Suberlucq G.	PS
Thomi J.C.	PS
Thorndahl L.	PS
Warner D.J.	PS
Wilson I.	SL
Wuensch W.	SL
Durand J.	PS
Mourier J.	PS
Pincott B.	PS

Haseroth