PS/LP Note 92-28 7 July 1992

POSITRON WORKING GROUP

Summary of the meeting at PSI on 6th and 7th of July

H. Braun

Participants:

C. Bourat, CGR-MeV
H. Braun, PSI
L. Rinolfi, CERN
M.A. Tordeux, LAL

1 Introduction

This meeting focused on the results of the last MD, the ongoing work on SNP25 and the planning of the future MD and LIL upgrade activities. A copy of the meeting program can be found in the Appendix. The first talk on this list had to be cancelled due to the impossibility of the speaker, to join the PSI at the last minute.

2 ESRF workshop

L. Rinolfi reported on a workshop held at ESRF on 4th and 5th of June this year. This workshop discussed design issues of a e^+ source for the ESRF synchrotron light source. The summary of the results of this workshop was distributed.

3 Results of MD

The last LIL MD took place on the 29th and 30th of June.

M.A. Tordeux reported on the high charge measurement with linac V. A strong aggravation of the transmission and the beam shape on WBS25 was observed if the pulse length of the gun was shortened, while keeping the pulse charge constant. This effect is not yet understood. Space charge effects or BBU were discussed as possible sources of this behaviour.

L. Rinolfi presented the results of the microbunch length measurements at the end of linac V using the Cherenkov radiation produced by the beam crossing a sapphire. Although it could be proved that the measured signals were really produced by the beam, the signal strength is a factor 10 lower than expected and its hard to believe that the measured signal shape corresponds to the bunch shape. Therefore the measurement will be repeated with some improvements on the apparatus and hopefully better beam conditions.

Copies of the transparencies from both talks are attached to this document.

4 Results from the SNP25 test stand

L. Rinolfi presented the latest results from the test stand. The spare SNP25 coil was used for tests with the new modulator. At present this modulator can only deliver 3 kA, which is half of its design value. No significant temperature increase of the coil could be measured at this current, when the water cooling was running at 1.7 l/min, which is close to the value of 1.6 l/min obtainable with the maximum of 10 bar water pressure difference at LIL. Therefore we can assume that there will be no major cooling problem with the increased pulse length of the new modulator. Copies from this presentation are also attached.

5 Program of next MD

The following experiments should be performed during the MD's end of August and end of this year (For exact dates see Appendix A of Summary of PWG first meeting), in the order of their priority :

1. Machine optimization.
   - steering
   - energy spectrum (linac phasing)
   - Check of 1,30,50 and 80 nC pulse charge
   - Try to reach 1 mm FWHM spotsize on WBS25 in both planes
   - If technical feasible try effect of 100 V voltage bias on WBS25 to get rid of the "strange" second peak at high charge.
   - Record beam characteristics on SLH11, MTV11, SLV12 and WBS25 together with magnet settings, to provide data for optic calculations.
2. Microbunch measurements
   - good beam on Cherenkov monitor
   - remove stainless steel wire on Cherenkov monitor.
   - move streak camera closer to the monitor
3. Space charge effects and beam loading
   - try again same charge for different pulse lengths with better machine conditions.
   - Check analog signals from UMA's at different linac positions to observe BBU effects, if they exist at LIL.
4. Microbunch measurement with deflecting structure at 4 MeV. (Only if M.A. Tordeux succeeds to compute a beam optics with a better resolution.)
5. Positron measurements.
   - conversion efficiency
   - accel./decel. mode
6. LIL optics, comparison of TRANSPORT computations (which will be performed by C. Bourat) and measurements.

6 Program for SNP25 test stand

The following measurements should be planned and performed:

1. Measurement of $\Delta\Theta$ at the design current of 6 kA.
2. Measurement of vibrations (qualitatively) at design current.
3. Measurements of the magnetic field distribution. It has to be investigated if this is possible at full current. If yes this would also allow to measure the vibrations quantitatively.
4. Try to decrease voltage losses in the supply lines of the SNP.
5. Install spare target to investigate mirror image effects (same measurements as above).
6. Install new SNP25 with its ceramic supports and repeat measurements.
7. If during these measurements sparking problems occur retry with vacuum in the SNP housing.

7 Program of next meeting

The next meeting of the PWG will take place on the 24th and 25th of August at CERN. It will coincident with a LIL MD. Apart from the MD work we intend to work on:

- Microbunch measurements at 4 MeV with the deflecting structure, theory and experiment.
- LIL V optics.
- Simulation of the effect of the target-SNP25 distance on the yield.

8 Distribution

S. Battisti
P. Berkvens (ESRF)
C. Bourat (GE)
H. Braun (PSI)
R. Chehab (LAL)
J.P. Delahaye
J.M. Filhol (ESRF)
B. Godenzi
J.C. Godot
K. Hübner
S. Kulinski (Frascati)
E. Marcarini
G. Mülhaupt (ESRF)
F. Neuvessel
J.P. Perrine (ESRF)
B. Pincott
R. Pitthan
J.P. Potier
L. Rinolfi
J.C. Thomi
M.A. Tordeux (LURE)
M. White (Argonne)

POSITRON WORKING GROUP PROGRAMME

Monday 6 July 1992

14 h	Microwave Cerenkov radiation	R. Pitthan
16 h	Summary of the e^+ workshop at ESRF	L. Rinolfi
17 h	Results of the M.D. made on 29 and 30 June	
	High charge in LIL	M.A. Tordeux
	Microbunch measurements at 200 MeV	L. Rinolfi

Tuesday 7 July 1992

09 h	Experimental results on SNP 25	L. Rinolfi
10 h	Round table for studies in the working group	
	Microbunch measurement at 4 MeV	M.A. Tordeux
	Simulations	H. Braun
	LIL optics	C. Bourat
14 h	Proposals for the next M.D.'s	
15 h	Tests programme for the different pulsed solenoids	

The meeting will take place at PSI (Villigen).
H. Braun will write the summary of the meeting.

High Charge Measurements
M. A. Tordeux

LPI
MACHINE DEVELOPMENT

→ 1st of june

→ 29th / 30th of june

With: Ch. BOURAT
H. BRAUN
L. RINOLFI
M.A. TORDEUX

and P. FERNIER
G.

Evolution of the Transmission efficiency :

AT PRESENT, NO OPTIMIZED SETTING

			LIL Front-End		
			07.92	1991 (New)	1989 (Peak Performance)
Gun energy		keV	80	80	70
Buncher output energy		MeV	4	4	28
No-load energy at the target		MeV	205	204	228
ΔE/E (full width at the base)		%		±6.6	±8
Transmission efficiency:					
- Bunching system	50 nC	%	70	67	66
	30 nC	%	72	72	61
	2 nC	%	66	77	56
- LIL primary beam	50 nC	%	64	75	76
	30 nC	%	75	83	83
	2 nC	%	84	90	90
Maximum charge at the target (e^-)		nC	50	83	48

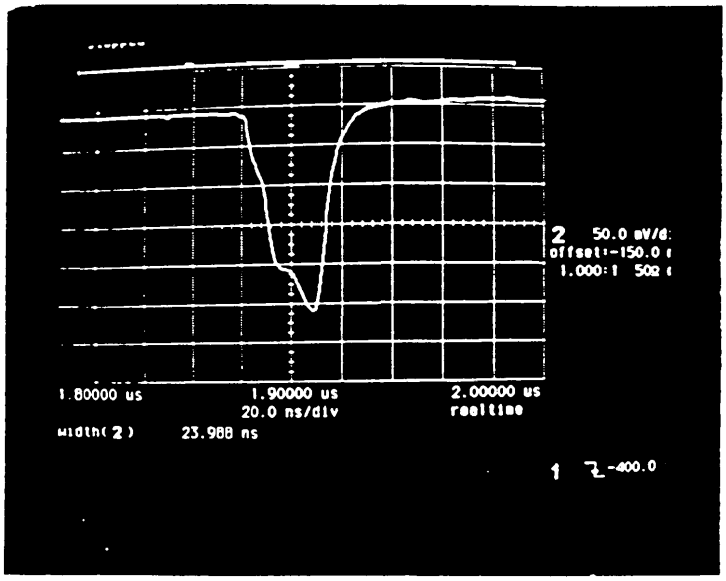
⚠ doesn't appear in this table :

* Space charge effect (more strong in 07.92)
* calibration of UMA monitor (disturbance from pulsed SNP 2S, ...)

30 nC ON THE TARGET

	e+	e-	POSITRONS Mon Jun 29 18:02:21	
EBM01	-3413.8	-3447.0	HOR(mm)	VER(mm)
MH11	-2457.0	-2468.4	-1.5	-0.7
MH12	-2465.6	-2481.0		
MH13	-1958.4	-1966.6	1.3	0.1
MH14	-1960.8	-1949.3	2.8	1.3
MH14	-1999.7	-1923.0		
MH15	-1979.4	-1687.2	2.7	0.2
MH16E	-5.7	17.0	111.1	111.1
MH25	-1845.5	-1634.4	2.3	-1.4
UMA27	-3.2	-3.2	-15.5	-7.1
UMA29	7.3	0.0	4.5	0.8
UMA30	8.6	0.0	-1.0	-0.8
UMA31	8.3	0.0	-2.4	-1.8
UMA32	8.2	-1.0	-1.1	-0.6
UMA33	8.4	0.0	-2.4	-0.8
UMA34	7.9	-0.9	-1.9	2.2
UMA35	7.1	-0.3	-3.1	0.5
UMA36	7.9	-0.3	-1.2	-2.7
UMA37	8.5	0.0	-0.8	-1.0
MCH37	7.1	0.3	-1.3	1.0

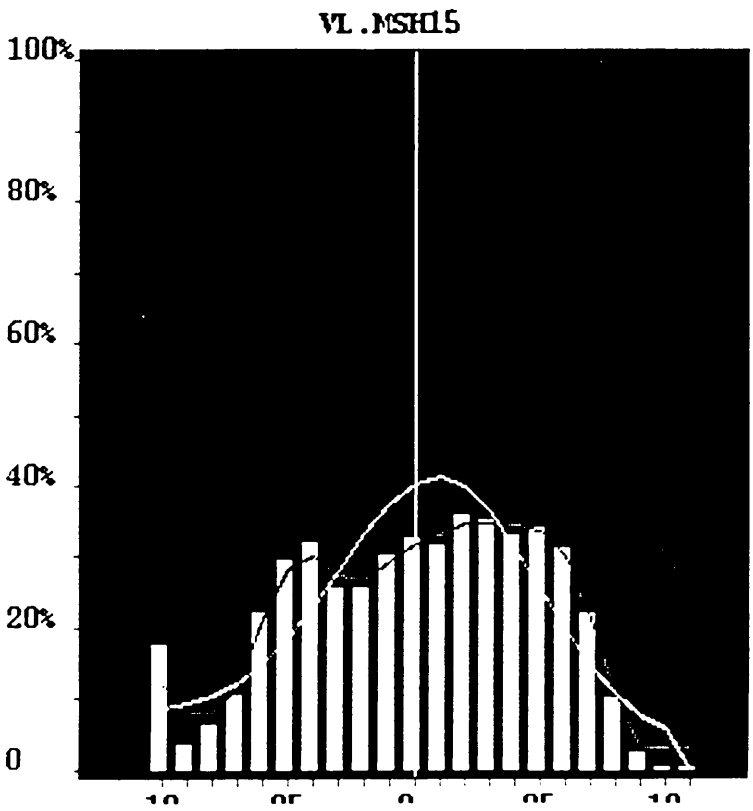
EPA Injection	UMA/MCH	HOR(mm)	VER(mm)	Ch.(EB)
HIH.UMA00	8.3	0.0	111.1	111.1	0.0
HIP.MCH00	-0.2		111.1	111.1	0.3



UMA LIL: 0 E10 VL.BSP15: 245.9 Jun 29 17:56:42 1992

:100

FREEZE



E(0)	197.76Mev
ΔE	12.96Mev
ΔE/E	6.55%
Mean	197.74Mev
Mode	201.04Mev

⚠ phase control:

equivalent Transmissio

MDK03	360°	340°
MDK13	320°	340°

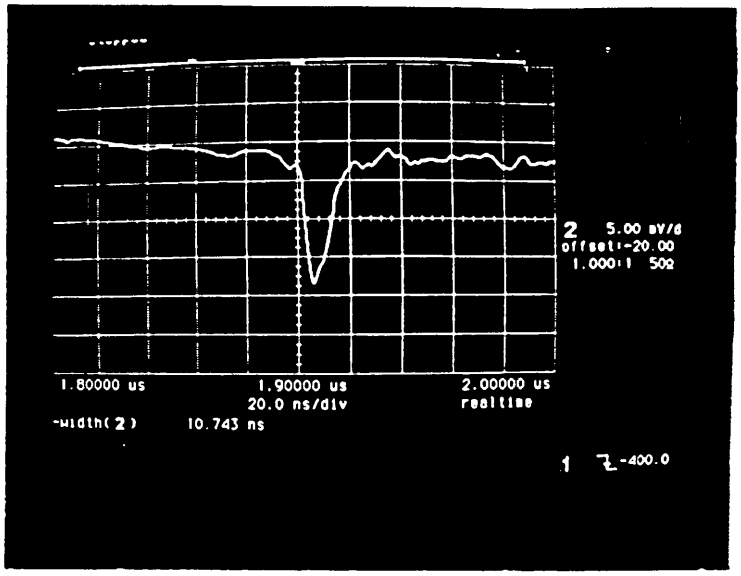
1 mC ON THE TARGET

Charge(E8) e- e- L I L ELECTRONS Mon Jun 29 20:22:08

			HOR(mm)	VER(mm)
ECM01	-3380.7	-143.6		
UMA11	-2439.3	-72.7	-1.4	-0.7
WCM11	-2445.1	-82.0		
UMA12	-1941.1	-58.6	2.4	1.0
UMA13	-1983.8	-66.4	3.9	1.3
WCM14	-1961.1	-57.1		
UMA15	-1861.5	-65.8	2.1	0.1
UMA165	0.0	4.2	34.7	33.1
UMA25	-1829.3	-43.7	15.4	5.3
UMA27	-1.9	-60.3	-2.0	3.3
UMA29	-0.3	-57.5	-0.5	-2.3
UMA30	0.0	-61.7	-1.4	-1.8
UMA31	0.0	-58.7	0.1	3.0
UMA32	-0.7	-54.2	0.9	2.9
UMA33	0.0	-58.0	0.8	0.3
UMA34	0.0	-57.9	-1.9	-2.4
UMA35	0.0	-59.0	0.4	-1.6
UMA36	0.0	-59.5	-0.4	1.0
UMA37	-0.3	-57.6	0.8	1.5
WCH37	-0.2	-58.1	1.3	1.5

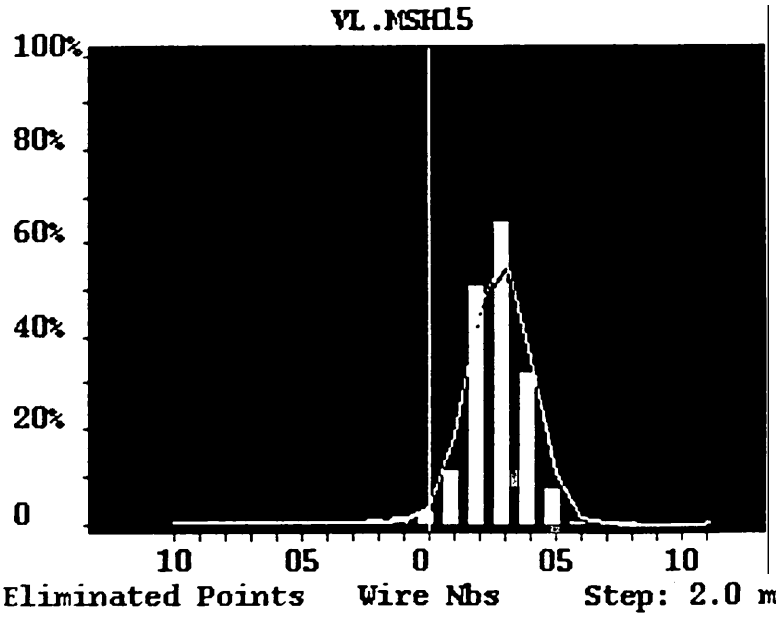
EPA-Injection UMA/WCH HOR(mm) VER(mm) Ch.(E8)

HIH.UMA00	0.0	-59.5	111.1	111.1	0.1
HIP.WCH00	-0.3		111.1	111.1	-0.3



UMA LIL: 0 E10 VL.BSP15: 255.9 Jun 29 20:13:22 1992

:100 FREEZE



E(0)	205.78Mev
ΔE	4.05Mev
ΔE/E	1.97%
Mean	208.87Mev
Mode	209.19Mev

Eliminated Points Wire Nbs Step: 2.0 mm 64.4% ADC Range

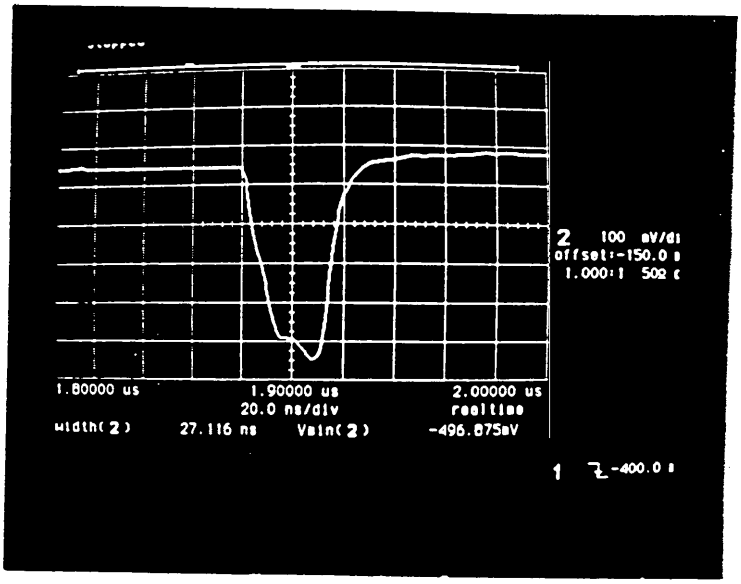
50 nC ON THE TARGET

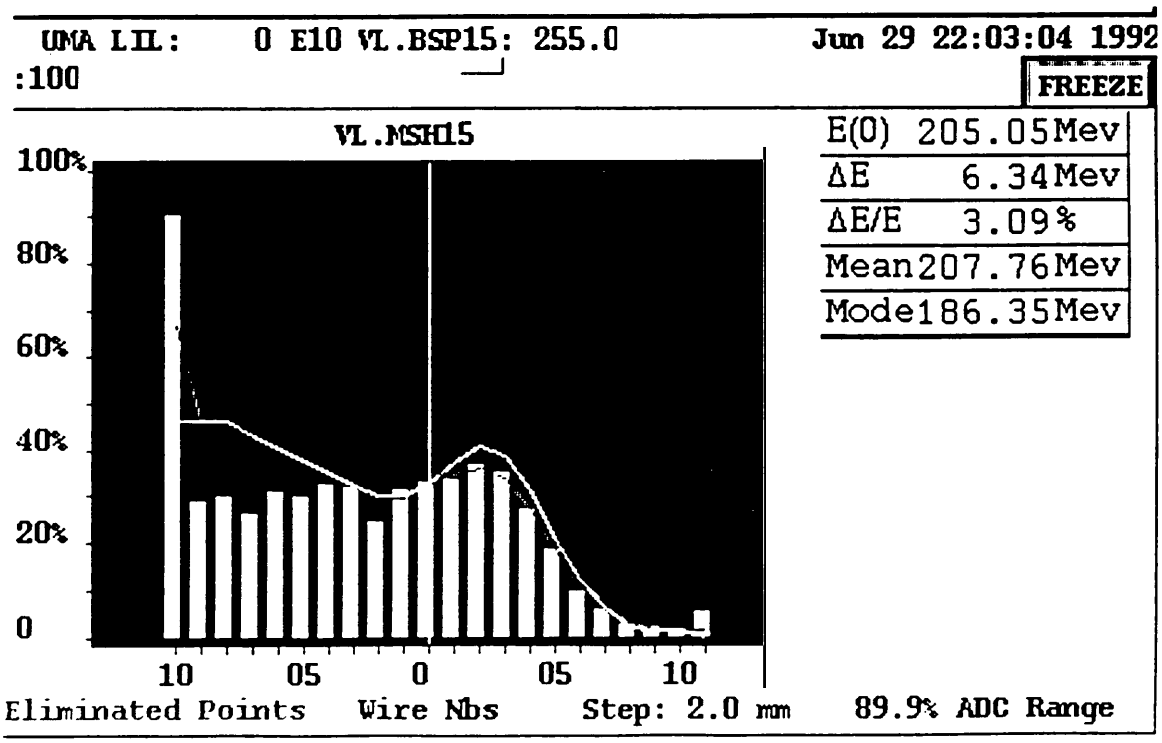
Long pulse / 200 MeV

harge(E8) et e- L I L POSITRONS Mon Jun 29 20:33:4

			HOR(mm)	VER(mm)	
CH01	[illegible]	-154.7			
MA11	-4891.2	-72.6	-1.6	-0.8	
CH11	-4900.5	-82.0			
MA12	-3283.2	-51.0	1.1	-0.2	
MA13	-3389.5	-66.1	2.6	0.9	
CH14	-3374.8	-57.1			
MA15	-3104.4	-65.5	3.1	-0.1	
MA165	0.0	4.2	111.1	111.1	
MMA25	-3128.1	-43.7	2.2	-1.5	
MA27	3.5	-61.0	-12.7	-0.8	
MA29	-1.3	-57.8	111.1	111.1	
MA30	-0.3	-62.0	111.1	111.1	
MA31	-0.0	-59.0	111.1	111.1	
MA32	-0.7	-54.6	111.1	111.1	
MA33	-0.3	-58.6	111.1	111.1	
MA34	-0.3	-58.2	111.1	111.1	
MA35	0.3	-59.4	111.1	111.1	
MA36	0.0	-59.8	111.1	111.1	
MA37	-0.3	-58.0	111.1	111.1	
MM37	-0.2	-58.8	111.1	111.1	

EPA-Injection	UMA/WCH	HOR(mm)	VER(mm)	Ch.(E8
M.UMA00	0.0	-60.2	111.1 111.1	0.1
P.WCH00	-0.3		111.1 111.1	0.0





50 nC ON THE TARGET

short pulse / 180 MeV

Charge(E8) e+ e- L I _ POSITRONS Tue Jun 30 22:17:23

			HOR(mm)	VER(mm)	
ECH01	-6418.9	-154.7			
UMA11	-4405.5	-1342.3	-0.2	-1.2	———
WCM11	-4433.2	-57.1			
UMA12	-3006.7	-36.4	-0.4	-2.3	
UMA13	-3004.2	-1048.6	0.6	-1.9	
WCM14	-2970.3	-61.3			
UMA15	-2300.2	-978.6	-0.6	-3.4	
UMH1EE	-5.7	-5.7	111.1	111.1	
UMA25	-2072.3	-849.7	-0.6	-1.0	
UMA27	-31.5	-56.7	-5.2	1.0	
UMA29	-24.7	-56.1	3.7	1.3	
UMA30	-23.4	-55.7	2.6	3.2	
UMA31	-24.1	-57.2	-6.1	-1.8	
UMA32	-26.2	-60.2	-2.3	0.7	
UMA33	-24.0	-56.7	-0.2	0.6	
UMA34	-23.5	-35.6	2.4	2.4	
UMA35	-22.0	-3.6	0.5	0.5	
UMA36	-21.5	0.0	0.4	0.6	
UMA37	-17.7	-0.3	1.3	-0.2	
WCM37	-15.8	0.3	3.3	-3.6	———

EPA-Injection	UMA/WCM	HOR(mm)	VER(mm)	Ch.(E8)
HIH.UMA00	-16.9	0.0	111.1	111.1	0.0
HIP.WCM00	0.0		111.1	111.1	0.3

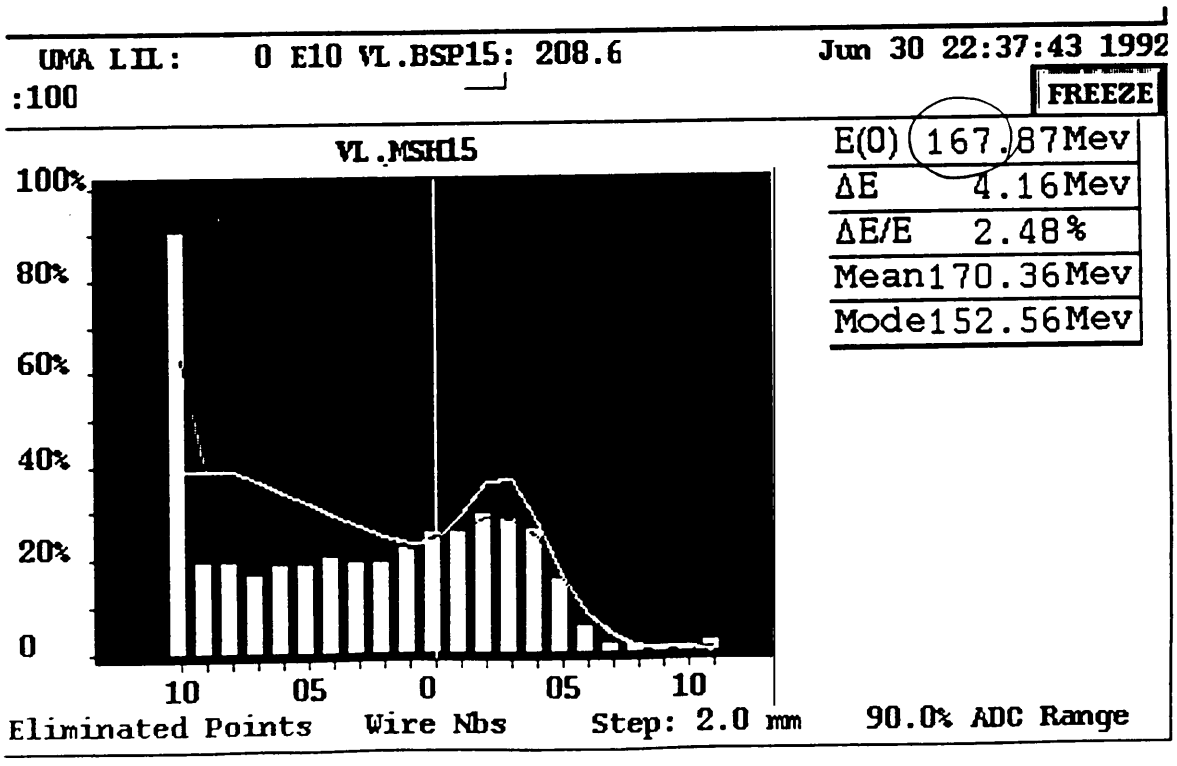
Pulse length

27 ns → 23 ns

(20 ns assigned

Linac efficiency

64% → 43%



50 nC ON THE TARGET

Short pulse / 200 MeV

ELECTRONS Tue Jun 30 22:52:49

			HOR(mm)	VER(mm)
	-6396.8			
	-4399.8		-0.1	-1.1
			0.2	-2.3
			0.9	-1.9
			0.3	-3.5
			111.1	111.1
JMH25	-2278.4	max Value	-0.1	-3.4
			-4.3	0.6
JMA29			-12.1	4.6
UMA30			12.0	13.9
UMA31			-6.1	5.7
UMA32	-5.3		-0.3	6.9
UMA33			6.7	10.4
UMA34	-4.4		8.2	9.9
UMA35			3.7	0.5
UMA36			-3.5	4.0
UMA37	-1.4		111.1	111.1
WCM37	-1.2		111.1	111.1

EPA-Injection UMA/WCM HOR(mm) VER(mm) Ch.(EB)

HIM.UMA00 -1.1 111.1 111.1 0.1

HIP.WCM00 0.0

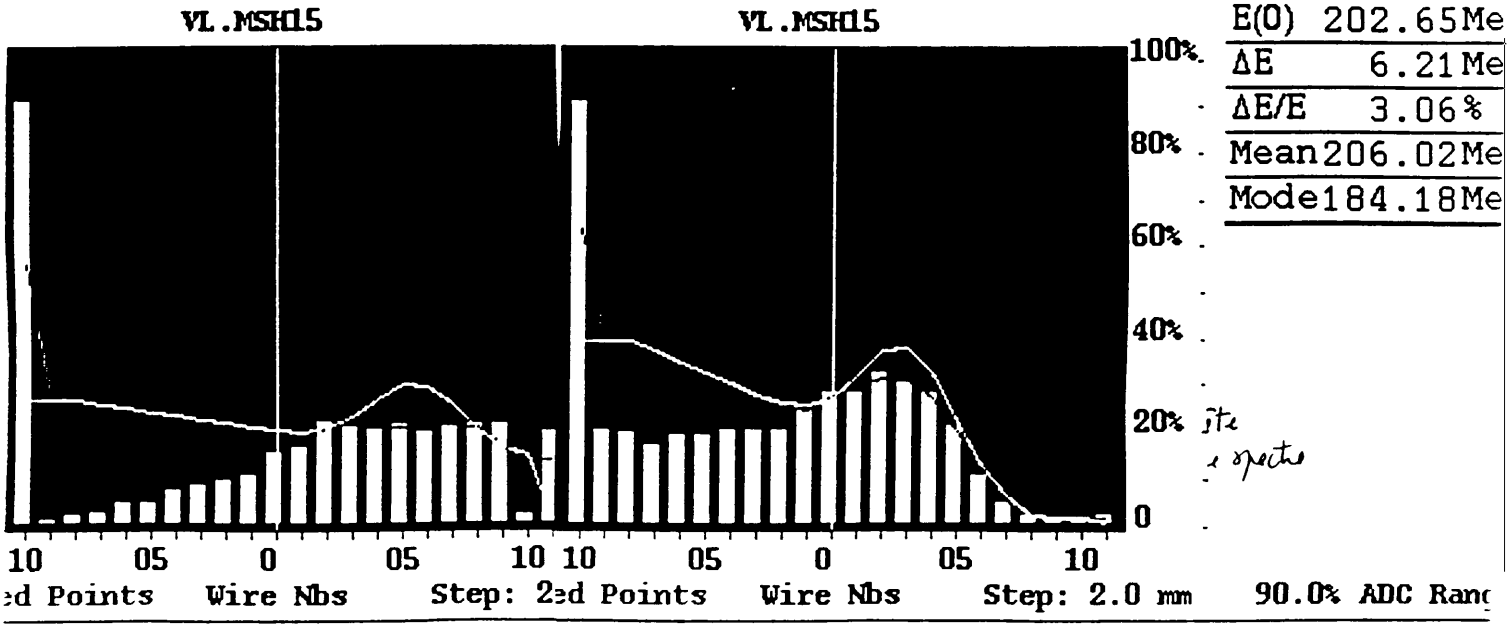
Linac eficiency

43% → 52%

180 MeV → 200 MeV

: 0 E10 VL.BSP15: 212.7 .: 0 E10 VL.BSP15: 252.0 Jun 30 22:49:40 1

FREI



E(0)	202.65Me
ΔE	6.21Me
ΔE/E	3.06%
Mean	206.02Me
Mode	184.18Me

ste
spectro

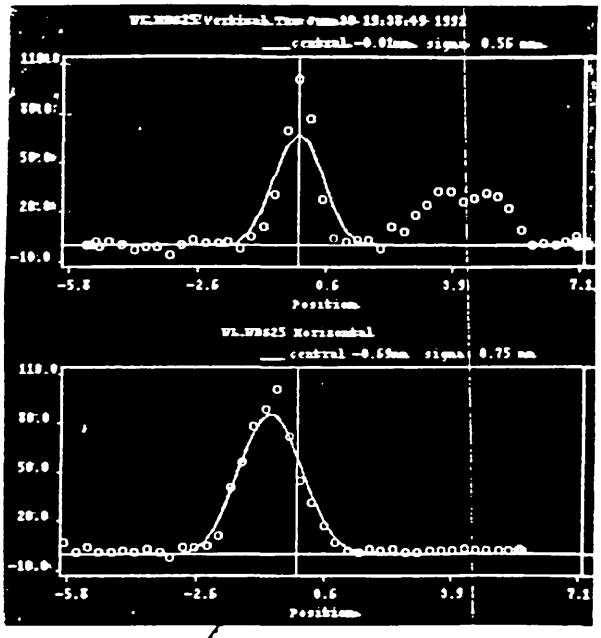
WIRE BEAM SCANNER study

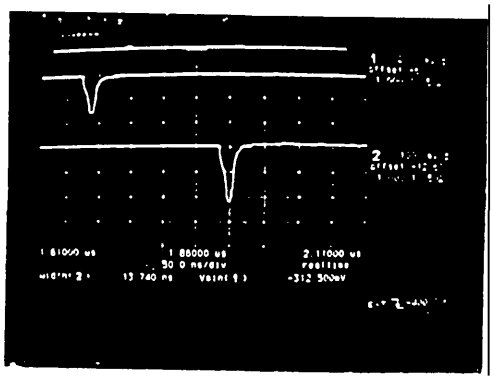
180 MeV beam.

At short pulse (14 ns),
A second peak appears at 16 nC

	e+	e-		HOR (mm)	VER (mm)
ECM01	**-1966.5**	-154.7	Nmeas:		
UMA11	**-1394.2**	-1342.8	UMA11	0.5	-0.1
UCM11	-1378.3	-87.1			
UMH12	-1140.5	-86.4		1.0	-1.6
UMH13	-1133.5	-1048.6	UMH13	1.5	-0.3
UCM14	-1090.0	-61.9			
UMH15	-1085.4	-978.6	UMH15	0.1	-1.1
UMH16E	-5.7	-5.7	UMA16E	111.1	111.1
UMA25	**-1012.0**	-849.7	UMA25	**0.4**	**-0.9**

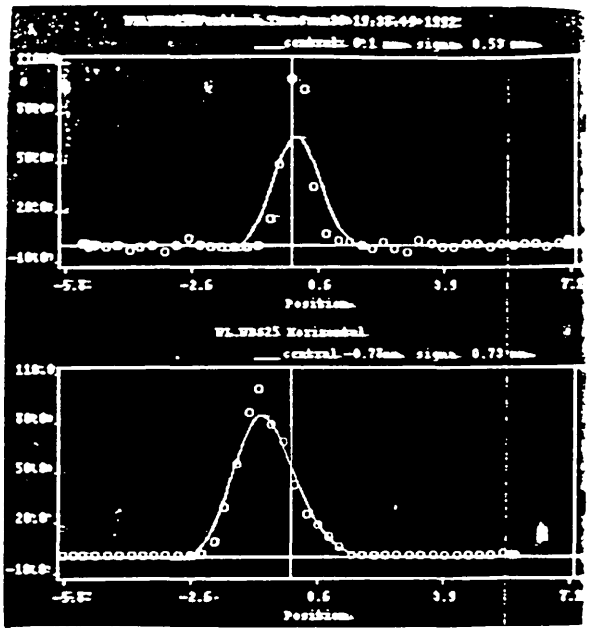
wrong UMA position

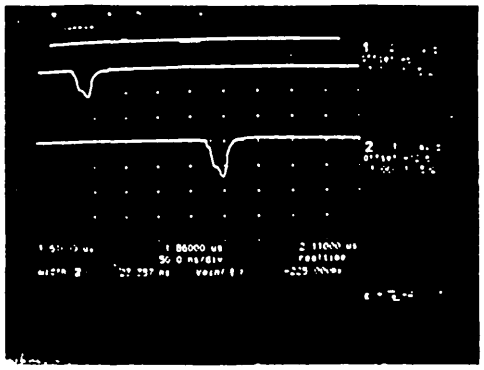




right position of the electon slit in the target
[transmission is verified]

Target E9	e+	e-	L I L	POSITRONS	Jun 30 20:29:11
ECM01	-1800.8	-154.7	Nmeas:		HOR(mm) VER(mm)
UMA11	-1333.9	-1342.8	UMA11		-0.3
ECM11	-1312.9	-97.1			
UMA12	-1088.1	-86.4		0	-1.7
UMA13	-1091.3	-1048.6	UMA13	1	-0.8
ECM14	-1061.5	-51.9			
UMA15	-1014.3	-978.6	UMA15	0.4	-1.0
UMA16S	-5.7	-5.7	UMA16S	111.1	111.1
UMA25	-1006.8	-949.7	UMA25	0.4	-1.1

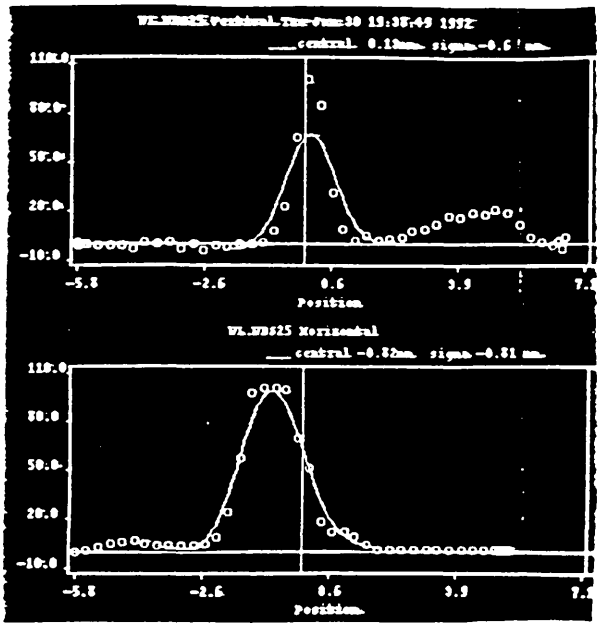


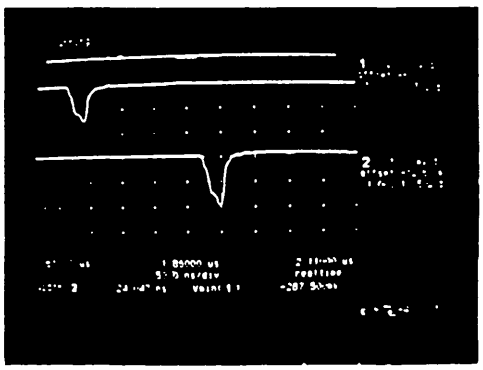


Same charge (16nC)

14 ns → 23 ns

Target E9	e+	e-	L I L	POSITRONS	Tue Jun 30 20:36:10
ECM01	-2518.9	-154.7	Nmeas:		HOR(mm) VER(mm)
UMA11	-1834.2	-1342.8	UMA11	0.4	-0.3
ECM11	-1313.7	-97.1			
UMA12	-1463.0	-86.4		0.9	-1.8
UMA13	-1485.0	-1048.6	UMA13	1.5	-0.6
ECM14	-1442.3	-51.9			
UMA15	-1377.3	-978.6	UMA15	0.4	-1.5
UMA16S	-5.7	-5.7	UMA16S	111.1	111.1
UMA25	-1342.2	-949.7	UMA25	-0.1	-0.9



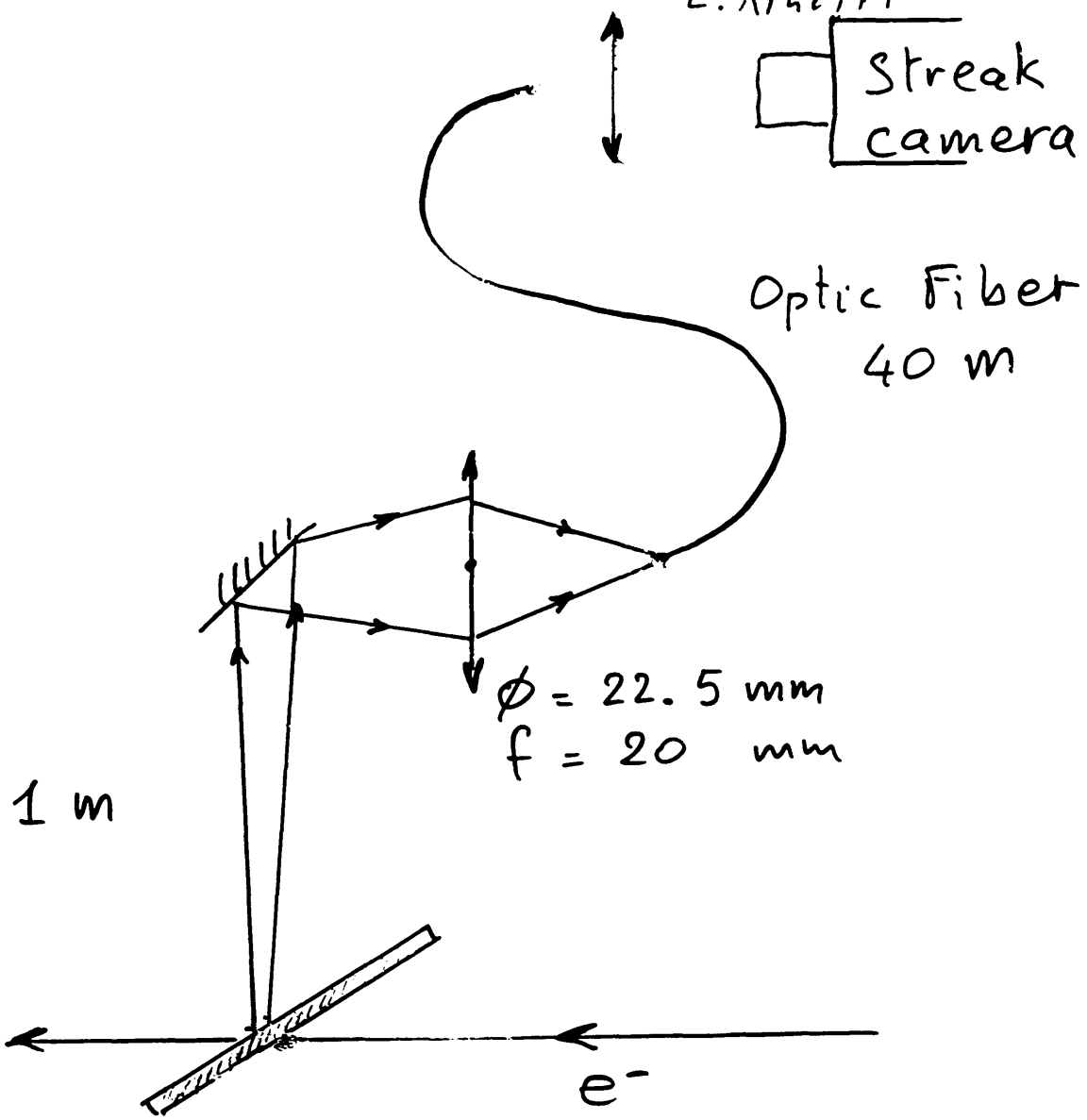


24 ns

higher charge

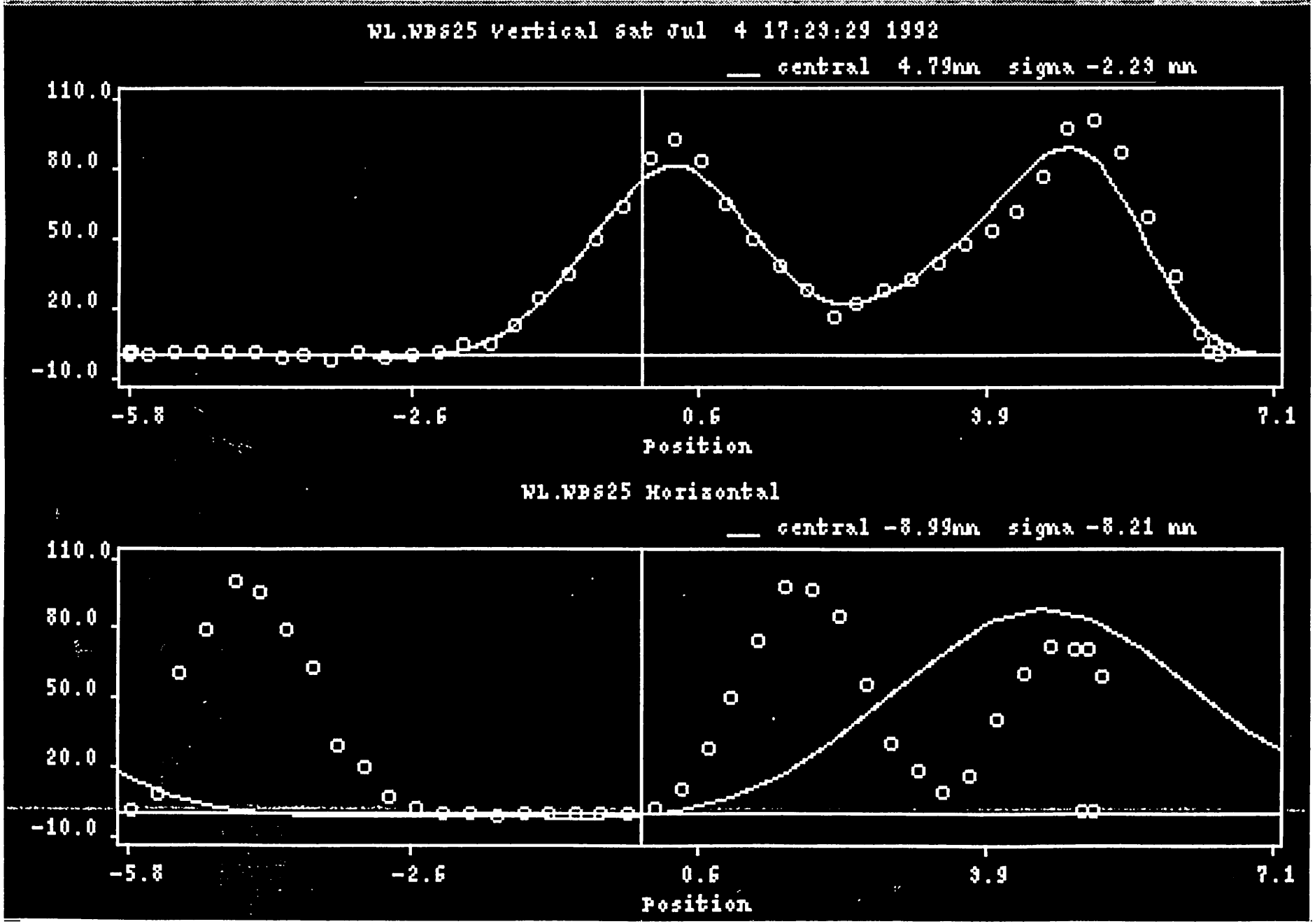
16 nC → 22 nC

Microbunch Measurements
L. Kindt



Microbunch measurements from Cerenkov ligth

View

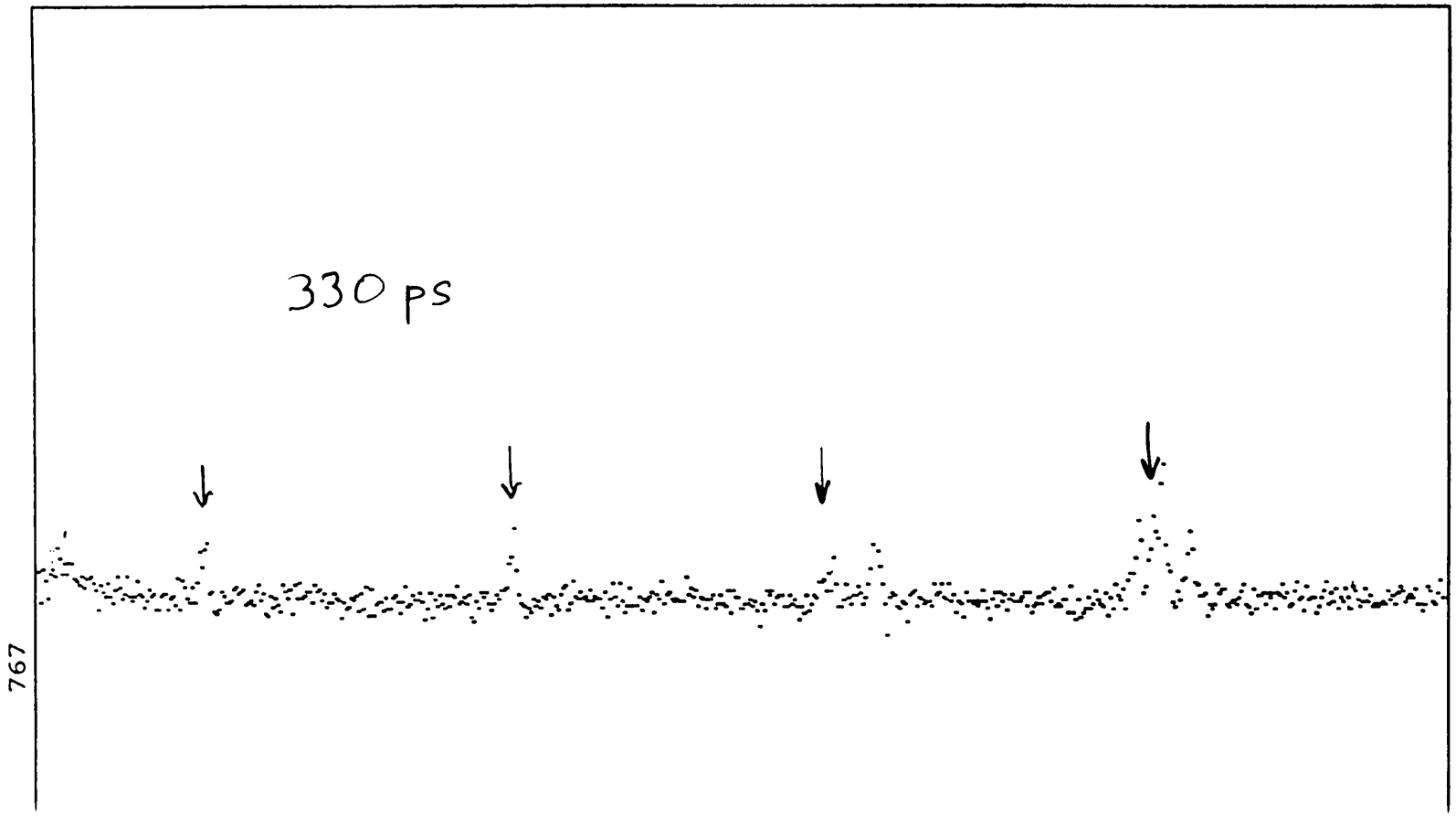

WL.WBS25 Vertical Sat Jul 4 17:29:29 1992
central 4.79mm sigma -2.29 mm
110.0
80.0
50.0
20.0
-10.0
-5.8
-2.6
0.6
3.9
7.1
Position
WL.WBS25 Horizontal
central -8.99mm sigma -8.21 mm
110.0
80.0
50.0
20.0
-10.0
-5.8
-2.6
0.6
3.9
7.1
Position

(4)

100 ptec. → 1.5 u.

600 1000 mm.

Window = 1.5 msec.



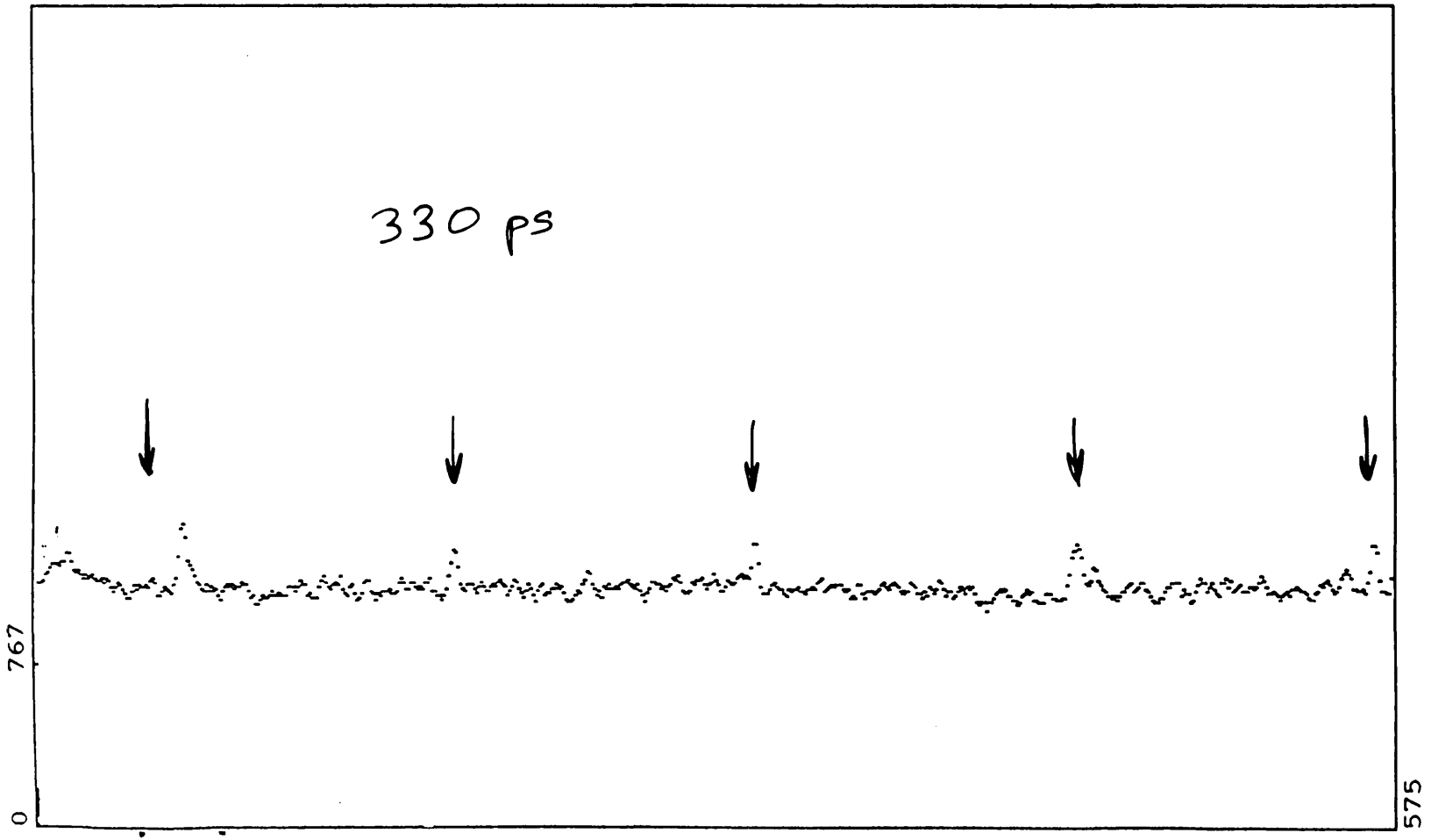
~ 75 ptec/cm

73.5 ps/cm

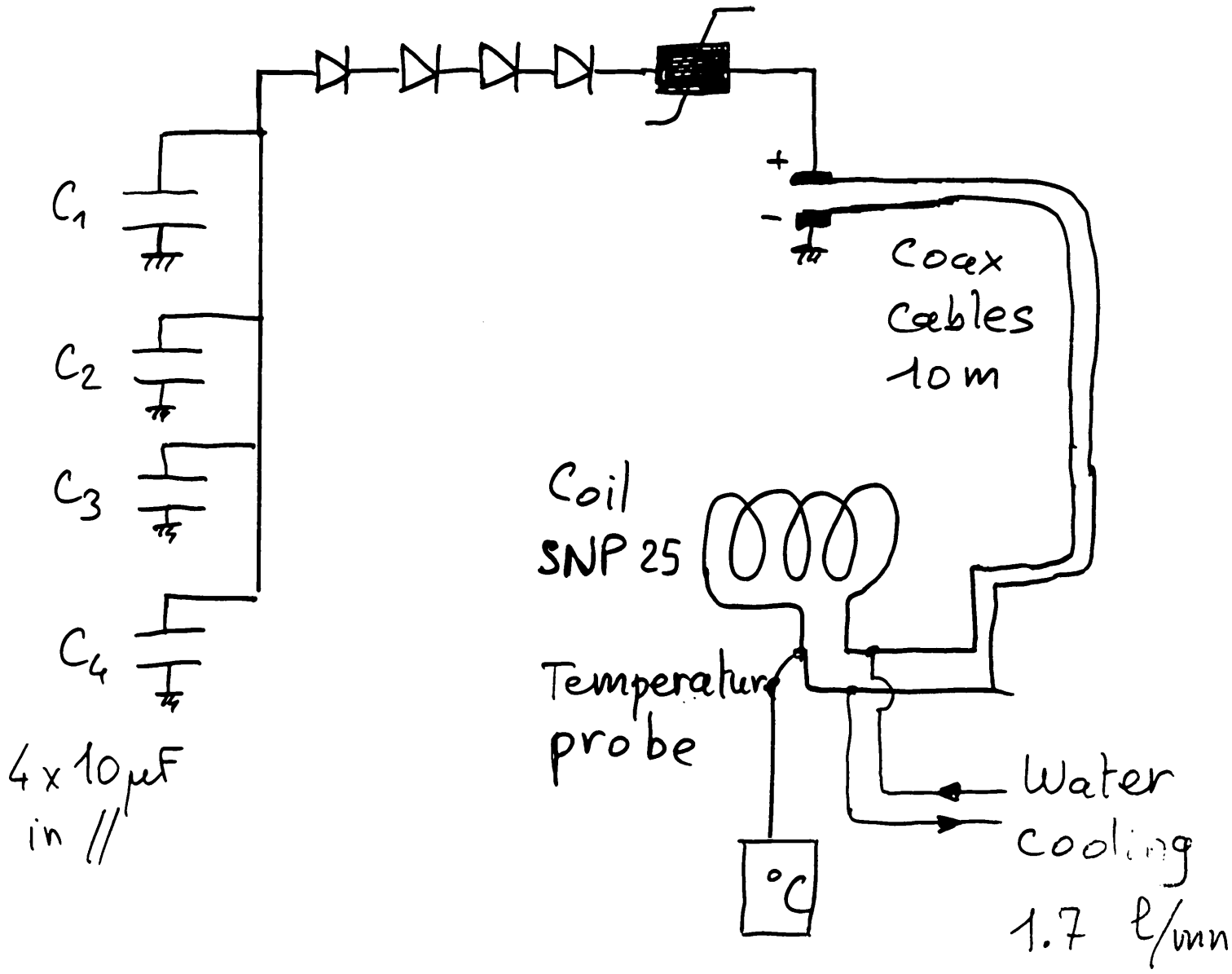
(3)

100 ptes angle 15 mrad.

image filtrée.



SUPLS Test Stand
C. Rinolfi

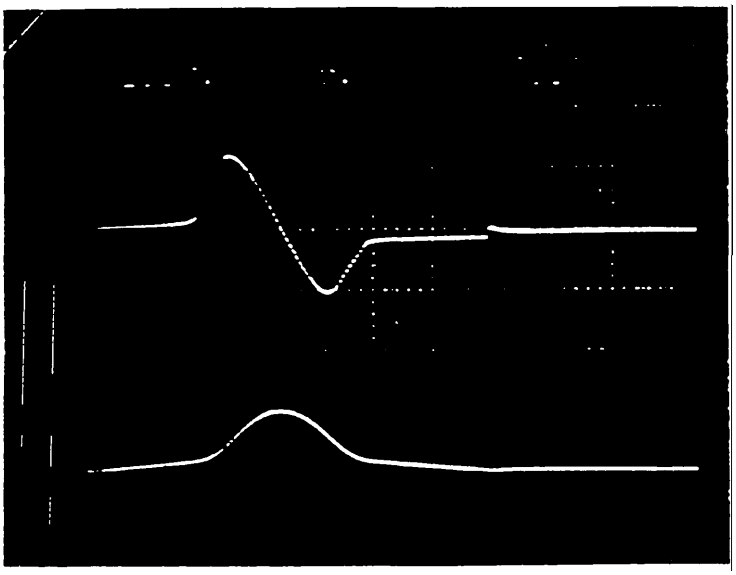


SNP_TEST

25/06/92

Essai sur charge réelle

Pulse 1 kA - 100 Hz

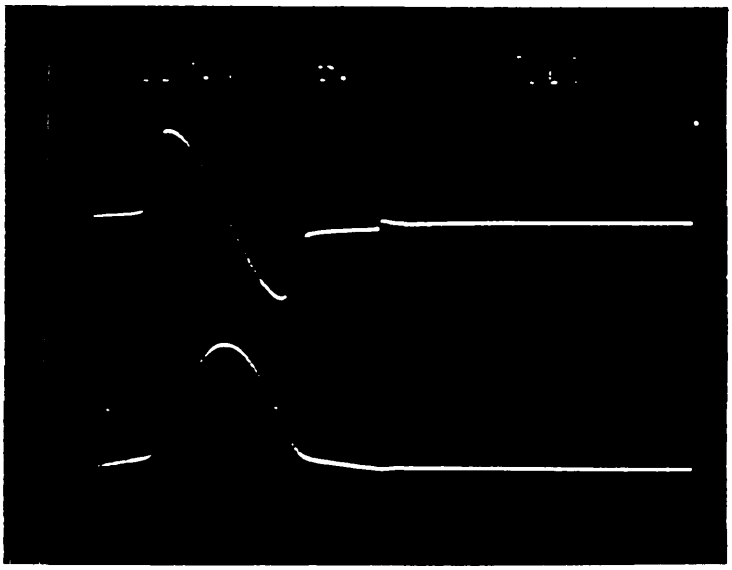


$I_{charge} = 1\,kA$

$V_{charge\,max} = 120\,V$

$t = 20\,\mu s$

$I = 1\,kA$

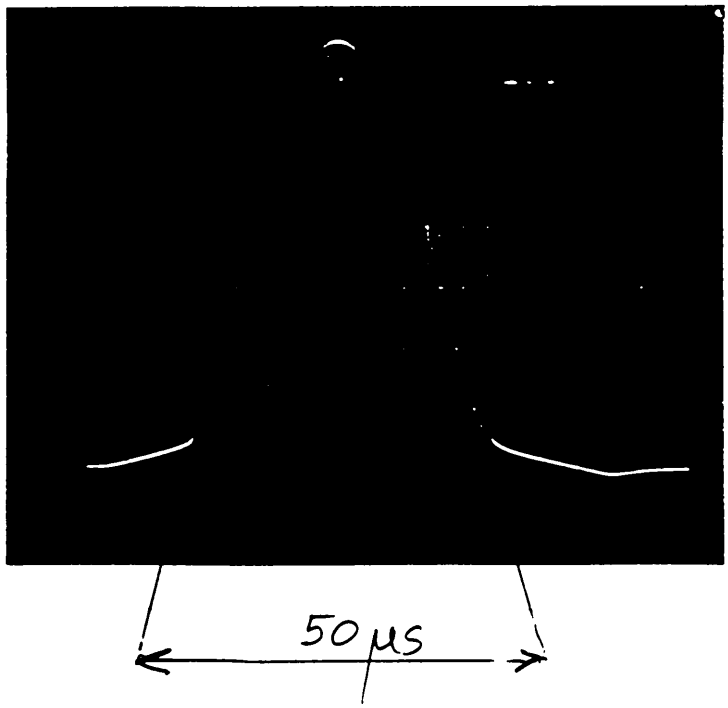


$I_{charge} = 2\,kA$

$V_{charge\,max} = 300\,V$

$t = 20\,\mu s$

$I = 2\,kA$



$I_{charge} \simeq 3\,kA$

$t = 10\,\mu s/div$

$I = 3\,kA$

$T_{pulse} = 50\,\mu S = \pi\sqrt{LC}$ $\qquad C = 40\,\mu F$

$2500\,10^{-12} = \pi^2 \times L\,C$

$L = \dfrac{2500}{\pi^2 \times C}\,10^{-6}$

$\underline{L_{totale} = 6\,\mu H}$

D'après mesure par HP $\qquad \underline{L_{charge} = 3,4\,\mu H.}$

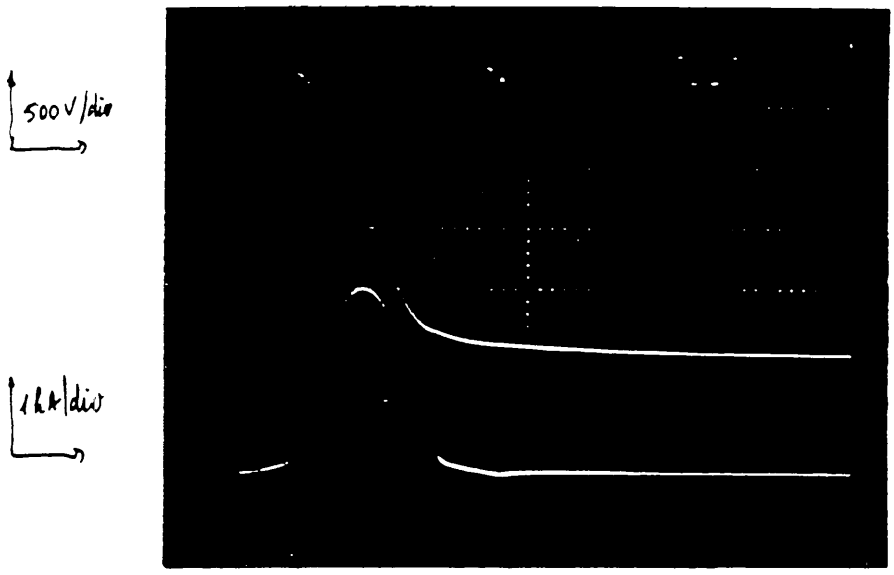
$I_{saturation\ self\ saturable} = 150A$

$I_{reverse} = -80A.$

$\dfrac{di}{dt_{ouverture}} = \dfrac{U}{L'_{totale}} \simeq 10\,A/\mu S = \dfrac{U}{L'_{totale}} = \dfrac{1.3\,kV}{L'_{totale}}$

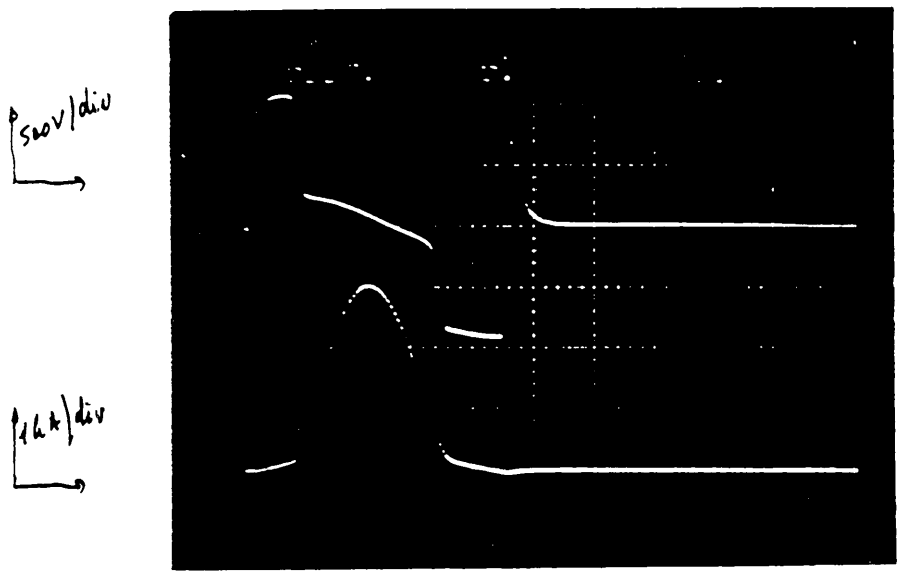
$L'_{totale} = L_{non\ saturée} + L_{parasite} + L_{charge}$

$\Rightarrow \underline{L_{non\ saturée} \simeq 120\,\mu H}$



$V_{aux\ décharge} = 1{,}3\ kV$

$I_{charge} = 3\ kA$



$V_{inductance\ saturable}$

$I_{charge} = 3\ kA$

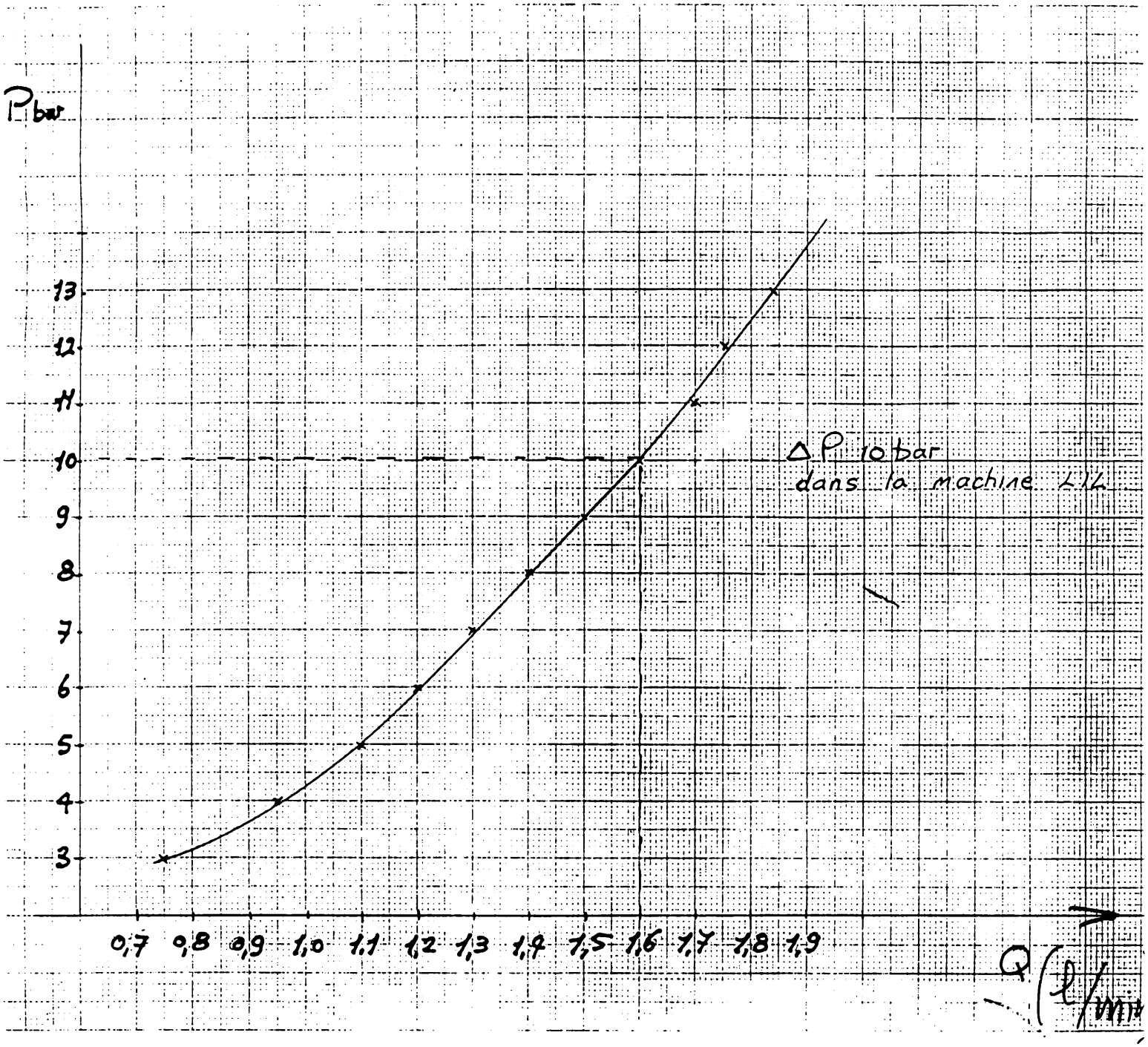
$\tau = 20\ \mu s/div$

$$1{,}3\ kV - 0{,}5\ kV = 0{,}8\ kV$$

↓ Power supply output

↓ SNP

↓ lost


P bar
13
12
11
10
9
8
7
6
5
4
3
ΔP 10 bar
dans la machine L12
0,7 0,8 0,9 1,0 1,1 1,2 1,3 1,4 1,5 1,6 1,7 1,8 1,9
Q (l/mn