

**EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE**

CERN - PS DIVISION

PS/ PA/ Note 94-09 (PPC)

**MINUTES OF THE PPC MEETING
HELD ON 1.2.94**

D. Manglunki

Geneva, Switzerland
16 February, 1994

Minutes of the PPC meeting held on February 1st, 1994

Present:

V. Agoritsas, B. Allardyce, G. Azzoni, J. Belleman, F. Blas, N. Blazianu, J. Boillot, M. Bouthéon, R. Cappi (Chairman), C. Carter, M. Chanel, A. Chapman-Hatchett, V. Chohan, G. Daems, D. Dumollard, C. Dutriat, E. Falk, H. Fiebiger, R. Garoby, G. Gelato, J. Gonzalez, H. Koziol, M. Le Gras, P. Lefèvre, R. Ley, D. Manglunki (Secretary), M. Martini, C. Metzger, J. Olsfors, A. Pace, M. Paoluzzi, F. Pedersen, R. Pittin, J.P. Riunaud, C. Saulnier, K. Schindl, G. Schneider, E. Schulte, D. Simon, Ch. Steinbach, A. Terrier, M. Thivent, H. Ullrich, B. Vandrope, M. Vretenar, E. Wildner.

Introduction

R.Cappi presents the agenda of the meeting :

- Results of the "December 93 LHC test"
- 1994 forecast for PSB and PS proton MDs.

The next three PPCs will be devoted to 1994 MD forecasts respectively for antiprotons (February 8th), leptons (February 22nd), and lead ions (March 15th). This organisation by particle type is similar to the one adopted for the PS Performance Day that took place in Eloise in the beginning of last year.

Results of the "December 93 LHC test" (K.Schindl)

- Linac 2 delivered a stable 160 μ A beam
- In the PSB, a three turn injection allowed to yield the best beam brilliance.
- Although 2 10^{12} protons/ring is a moderate intensity for the PSB, it gives a high ΔQ at this very low emittance (1.2 μ m in LHC definition).
- Acceleration to 1.4 GeV in the PSB corresponds to an induction field of 0.868T, 40% above the design value, for 800MeV protons. One should not think the machine had been overdesigned, but the coil had been designed to minimise the Joule losses and the operations costs.
- The linearity of the PSB has been demonstrated: the tune values are constant over the acceleration between 1 and 1.4GeV : no saturation effect was found.
- Transverse instabilities were observed in the PS at 1GeV, but not at 1.4 GeV.
- Emittance measurements with the flying wire and the SEMwires showed a good agreement.
- "Ultimate" and "nominal" beams were tested with injection energies of 1 and 1.4 GeV. The final results, very encouraging for the LHC project, will be published soon as a divisional report. Meanwhile several MD notes on the various systems are being written by the different specialists. (see attached copies of transparencies).

1994 forecast for PSB and PS proton machine developments (R.Cappi)

- 1st priority : Pb simulation
 - Optimise ISOLDE beam
 - High intensity SFT for neutrino production
 - Studies on the LHC beam
 - Fusion machines
 - Pbar deceleration
- (see attached copies of transparencies)

List of MD reports published in 1993 and 1994

14.1.93	PS/OP/Note 93-02 (MD)	Oxygen ions storage test (5-10.5.92)	S. Baird, J. Bosser, M. Chanel, R. Ley, D. Manglunki (editor), G. Tranquille
13.01.93	PS/OP/Note 93-01 (MD)	Mesures des chromaticités au PS	G. Azzoni
24. 2. 93	PS/LP Note 93-10	LIL-V Optics: MD Results for December 1992	C. Bourat (CGR MeV), H Braun, L. Rinolfi, M.A. Tordeux (LURE)
2.03.93	PS/OP/Note 93-08(MD)	Mesures d'émittances du faisceau protons pour SPS en cible fixe (SFT	B. Vanderpe
8. 3. 93	PS/LP Note 93-14	Etude des Longueurs des Paquets du LIL à 4 MeV - Mesures effectuées du 7 au 11. 12. 1992	M.A. Tordeux (LURE, Orsay)
22.3.93	PS/LP Note 92-23 (MD)	Status report on LIL-V optics and MD results for Aug 92	C. Bourat, L. Rinolfi
22.3.93	PS/LP Note 92-31	Mesures de longueurs de paquets à 4 MeV - Focalisation du faisceau	C. Bourat
22.3.93	PS/LP Note 93-03	Measurement of beam break-up in LIL	C. Bourat, H. Braun, L.Rinolfi
22.3.93	CERN/PS/LP 92-26	Optique LIL avec conditions initiales connues	C. Bourat, L.Rinolfi
2.8.93	PS/OP/Note 93-50	Machine development on slow extraction SE61 from 25.6 to 15.7.93	Ch. Steinbach
16.9.93	PS/RF/note 93-14	PSB Machine Development Report of 23.8.1993.	F. Blas, J. Boucheron, A. Krusche, F. Pedersen, M. Paoluzzi, G.C. Schneider
27.9.93	PS/RF/note 93-15	PSB Machine Development Report of 1.9.1993	F. Blas, J. Boucheron, A. Krusche, F. Pedersen, M. Paoluzzi, G.C. Schneider

12.1.94	PS/RF/note 94-04	PS Machine Development Longitudinal beam manipulations in the PS for the LHC	R. Garoby, S. Hancock
2.2.94	PS/PA Note 94-01	Chromaticity orrection in the PS	G. Azzoni, M. Martini
8.2.94	PS/PA Note 94-02	Double batch filling in the PS	G. Daems, J. Philippe, J.P. Riunaud
27.1.94	PS/PA Note 94-03	Single bunch transverse instabilities at 1 GeV	R. Cappi
28.1.94	PS/PA Note 94-04	Compensation of 2 QY=12 resonance of the LHC test beam	R. Cappi, E. Wildner

1.2.94	PS/BD/Note 94-03	Preparation of PS Instrumentation for the LHC test	J. Belleman, J.L. Gonzalez, S. Johnston, E. Schulte
11.02.94	PS/OP/Note 94-12 (MD)	Test LHC 1,4 GeV/c : modulation des courants des septa et d'un quadrupôle par PLS	G. Cyvoct, G. Daems
3.2.1994	PS/RF/Note 94-3	LHC Test Beam in the PSB MD end 1993	G. Schneider
4.2.1994	PS/RF/Note 94-5 (MD)	Tests of controlled longitudinal blow-up in the PSB	R. Garoby, S. Hancock
7.2.94	PS/AR/Note 94-03	Summary of the MD's on ECOL - Dec 93	J. Bosser
11.2.94	PS/HI Note 94-01	The PSB Energy Increase to 1.4 GeV for the LHC	Reported by K. Schindl
14.2.94	PS/PA Note 94-06	Les septa DC du PSB et du PS utilisés à 1.4 GeV pour le "Test LHC"	M. Thivent
10.2.94	PS/OP/Note 94-11 (MD)	Use of the PS fast wire scanner during the LHC Test MD of December 1993	E. Falk, F. Hoekemeijer, J. Olsfors, Ch. Steinbach

FORTHCOMING + PPC'S

1) RECENT RESULTS / STATUS

2) 1994 MAIN MD PROGRAM

ON

TO DAY (1.2.94) : PROTONS

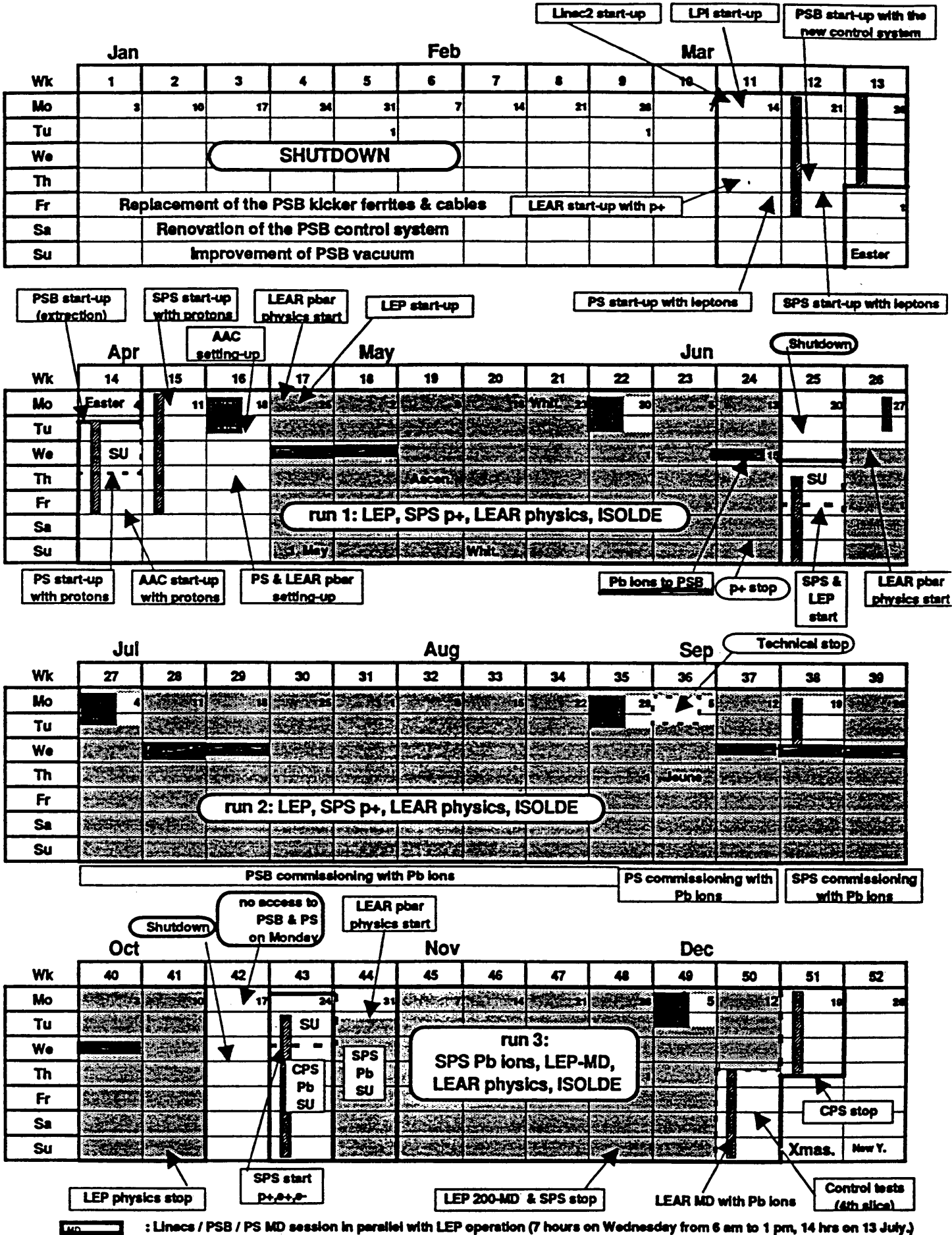
NEXT WEEK (8.2.94) : \bar{p}

22.2.94 : e^+

15.3.94 : $\frac{D}{b}$

1994 - P S COMPLEX SCHEDULE

Approved by
Research Board
25 November 1993



Test of LHC Proton Beam End 1993

K.Schindl 21.1.1994

Full Scheme	Test
RFQ2 installed	RFQ2 installed (1993 shut-down)
Linac2 180 mA in 20 μ s	Linac2 180 mA in 20 μ s (160 mA reached)
PSB h=1, all 4 rings	PSB h=1 prototype in ring 3
PSB h=2, all 4 rings	PSB h=2 prototype in ring 3
PSB accelerating to 1.4 GeV on all cycles (except ISOLDE), all 4 rings	PSB accelerating ring 3 to 1.4 GeV on two cycles during 14.4 sec (Bp +26%)
PSB to PS line: all elements at 1.4 GeV and pulsed (ejection, recombination, transfer, injection PS, all +26%)	PSB to PS line: only elements dealing with level 3 to be increased by 26%, on 2 cycles in 14.4 sec
Two PSB cycles to fill PS (2*4 = 8 bunches)	Two PSB cycles to fill PS (2*1 bunches). (Part of the test done with 1 PSB bunch)
In PS, each of the 8 bunches is split into two at the end of the 1.4 GeV front porch (h=8 to h=16). The 16 bunches are accelerated on h=16 to 3.56 GeV/c.	In PS, each of the 2(1) bunches are split into two at the end of the 1.4 GeV front porch (h=8 to h=16). The 4(2) bunches are accelerated on h=16 to 3.56 GeV/c
On the 3.56 GeV/c intermediate flat top, possibility of controlled longitudinal blow-up according to the needs.	On the 3.56 GeV/c intermediate flat top, some controlled longitudinal blow-up is applied.
Acceleration of 16 bunches with h=16 to 26 GeV/c	Acceleration of 4(2) bunches on h=16 to 26 GeV/c
De-bunching and re-bunching on h=84 in the PS on 26 GeV/c to generate 84 LHC bunches with a spacing of 25 ns.	No 40 MHz (h=84) cavity installed
Ejection of 81 bunches with 25 ns spacing towards the SPS.	Ejection of 4(2) bunches and transverse profile measurement on new secondary emission monitors (harps) with 0.5 and 0.35 mm pitch in the PS-SPS line TT2

LHC Proton Performance Levels in PS Complex

		Commission- ing	Nominal	Beam-beam limit
LHC	Np per bunch	$1.67 \cdot 10^{10}$	10^{11}	$1.67 \cdot 10^{11}$
	ϵ^* (collis.) [μm]	0.75	3.75	3.75
	Luminosity 2 experiments [$\text{cm}^{-2} \text{sec}^{-1}$]	$1.3 \cdot 10^{33}$	10^{34}	$2.5 \cdot 10^{34}$
PS	LHC bunches per PS bunch	10.5 (5.25)		
	# bunches	8 (16)		
	ϵ^* [μm]	0.6	3.0	3.0
	Np per PS bunch	$1.75 \cdot 10^{11}$ ($0.88 \cdot 10^{11}$)	$1.05 \cdot 10^{12}$ ($0.53 \cdot 10^{12}$)	$1.75 \cdot 10^{12}$ ($0.88 \cdot 10^{12}$)
PSB	LHC bunches per PSB bunch	10.5		
	# bunches/ring	1		
	ϵ^* [μm]	0.5	2.5	2.5
	Np per PSB bunch	$1.8 \cdot 10^{11}$	$1.1 \cdot 10^{12}$	$1.8 \cdot 10^{12}$

$$\epsilon^* = (\beta\gamma) \sigma^2/\beta$$

KS 30.11.93

LHC Test Last Schedule 15.12.93 13:00. - End of MD Thursday 16.12. 08:00

LHC PROTON BEAM TEST 3.-15. December 1993 (in shifts of 8 hours)		PREP. 1.4 GeV							1.4 GeV			Mr. X			
RC=Coppi, RG=Garoby, MM=Martini, JPR=Ritounod, KS=Schindl	Hardware changes	F	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	15
BE3KFA Modif. in tunnel															
BE3KFA Modif. outside tunnel															
Main PSB Supply upgrade (fourth group, etc). Intermittent pulsing!															
PSB h=2 cavity ring 3 (h=5 ==> h=2 change)															
Trapezoid* power supplies PSB-PS Line (5)															
Other modifications PSB & PS (PU, dampers.....)															
Linac2 + PSB: Studies with beam															
Linac2 preparation (to achieve 180 mA if possible)															
Acceleration (h=1, h=2) to 1 GeV in PSB, and h=8/16 to 26 GeV/c in PS (overall check)															
PSB injection + acceleration on h=1 and 2 to 1.4 GeV (no ejection)															
Optimisation: magnet cycle B(t), Q(t), adjust transv. dampers, measure emittances															
Prepare settings for longitudinal blow-up and bunch shaping with h=10															
Extraction (special) ring 3 + transport to PS @ 1.4 GeV															
PS: Studies with beam @ 1.4 GeV															
Injection into PS: KFA and SMH, measurements with SEMs, CODD															
Bunched (h=8) beam dwelling @ 1.4 GeV for 1.2 sec: Q, transv. feedb., measure Ex Ey															
Acceleration on h=8 to 3.56 GeV/c: coarse adjustment of B(t), Vrf(t), Qx, y(t).															
Bunch splitting h=8/16, acceleration on h=16 to 26 GeV/c: PFW, Q(t)															
Ejection @ 26 GeV/c: setting up FE16 + TT2 line, first series of emittance meas.															
Long. blow-up PSB 1.4 GeV, optimise injection (Q's etc) PSB															
Measure emittances with flattened bunches ("blow-up") from PSB in PS @ 1.4 GeV															
Double-batch filling @ 1.4 GeV															
Test of double-batch filling of PS @ 1.4 GeV: set up PLS, accelerate 4 bunches to TT2															
Verification @ 1 GeV															
Setting-up of PSB @ 1 GeV (B(t), Q(t), h=1 and 2 systems, PSB-PS transport).															
Setting-up of PS: B(t), Q(t) on 1 GeV front porch, acc. h=8 + 16, ejection to TT2															
Set of emittance measurement with 2E12, 1.8E12, 1.1E12 under various conditions															
Setting-up of longitudinal bunch flattening @ 1 GeV in PSB															
Emittances in PS with flattened bunches from PSB for 2E12, 1.8E12, 1.1E12 in TT2															
Transverse beam blow-up on 1 GeV front porch: more exotic means to overcome it															
In parasite: Acceleration and transport to PSB beam dump of ring 2 (in view of CO1 test)															
PSB controlled access (intermittent magnet pulsing) - no beam															
PS controlled access possible															
Transfers AA - LEAR possible (no refilling AA)															

Current Schedule for the LHC proton test in the PS Complex, in shifts of 8 hours (06:00-14:00, 14:00-22:00). K.Schindl

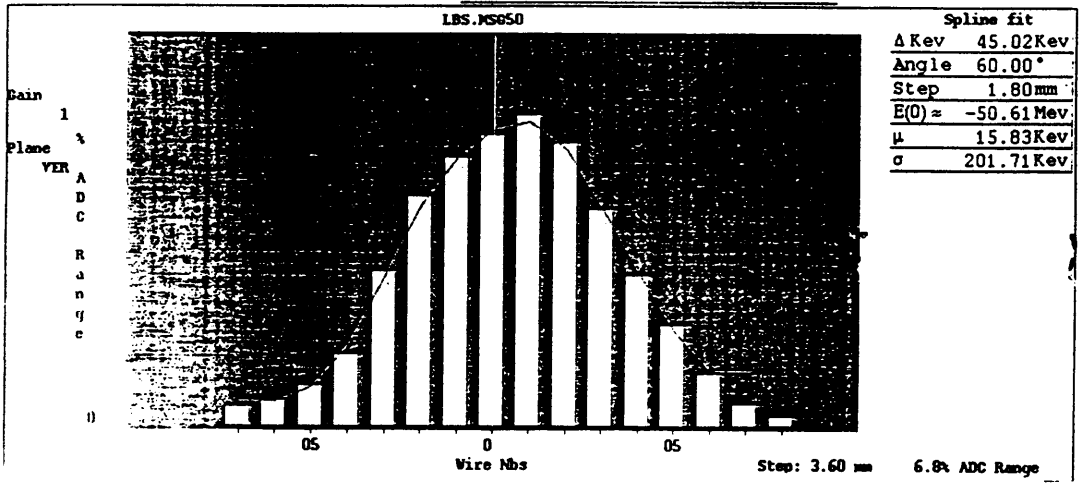
10/12/93:

CONDITIONS LINAC SINCE 7.12.93

(VALID FOR ALL ENTRANCES MEASUREMENTS SERIES)

Pls: Zero LX.ETC 20250 US LTB.BH240 57.7 AMP LTB.TRAG6MEAS 58.4 LBS.SLV10P0502.00MM Dec 7 18:05:21 1993
 LX.AGEN 20000 US LBS.BVT10-198.5 AMP LBS.TRAG2MEAS 4.6 LBS.SLV10AP 2.20MM
 LBS.TRAG4MEAS 3.6 LBS.MSG50AN 12.60-

LBS ring

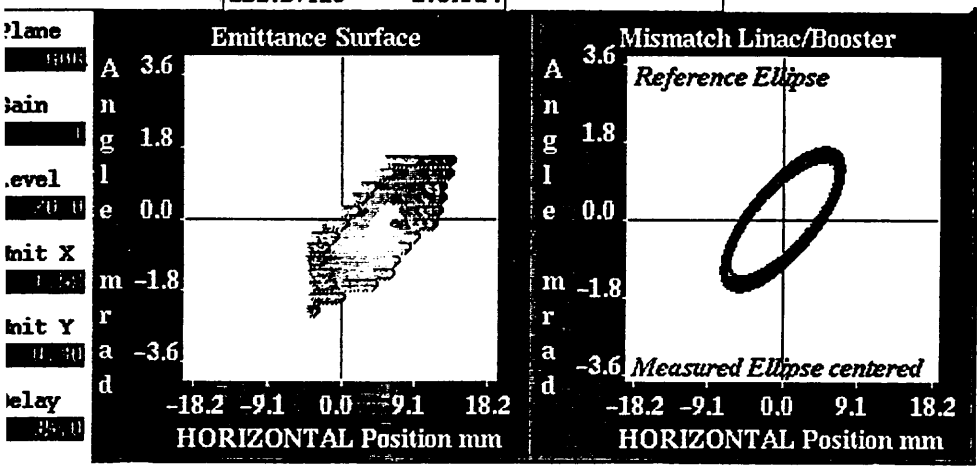


DB11 amplitude
2750

Optimized for
Bf after PS capture.

LX.WEMI	1999.0US
LX.ETC	2045.0US
LX.WEMI	1999.0US
LX.ETC	2045.0US
LBE.QFWY10	2.8-
LBE.QDWWY20	2.4-
LBE.KHZ10	1.2-
LBE.KVT10	1.2-
LBE.DHZ10	8.1AMP.
LBE.DVT10	-2.0AMP.

Dec 5 20:00:34 1993
ENTRY PIR: I = 160 uA
(σ = 0.33)



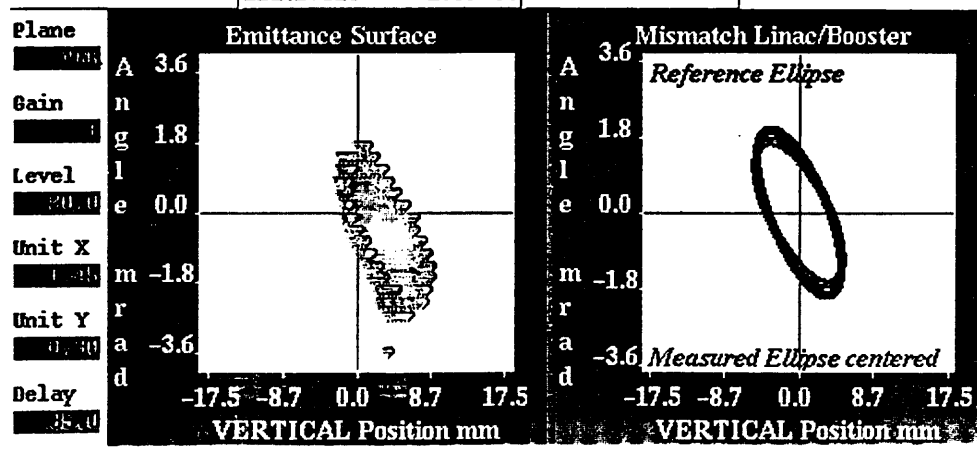
E0	7.5 mm.mrad
Xmean	3.9 mm
Ymean	-0.2 mrad
Xmax	7.0 mm
Ymax	1.6 mrad
α	-1.1
β	6.7
γ	0.3
Misma	12.9%

$\epsilon_{r.m.s}^* \approx 1.2 \mu m$

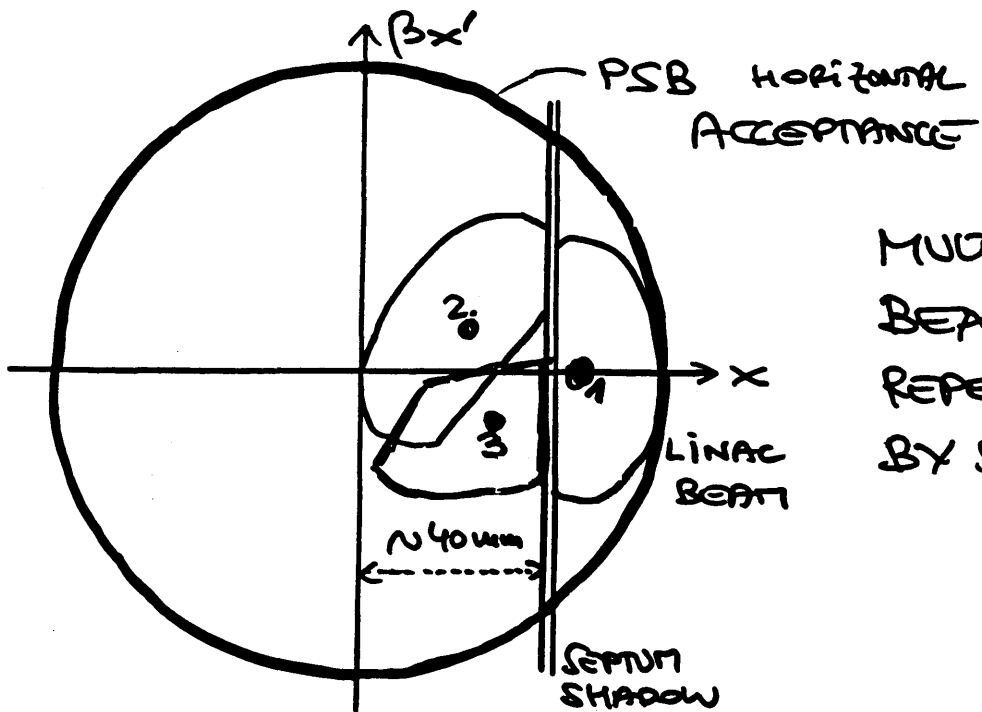
$\epsilon_0 = 2\epsilon_{1\sigma}$ if Bi-gaussian, $\epsilon_{x(1\sigma)}^* \approx \left(\frac{7.5+7.1}{2}\right) \times \frac{1}{2} * 0.33 = 1.20 \mu m$

LX.WEMI	1999.0US
LX.ETC	2045.0US
LX.WEMI	1999.0US
LX.ETC	2045.0US
LBE.QFWY10	-2.8-
LBE.QDWWY20	-2.4-
LBE.KHZ10	1.2-
LBE.KVT10	1.2-
LBE.DHZ10	2.0AMP.
LBE.DVT10	-2.0AMP.

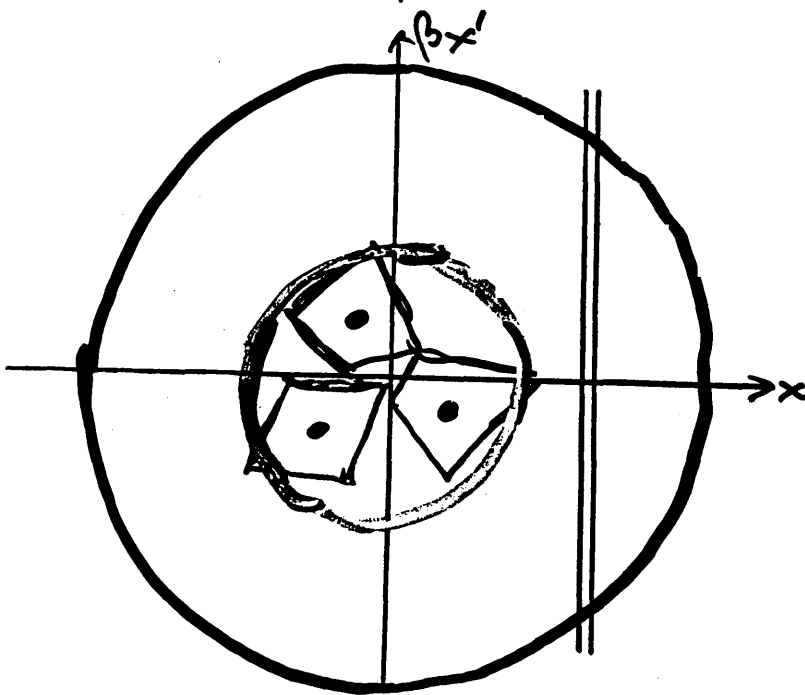
Dec 5 20:01:32 1993
 VALUE NOMINAL



E0	7.1 mm.mrad
Xmean	2.6 mm
Ymean	-0.4 mrad
Xmax	4.9 mm
Ymax	2.0 mrad
α	0.9
β	3.4
γ	0.5
Misma	27.6%

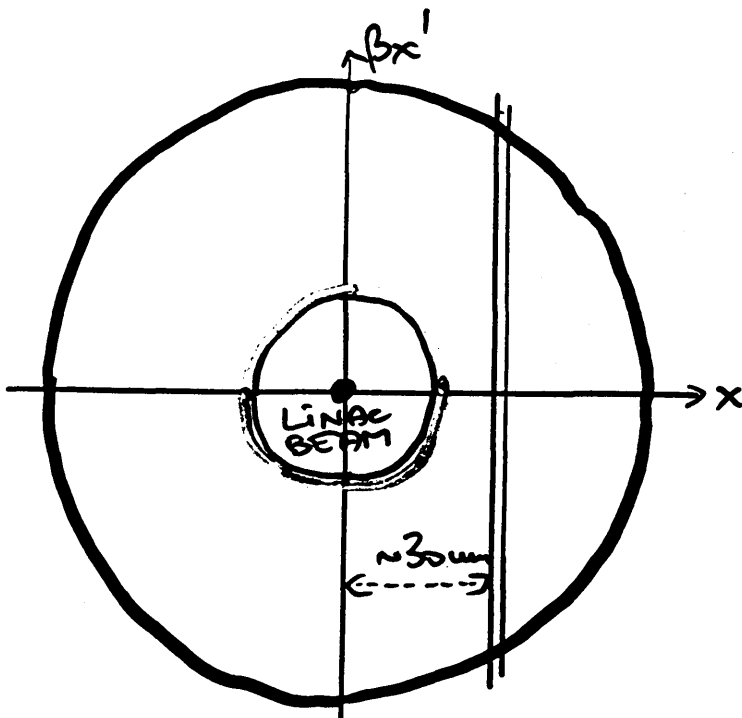


MULTI-TURN:
BEAM CUT
REPETITIVELY
BY SEPTUM



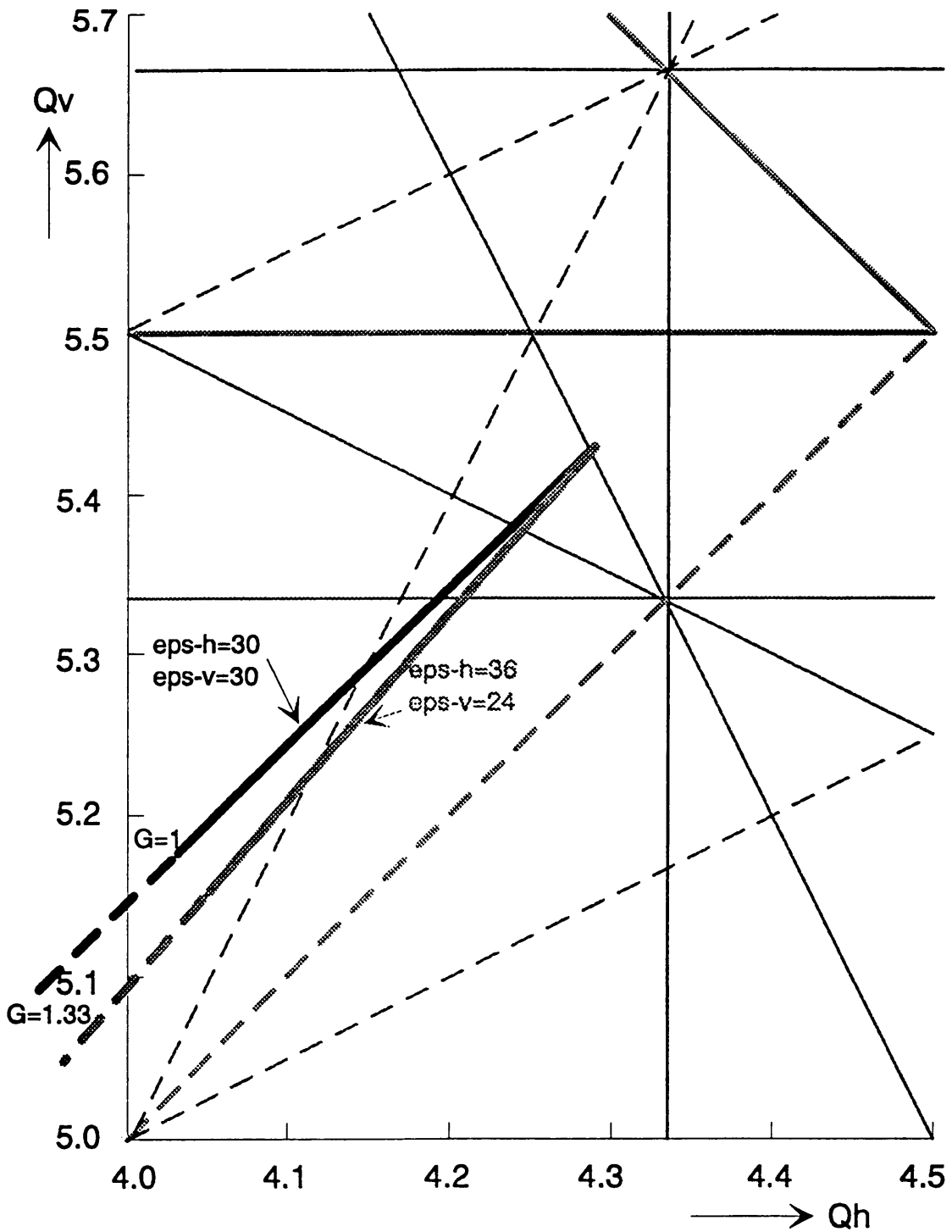
MULTI-TURN:
3 TURNS IN
PHASE PLANE
AFTER INJECTION

LARGE HORIZ.
EXTENTANCE



SINGLE-TURN:
BEAM MATCHED
SMALL HORIZ.
EXTENTANCE

PSB Tune Diagram

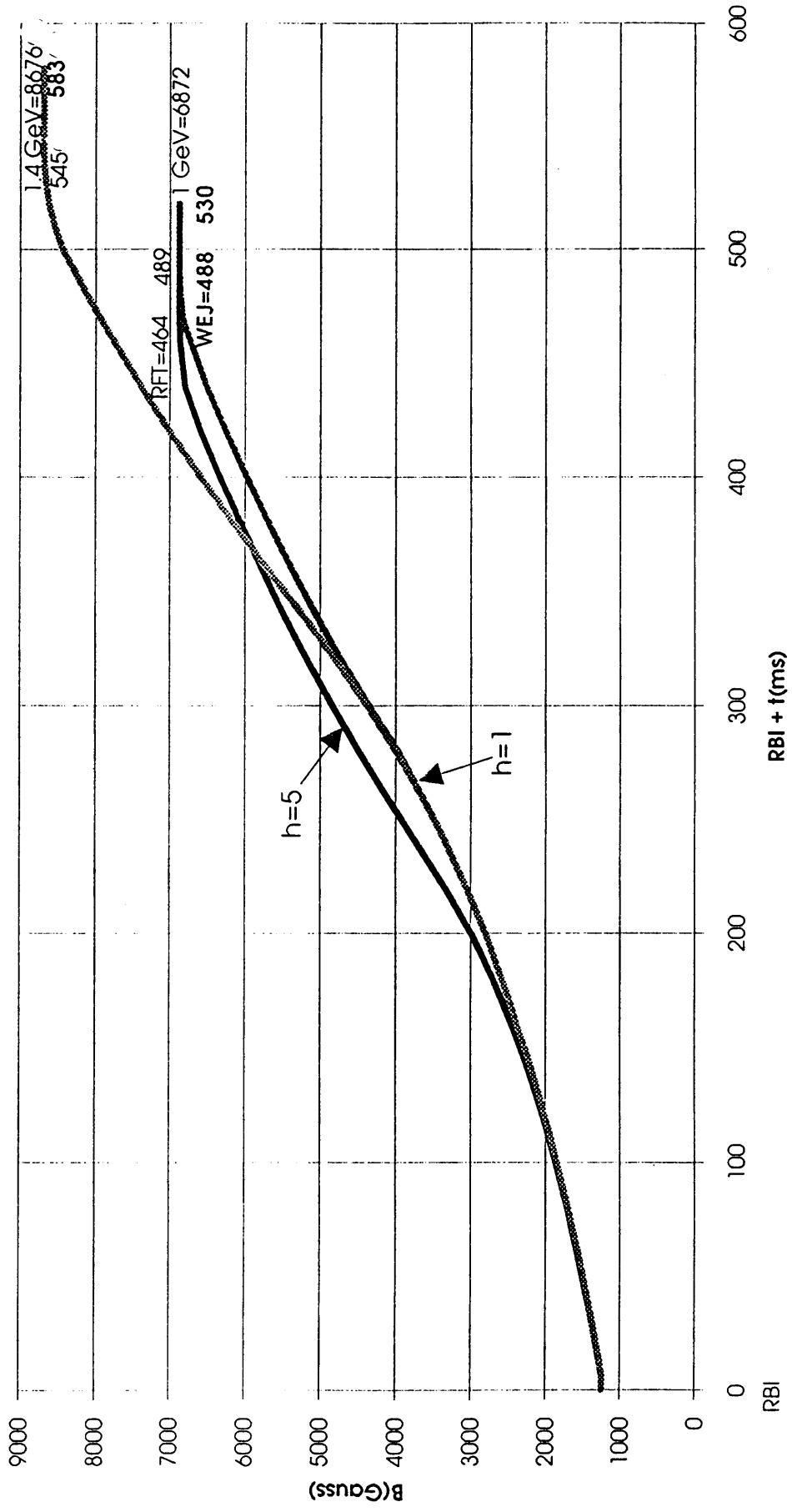


Laslett tune shift for LHC beam in PSB at 50 MeV. $N=2E12$ p, $B_f = 0.55$.

Emittances (physical) in $4\sigma^2/\beta$

$\epsilon \rightarrow$	$4\sigma^2/\beta$	$(\beta\gamma)\sigma^2/\beta$ [DEFIN. LHC]
ϵ_H	36	3
ϵ_V	24	2

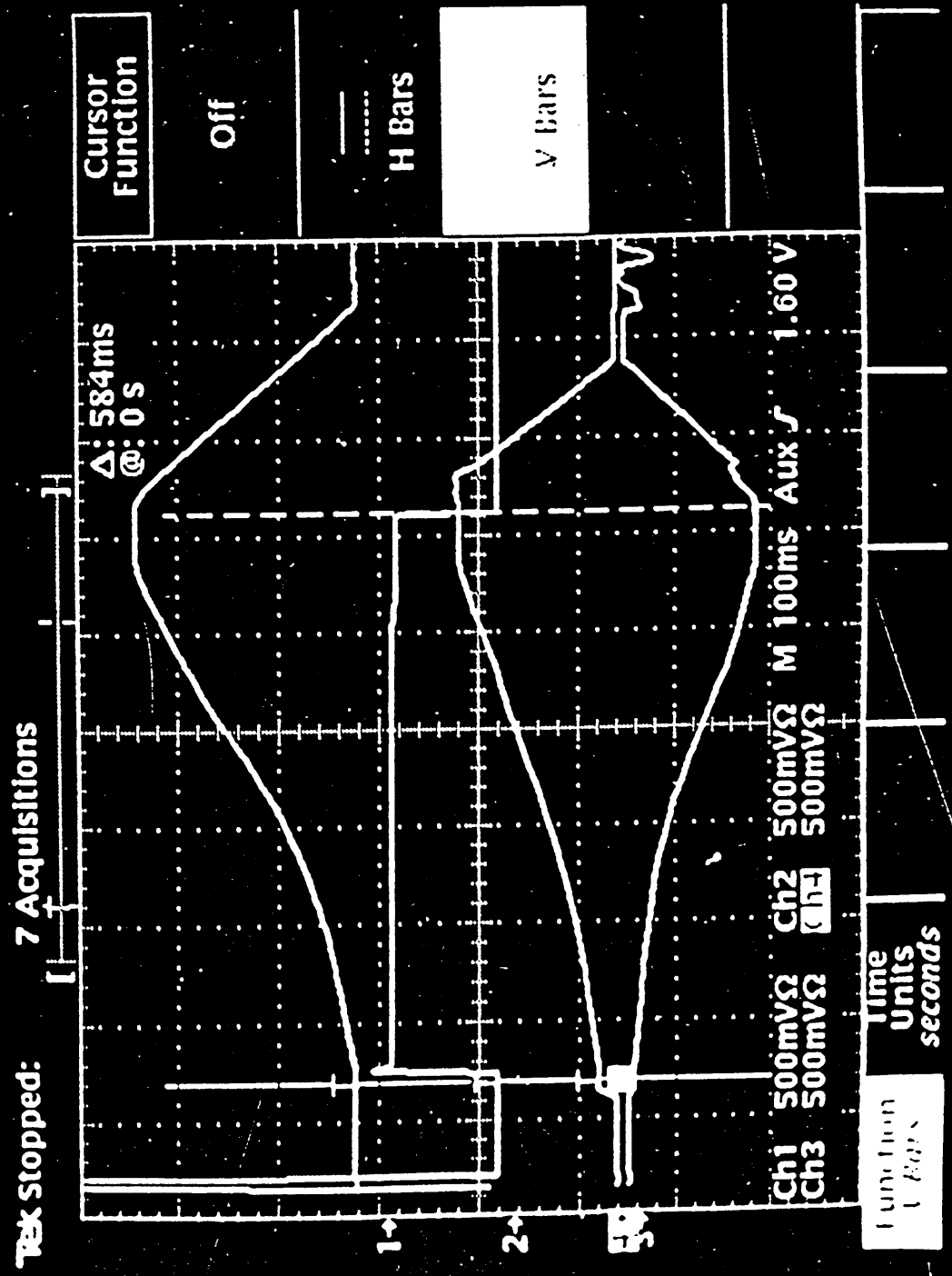
PSB Magnet Cycles for 1 GeV (3 groups) and 1.4 GeV (4 groups)



9/12/93

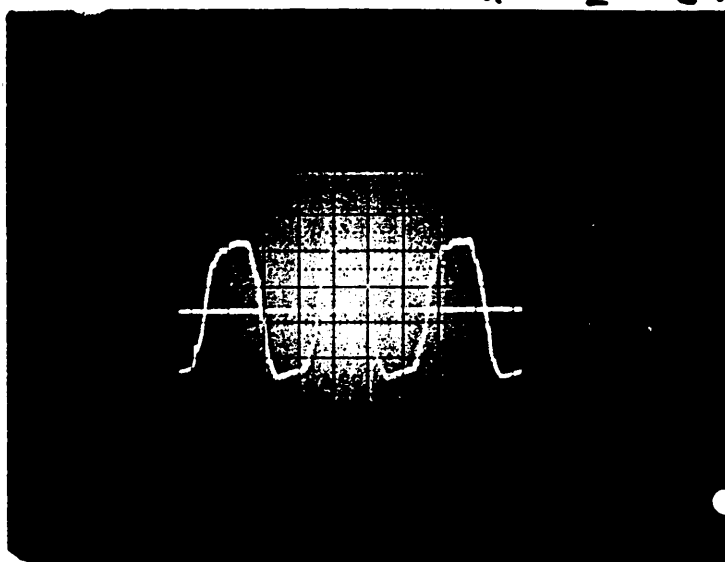
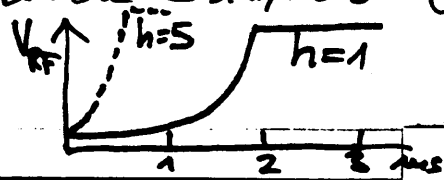
PSB MAIN MAGNET
CYCLE FOR
1.4 GeV
[0.125 T \rightarrow 0.868 T]

BEAM CURRENT
TRANSFORMER BIN43



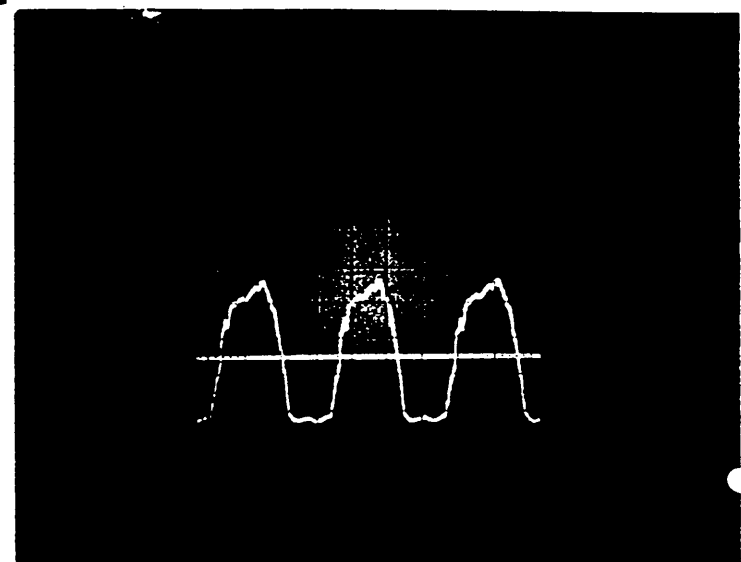
Bunch Shapes @ Injection PSB 7/12/93

ADIABATIC CAPTURE



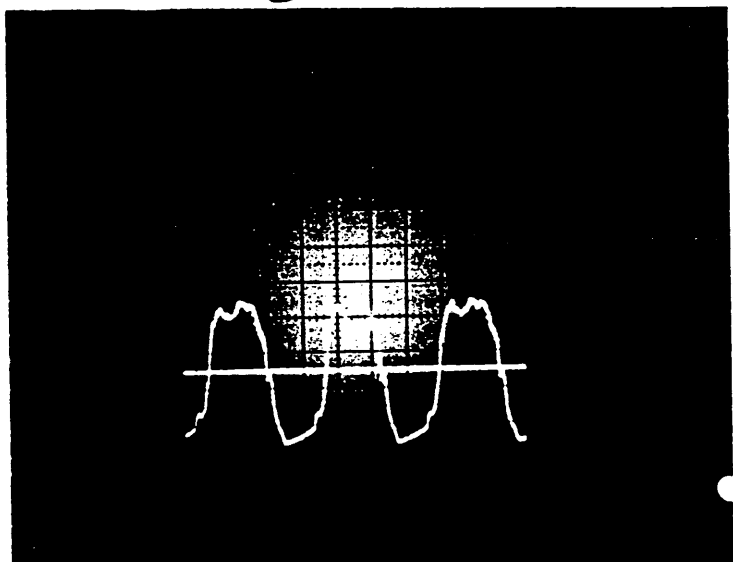
W10 + 3 μ s

BF \approx 0.52

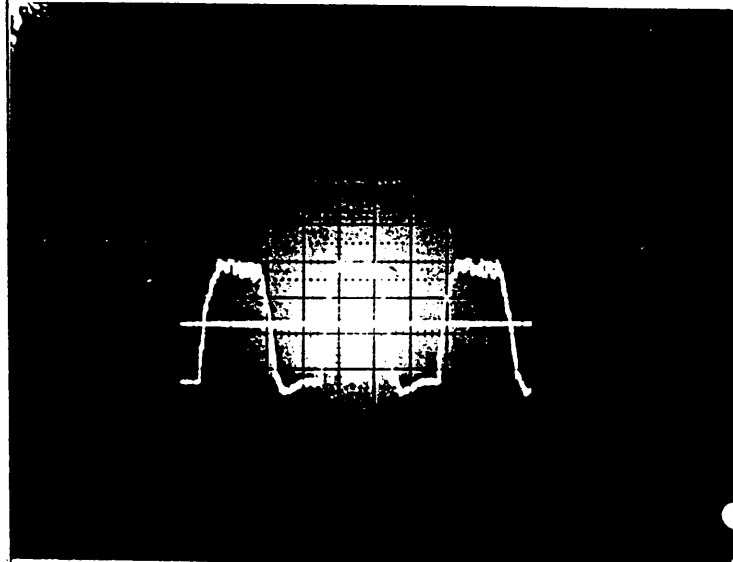


+ 3 μ s

BF \approx 0.56

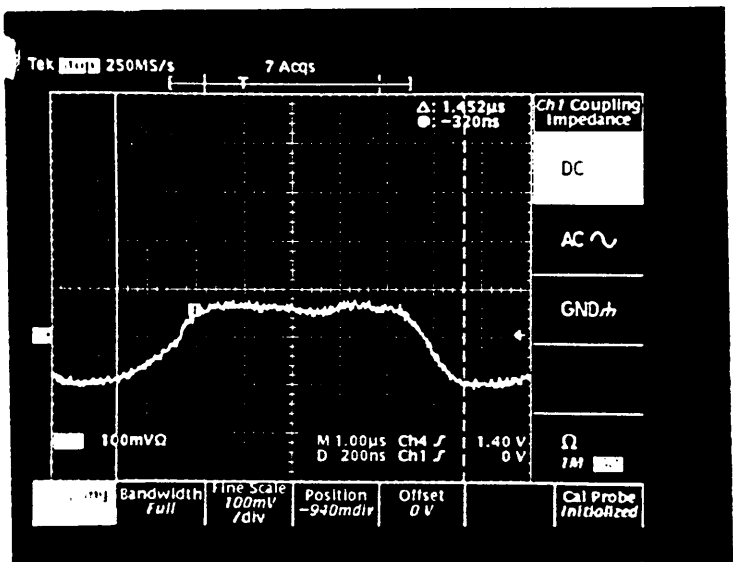


W10 + 4 μ s

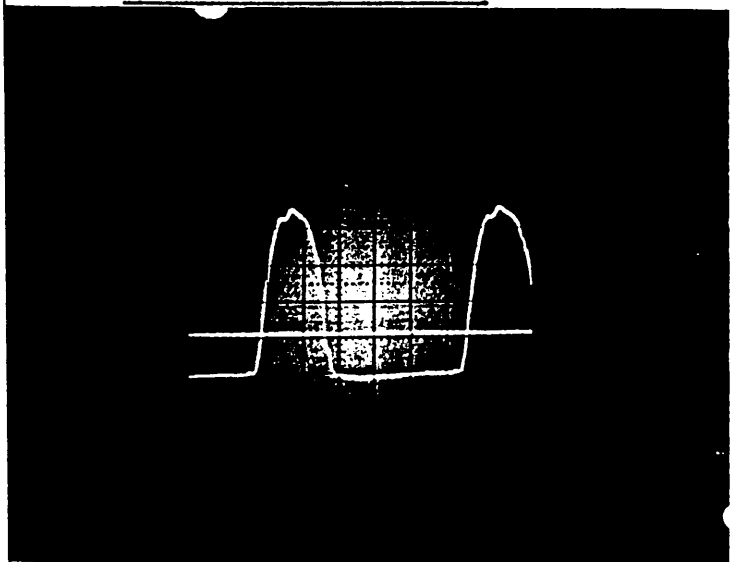


W10 + 3 μ s

INJECTION

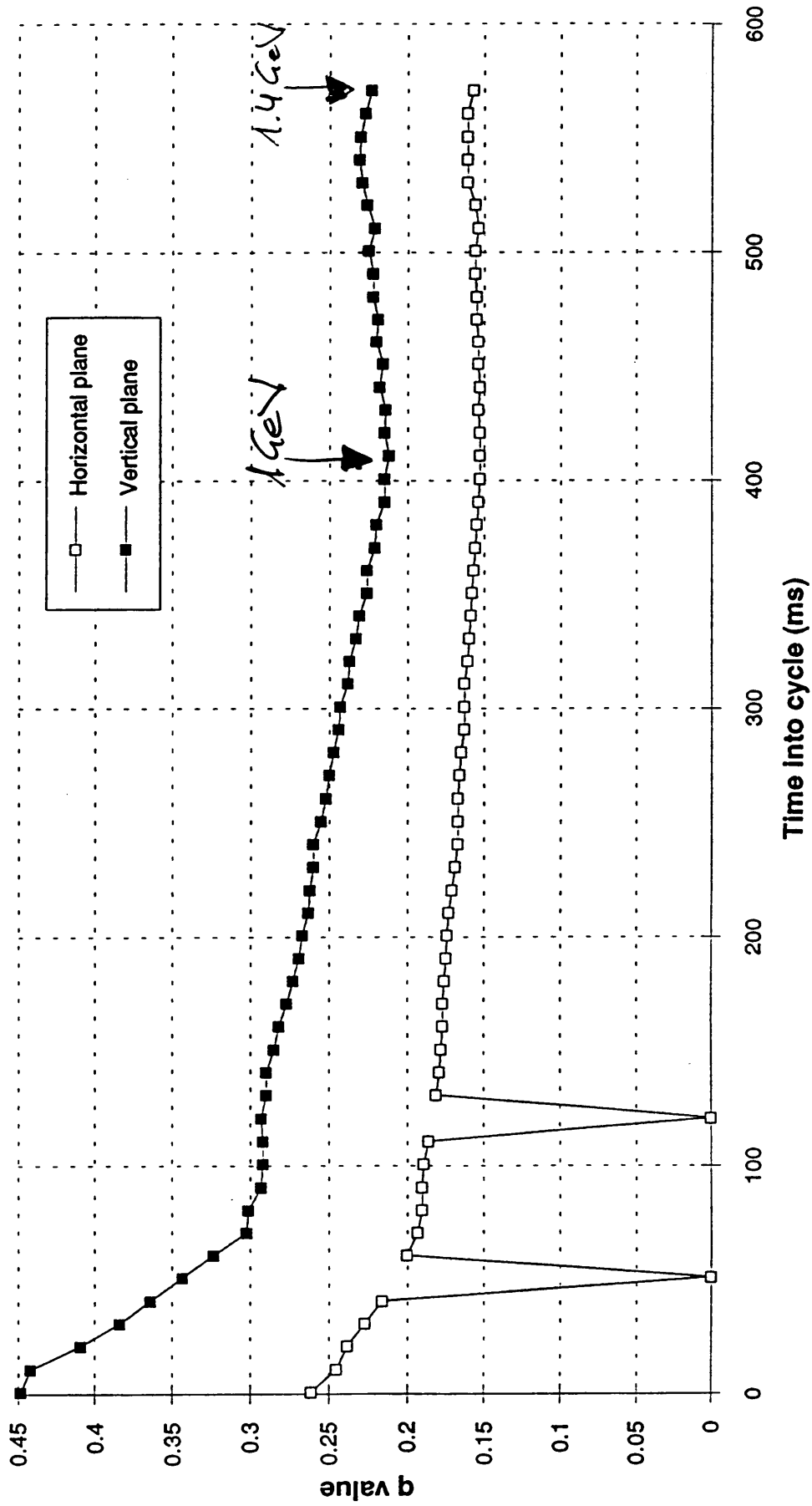


W10 + 1.1 μ s



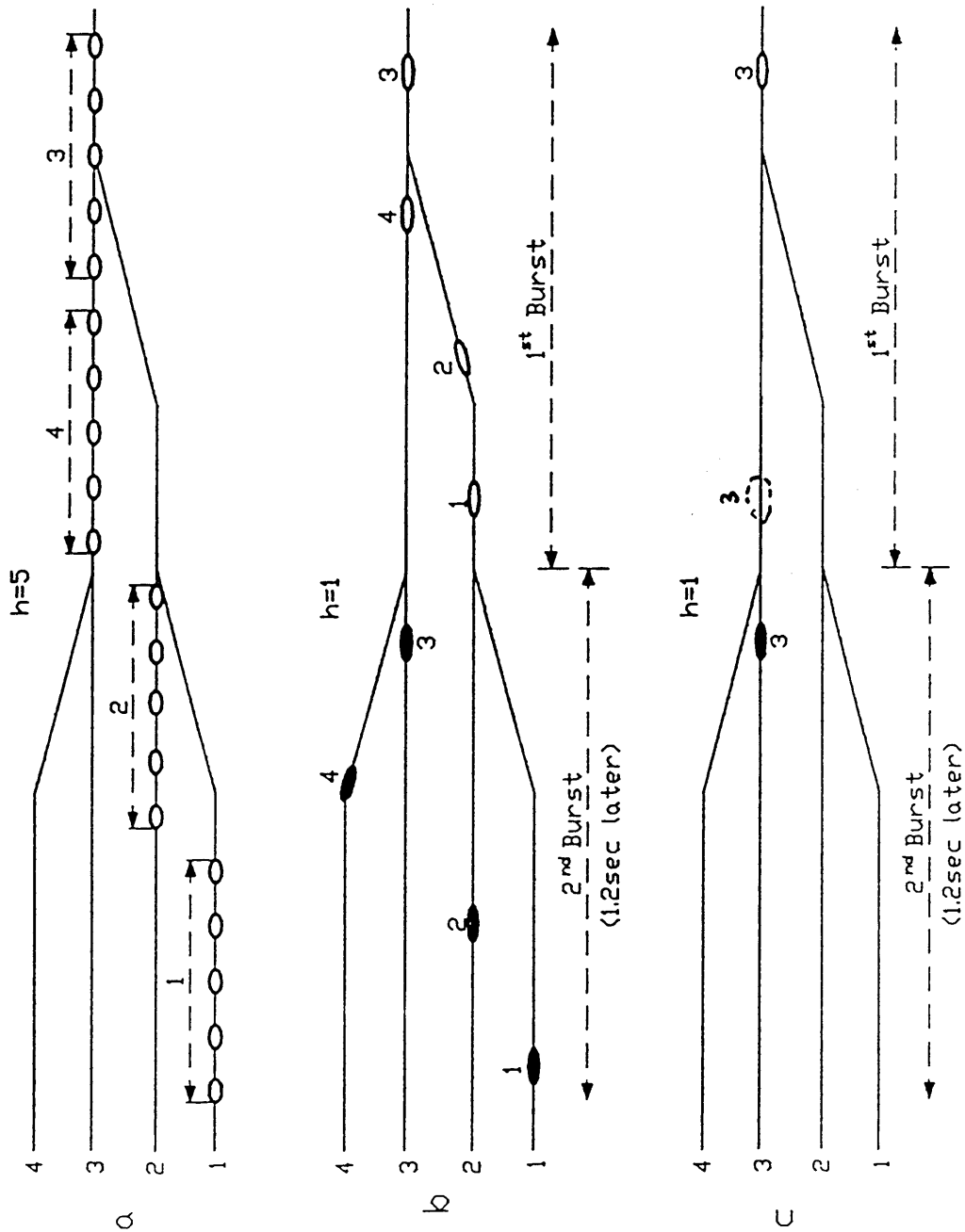
TEFT + 33 μ s

PSB Q-measurement by FFT at 1.4GeV Wednesday 8th December, 10:30am

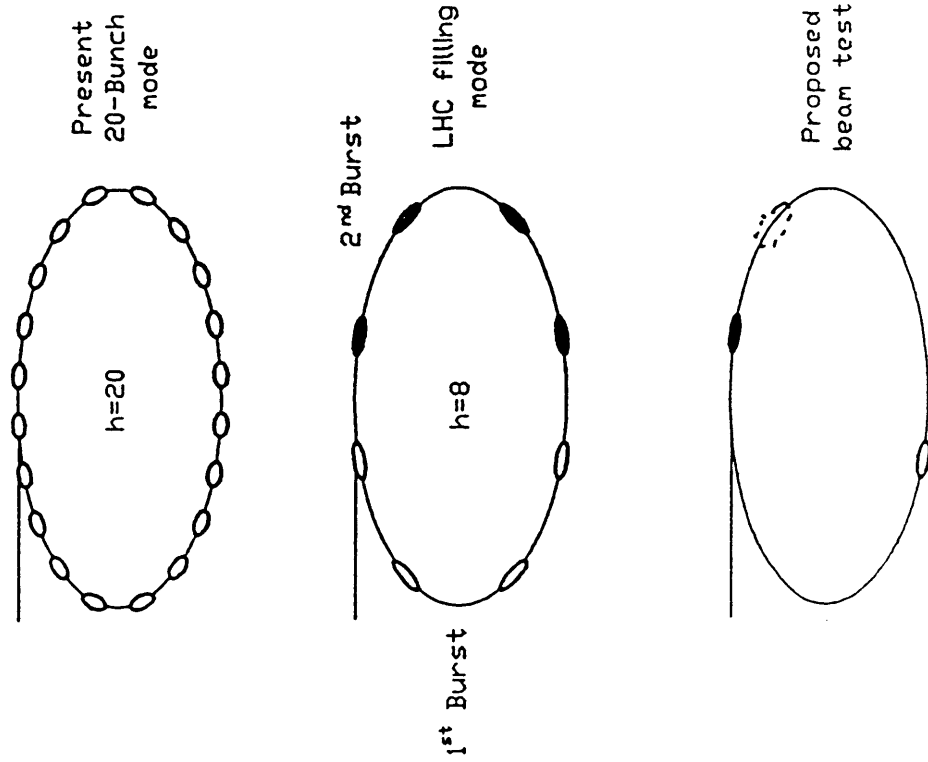


PSB-PS Recombination Schemes

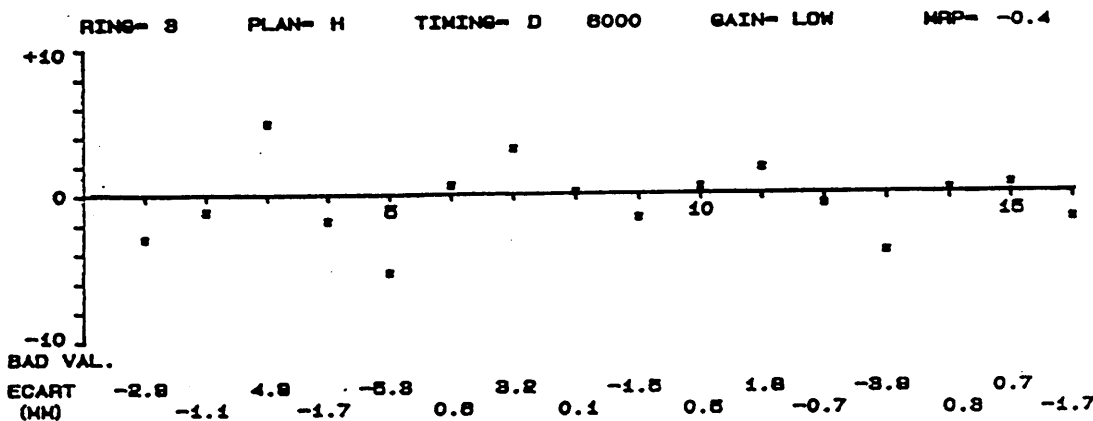
PSB



PS



RING ORBIT PSB-PS TRAJECTORY } AT 1.4 GeV, RING 3 h=1



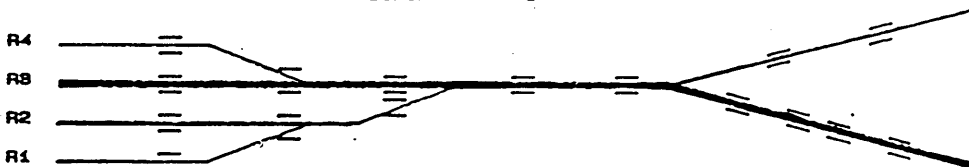
$f_{RF} = 1.7482 \text{ MHz}$
(NOMINAL)

$B = 8676 \text{ G}$
(NOMINAL)

$\overline{DR} = -0.4 \text{ mm!}$

BRU OK with h=1

PLS OPTION MD 8 -DEC-89 17:59:56
TRANSFER PU BEAM POSITION DESTINATION PS
RING 3 MODE 20 B
PLANE HORI
SENSITIVITY LOW
BUNCH 3



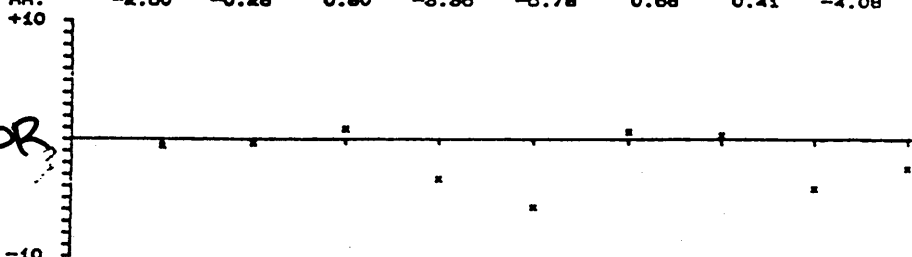
TRANSFER:

BEBSW
INSUFFICIENT

⇒ COMPENSATED
BY "EJECTION
CORRECTION DIPOLES"

	BT	BT	BT	BT	BT	BTH OR BTP			
MM.	UE800	UE810	UE820	UE830	UE840	UE800	UE810	UE820	UE830
+10	-2.60	-0.28	0.80	-8.88	-5.78	0.68	0.41	-4.08	-2.88

HOR

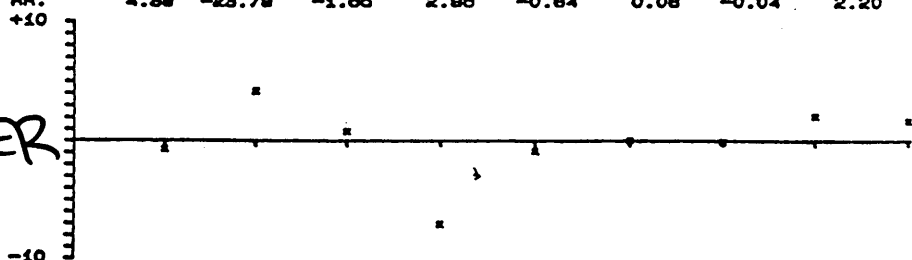


REFERENCE VALUES

-2.00	0.00	0.00	0.00	0.00	0.00
-------	------	------	------	------	------

	BT	BT	BT	BT	BT	BTH OR BTP			
MM.	UE800	UE810	UE820	UE830	UE840	UE800	UE810	UE820	UE830
+10	4.88	-23.78	-1.65	2.88	-0.64	0.08	-0.04	2.20	1.78

VER



REFERENCE VALUES

5.00	-28.00	-2.50	10.00	0.00	0.00
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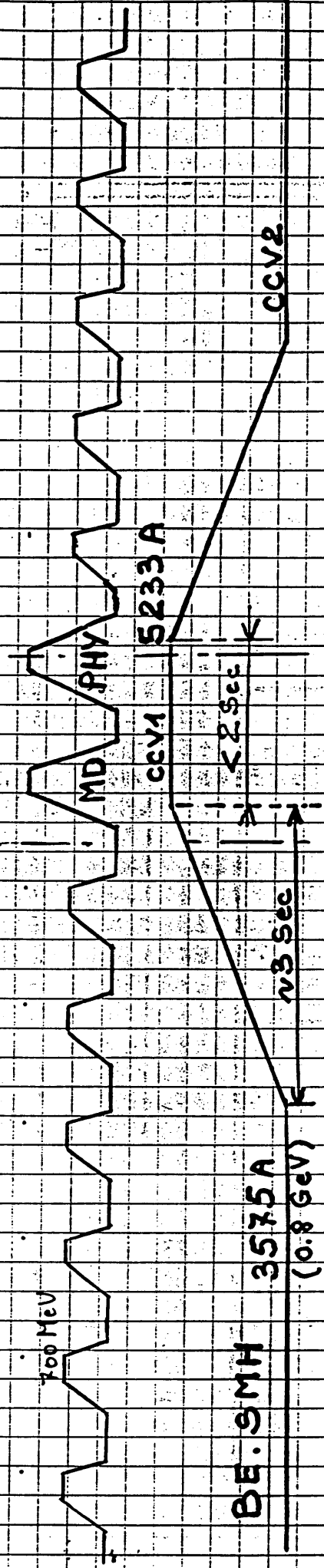
VIRTUALLY SAME
RING 3 TRAJ.
AS WITH 1 GeV

BTU OK with
h=1

Start supercycle

"RAMPING" TO REDUCE HEAT LOAD

PLS 7 user 8 user 9 user 10 user 11 user 12 user 3 user 1 user 2 user 3 user 4 user 5 user 6 user 7 user 8



WTD

Interrupt F25 A0 ligne next

Train PLS $\approx 300 \text{ ms}$

WES $\approx 300 \text{ ms}$

BE BKFA!

Next user	1 : ccv1	2 : ccv1	3 : ccv1	4 : ccv2	5 : ccv2	User	PSB	PS
						1	MD	MD (3.6 sec) BE.SMH contro
						2	PHY	+ Supercycle
						3	TST	LEA
						4	ME2	PHY (2.4 s)
						5	SFT	Spare

(Warning Transfer Data)

LHC Tests

PI SMH42 1665 A \rightarrow 2440 A
idem BE.SMH

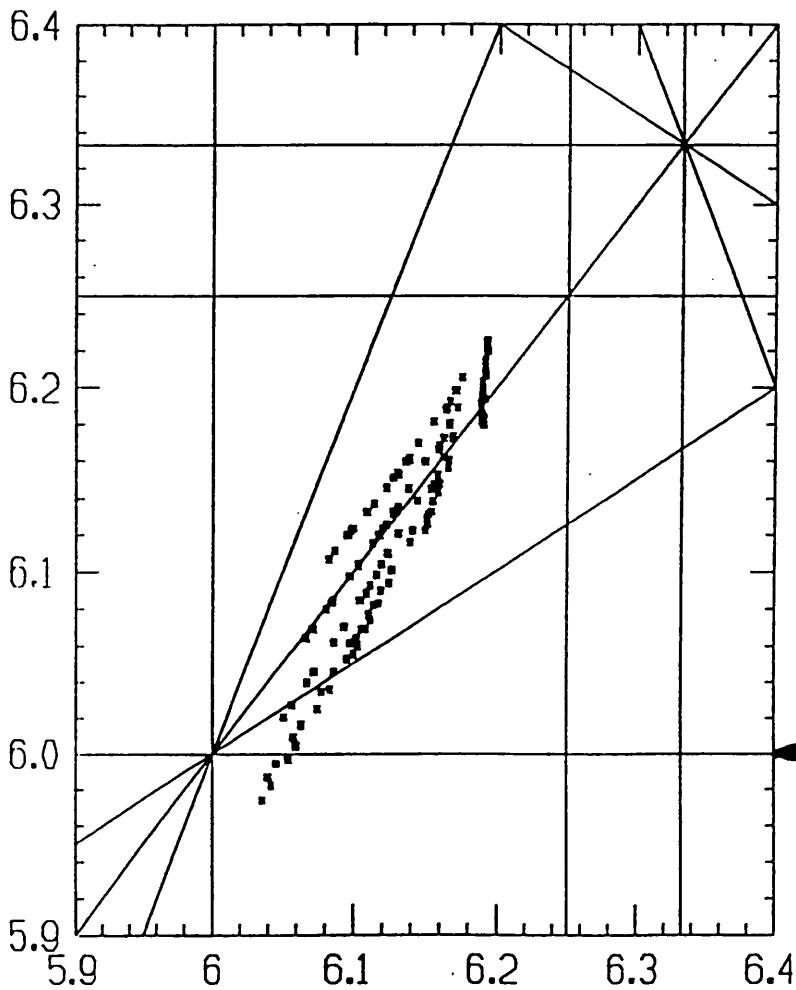
BT.QNO40 268 A \rightarrow 320 A
idem BE.SMH

G.DAETS G.D. 1-10-9
G.CYNDCT G.C. 18-10-9

Space-Charge Tune Spread of the LHC Beam in the PS

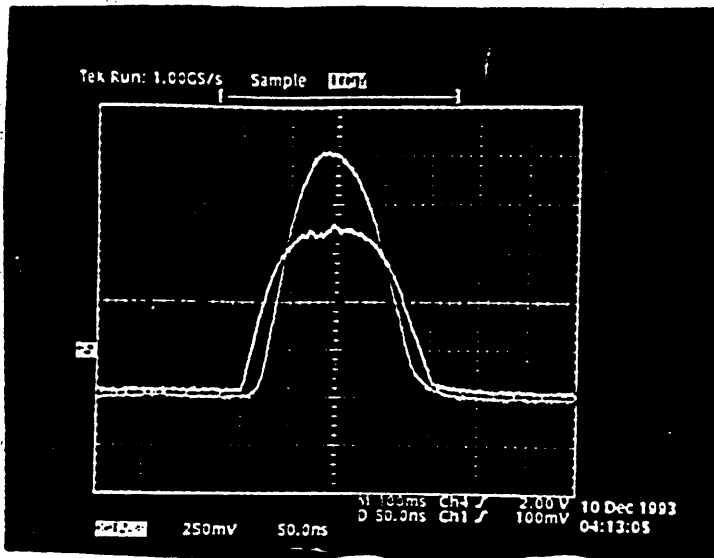
1.4 GeV front porch
 1.4 10^{13} protons in 8 bunches
 $\epsilon_x^* / \epsilon_y^* = 3.5/1.75 \mu\text{m}$
 $\Delta p/p = 2.5 \cdot 10^{-3} (2\sigma)$
 bunch length 190 ns

\Rightarrow 220 ns WITH
 CONTROLLED BUNCH!
 BLOW-UP IN PS!



FOR SAME INTENSITY
 NORMALIZED EMITTANCE }
 BUNCH LENGTH

$$\Delta Q_{\text{line}} [1.4 \text{ GeV}] \approx 0.66 \Delta Q_{\text{line}} [1.0 \text{ GeV}]$$

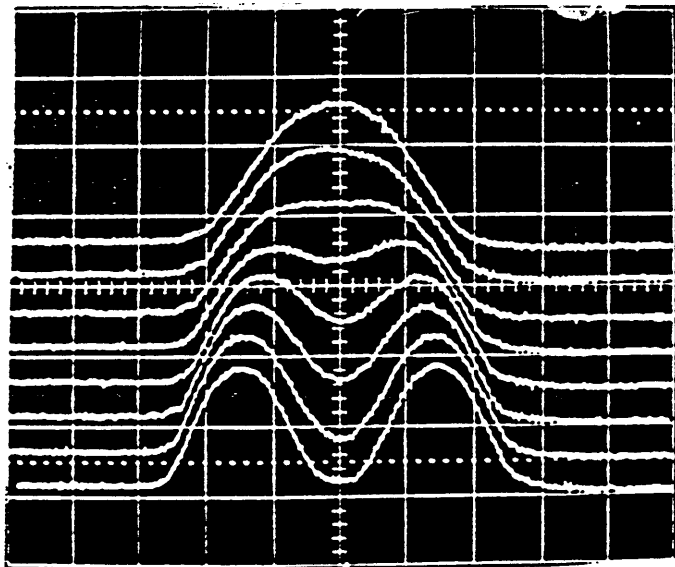


CONTROLLED BUNCH BLOW-UP

BEFORE EXTRACTION FROM PSB
TO IMPROVE THE "BUNCHING
FACTOR" (DECREASE SPACE CHARGE
AT INJECTION INTO PS

UPPER TRACE:
BUNCH BEFORE BLOW-UP

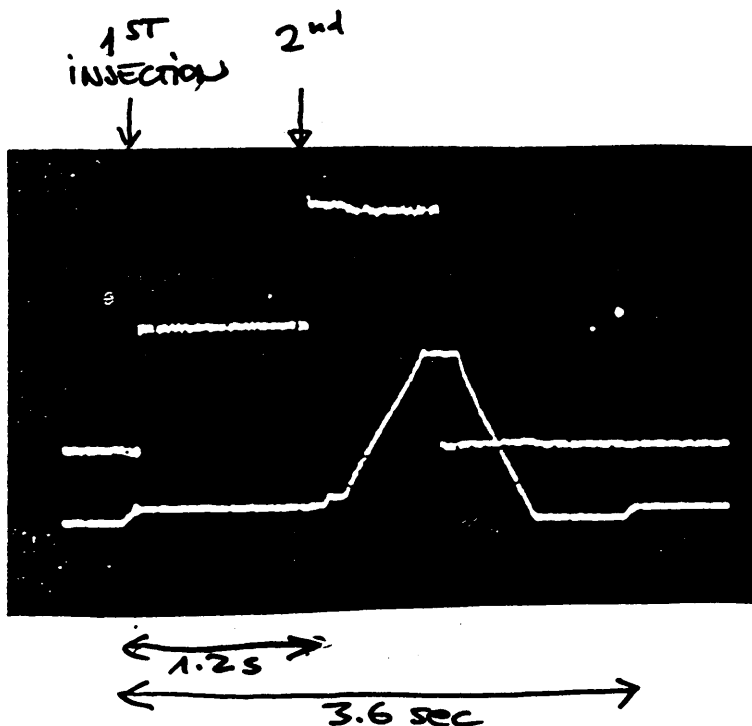
LOWER TRACE:
BUNCH AFTER BLOW-UP



BUNCH SPLITTING $h=8 \Rightarrow 16$

AT THE END OF PS PLATEAU
(1 GeV OR 1.4 GeV). THE HIGHER
BUNCH HARMONIC EASES
DEBUNCHING - REBUNCHING
($h=16 \Rightarrow 84$) TO OBTAIN
25 ns BUNCH SPACING AT
26 GeV/c.

SHOWN ARE BUNCH SHAPES
(1 SWEEP EVERY ≈ 2 ns)

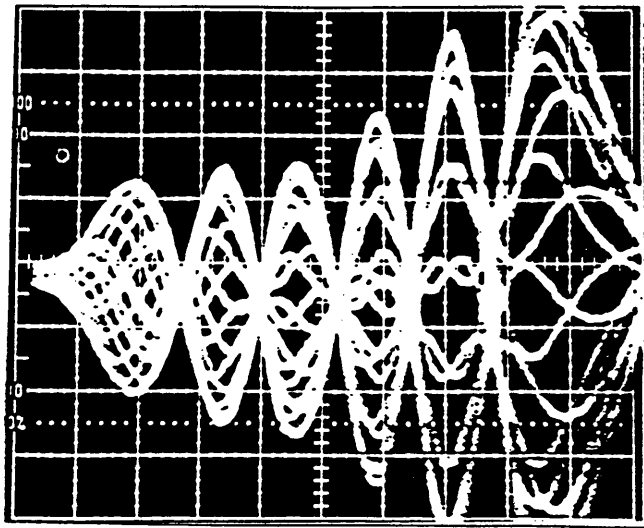


DOUBLE-BATCH FILLING OF PS

UPPER TRACE:
BEAM TRANSFORMER SHOWING
THE TWO INJECTIONS AND
ACCELERATION TO 26 GeV/c

LOWER TRACE:
THE PS MAGNET CYCLE
(REP. TIME 3.6 sec) WITH ITS
1.4 GeV INJECTION FLATEAU

HEAD-TAIL HORIZONTAL INSTABILITIES ON PS 1GeV PLATEAU



a)

PS 1 GeV
INJECTION PLATEAU

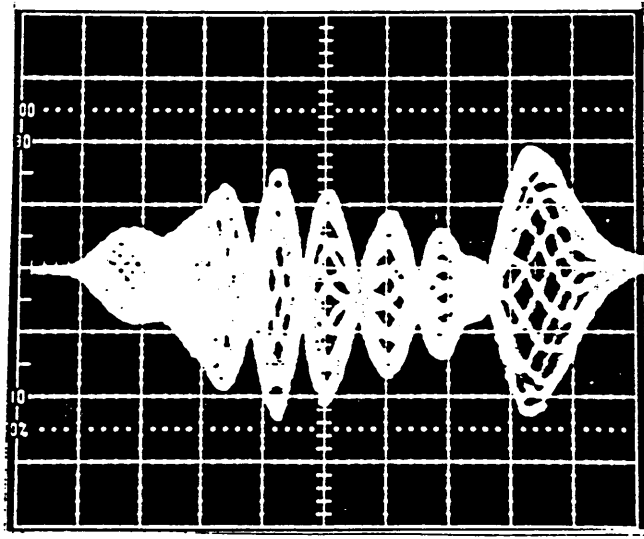
1 BUNCH CIRCULATING

$T_b \approx 200 \text{ ns}$

$h = 8$

$N_b = 2 \cdot 10^{12} \text{ p/bunch}$

$\epsilon_x^* \sim \epsilon_y^* \sim 2.5 \mu\text{m}$

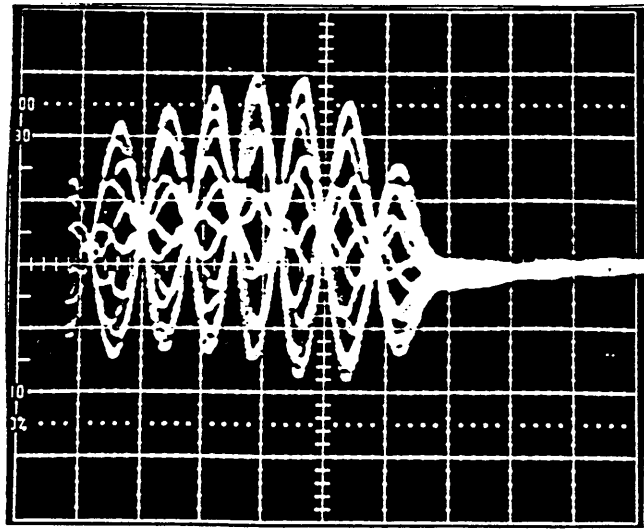


b)

CURE:

BETTER CONTROL
OF $f_{h,v}$ ON
INJECTION PLATEAU
WITH PFW

BEAM PROVED STABLE
AT 1.4 GeV
(ALSO MORE FAVOURABLE
"ON PAPER")



c)

Fig.1 ΔR signal from a beam position monitor on several consecutive turns. Time scale: 20 ns/div.
 a) $m = 5$ (most common) b) $m = 5 + 6$ (?) c) $m = 7$

"NOMINAL" [1.10^{12} p/bunch] LHC BEAM
 FAST WIRE SCANNER AFTER INJECTION AT 1 GeV IN PS
 [C220]

10/5


Help

File View Options Control Fast Wire Scanner ALL *** Feb 1 09:57:57

Device	H64	Occurrence	ANY	Expected Ip	5e11	Wire Velocity	20 m/s
SWEEP	DOUBLE	C Forward	220	C Backward	320		
PM Voltage (1)	750	Opt_Filter (1)	2				

Acquired Settings Wire Scanner H64 (Dec 13 12:39:25) User MD

	FORW.	BACK					
ε pulse	803	804				FORW.	BACK
γ (MeV/c)	1685	1687				ε (2σ) (π mm mrad)	5.370 5.001
Ip (10e10)	3	109				ε (2σ) normalized	9.644 8.993
PM Voltage	749	749				Δφ (mm)	16.452 15.876
Optical Fiber	2	2					



Results for dp/p = 1.90 E-3, beta = 12.6

Measurement Finished.

TT2.

HOR PLANE

2.10^{12} p/BUNCH

(MORE THAN

BEAM-BEAM

LIMIT⁴ LHC)

$\sigma_{rms} =$

$$= (\beta\gamma) \cdot \frac{\epsilon(2\sigma)}{4}$$

$$= 2.8 \mu\text{m}$$

Context Working Sets Sequenc Measur Synopt General Tests

Context: CPS A PLS: HD

Momentum Spread

0.50 E-3

Close

Bit Options Control

Correctors Number of correctors used: 3

Instruments	Position	Correctors	Initial CCV	Current CCV	Increments	New CCV
FT16.MSC257	-0.70 mm	FT16.BHZ117	211.74 A	210.46 A		
FT16.MSC267	0.64 mm	FT16.BHZ147	199.34 A	200.86 A		
FT16.MSC277	-0.15 mm	FT16.BHZ167	179.69 A	175.26 A		
		FT16.DHZ237	0.00 A	0.00 A		

File Controls Options View Pls Option

FX.A5002 250 - PR.TNA-BEF-OP16 209.2

q(2σ): 0.40 n μm Δp/p: 0.50 E-3

FT16.MSC257

Status: HV IN 40%

Plane A 40%

Plane C 20%

Plane R 20%

HER n 0

HER p 0

Step: 0.50 mm 35.7% ADC Range

Spline fit

4σ²/β	0.36 n μm
μ	-0.70 mm
σ	1.28 mm
G	1.11
B	-0.31

FT16.MSC267

Status: HV IN 80%

Plane A 60%

Plane C 40%

Plane R 20%

HER n 0

HER p 0

Step: 0.35 mm 64.4% ADC Range

Spline fit

4σ²/β	0.48 n μm
μ	0.64 mm
σ	0.91 mm
G	0.65
B	0.24

FT16.MSC277

Status: HV IN 40%

Plane A 40%

Plane C 20%

Plane R 20%

HER n 0

HER p 0

Step: 0.50 mm 31.6% ADC Range

Spline fit

4σ²/β	0.30 n μm
μ	-0.15 mm
σ	1.43 mm
G	1.35
B	0.05

Plane: KKM

Twiss	FT16.MSC257	FT16.MSC267	FT16.MSC277
α	1.809	-0.029	0.684
β(m)	17.982	7.046	27.592
γ(rad)	14.453	14.706	14.856
D(mm)	3444.000	-590.000	-4105.000

Close

FT16.MSC257 HORIZONTAL

σ(2σ): 0.40 n μm

4σ²/β: 0.36 n μm

Blow up: 35.81 %

β(G): 16.27 1.11

α(B): 1.36 -0.31

Matching vector

Close

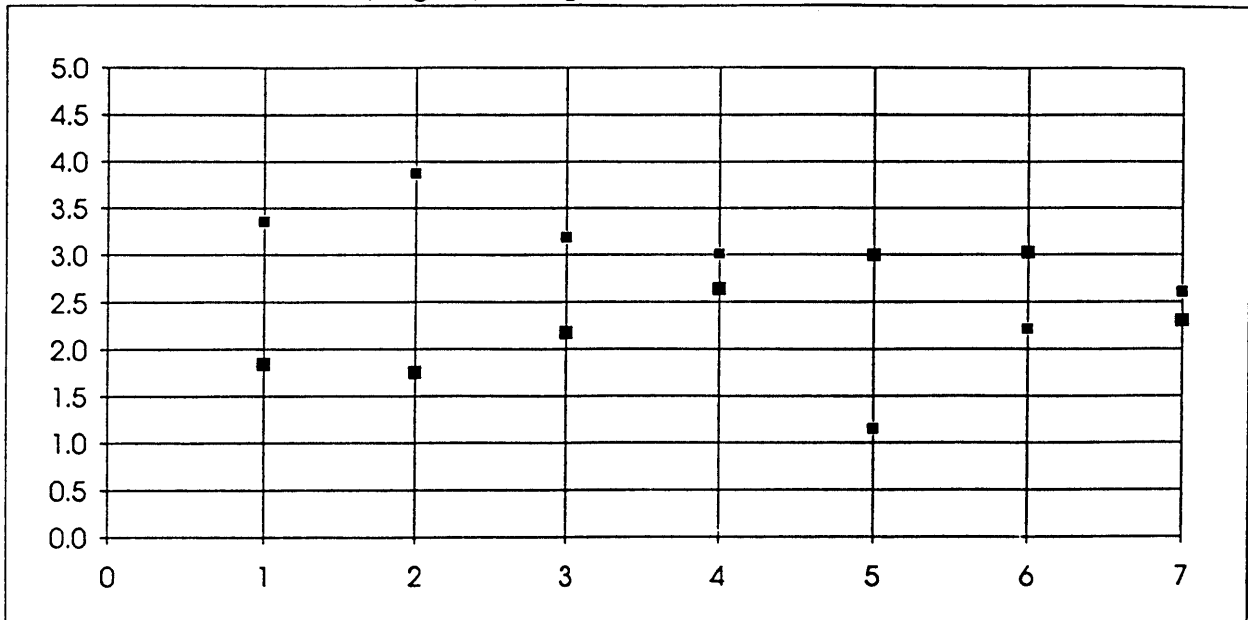
Rest Position Single Shot Unfreeze Run Math

Programme in pause !!!

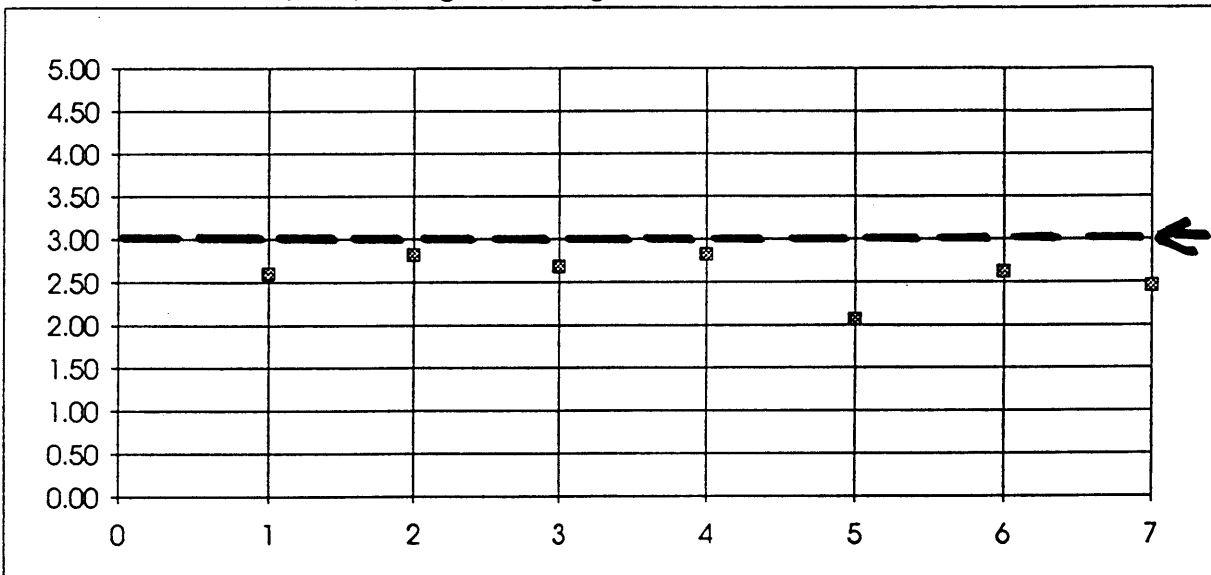
Emittance H & V (1 sigma, average,normalised)

Nb= 1.8 E12

"Beam-Beam
Limit"



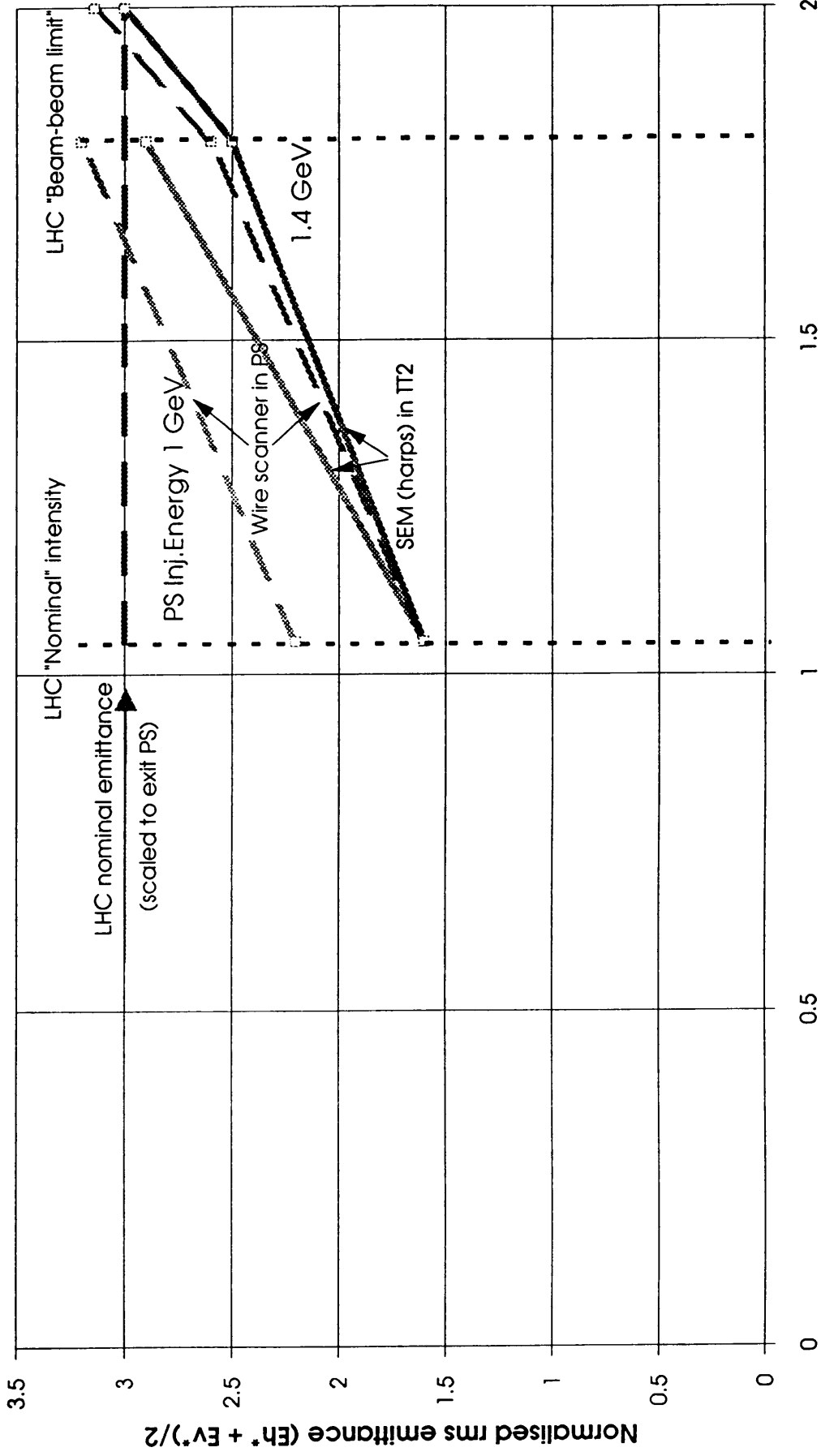
Emittance (H+V)/2 (1 sigma, average,normalised)



LHC 26 Exi

- | | |
|----------------|-----------------------|
| 1 Beamscope | 1.4 GeV |
| 2 S-G PS | 1.4 GeV Injection |
| 3 Fil PS C220 | 1.4 GeV Debut palier |
| 4 Fil PS C1400 | 1.4 GeV Fin de palier |
| 5 Fil PS C1620 | 3.5 GeV/c |
| 6 Fil Ps C2397 | 26 GeV/c |
| 7 S-G TT2 | 26 GeV/c |

Emittance vs Intensity for LHC at 26 GeV/c - PRELIMINARY (28.1.94 KS)



Beam intensity in 10^{12} p/pulse (corresponding to 10.5 LHC bunches)

COMMENTS

• BUNCH LENGTH AT INJECTION PS

T [GeV]	bunch length [ns]	Kicker rise time [ns]
1.0	~ 220	≤ 80
1.4	~ 180	≤ 105

• EMITTANCES WITH FINAL SCHEME WILL TEND TO BE LARGER BECAUSE OF:

- RECOMBINATION OF 4 RINGS
 - MORE BUNCHES IN PS \Rightarrow TRANSVERSE INSTABILITIES
 - DEBUNCHING - RECAPTURE AT 26 GeV/c \Rightarrow BLOW-UP?
- \Rightarrow EMITTANCE MARGIN WELCOME

• STILL TO BE STUDIED:

"COMMISSIONING" BEAM

- HOW TO PRODUCE IT (LINAC2/PSB)
- HOW TO KEEP EMITTANCE SMALL

NEW RF SYSTEMS IN PSB AND PS AT HIGHEST INTENSITIES (ISOLDE, SPS & OSC. ...)

LHC: $2 \cdot 10^{12}$ p/BUNCH

ISOLDE: $8 \cdot 10^{12}$ p/BUNCH ↓

CONCLUSIONS (SUBJECTIVE) + PRELIMINARY)

- PSB CAN BE MADE WORKING @ 1.4 GeV
NO SATURATION EFFECTS IN MAIN MAGNETS
- PSB CAN RUN WITH ONE BUNCH/RING. ($h=1$)
UP TO $2 \cdot 10^{12}$ /RING (LHC MAX. INTENSITY)
- PS CAN ACCELERATE ON $h=8, h=16$
AND BUNCH SPLITTINGS WORKS
- FILLING OF PS WITH TWO PSB PULSES FEASIBLE
- LHC REQUIREMENTS ON BEAM BRIGHTNESS CAN
BE SATISFIED UP TO THE "BEAM-BEAM LIMIT"
WITH 1.4 GeV, LEAVING SOME MARGIN.
- "NOMINAL" LHC BEAM FEASIBLE WITH PSB @ 1 GeV,
(LEAVING A MARGIN), THANKS TO
 - CONTROLLED BUNCH BLOW-UP ON PSB FLAT TOP;
 - CORRECTION OF $2Q_y = 12$



PROPOSED PROJECT FOR UPGRADING OF PS
AS LHC PREINJECTOR

- HAS THE CORRECT CHOICES
- WILL FULFIL THE TASK
- JUST NEEDS APPROVAL

1994 proton MD FORECASTS

R.C.
1.2.94

• ISOLDE (PSB)

- ** MINIMIZE LONG. BEAM LOSSES D⁶
 - ** " EJ. SEPTUM " " D
 - ** COMM. OF NEW TRANSV. FEEDBACK AMPLIFIERS ~D
 - ? HORIZONTAL SEPAR. OF BEAMS/TARGET IF REQUESTED
- STUDIES ON INTEGER STOPBANDS

• SFT (PS)

- *** COMM. OF HIGH INTENSITY ($> 2.5 \cdot 10^{13}$ PPP)
- ** COLLECTIVE EFFECTS & CT OPTIM.

(*) D = DEDICATED (OR PARTIALLY DEDICATED) MD TIME

• LHC

- * FLAT BUNCHES (PSB & PS) D
 $k=1+2$ $k=8$
 - * "INITIAL BEAM" (PSB + PS?) D ?
 $I/10$ $\epsilon_{x,y}^*/5$
 - * TRANSV. INSTABILITIES (PS @ 1 GeV)
 CHANGE ξ WITH PFW'S
 - * ADIABATIC DEBUNCHING (PS @ 26 GeV/c)
 $k=16$ or $k=20$
 - * IMPEDANCE MEASUREMENTS (PS)
 HOM'S EFFECTS "
 BTF MEASUREMENTS "
- LINAC2 (HIGHER CURRENT - PPM ?)

• FUSION MACHINES

- * VERY HIGH SPACE CHARGE (PS)
 $\Delta Q \sim 1$
- * INTEGER STOPBAND COMPENSATION (PS)
 $2Q_x = 12$
 $2Q_y = 12 \dots$

• OTHERS (see future PPC's)

** \bar{P} DECELERATION (PS)
NEW f-PROGRAM

*** P_L SIMULATION (PSB & PS) D
S.U. OF BEAM CONTROLS, MAGN. CYCLES,
EXTRACTIONS, ETC.