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

PS/PA Note 94-09 (PPC)
February 17, 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. Vandorpe, 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 μA 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 μm 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. Vandorpe
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) : $\bar{p}$

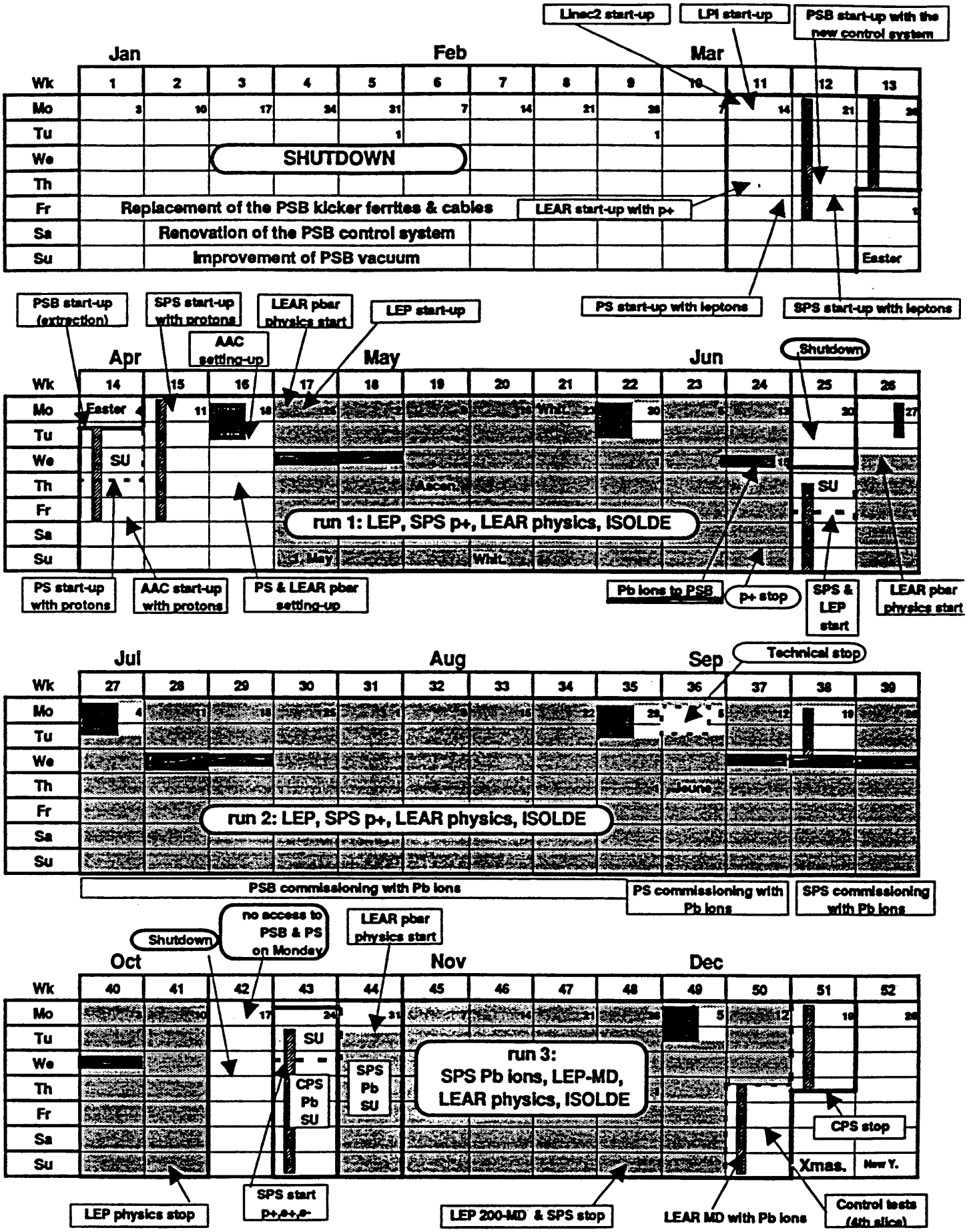
22.2.94 : $e^{\pm}$

15.3.94 : p_b

jb

1994 - PS 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 μs	Linac2 180 mA in 20 μs (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 (Bρ +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

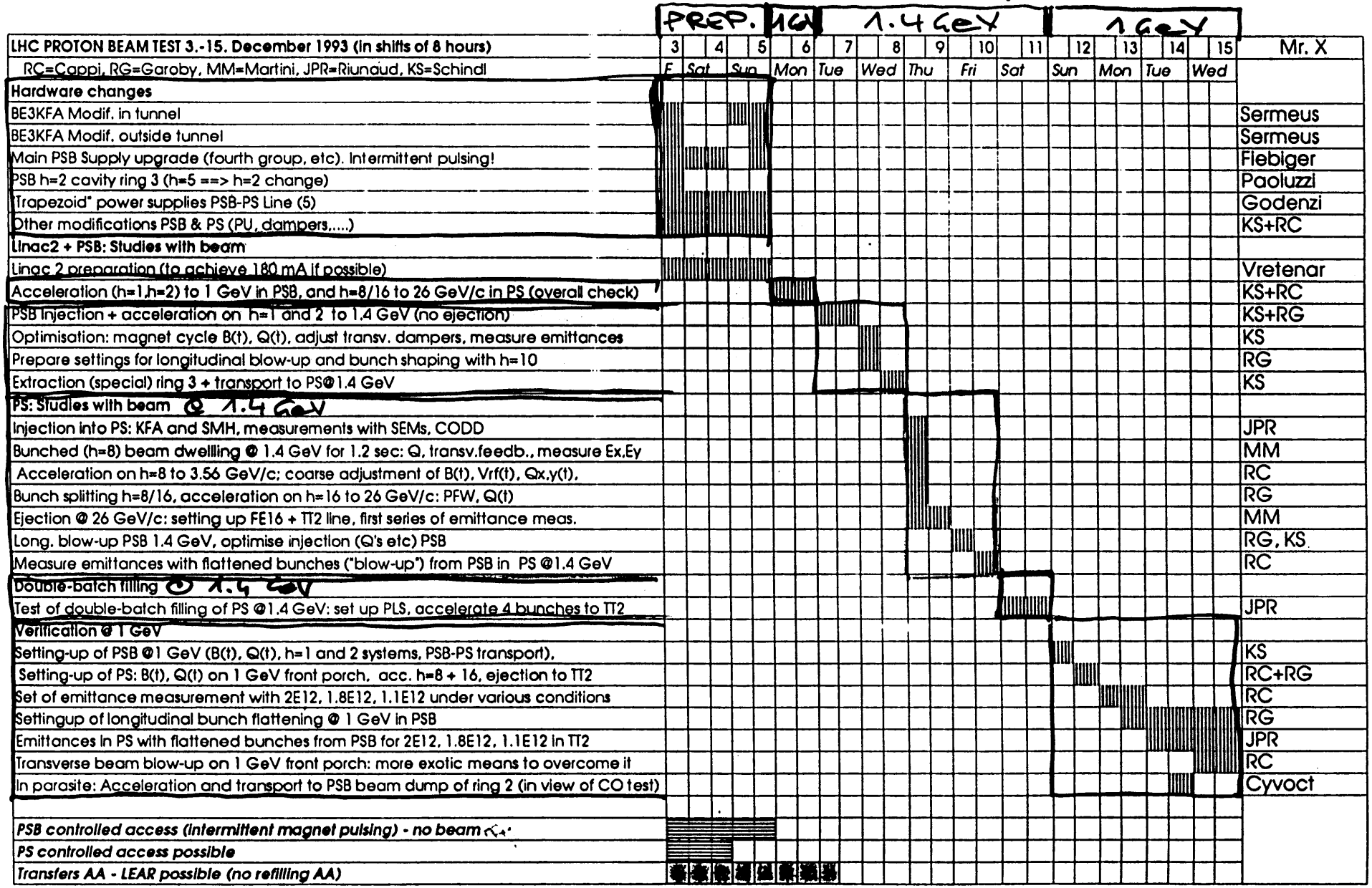
LHC Proton Performance Levels in PS Complex

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

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

KS 30.11.93

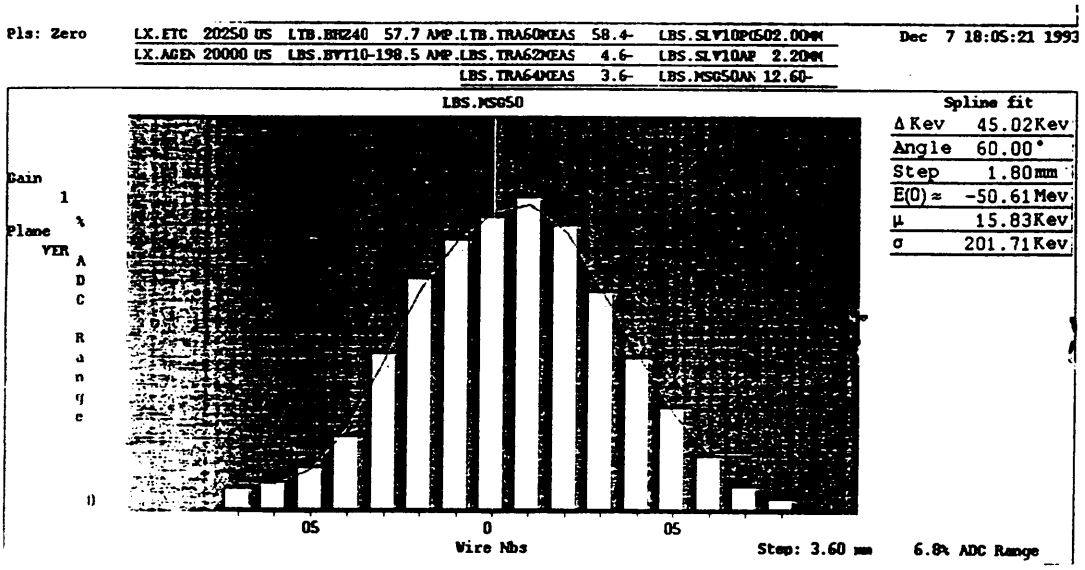
LHC Test Last Schedule 15.12.93 13:00. - End of MD Thursday 16.12. 08:00



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 EMITTANCE MEASURMENT SERIES)



LBS LINE

DB11 amplitude 2750

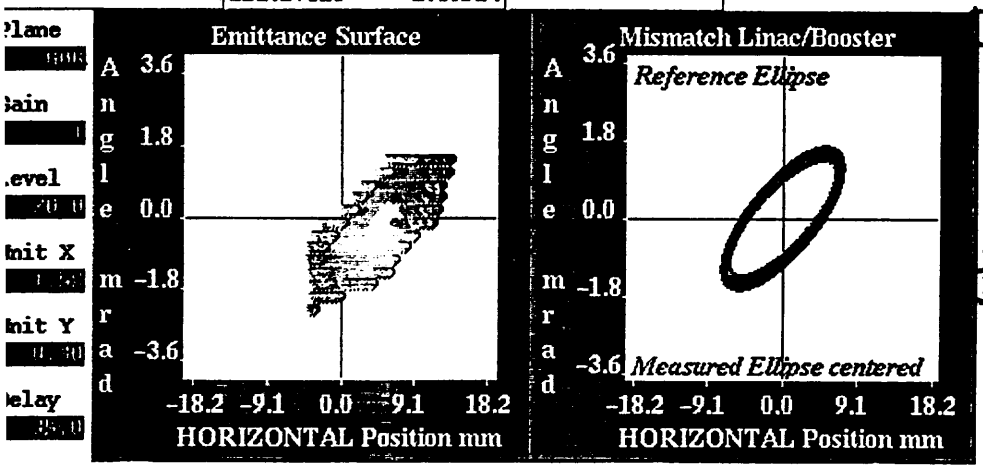
Optimized for Bf after PS capture.

LTB.TRA60	160.3-	LT.BHZ20	206.2AMP.	LX.WEMI	1999.0US
LBE.TRA65	3.0-	LTB.BHZ40	-96.0AMP.	LX.ETC	2045.0US
		LBE.QFWV10	2.8-		
		LBE.QDWV20	2.4-		
		LBE.KHZ10	1.2-		
		LBE.KVT10	1.2-		
		LBE.DHZ10	8.1AMP.		
		LBE.DVT10	-2.0AMP.		

LBE

Dec 5 20:00:34 1993

ENTRY PSB : I = 160 mA ($B\rho$=0.33)



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

$\varepsilon^*_{r.m.s} \approx 1.2\pi mm$

$\varepsilon_0 = 2\varepsilon_{1\sigma}$ if Bi-gaussian.

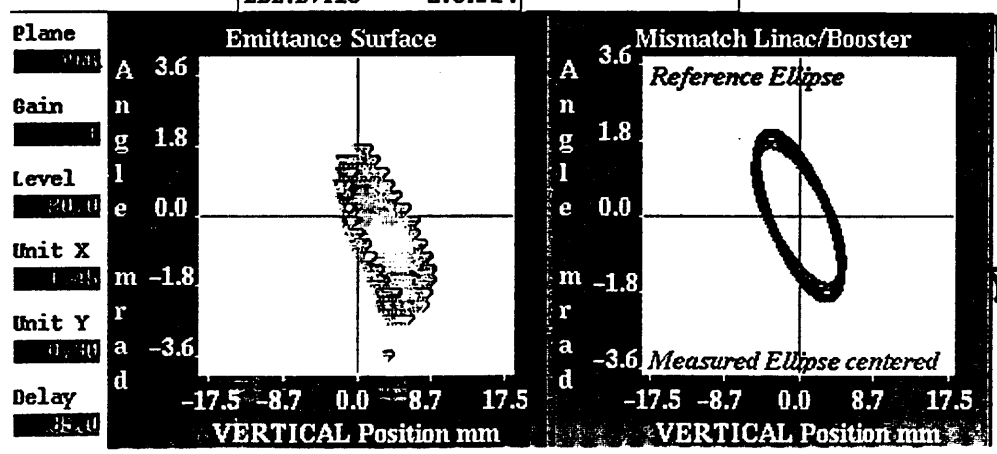
$\varepsilon^*_{(1\sigma)} \approx \left(\frac{7.5+7.1}{2}\right) * \frac{1}{2} * 0.33 = 1.20\ \mu m$

il VALORE NOMINALE

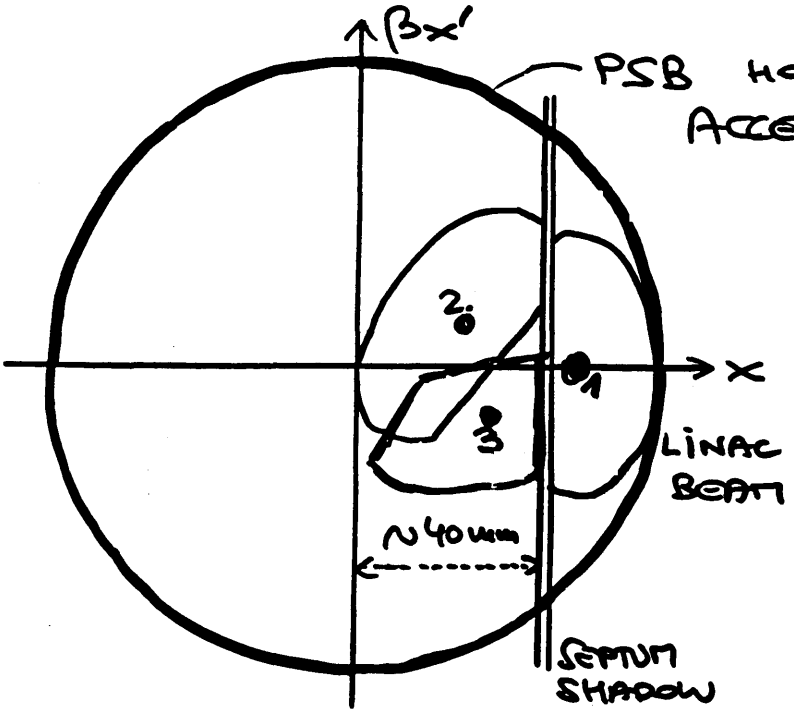
LTB.TRA60	159.2-	LT.BHZ20	206.2AMP.	LX.WEMI	1999.0US
LBE.TRA65	2.9-	LTB.BHZ40	-97.7AMP.	LX.ETC	2045.0US
		LBE.QFWV10	-2.8-		
		LBE.QDWV20	-2.4-		
		LBE.KHZ10	1.2-		
		LBE.KVT10	1.2-		
		LBE.DHZ10	2.0AMP.		
		LBE.DVT10	-2.0AMP.		

LBE

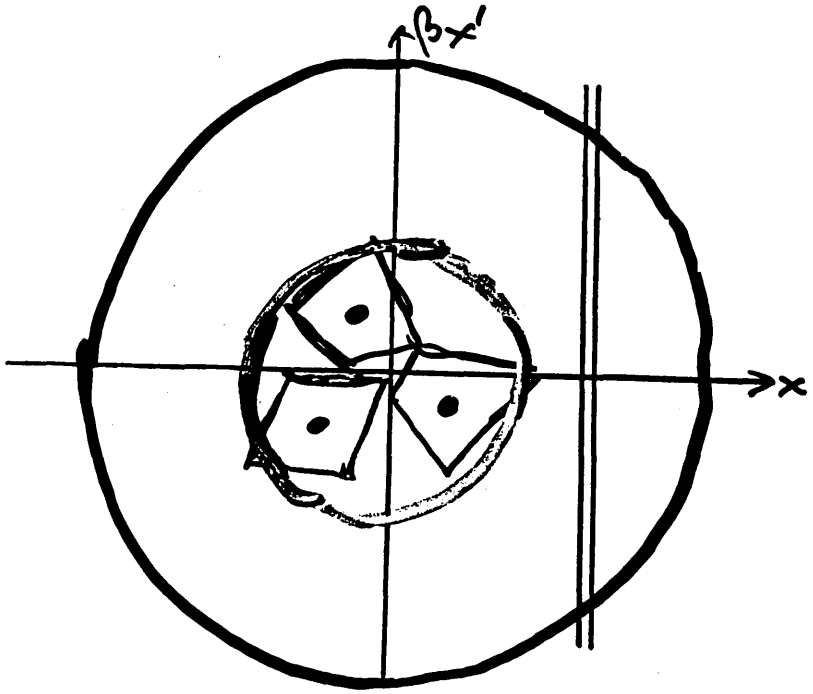
Dec 5 20:01:32 1993



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

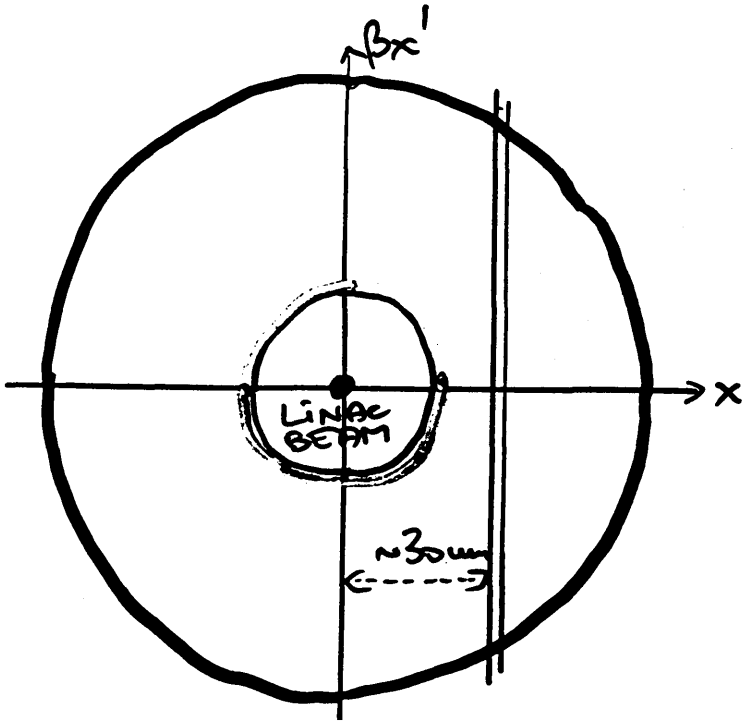


MULTI-TURN: BEAM CUT REPETITIVELY BY SEPTUM



MULTI-TURN: 3 TURNS IN PHASE PLANE AFTER INJECTION

LARGE HORIZ. EMITTANCE

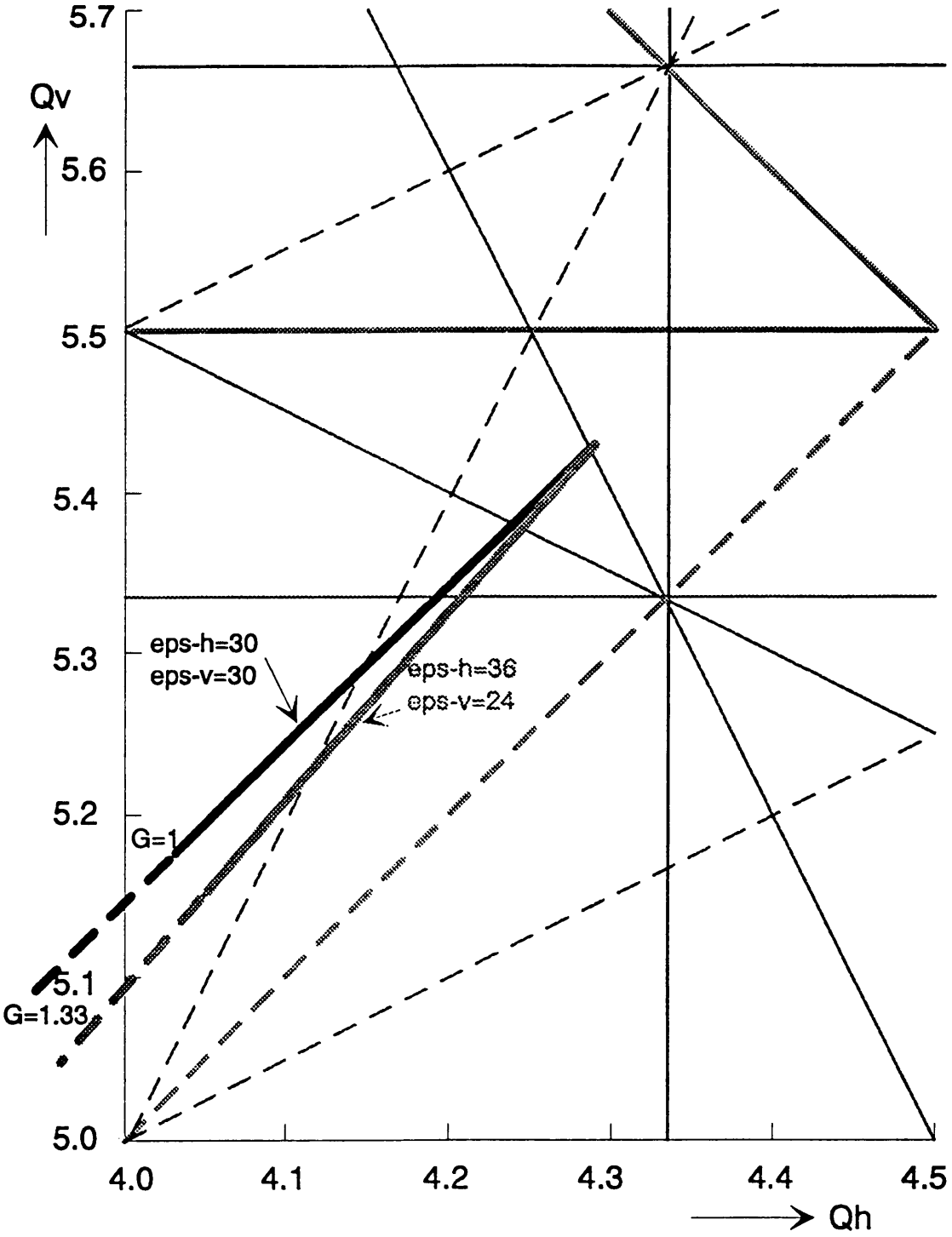


SINGLE-TURN: BEAM MATCHED

SMALL HORIZ. EMITTANCE

K.S. 2/93

PSB Tune Diagram

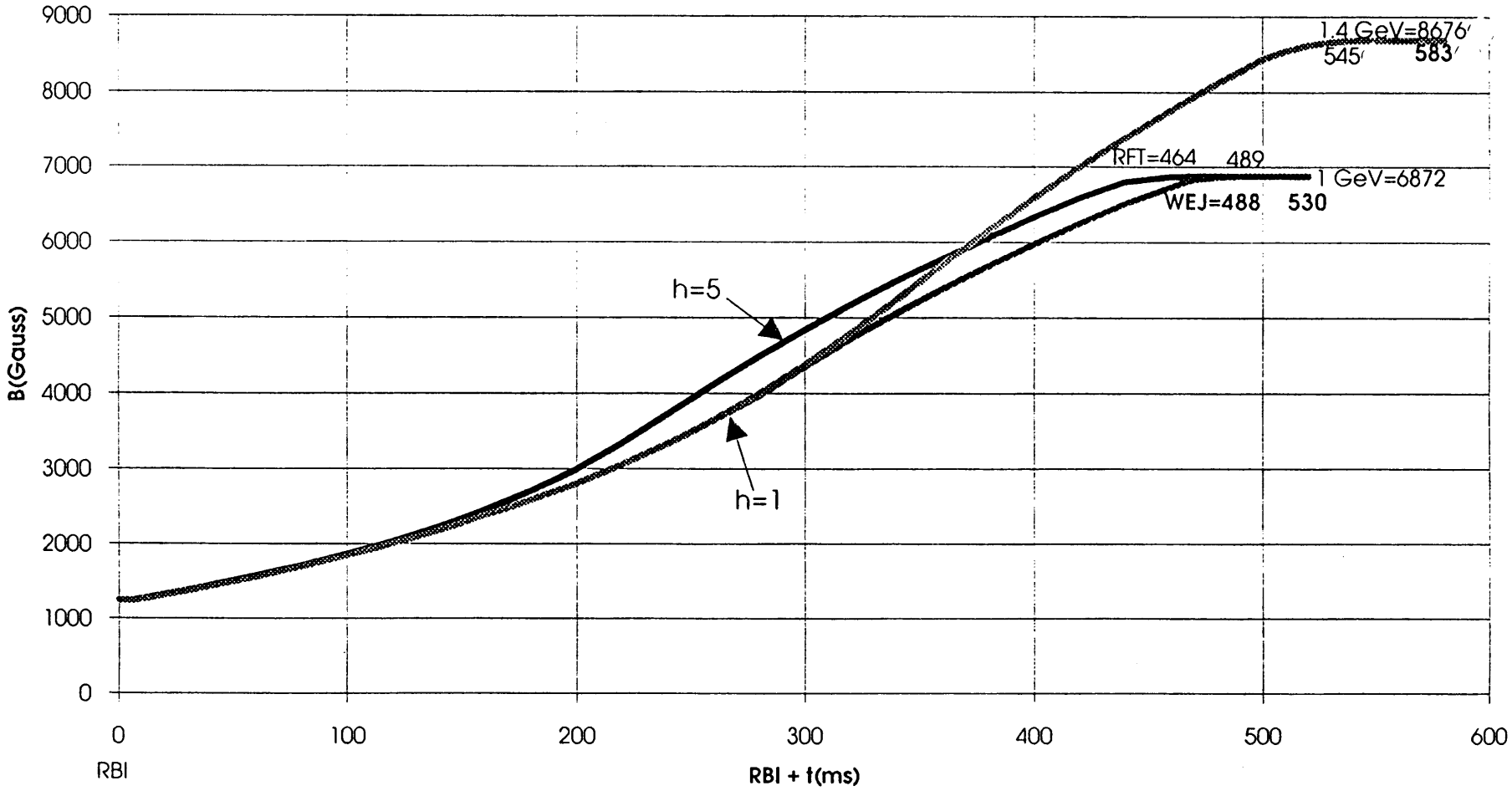


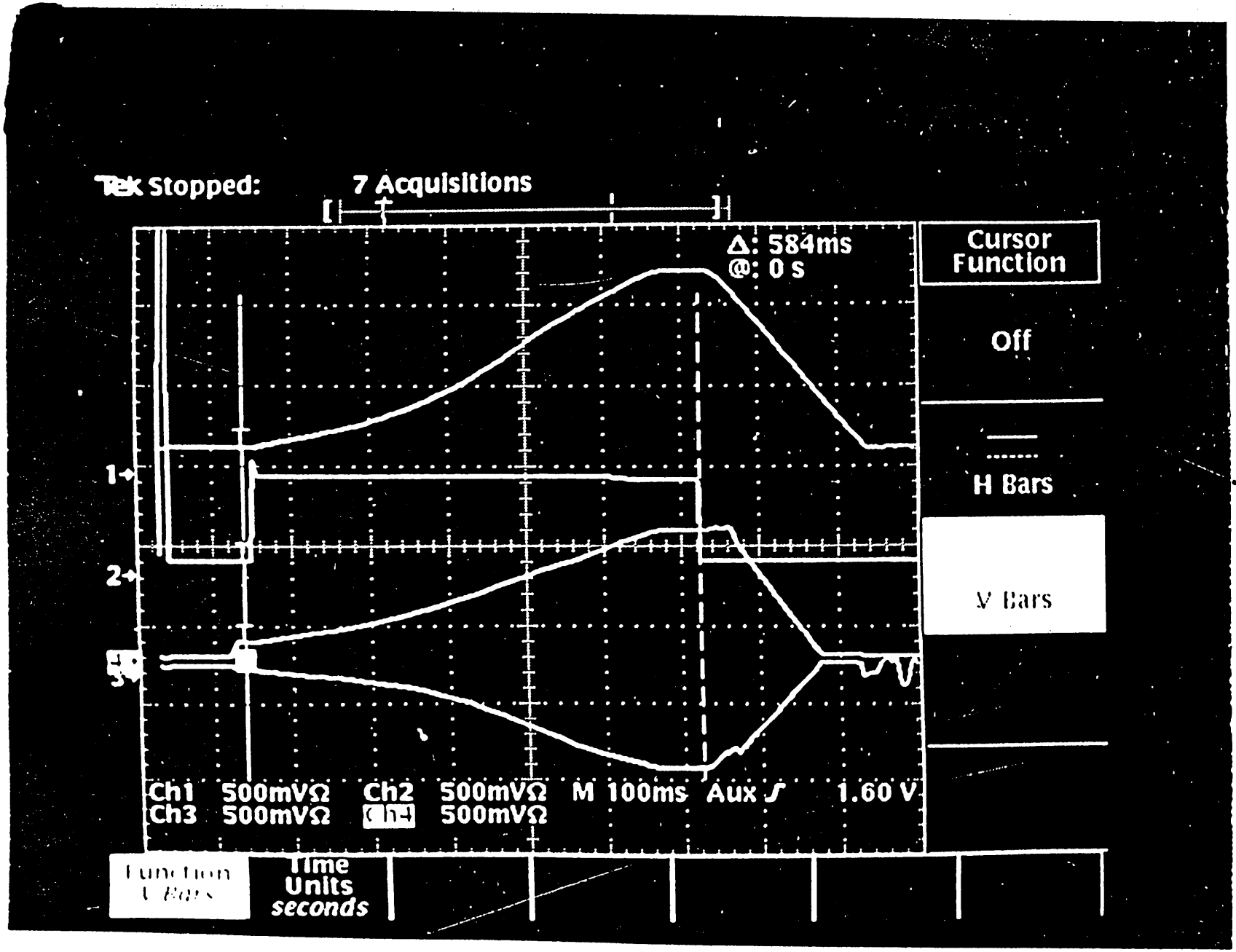
Laslett tune shift for LHC beam in PSB at 50 MeV. N=2E12 p, Bf = 0.55.

Emittances (physical) in 4*sigma.2/beta

$\varepsilon \rightarrow$	$4\sigma^2/\beta$	$(\beta\gamma)\sigma^2/\beta$ [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

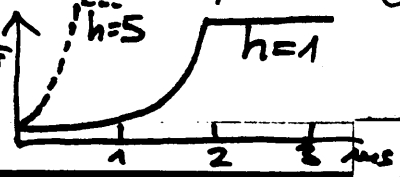
PSB MAIN MAGNET CYCLE FOR 1.4 GeV [0.125T → 0.868T]

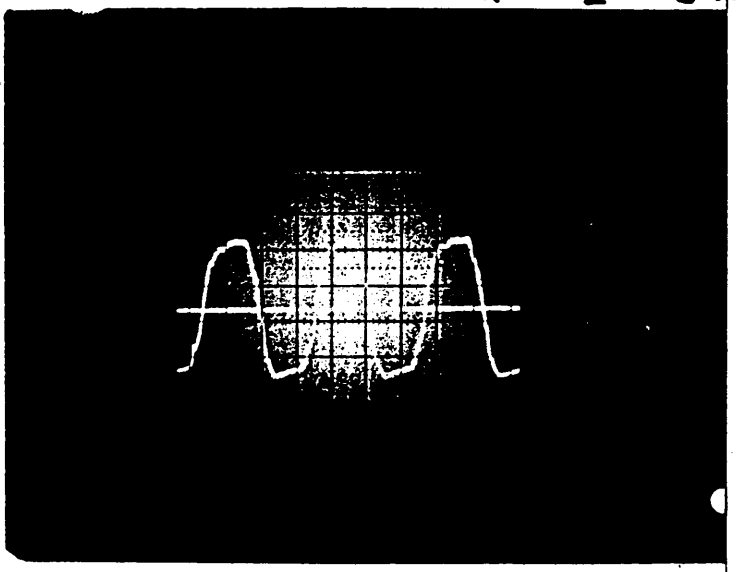
BEAM CURRENT TRANSFORMER RING 3

H1+H2 (L

Bunch Shapes @ Injection PSB 7/12/93

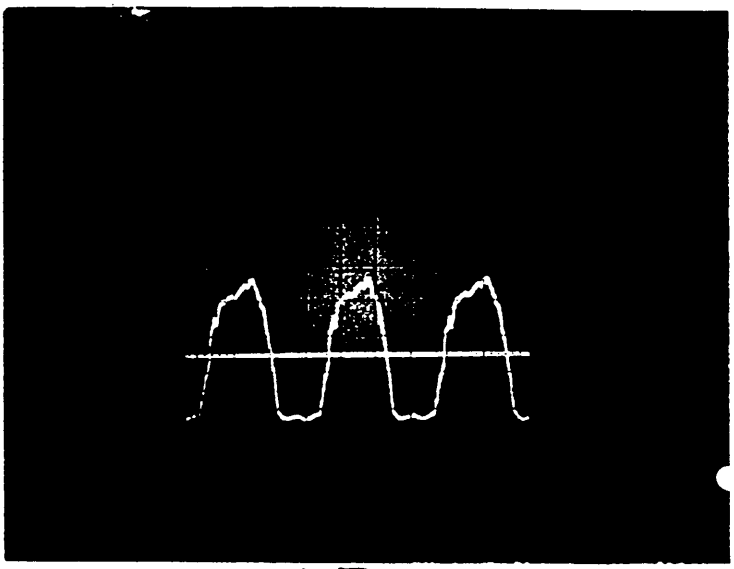
ADIABATIC CAPTURE





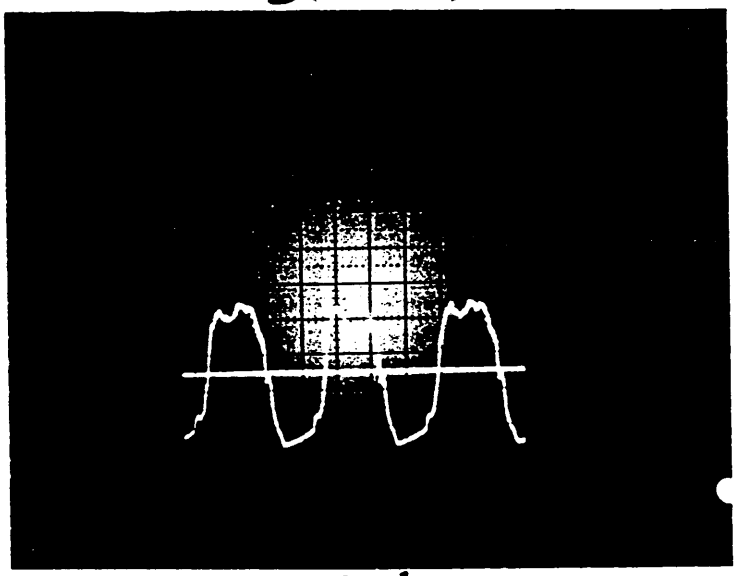
W10 + 3 ms

BF ÷ 0,52

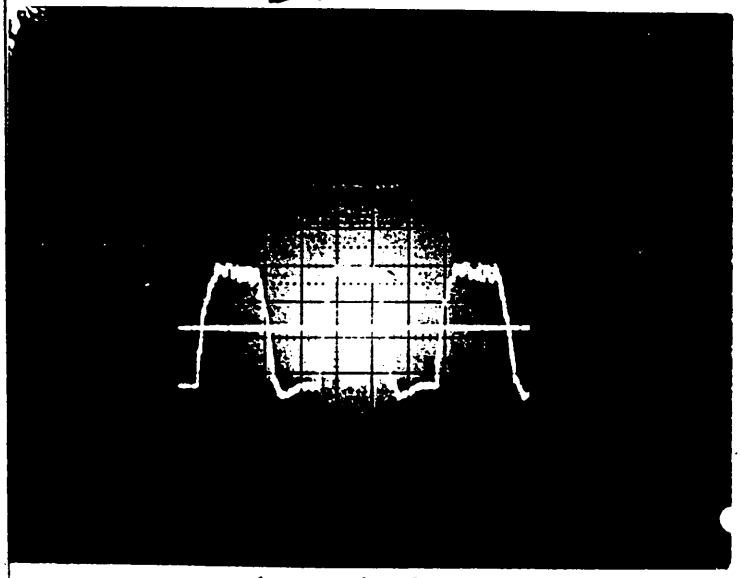


+ 3 ms

BF ÷ 0,56

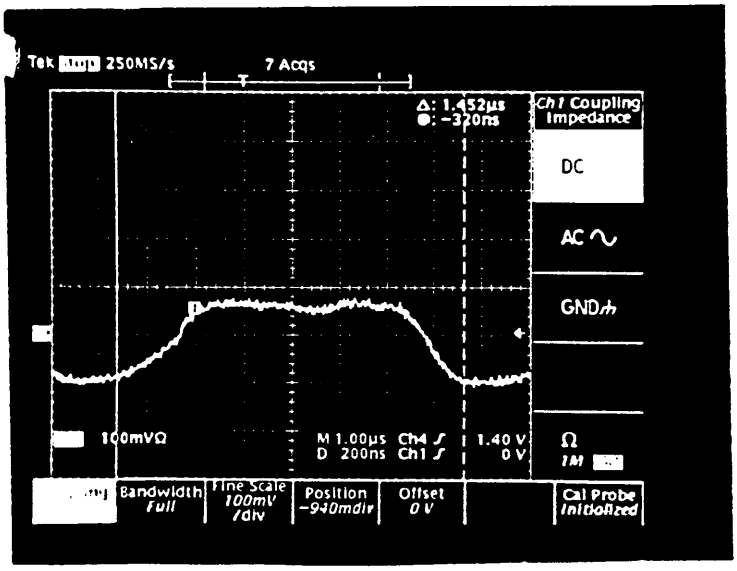


W10 + 4 ms

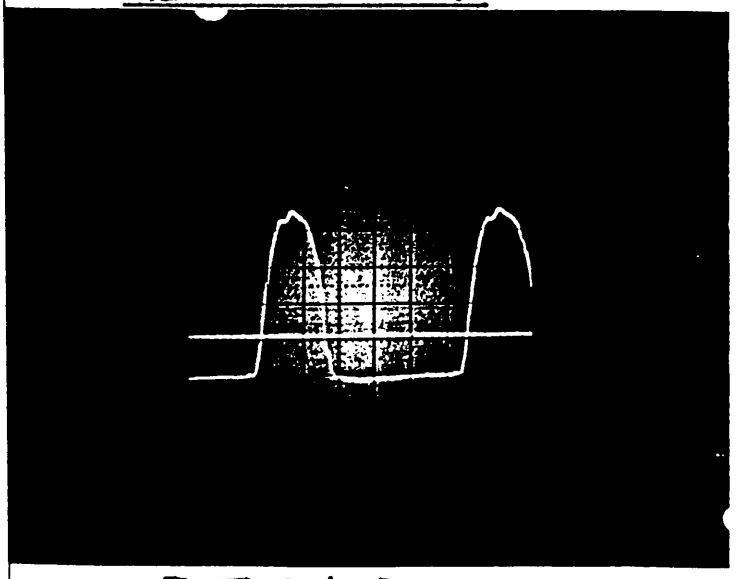


W10 + 3 ms

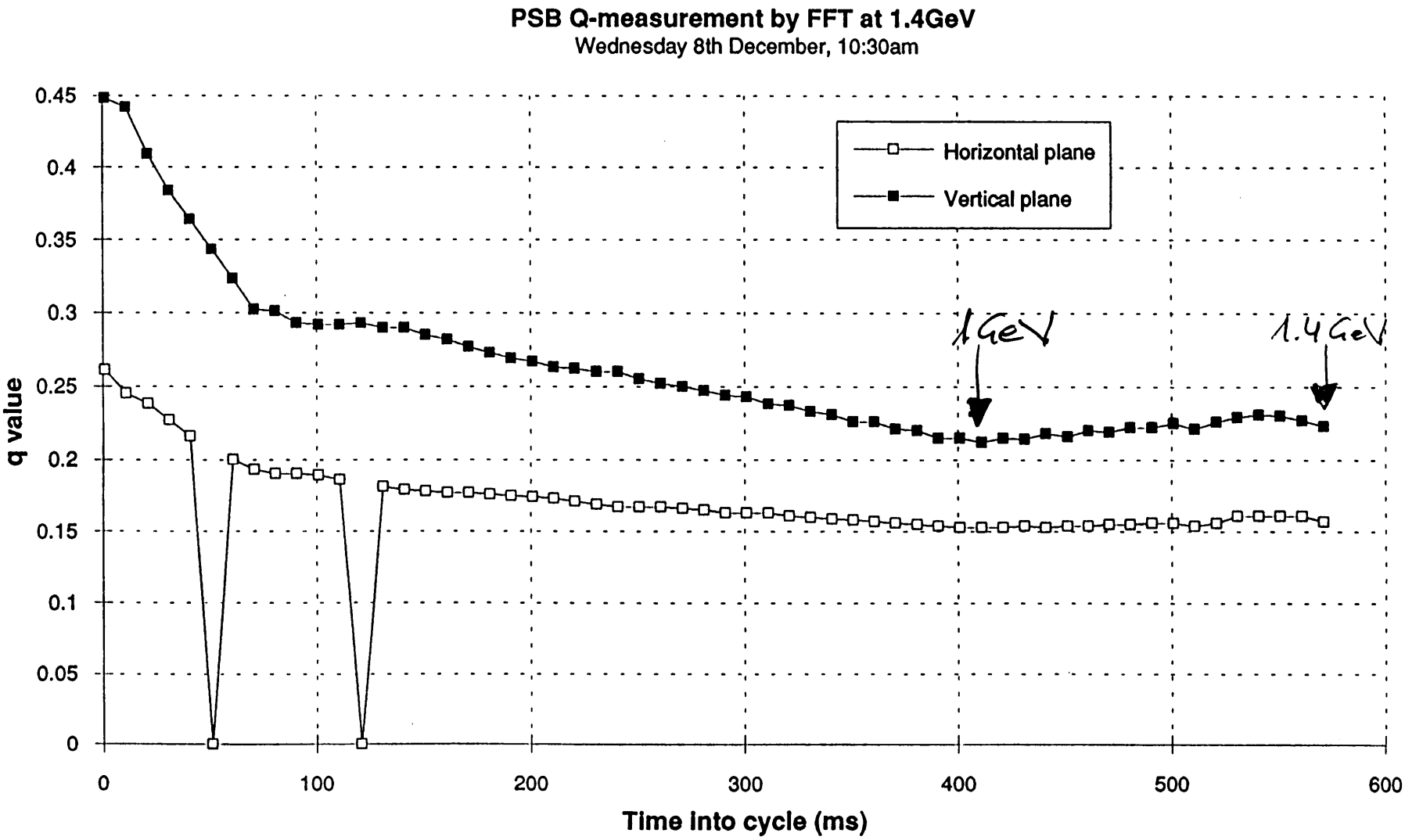
EJECTION



W10 + 1,1 ms

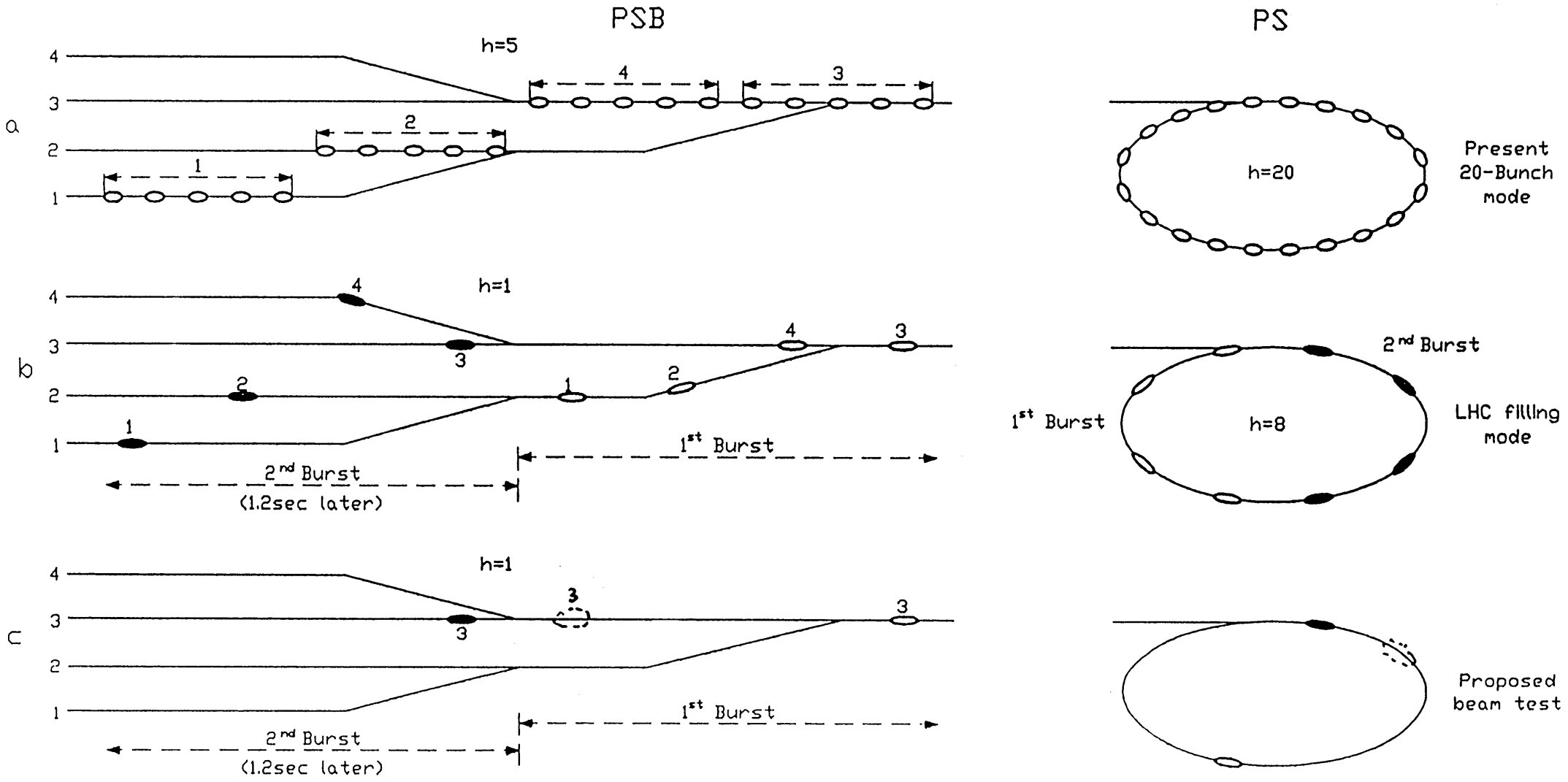


TEST + 33 ms

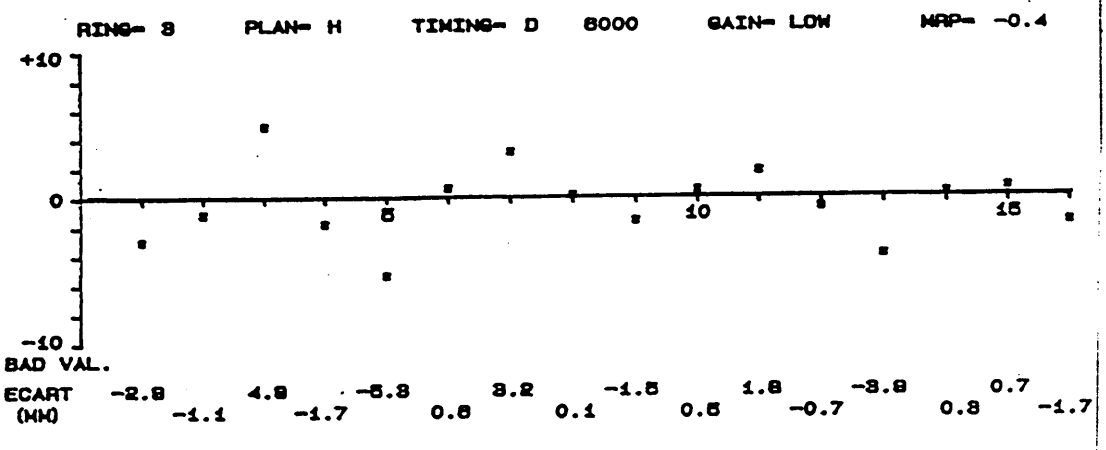

PSB Q-measurement by FFT at 1.4GeV
Wednesday 8th December, 10:30am
Horizontal plane
Vertical plane
1GeV
1.4GeV
q value
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
100
200
300
400
500
600
Time into cycle (ms)

KS

PSB-PS Recombination Schemes



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

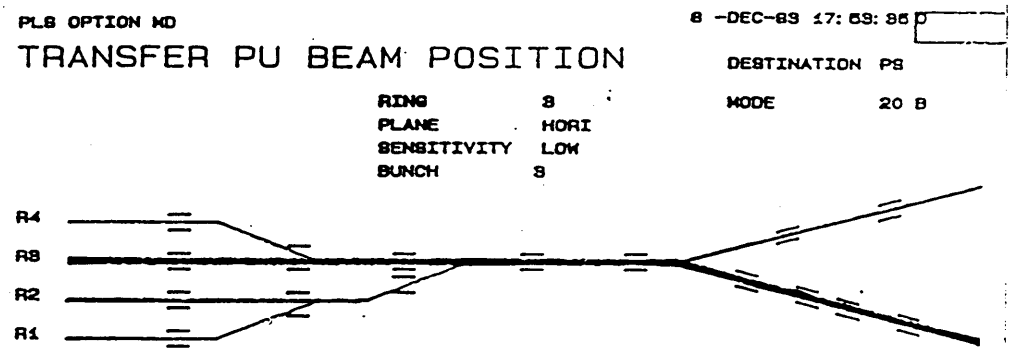


$f_{RF} = 1.7482$ MHz (NOMINAL)

$B = 8676$ G (NOMINAL)

$\overline{\Delta R} = -0.4$ mm !

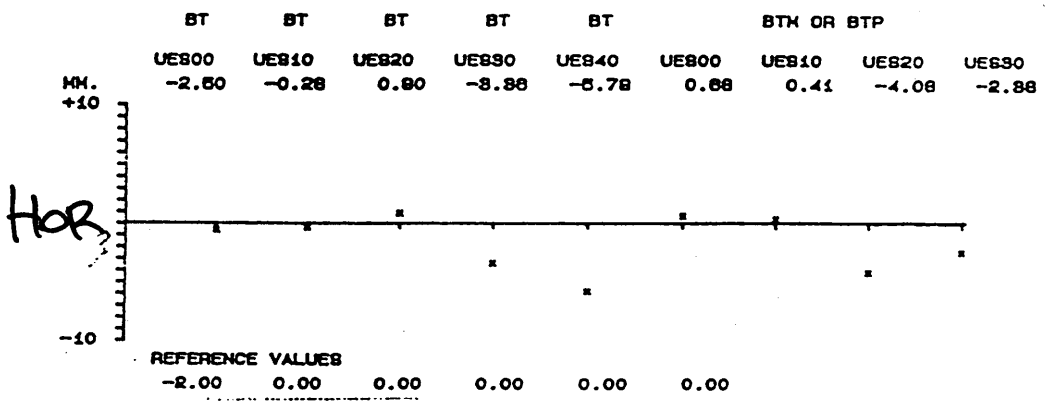
BRU OK WITH h=1



TRANSFER:

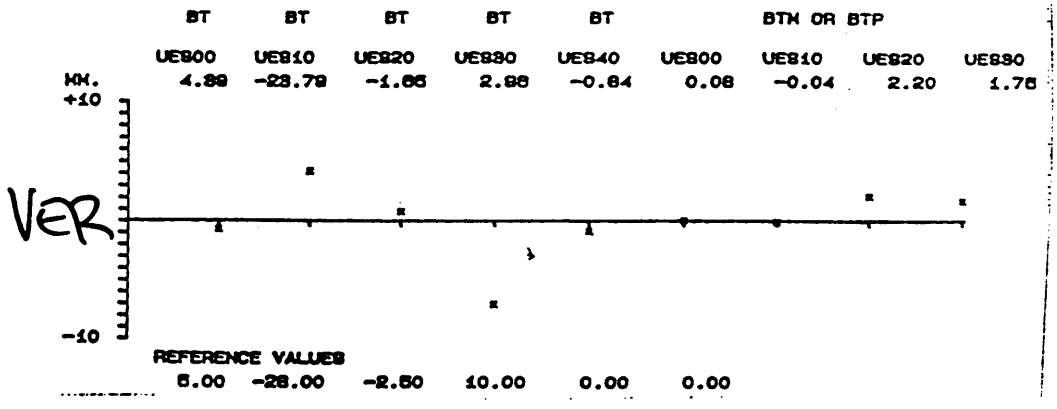
BEBSW INSUFFICIENT

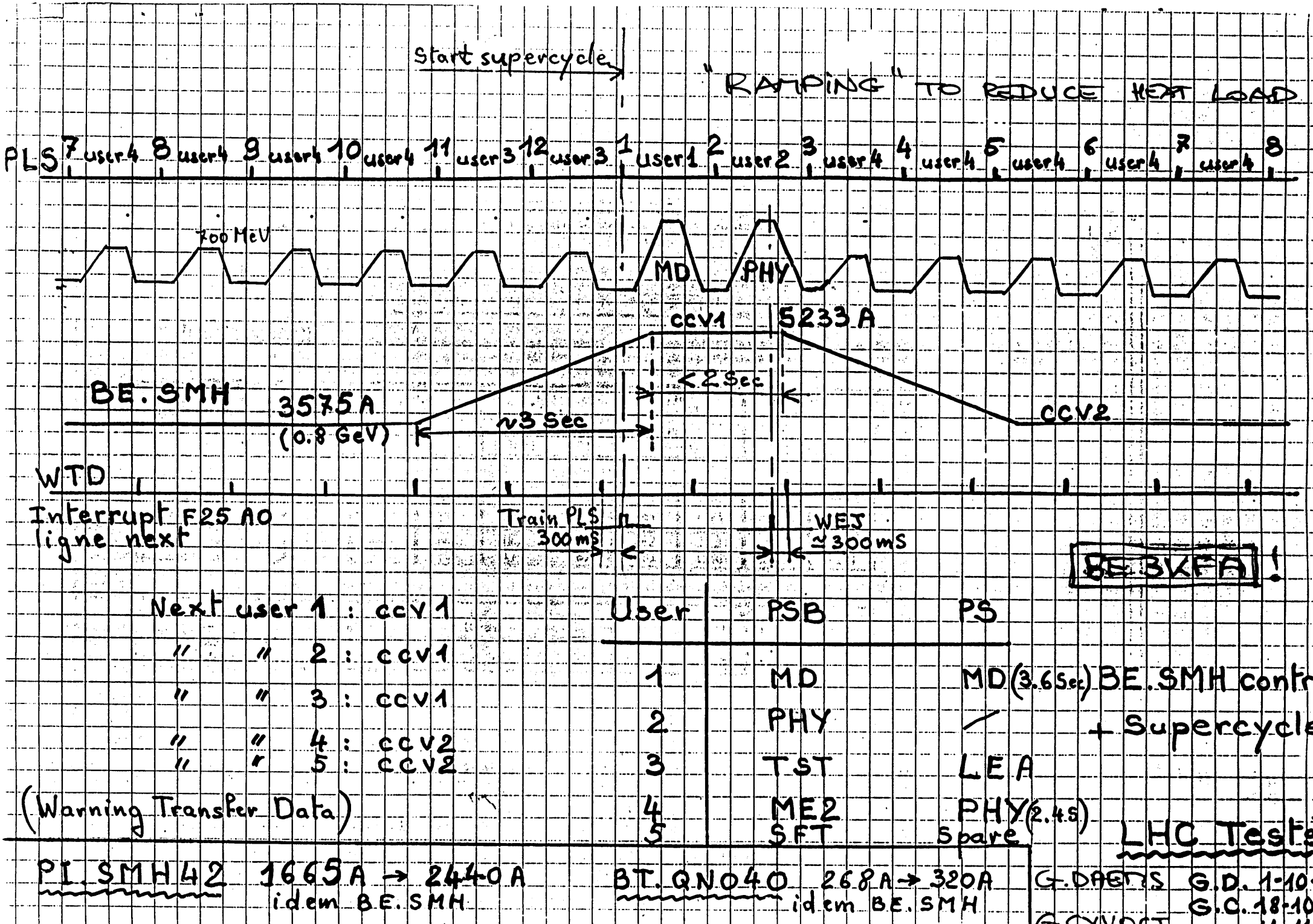
⇒ COMPENSATED BY "EJECTION CORRECTION DIPOLES"



VIRTUALLY SAME RING 3 TRAJ. AS WITH 1 GeV

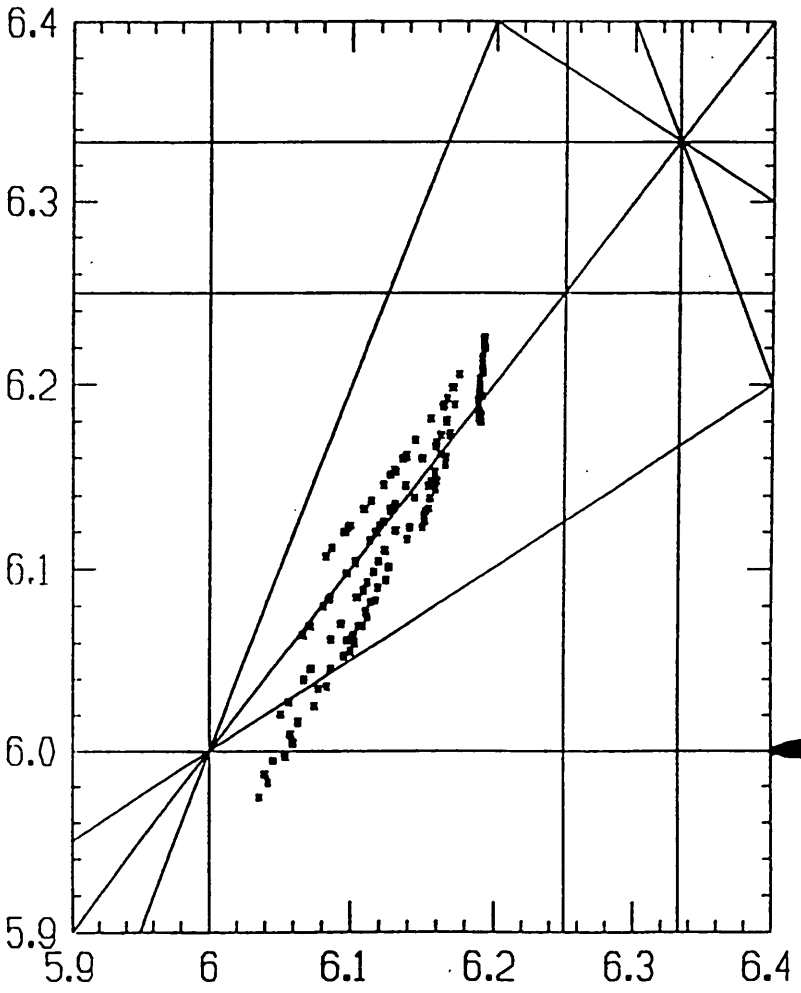
BTU OK WITH h=1




Start supercycle
"RAMPING" TO REDUCE HEAT LOAD
PLS 7 user4 8 user4 9 user4 10 user4 11 user3 12 user3 1 user1 2 user2 3 user4 4 user4 5 user4 6 user4 7 user4 8
700 MeV
MD
PHY
CCV1
5233 A
BE.SMH
3575 A
(0.8 GeV)
< 2 Sec
≈ 3 Sec
CCV2
WTD
Interrupt F25 A0
ligne next
Train PLS
300 ms
WEJ
≈ 300 ms
BE.BKFA !
Next user 1 : CCV1
" " 2 : CCV1
" " 3 : CCV1
" " 4 : CCV2
" " 5 : CCV2
(Warning Transfer Data)
User | PSB | PS
1 | MD | MD (3.6 Sec)
2 | PHY | /
3 | TST | LEA
4 | ME2 | PHY (2.4 S)
5 | SFT | Spare
BE.SMH contro
+ Supercycle
LHC Tests
PI.SMH42 1665 A → 2440 A
idem BE.SMH
BT.QNO40 268 A → 320 A
idem BE.SMH
G.DAENS G.D. 1-10-9
G.CYVOCT G.C. 18-10-1
11-11-9

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

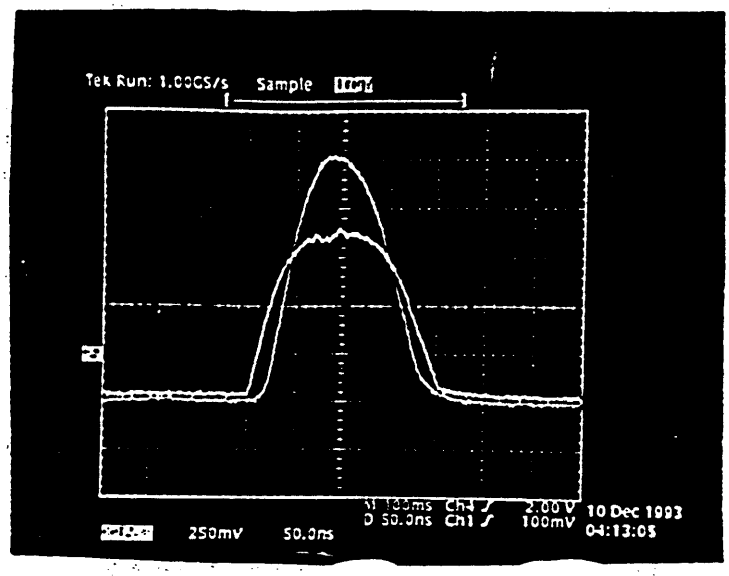
1.4 GeV front porch
1.4 10^{13} protons in 8 bunches
$\varepsilon_x^* / \varepsilon_y^* = 3.5/1.75$ μm
$\Delta p/p = 2.5\ 10^{-3}$ (2σ)
bunch length 190 ns ⇒ 220 ns WITH CONTROLLED BUNCH BLOW-UP IN PSB !



CORRECTION OF $2Q_y = 12$! @ 1 GeV

FOR SAME INTENSITY
NORMALISED EMITTANCE
BUNCH LENGTH

ΔQ_{inc} [1.4 GeV] $\approx 0.66\, \Delta Q_{inc}$ [1.0 GeV]

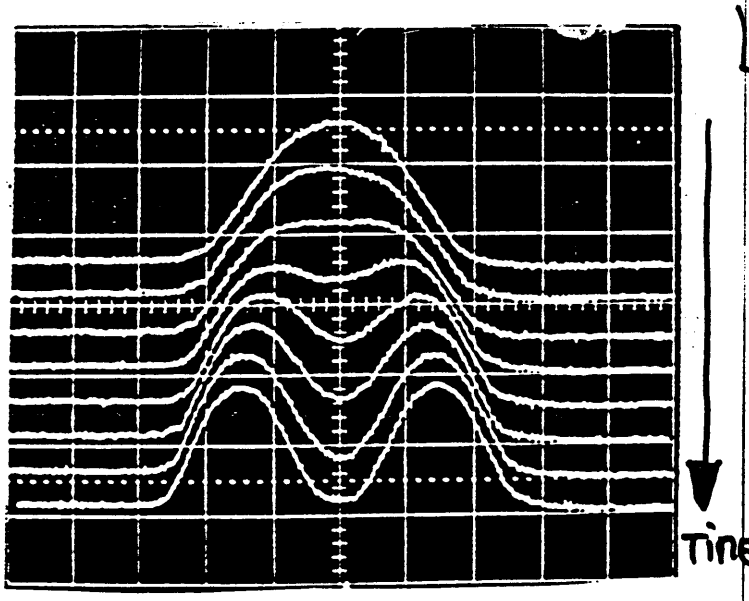


CONTROLLED BUNCH BLOW-UP

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

UPPER TRACE:
BUNCH BEFORE BLOW-UP

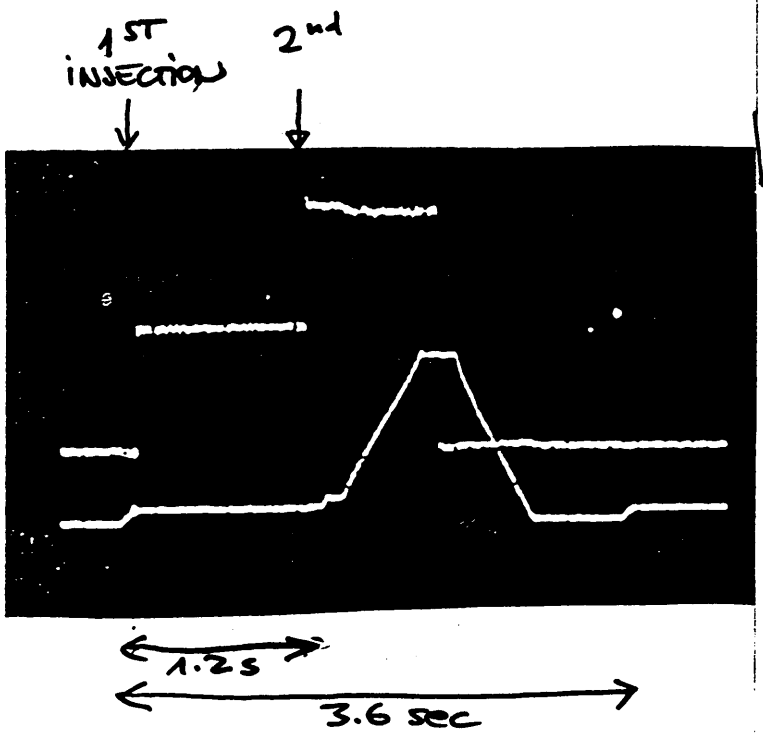
LOWER TRACE:
BUNCH AFTER BLOW-UP



BUNCH SPLITTING h=8⇒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 ms)

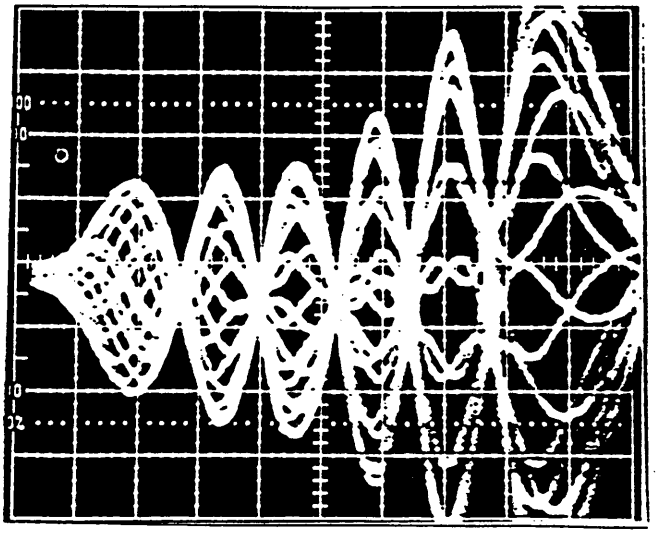


DOUBLE-BATCH FILLING OF PS

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 PLATEAU

HEAD-TAIL HORIZONTAL INSTABILITIES ON PS 1GeV PLATEAU



a)

PS 1 GeV
INJECTION PLATEAU

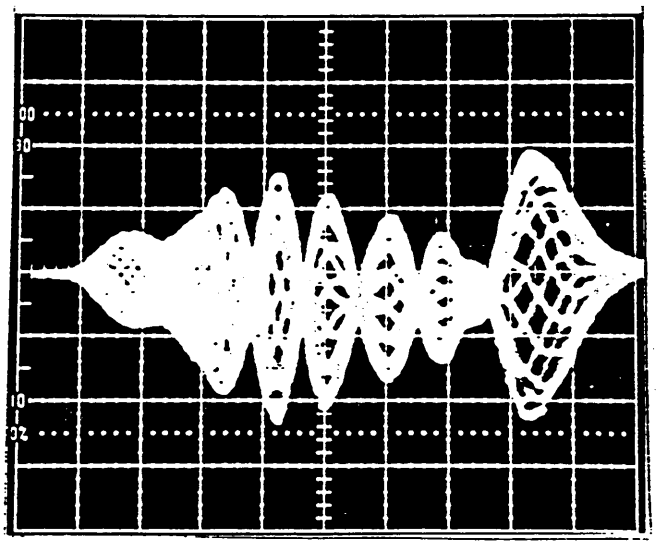
1 BUNCH CIRCULATING

$T_b \approx 200$ ns

$h = 8$

$N_b = 2.10^{12}$ p/bunch

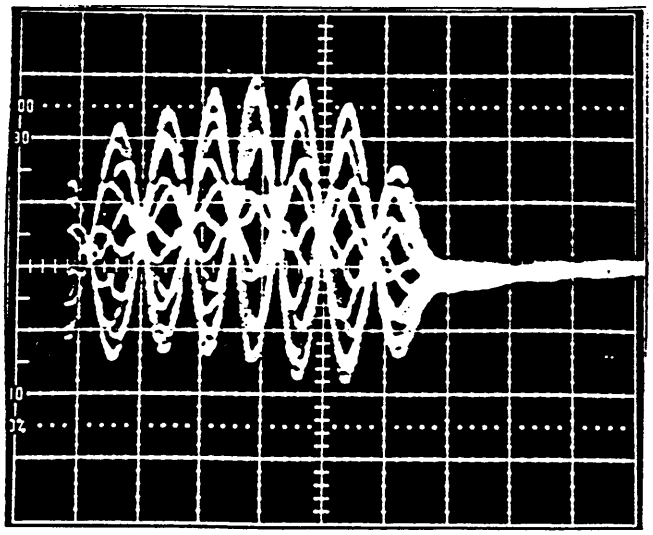
$\varepsilon_x^* \sim \varepsilon_y^* \sim 2.5 \mu m$



b)

CURE:
BETTER CONTROL
OF $\xi_{h,v}$ ON
INJECTION PLATEAU
WITH PFW

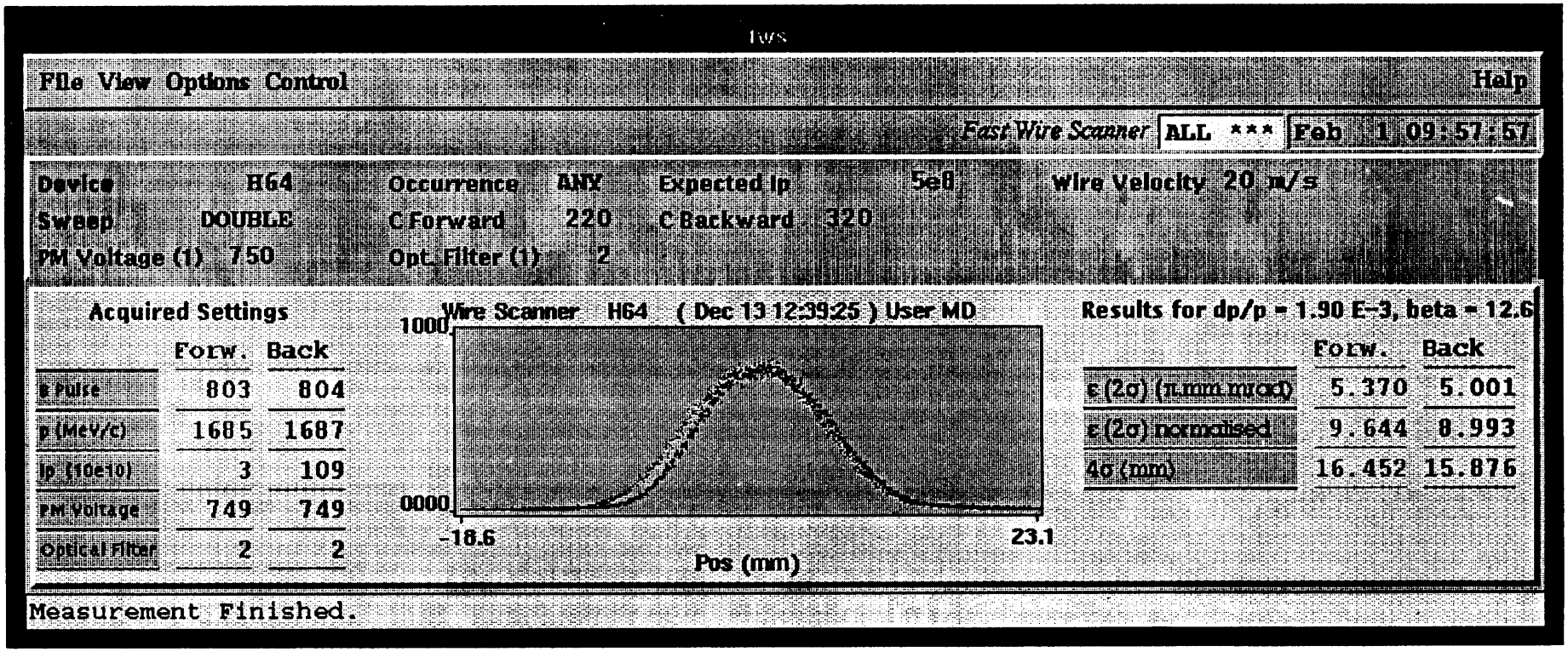
BEAM PROVED STABLE
AT 1.4 GeV
(ALSO MORE FAVOURABLE
"ON PAPER")

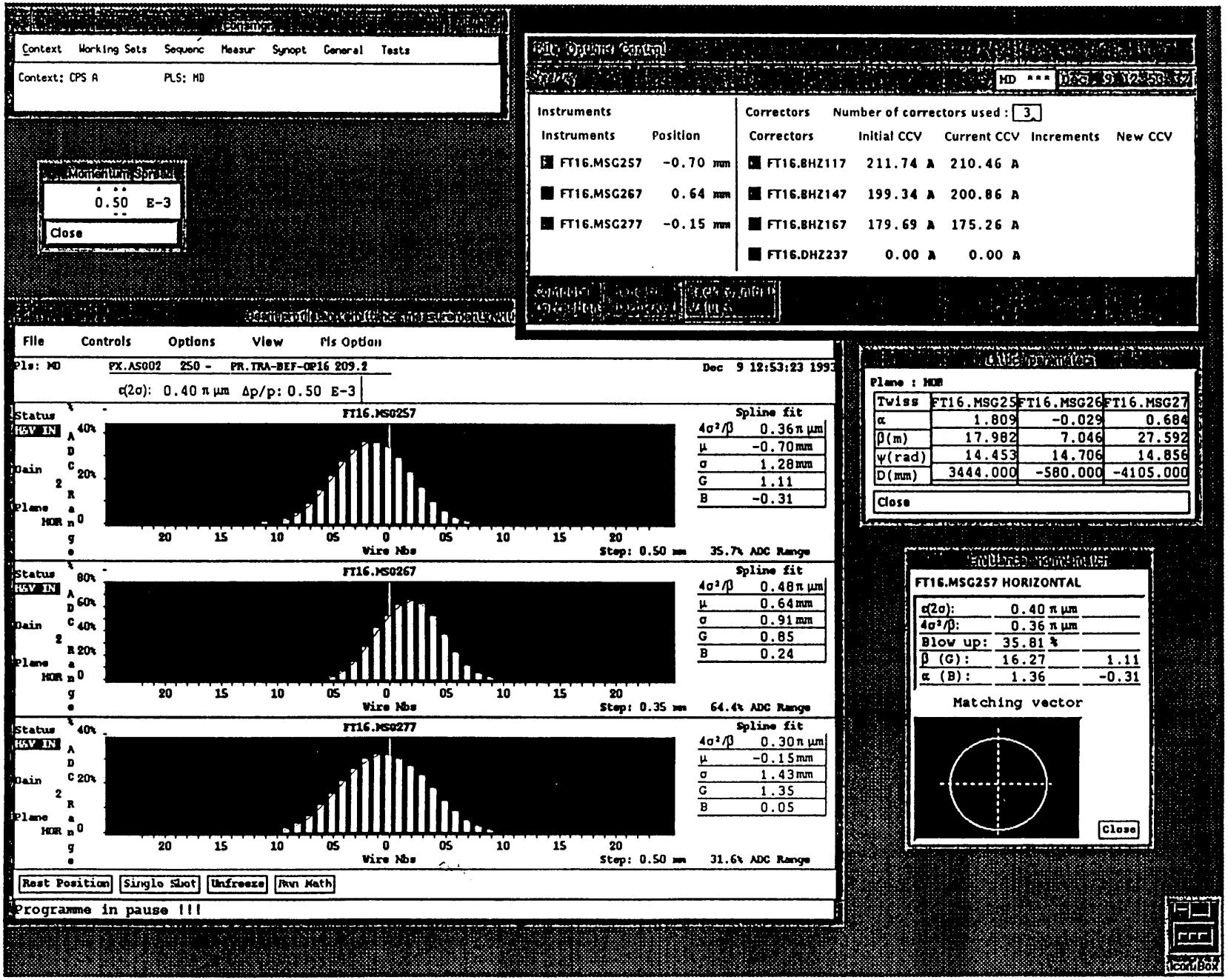


c)

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]



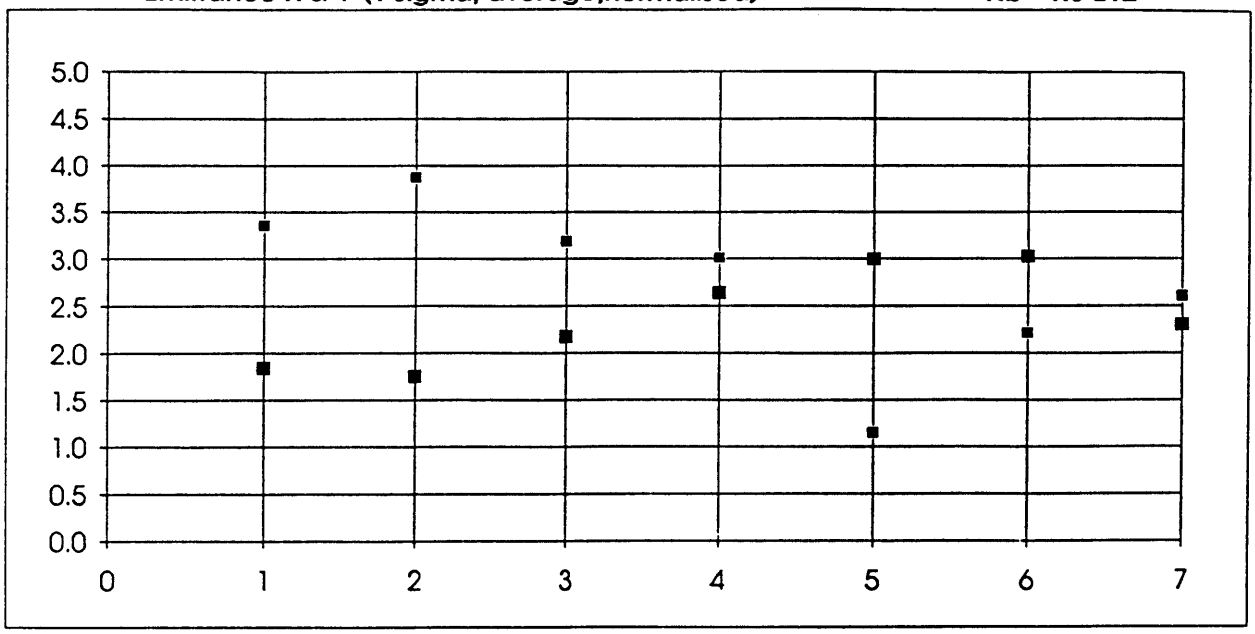


TT2.
HOR PLANE

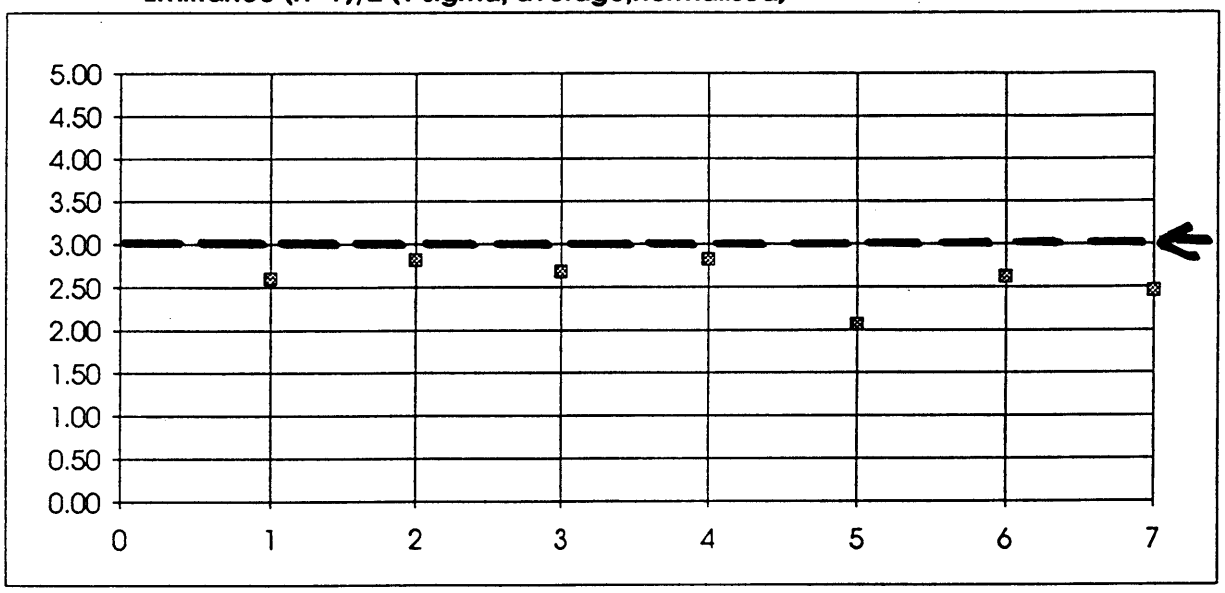
2.10^{12} p/BUNCH
(MORE THAN
"BEAM-BEAM
LIMIT" LHC)

$\varepsilon^*_{rms} =$
$= (\beta\gamma) \cdot \frac{\varepsilon(2\sigma)}{4}$
$= 2.8 \mu m$

Emittance H & V (1 sigma, average,normalised) Nb= 1.8 E12 "Beam-Beam Limit"

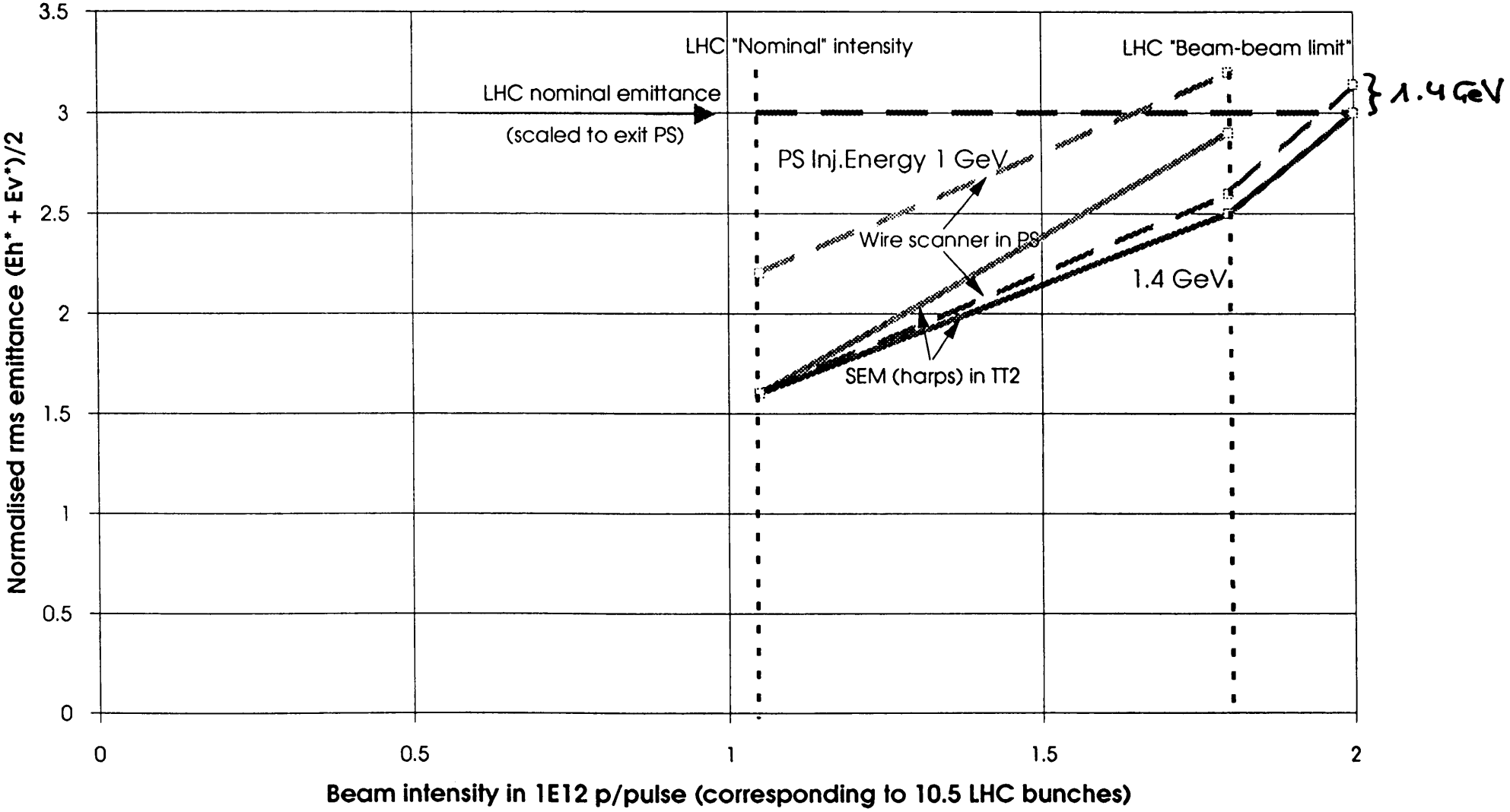


Emittance (H+V)/2 (1 sigma, average,normalised)



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)



COMMENTS

- BUNCH LENGTH AT INJECTION PS

T [GeV]	bunch length [ns]	kicker rise time [us]
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 ⇒ TRANSVERSE INSTABILITIES
  - DEBUNCHING – RECAPTURE AT 26 GeV/c ⇒ BLOW-UP?

  ⇒ 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: 2.10^{12} p/BUNCH

  ISOLDE: 8.10^{12} p/BUNCH !

CONCLUSIONS (SUBJECTIVE + PRELIMINARY)

- PSB CAN BE MADE WORKING @ 1.4 GeV
  NO SATURATION EFFETS IN MAIN MAGNETS

- PSB CAN RUN WITH ONE BUNCH/RING ($h=1$)
  UP TO 2.10^{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 1.4GeV, LEAVING SOME MARGIN.

- "NOMINAL" LHC BEAM FEASIBLE WITH PSB@1GeV, (LEAVING A MARGIN), THANKS TO
  - CONTROLLED BUNCH BLOW-UP ON PSB FLATTOP;
  - 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 D

** " 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
$h=1+2$ $h=8$

* "INITIAL BEAM" (PSB + PS ?) D ?
$I/_{10}$ $\varepsilon^{*}_{n,y}/5$

* TRANSV. INSTABILITIES (PS @ 1 GeV)
CHANGE ξ WITH PFW's

* ADIABATIC DEBUNCHING (PS @ 26 GeV/c)
$h=16$ or $h=20$

* 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)
$2Q_x = 12$
$2Q_y = 12$ ...

- **OTHERS** (see future PPC's)

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

*** $\frac{D}{D_t}$ SIMULATION (PSB & PS) D

S.O. OF BEAM CONTROLS, MAGN. CYCLES, EXTRACTIONS, ETC.