EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN - PS DIVISION

PS/ PA/ Note 95-09 (PPC)

Minutes of the PPC Meeting held on 19.5.1995

D. Manglunki

Geneva, Switzerland
29 May 1995

PS/PA Note 95-09 (PPC)
May 29th, 1995

Minutes of the PPC meeting held on May 19th, 1995

Present :

S. Baird, J. Belleman, R. Cappi (Chairman), F. Caspers, M. Chanel, J. Clendenin, G. Daems, D. Dekkers, D. Dumollard, T. Eriksson, R. Garoby, M. Giovanozzi, J. Gonzalez, J. Gruber, H. Haseroth, C. Hill, H. Koziol, M. Lindroos, D. Manglunki (Secretary), M. Martini, H. Mulder, F. Pedersen, J.P. Riunaud, K. Schindl, H. Schönauer, D. Simon, E. Schulte, E. Tanke, G. Tranquille, M. Vretenar, E. Wildner.

1. Introduction (R. Cappi)

· Welcome to two new PPC members : Mats Lindroos is a new PSB supervisor recently hired in the OP group ; James Clendenin is on leave from SLAC and is replacing Luigi Rinolfi who is on a sabbatical leave, as an LPI supervisor.

· The MD session which was foreseen for the 5th of July is displaced to the 12th.

· The Linac 3 should deliver Pb ions to LEAR (MD) from June 29th to July 6th and to the PSB before July 12th ; the big PS/SPS setting-up MD session will take place on September 11th, but the PS will try to send Pb ions to the SPS already in August.

· After the machine summaries, E.Schulte will present the new CODD. Now is the right time to discuss it, before all options are iced.

2. Machine summaries (see attached copies of transparencies)

a. LINACs (M. Vretenar)

· Linac 2 has been successfully realigned.

· Reliable operation of LBS spectrometer (automatic cycling).

· No instability of trajectory or intensity detected so far.

· Linac 3 : the Pb ion source current has been brought from 80 to 120 μA; and from 60 to 90 μA at the end of the Linac 3.

· No problem foreseen for delivering Pb ions to PSB in July.

b. PSB (H. Schönauer)

· Automatic Beam Steering gives about the same quality as a manual optimisation, but the time it takes is reduced by a factor 50.

· Tracking precision tests on QF-QD power supplies allowed to reduce it from 8 to 4×10^{-3} by reinjecting a part of the main power supply current in the QF-QD power supply. This loop is staying in operation and the tune calculation now gives correct results.

· Observation and damping of quadrupolar and octupolar modes using synchronous detection : when 2nd harmonic voltage exceeds 50%, the method of peak detection/feeding does not work. Decapolar mode (m=5) can be observed strongly on ring 3 at high intensity.

c. LPI (J. Clendenin)

· Irradiation studies at 308MeV for LHC.

· Remapping the energy map of LIL-V/W.

· Recycling of EPA magnets; reference values are now restored.

· Exploration of tune space diagram.

· Distorsion of transverse focusing lead to a lower e+ accumulation rate. It is due to be back to normal soon, after optimisation.

d. AAC (T. Eriksson)

· The settting-up has been quite straightforward, but the Lithium lens broke down. It has been replaced with a 400kA magnetic horn.

· The production rate suffers from the "new" production beam. (Note : on May 18th, was held a discussion between the PS group leaders about this issue. The outcome is that the hardware will be reassembled in July, and setup with beam will take place in October/November, to have the 4-ring production beam ready for the December run, when LEAR needs it most).

· The intrinsic AAC stacking performance is as good as last year.

· The longitudinal emittance of the stack is smaller, thanks to improvements in the stochastic cooling systems.

· One stack has been lost because of a water leak.

· The next MDs will be devoted to further improvements on the cooling systems.

e. LEAR (M. Chanel)

· Many measurements and beam studies on the Electron cooling : instabilities, ion shaking, electron beam space-charge and potential distribution, cooling time measurements, recombination, emittance vs intensity, ...

· Calibration of the Beam profile monitor vs H0 beam.

· Studies of the "2 Qv = 5" stopband.

· Betatron phase advance measurements

· The "200 MeV/c ghost" could not be observed with protons. Its influence on the antiproton beam seems to occurr less frequently

· A feedback system on the extracted beam intensity has been put into operation.

f. PS (R .Cappi)

· Dynamic aperture measurements at 26 GeV/c for the LHC beam. The large dp/p ($\approx\pm 3\times10^{-3}$) LHC beam is simulated by sampling the momentum space with a small dp/p ($\approx\pm 0.3\times10^{-3}$) beam. The PS can extract a beam of dp/p $\approx\pm 4\times10^{-3}$ with less than 1% losses.

No transverse blow-up was observed, but more time is needed to study the PS-TT2-TT10-SPS matching.

· Dispersion measurements in SS31 on SFTPRO indicate a good agreement with theory. Those measurements could not be repeated on the AA beam due to lack of time.

· There seems to be some times a vertical kick in the SE61 beam trajectory, under investigation, but the PFWs are not the culprits.

3. The New CODD (E. Schulte)

On top of the present capabilities:

· We want to be able to measure the trajectory of each of the eight bunches of the same beam we will send to LHC.

· For dynamic aperture measurements, we also desire to measure (x, x') and (y,y') for up to 100,000 turns.

· The new device should be able to work on any harmonic number.

· Would it be possible to measure the 84 LHC bunches close to extraction? To be checked.

LINAC 2 SUMMARY

1. Re-alignment of source / low energy beam transport with respect to RFQ successful (better dynamics, stable RFQ, high current),

but:

due to the problematic start-up
(the 1 week time foreseen for MD studies at the start-up has been lost in hardware and software debugging...),
the analysis of beam trajectory in the linac remains to be done

2. LBS Spectrometer

- new coil, improved power supply: can be used reliably for protons and ions
- automatic cycling done when calling the LBS program: precise reference energy

3. Since the start-up, *no complains* from PSB of instability of the linac beam (...)

LINAC 3 SUMMARY

1. Source studies in March/April :

   (MD Note by C.Hill)

   ☆ opening of the extraction gap ⇨ stable Pb current of *120 μA* (80/90 μA in 1994)
   ☆ test of support gases different from Oxygen ⇨ no improvements
   ☆ test of other ions (Argon, Krypton). ⇨ 15 kV minimum source extraction voltage

2. Linac 3 start-up from May 9th, priorities:

   ☆ study the transport of the higher source current ⇨ *90 μA* at the end of the linac before stripping (60 μA in 1994)
   still to analyze energy and optimise optics

   ☆ analyse the behaviour of IH tanks after re-alignment: interrupted (15.5) by series of problems (vacuum, RF)

10.05.95

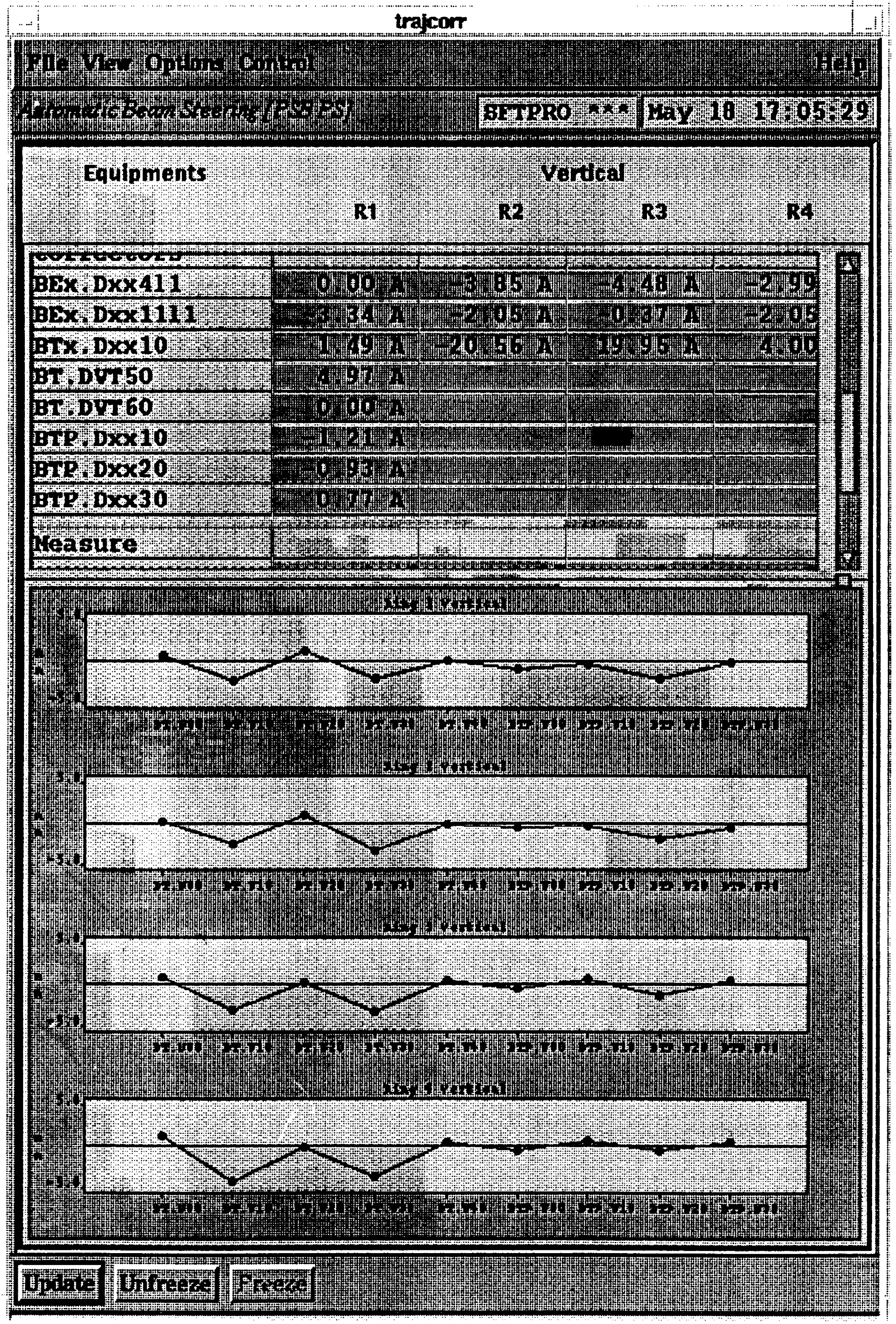
PROGRAM of PSB-PS MD on 15&16.05.95

Monday 15.5.95

14.00-18.00	PSB ME: ejection tests with ABS. In the PS: MDSPS @ 13GeV/c, cycle H, beam on int. dump at injection energy.	B. Autin G.H. Hemelsoet E. Wildner
18.00-00.00	PSB ME: observation and damping of quadr. & octup. modes using synchronous detection and >50% of 2nd. harm. voltage. No beam in the PS.	F. Blas F. Pedersen G. Schneider

Tuesday 16.5.95

03.00-07.00	PSB ME: tracking precision tests on QF-QD power supplies. No beam.	H. Fiebiger F. Gendre T. Salvermoser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File View Options Control Help
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SFTPRO ***
May 18 17:05:29
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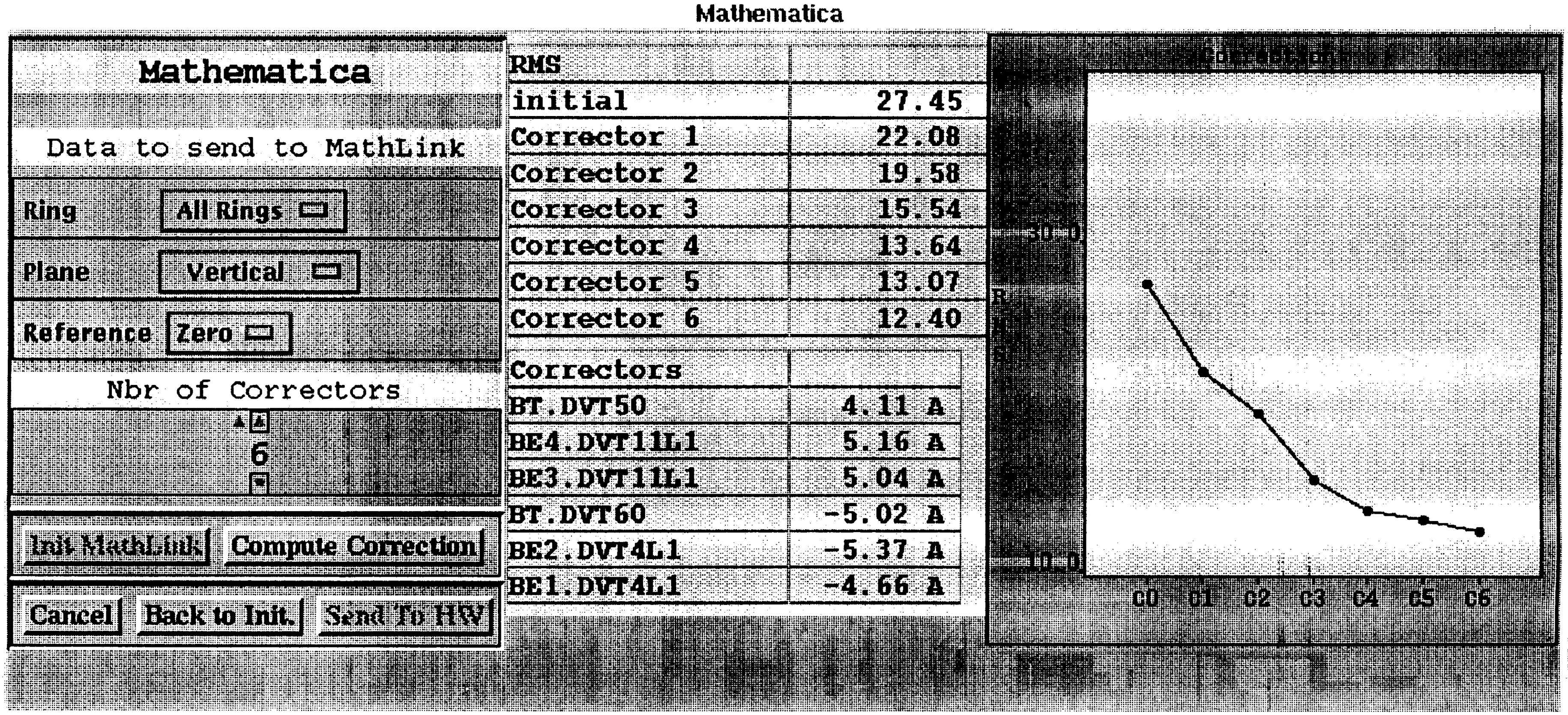
Vertical
R1 R2 R3 R4
BEx.Dxx411 0.00 A -3.85 A -4.48 A -2.99
BEx.Dxx1111 3.34 A -2.05 A -0.37 A -2.05
BTx.Dxx10 1.49 A -20.56 A 19.95 A 4.00
BT.DVT50 4.97 A
BT.DVT60 0.00 A
BTP.Dxx10 -1.21 A
BTP.Dxx20 0.93 A
BTP.Dxx30 0.77 A
Measure
Update
Unfreeze
Freeze

1


Mathematica
Mathematica
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Ring All Rings
Plane Vertical
Reference Zero
Nbr of Correctors
6
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Compute Correction
Cancel
Back to Init.
Send To HW
RMS
initial 27.45
Corrector 1 22.08
Corrector 2 19.58
Corrector 3 15.54
Corrector 4 13.64
Corrector 5 13.07
Corrector 6 12.40
Correctors
BT.DVT50 4.11 A
BE4.DVT11L1 5.16 A
BE3.DVT11L1 5.04 A
BT.DVT60 -5.02 A
BE2.DVT4L1 -5.37 A
BE1.DVT4L1 -4.66 A
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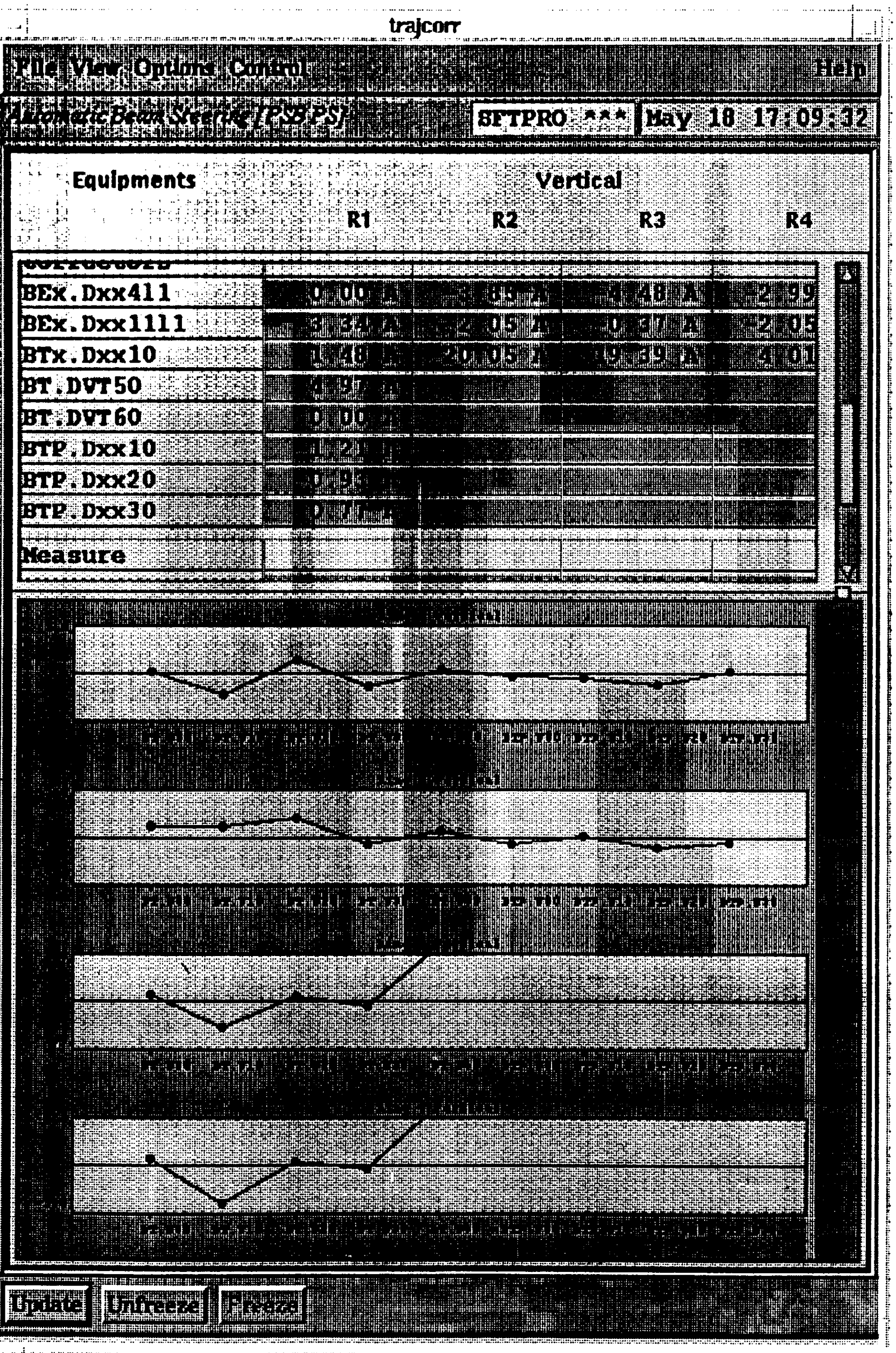
C6



trajcorr
File View Options Control
Help
Automatic Beam Steering [PSB PS]
SFTPRO ***
May 18 17:09:32
Equipments
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R2
R3
R4
BEx.Dxx411
BEx.Dxx1111
BTx.Dxx10
BT.DVT50
BT.DVT60
BTP.Dxx10
BTP.Dxx20
BTP.Dxx30
Measure
Update
Unfreeze
Freeze

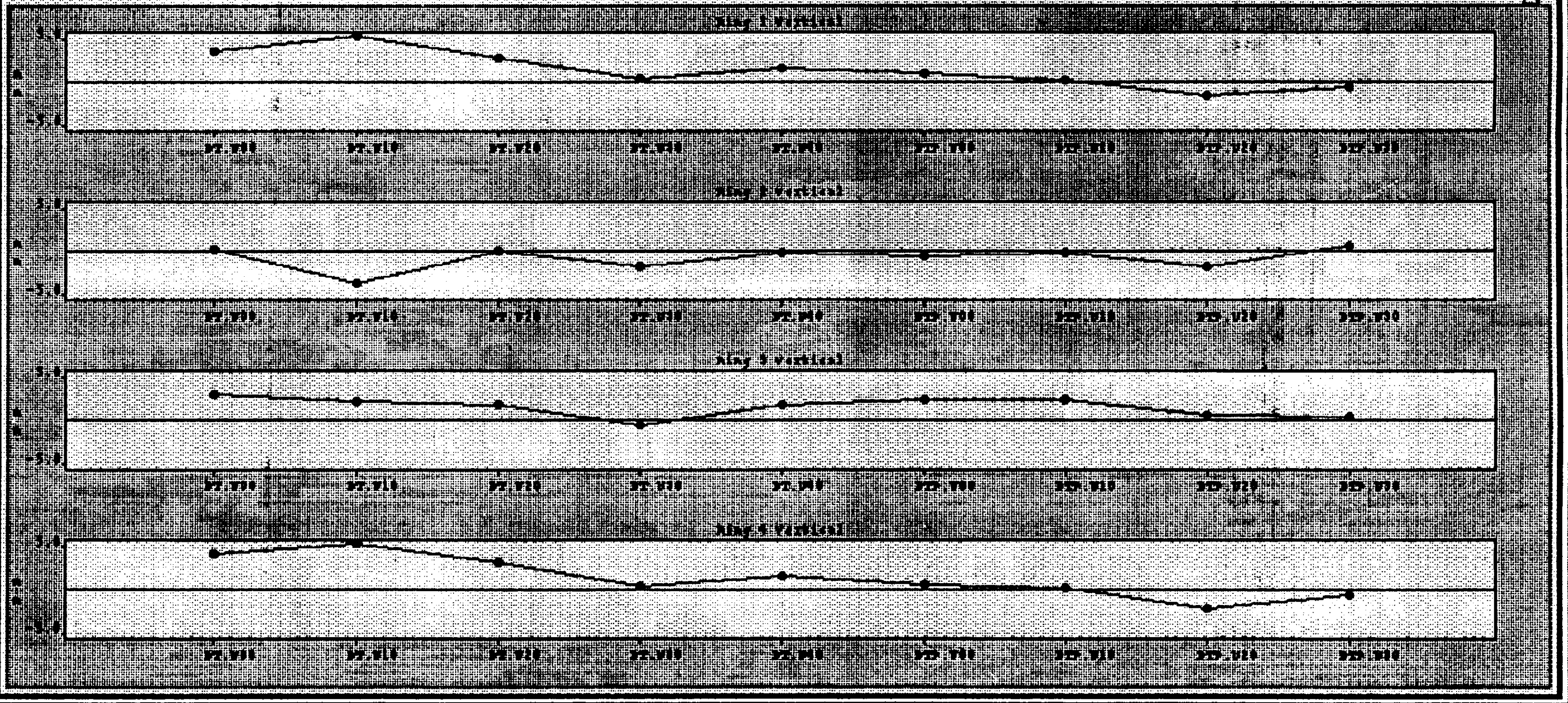
3

trajcorr

File View Options Control — Help

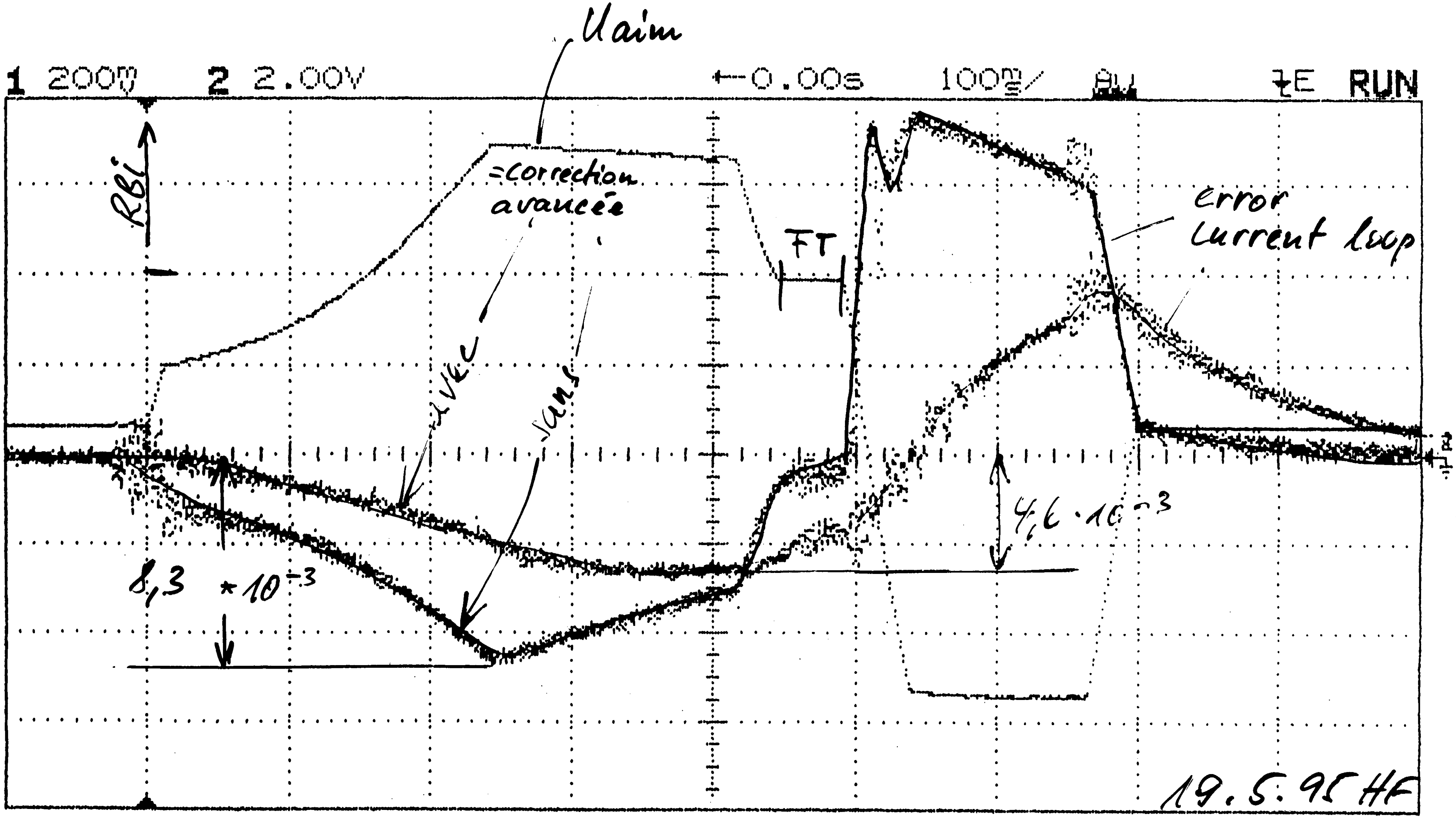
Automatic Beam Steering [PSB PS] — SFTPRO *** — May 18 17:40:58

Equipments	Vertical R1	R2	R3	R4
BT.U00	3.57 mm	0.14 mm	3.03 mm	4.10 mm
BT.U10	5.27 mm	-3.73 mm	2.14 mm	5.27 mm
BT.U20	2.78 mm	0.09 mm	1.78 mm	3.14 mm
BT.U30	0.43 mm	-1.78 mm	-0.54 mm	0.43 mm
BT.U40	1.53 mm	-0.18 mm	1.83 mm	1.53 mm
BTP.U00	0.96 mm	-0.67 mm	2.27 mm	0.66 mm
BTP.U10	0.29 mm	-0.10 mm	2.38 mm	0.29 mm
BTP.U20	-1.66 mm	-1.75 mm	0.61 mm	-2.23 mm
BTP.U30	-0.59 mm	0.59 mm	0.41 mm	-0.59 mm
Correctors				



Update Unfreeze Freeze

BR. QFO



Uaim
1 200mV 2 2.00V ←0.00s 100ms/ Av ⊥E RUN
RBi
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avec
sans
FT
error current loop
8,3 * 10⁻³
4,6 · 10⁻³
19.5.95 HF

19 Mai '95

LPI MD Report

1. 308 MeV running for LHC vacuum studies at LHe temperature.

2. Decrease power in Modulators 25, 31, 35 from ~15.4 to ~14.4 MW to make e^- beam at end of LIL-W ~505 MeV. Increase power in modulator 27 (used for e^+ only) fm ~17.5 MW to ~18.2 MW so e^+ beam also ~505 MeV.

3. Degauss EPA magnets. As result, find we no longer need to tweak quads.

4. Explore usable tune space for EPA for e^+ and e^-, with and without ion clearing voltage on. Set final tune in center of this area.

5. Final settings leave e^+ accumulation rate in EPA a little low, probably due to poor focusing in injection line. This is being improved.

JEC / JPP

AAC STACKING -95

- 400 kA Magnetic Horn
- Reduced production beam
- 2/6 PS-cycles

GENERAL AAC PERFORMANCE CHECK (REMOVED POOR SHOTS)

1995-05-18-12:09:51 STACK 4.12E11

	Q AT PEAK	95% EMITTANCE, p mm mrad AT PEAK	95% EMITTANCE, p mm mrad AVERAGE
HOR.	2.2546	2.6	2.7
VERT.	2.2600	.7	1.2

TRANSFORMERS	
PS-IP	0
TF9012	9.46
TF9053	9.14
TF5309	1288

PEAK AT 1855.14 kHz

MEAN AT 1855.13 kHz, rms WIDTH 81 Hz

AC EMITTANCE			
H	6	V	8

	ACAA			ACN			ACATL	
YIELD	40.9	EFF.		41.7	EFF.		41.9	EFF.
AC 5.3	3.73	1.00		3.91	1.00		3.83	1.00
AC 1.5	3.14	.84		3.26	.83		3.16	.82
AC 5.3				3.12	.79	.95		
AC .18				3.05	.78	.97		
AA .21	2.64	.70	.84					
PR .21	3.22	.86	1.22					
PR.052	3.00	.80	.93					
ST .21	2.85	.76					.03	0
ST.052	2.03	.54	.67					
STACKED							3.30	.86
LOSS E7/h				96				

AAC performance -95 vs. -94

	-95 400kA Horn	-94 20mm Li-Lens	
Production beam, 10^{10} ppp	900–1000	1300–1500	
$\bar{p}$ Yield, 10^{-6}	42	46	
Stacking, 10^{7}/shot	3,0	4,8	operational values 2/6 cycles
Stacking, 10^{10}/hour	1,5	2,4	
Global stacking eff. %	80	85	from perf. check
Global transfer eff. %	75-85	80-90	

Major faults

13/4 Li-Lens primary winding breakdown during startup
400 kA Horn installed and running within 48 hours.

28/4 Stack of 5,3 10^{11} $\bar{p}$ lost due to a broken water
hose for the AC septa

To be done

- Adjust stack. cooling to cope with 3/6 cycles production
- Improve xfer efficiency. tst ?

PPC 19 may 1995 -LEAR

MD protons mars avril 1995.

1-Ecool instabilities:. fréquences d'instabilité en fonction des paramètres avec neutralisation on/off.

courant solénoïde,tension repeller,temperature cathode.....
vitesse de propagation des ondes.

2-Ecool shaker effect: l'addition d'un shaker sur le faisceau d'électrons à une frequence de ~100 kHz permet d'éliminer les ions ou de maintenir le niveau de neutralisation.

3-mesure de potentiel dans le faisceau d'electrons: la mesure du potentiel par déplacement de position du faisceau de protons et mesure de son énergie. Mesure de léffet de neutralisation même partielle. Possibilité d'un fond plat de la cuvette d'environ ±15 mm

4-comparaison emittance BIPM-H0: bonne corrélation en vertical mais différent en horizontal.

5-mesure temps de cooling avec neutralisation on/off: un gain de 1.4 a été observé les bons jours" "mais il faut s'intéresser aux queues des distribution.

6-comptage H0 en fonction Ne ,Np,p,modul. elect.: ce comptage ne suit pas la théorie pour en déduire correctement la température des électrons. (alignement p-e ?)

7-mesure de émittance et dqi en fonction de Np: courbe eps~N^(0.3..0.5) dqi mesuré par pu quadripolaire.

8-mesure de epsh,v et dqi en fonction de Qv; ceci donne l'influence de la résonance 2 Qv=5 sur la distribution du faisceau même sous electron cooling.

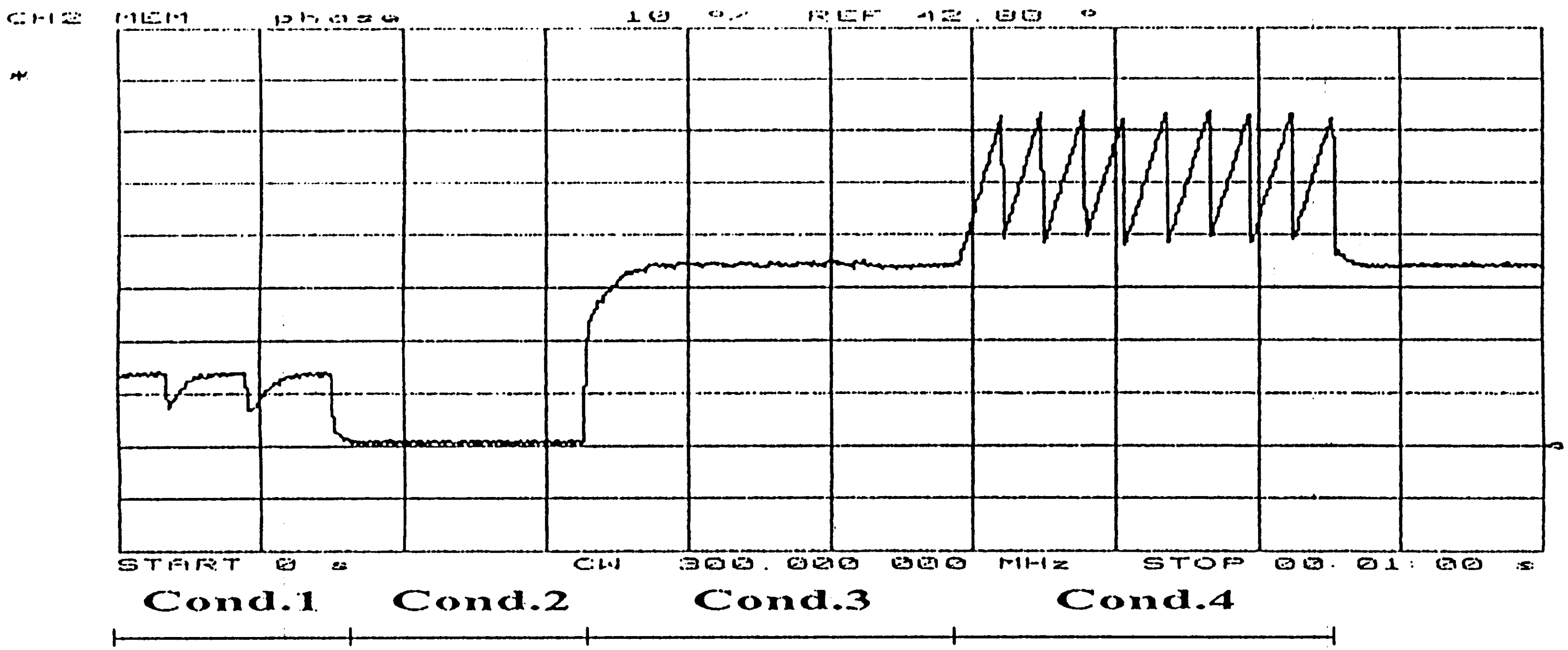
9-mesure de l'avance de phase entre pus h et v: utilisation de la btf et rapport de la réponse entre 2 pus sur une bande de fréquence de 40 Mhz après calibration. mesure à ±0.5 deg ..erreur sur la machine 4 deg(V), 8deg(H)

10-mesure de émittance du faisceau extrait à 200 MeV/c: eps rms ~1 πmmmrad.

11-fantôme à 200 MeV/c: pas díndication claire à 200 MeV/c protons. Encore là avec antiprotons,mais moins fréquent (vide meilleur cette année?) ,pas toujours lié à émittance blow-up. mais....

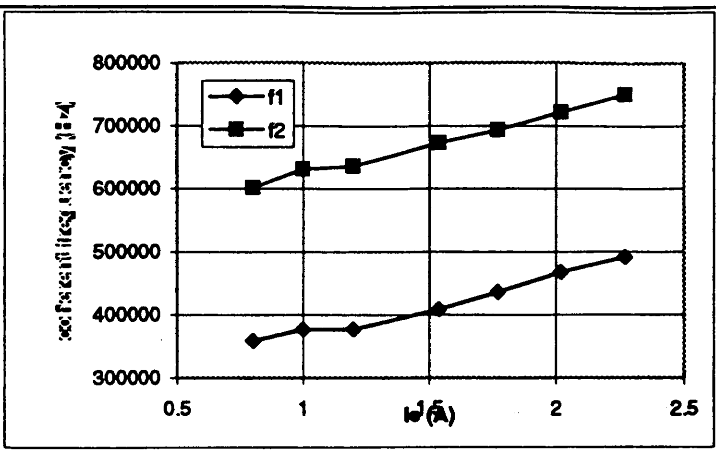
12-mise en service d'un feedback sur l'éxtraction: la mesure du flux reçu par une expérience sert à réguler ce flux en modulant l'avancement du bruit dans le stack. ceci à permit de minimiser l'influence du fantôme vue par l'expérience.

Phase measurement by the time of flight method



Different uses of the "shaker"

Cond.1 Shaker (feedback) OFF, at natural neutralisation the neutralisation factor is unstable
Cond.2 Shaker ON, the natural neutralisation factor is reduced, but stable
Cond.3 The neutralisation is ON (6kV on U_{nc2} and U_{ne2}) while the shaker is still ON
Cond.4 The shaker is OFF while the neutralisation voltages are maintained,the neutralisation factor increases , but becomes unstable


800000
700000
600000
500000
400000
300000
f1
f2
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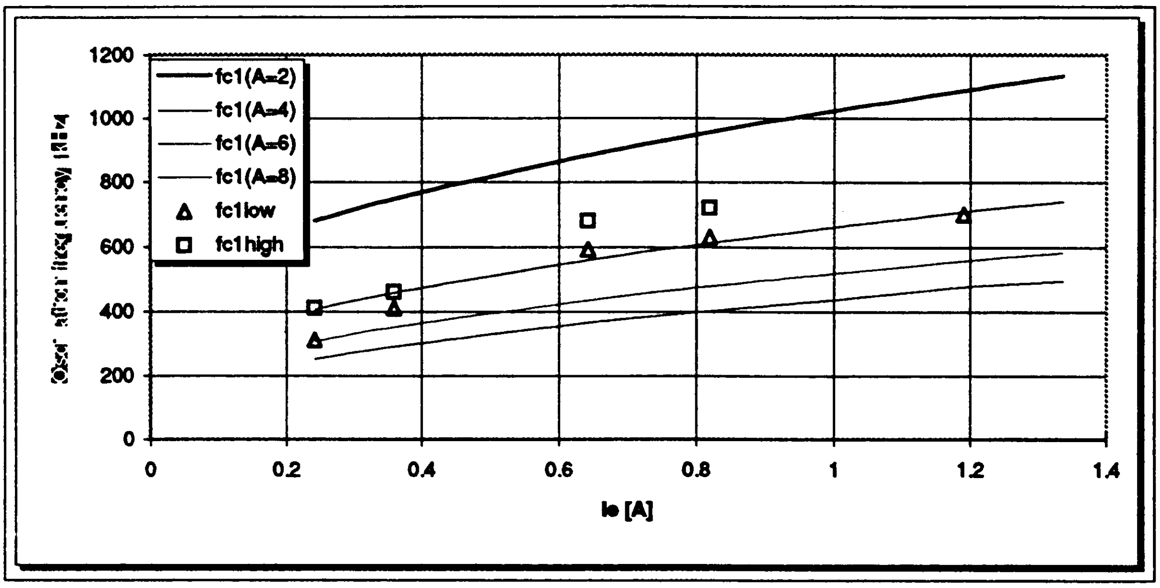
1
1.5
2
2.5
Ie (A)


1200
1000
800
600
400
200
0
fc1(A=2)
fc1(A=4)
fc1(A=6)
fc1(A=8)
fc1low
fc1high
0
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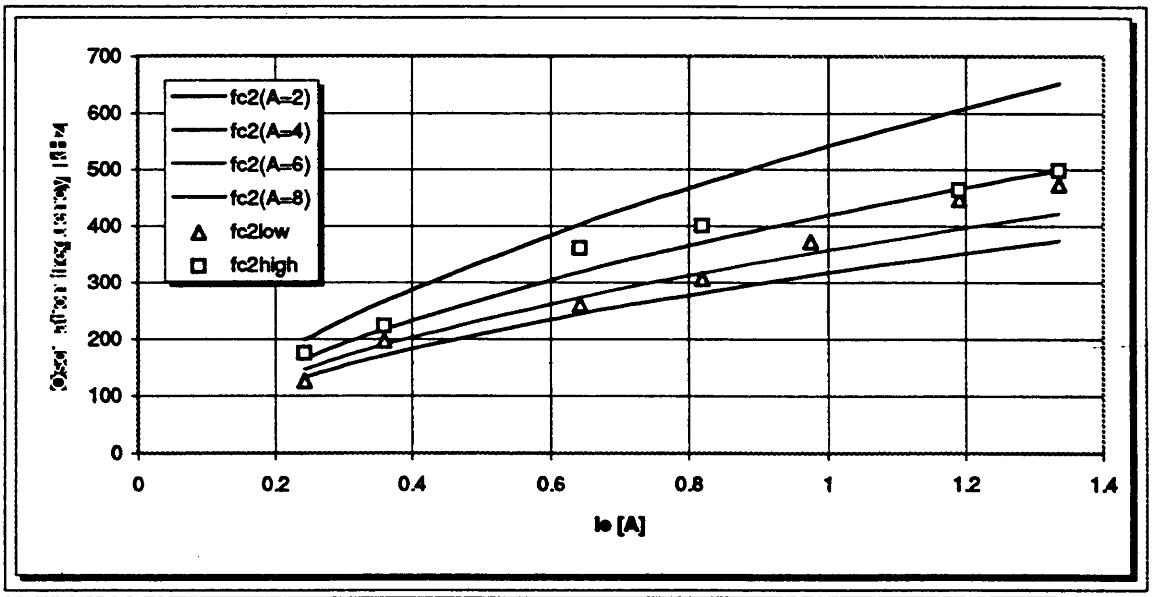
Ie [A]


700
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fc2(A=4)
fc2(A=6)
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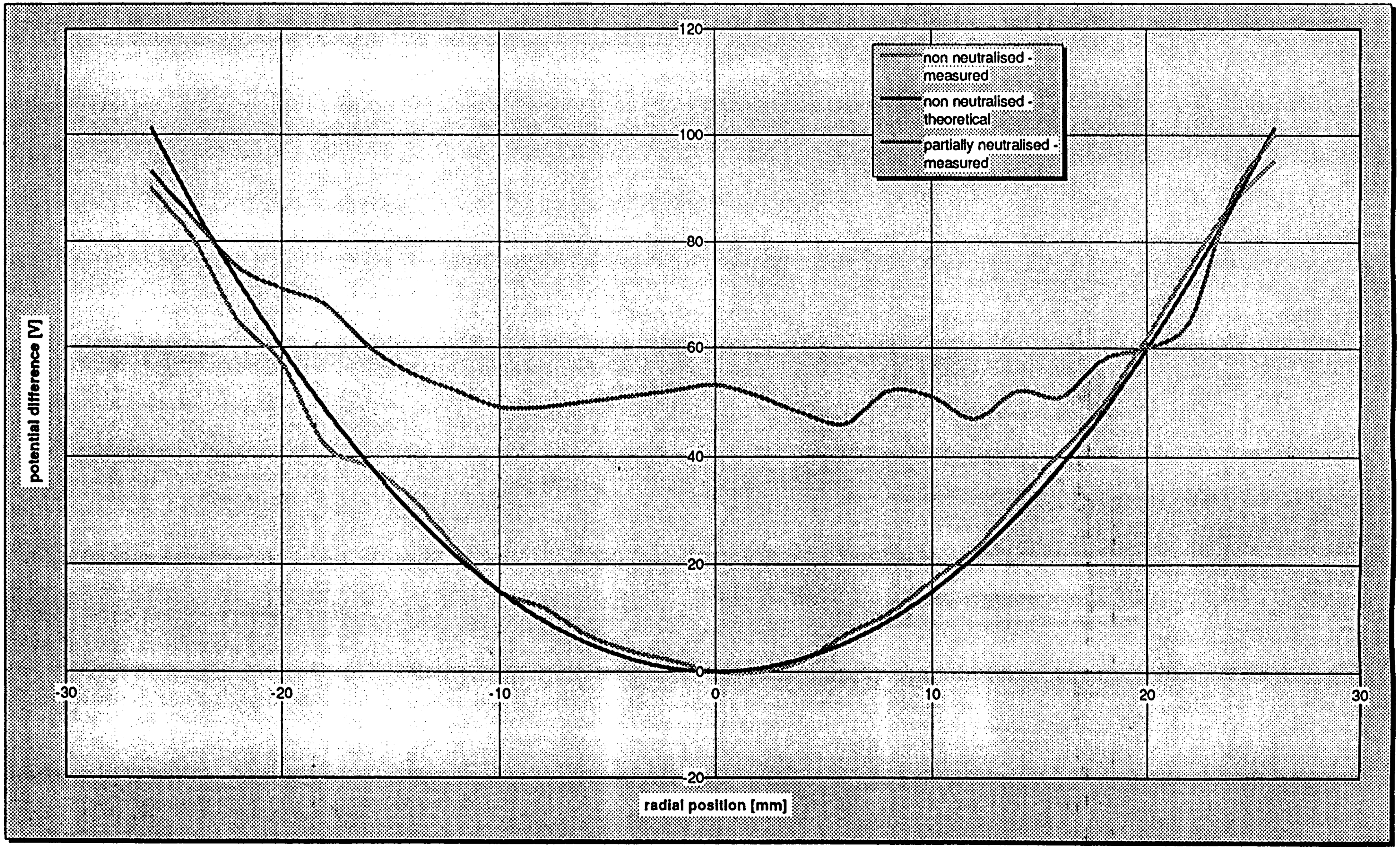
non neutralised - measured
non neutralised - theoretical
partially neutralised - measured
120
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60
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20
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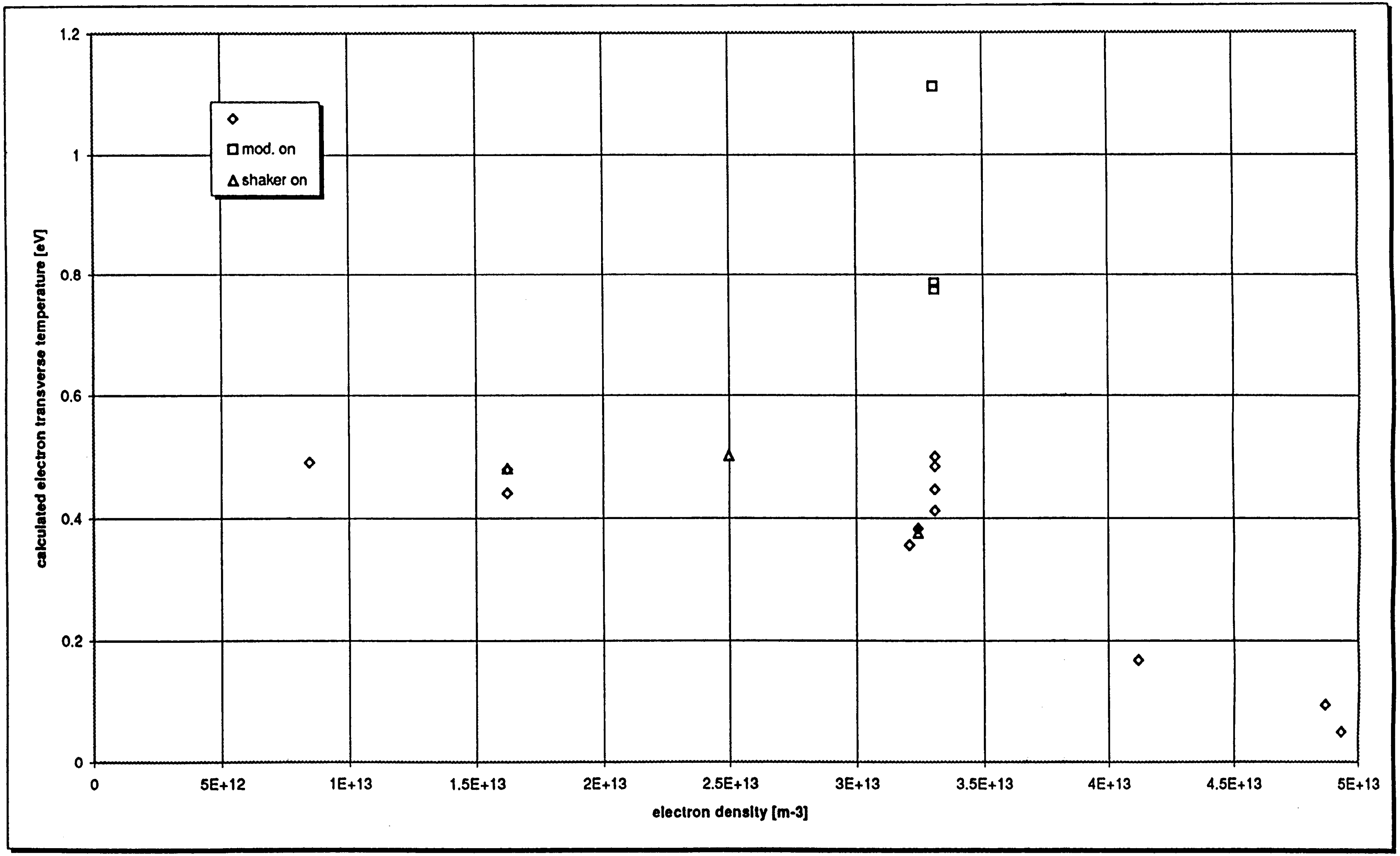
-20
-30
-20
-10
0
10
20
30
potential difference [V]
radial position [mm]


1.2
1
0.8
0.6
0.4
0.2
0
calculated electron transverse temperature [eV]
mod. on
shaker on
0
5E+12
1E+13
1.5E+13
2E+13
2.5E+13
3E+13
3.5E+13
4E+13
4.5E+13
5E+13
electron density [m-3]

qh	3 qh=7	qv	2qv=5	2h-qv=2	3qv=8				
2.25	2.33333	2.5	2.5	2.5	2.66666				
2.35	2.33333	2.7	2.5	2.7	2.6666				
mes 1		mes2			mes3		mes4		mes 5
2.3177	2.6227	2.3182	2.5978	2.3185	2.5775	2.3181	2.5502	2.3185	2.5277
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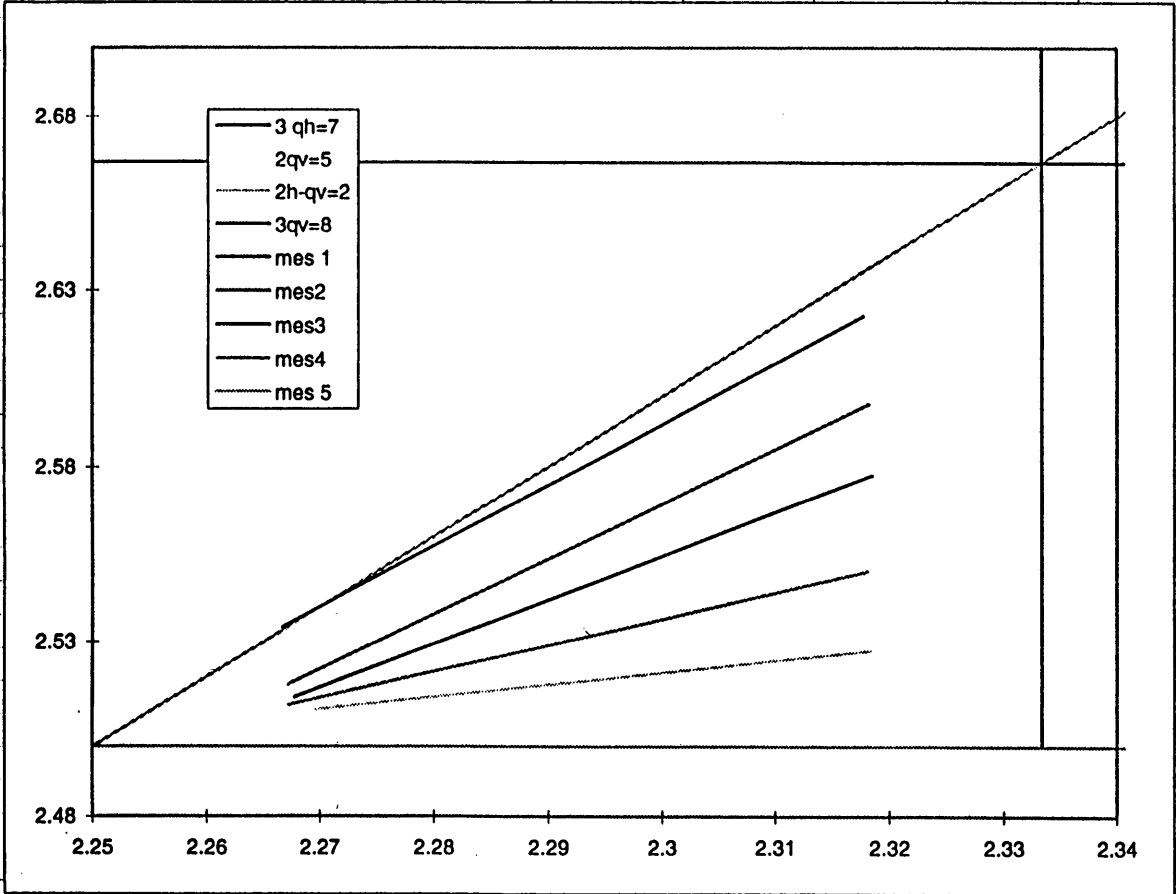

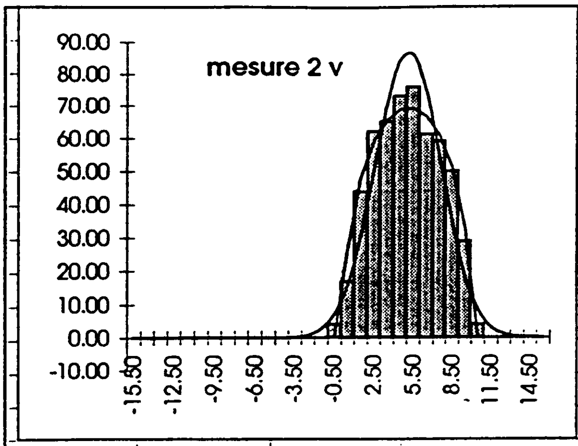
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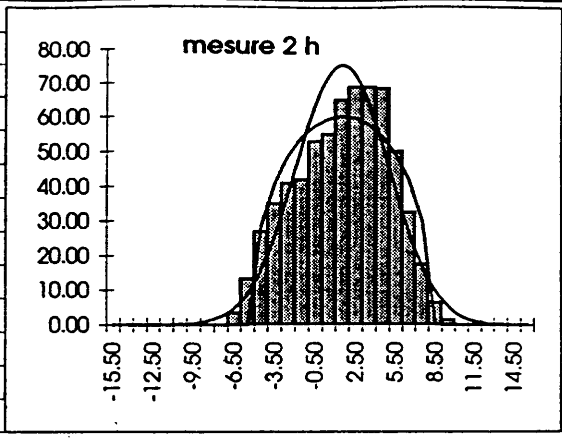
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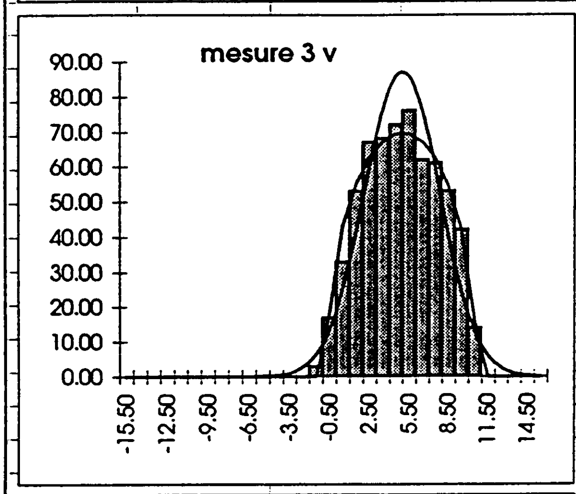
mesure 3 v
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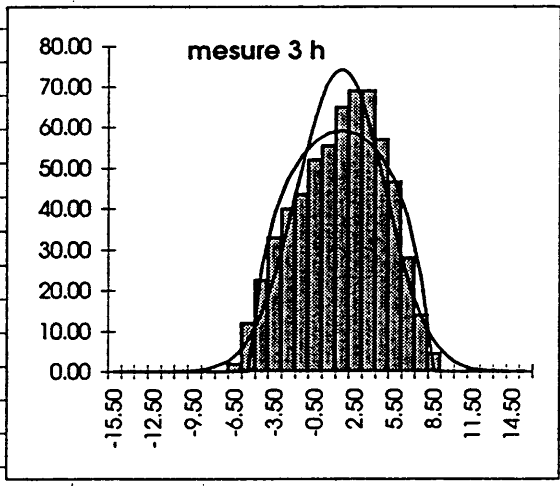
mesure 3 h
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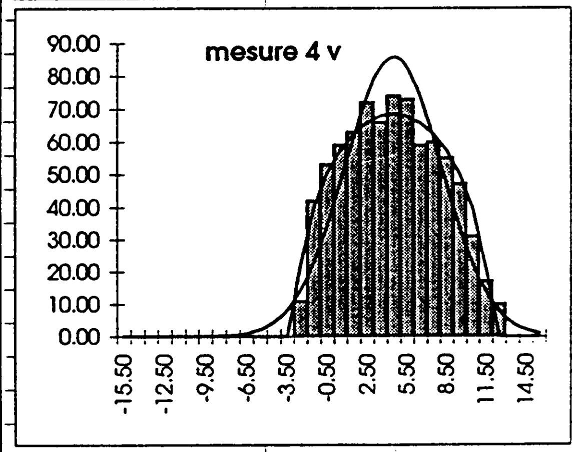
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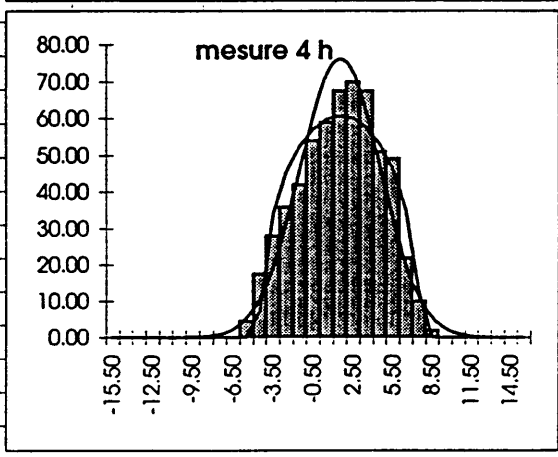
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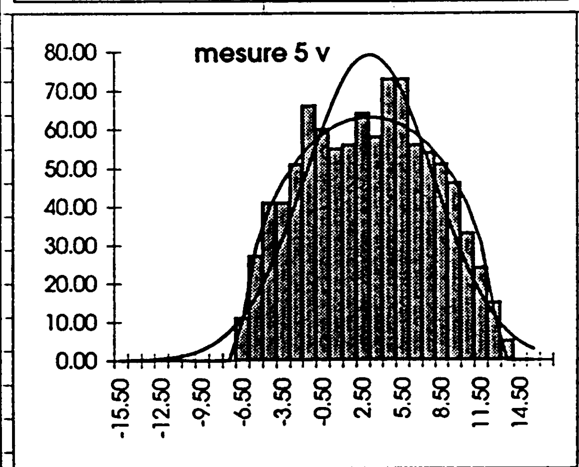
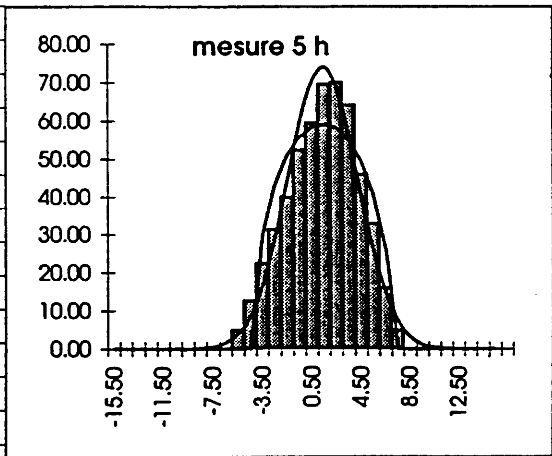
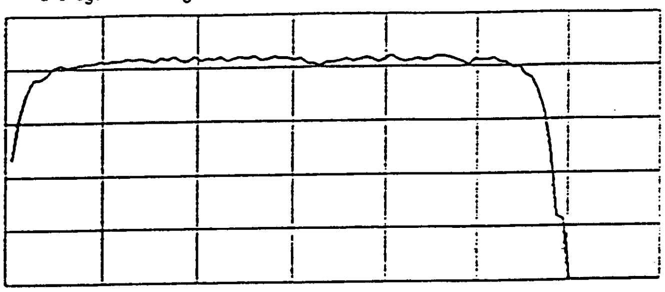
8.50
11.50
14.50


mesure 5 v
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-15.50
-12.50
-9.50
-6.50
-3.50
-0.50
2.50
5.50
8.50
11.50
14.50

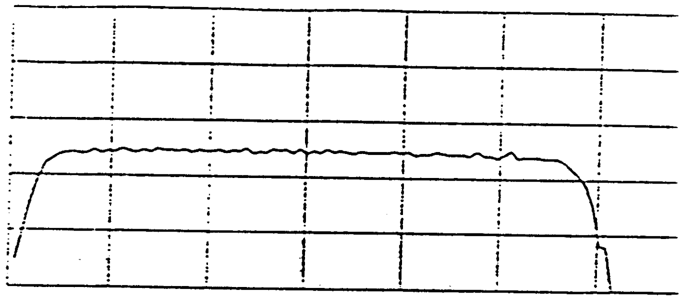

mesure 5 h
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-15.50
-11.50
-7.50
-3.50
0.50
4.50
8.50
12.50

3:52 WE SAW A GHOST DURING THE
WASN'T TOO BAD.

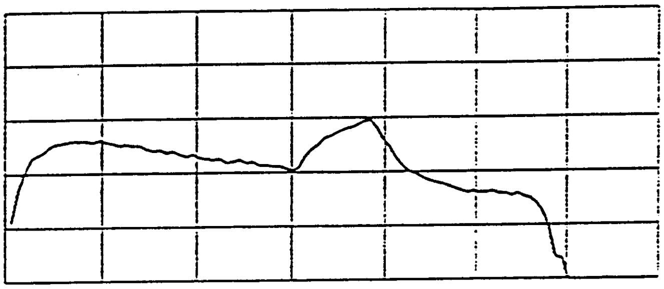
PS195
integrated intensity: 3.22583E+09 spill time: 4792 sec
average intensity: 791964 full scale : 1000000



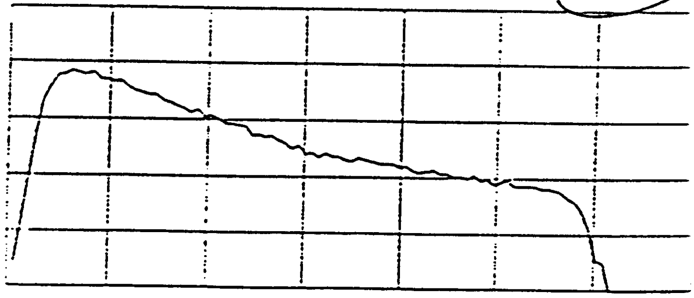
PS195
integrated intensity: 3.27543E+09 spill time: 4074 s
average intensity: 924119 full scale : 2000000



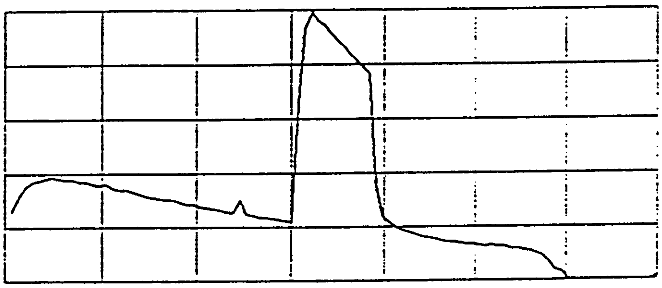
PS201
integrated intensity: 1.74760E+08 spill time: 4792 sec
average intensity: 42904 full scale : 100000



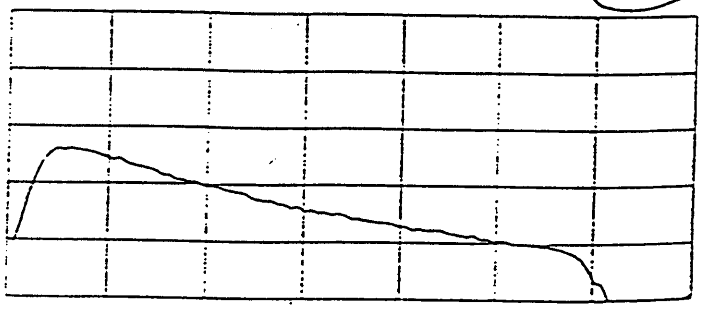
PS201
integrated intensity: 1.78522E+08 spill time: 4074 sec
average intensity: 50367 full scale : 100000



PS201
integrated intensity: 6.68752E+06 spill time: 4792 sec
average intensity: 1541 full scale : 5000



PS201
integrated intensity: 5.64429E+06 spill time: 4074 sec
average intensity: 1592 full scale : 5000



3:55 RESTART VSLE02, AS NOTHING [illegible]

10.05.95

PROGRAM of PSB-PS MD on 15&16.05.95

Monday 15.5.95

06.00-14.00	PS MD: $\varepsilon_{x,y}$ measurements in the PS and TT2 with various beam conditions. Ip<2 10^12 ppp. 1) MDLHC @ 26GeV/c, cycle C, FE16S/D3, or 2) MDPRO @ 20GeV/c, cycle F, FE16I/D3, or 3) MDSPS @ 13GeV/c, cycle H, FE16D/D3.	R. Cappi D. Manglunki M. Martini J.P. Riunaud B. Vandorpe
	in parallel: PFW effects on SE61. PHYSE @ 24GeV/c, cycle B, SE61. Supercycle CBCBCB.	L.Durieu J.Y. Hemery Ch. Steinbach
14.00-18.00	PSB ME: ejection tests with ABS. In the PS: MDSPS @ 13GeV/c, cycle H, beam on int. dump at injection energy.	B. Autin G.H. Hemelsoet E. Wildner
18.00-00.00	PSB ME: observation and damping of quadr. & octup. modes using synchronous detection and >50% of 2nd. harm. voltage. No beam in the PS.	F. Blas F. Pedersen G. Schneider

Tuesday 16.5.95

00.00-03.00	PS MD: working point optimisation with PFW's. Ip<10^12ppp. AAMD @ 26GeV/c, cycle C, FE16A/D3.	G. Azzoni
03.00-07.00	PSB ME: tracking precision tests on QF-QD power supplies. No beam.	H. Fiebiger F. Gendre T. Salvermoser
07.00-11.00	PS MD: Dispersion measurements in SS31 on CT and AA beams. Ip ~ 5 10^11 ppp. 1) SFTMD @ 14GeV/c, cycle A, CT/D3 or int. dump or 2)AAMD @ 26GeV/c, cycle C, FE16A/D3 or int. dump.	D. Manglunki MCR crew
	in parallel: preparation of the low ε_l beam for the SPS-MD of Wed. 17.5. Ip<10^12ppp MDLHC @ 26GeV/c, cycle C, FE16S/D3. Supercycle ACACAC.	R. Cappi R. Garoby S. Hancock J.L.Vallet
11.00-12.00	End of MD and back to normal operation.	MCR crew

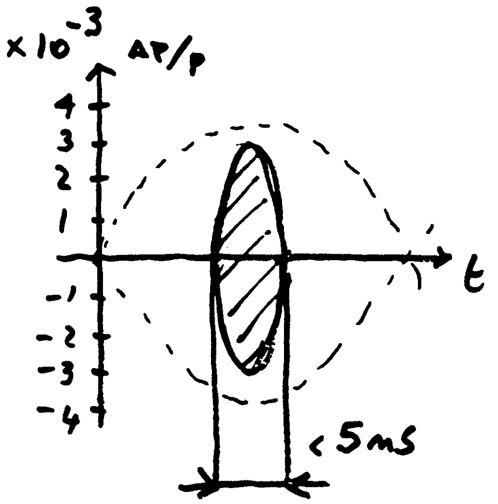
R. Cappi

PS for LHC : Dynamic Aperture Meas. at 26 GeV/c

$\frac{dp}{p} = \pm .35 \cdot 10^{-3}$

TEST BEAM

SPS INJECTION



FOR BEAM STABILITY (μW):

$$\frac{dp}{p} > \sqrt{C \cdot N_b \frac{Z_{\parallel}}{n}}$$

⇓

$\frac{dp}{p}$ AS LARGE AS "POSSIBLE"

Question : WHAT IS "POSSIBLE"? (e.g. Reminder : $\bar{p}$ $\frac{dp}{p} = \pm 3$.

LIMITATIONS ARE IN:

→ 1) CIRCULATING BEAM (Dynamic Aperture)

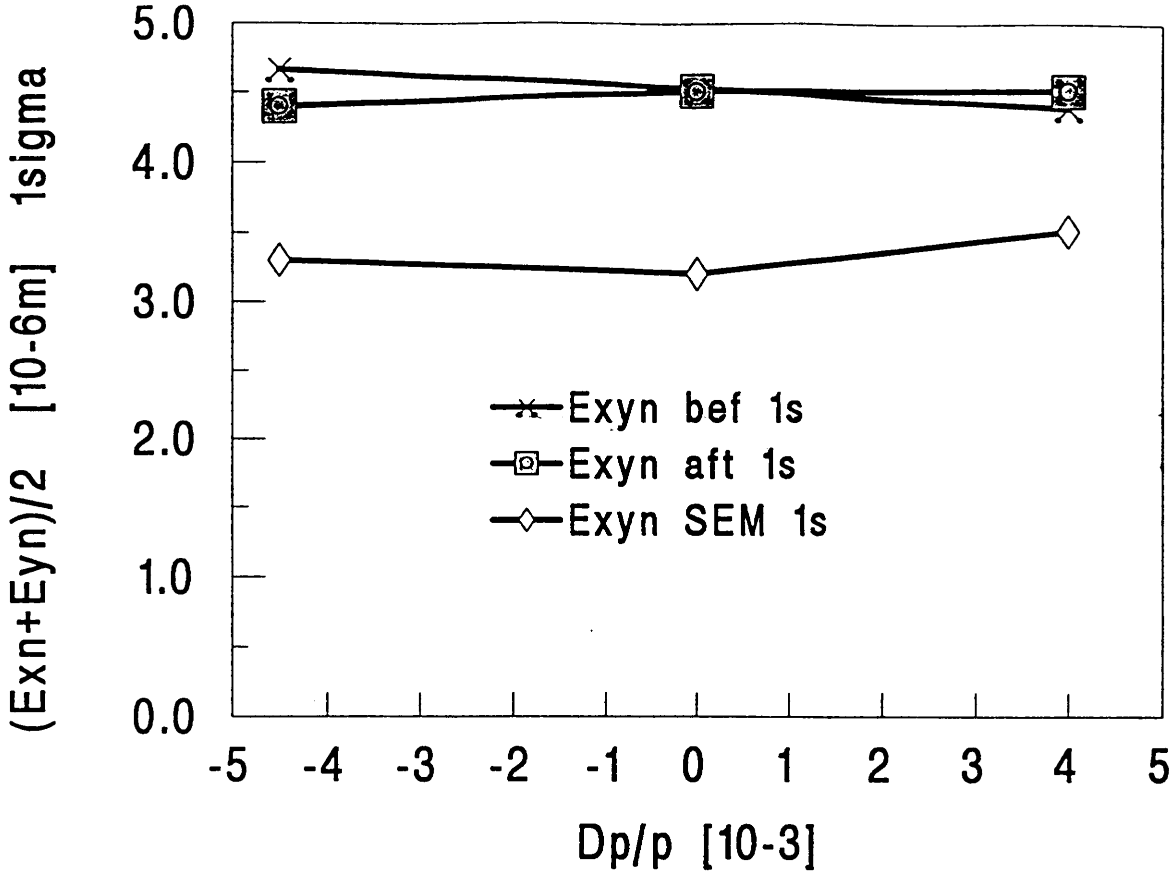
→ 2) AT EXTRACTION (Mech. Aperture, Stray fields

3) TRANSFER LINE (optics)

4) SPS INJECTION (optics, Mech. Aperture, Steering / Matching, ..)

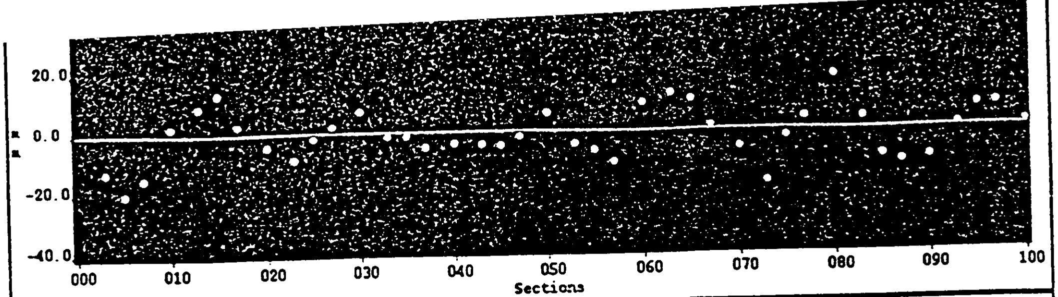
n) <u>RF VOLTAGE</u>!

MDLHC 15.5.95 **RESULTS**

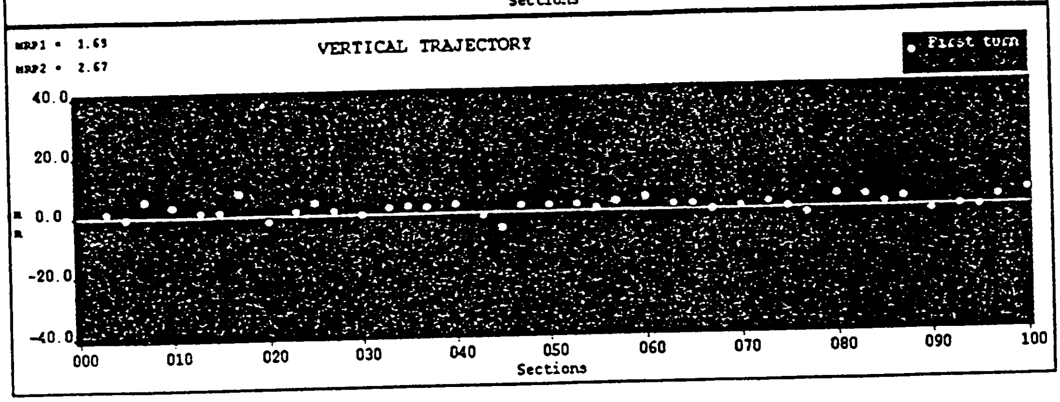


– FOR $\frac{\Delta P}{P} = \pm 4‰ \Rightarrow \eta_{extr.} = 99\%$

→ MISMATCH : ? ... MORE MD's NEEDED ALSO WITH SPS.

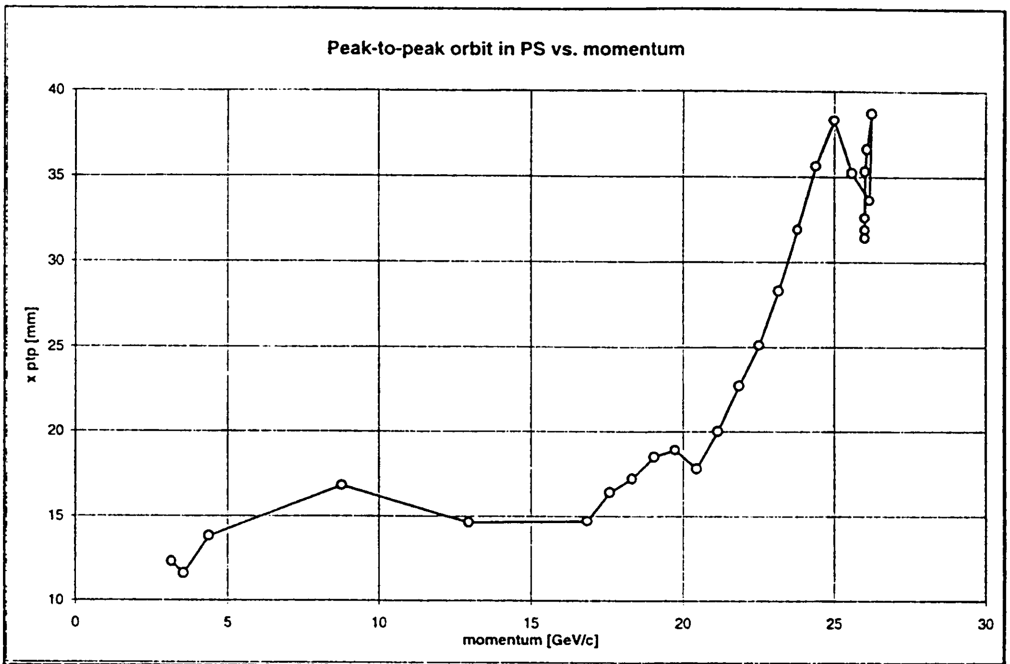


20.0
0.0
-20.0
-40.0
000
010
020
030
040
050
060
070
080
090
100
Sections

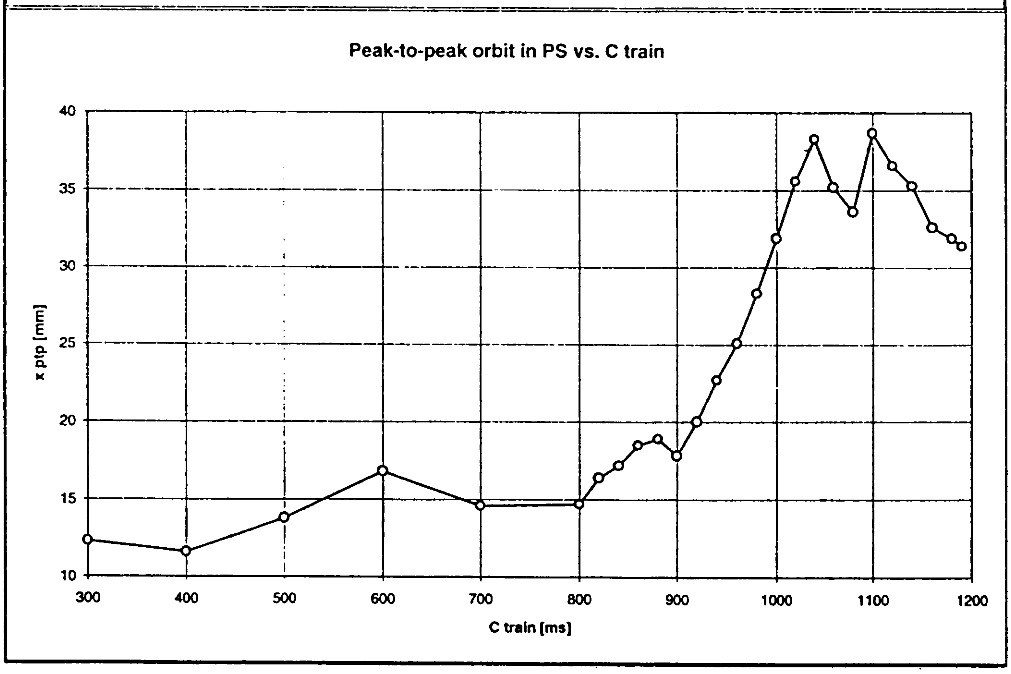


VERTICAL TRAJECTORY
First turn
40.0
20.0
0.0
-20.0
-40.0
000
010
020
030
040
050
060
070
080
090
100
Sections

Sheet1

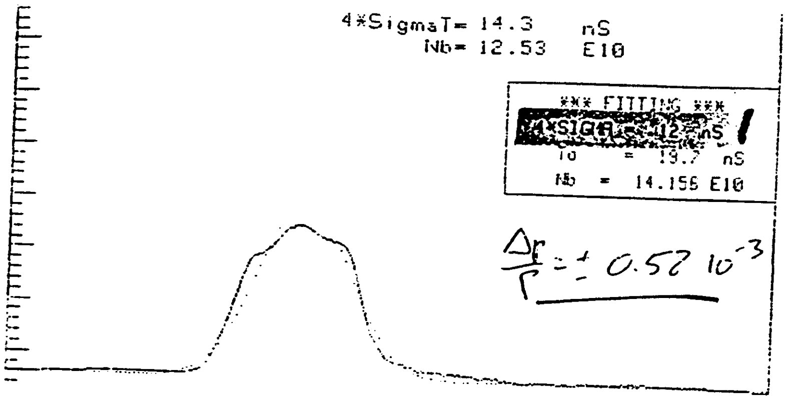


Peak-to-peak orbit in PS vs. momentum
x ptp [mm]
momentum [GeV/c]



Peak-to-peak orbit in PS vs. C train
x ptp [mm]
C train [ms]

Bunch rotation for SPS MD for checking of μW instability threshold

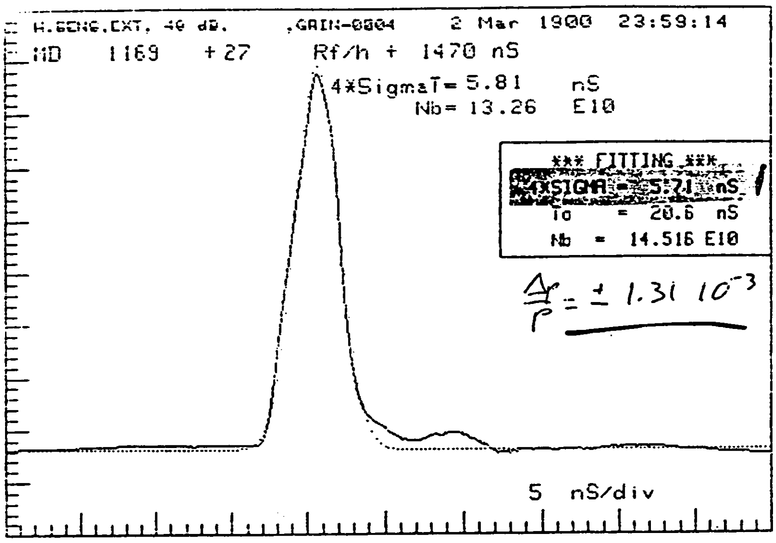


$\varepsilon_l \sim 0.3$ eVs

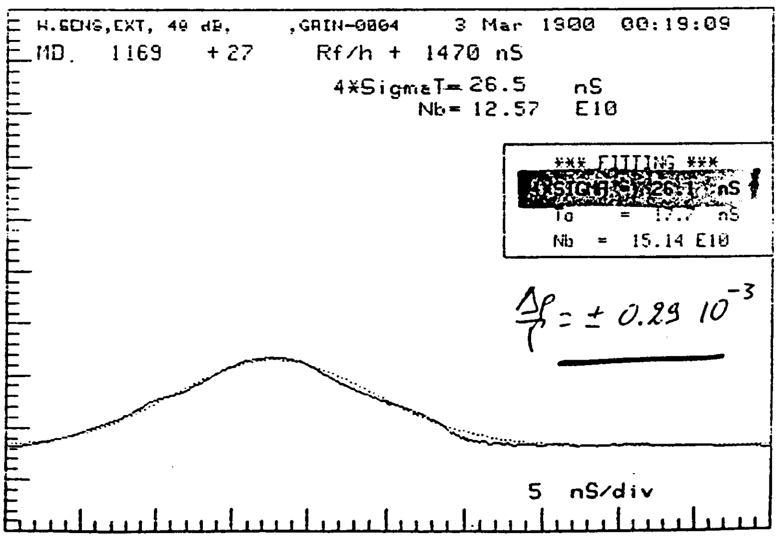
B = 12560 G

V = 200 kV · h = 20 ⇒ A. = 10.8 eVs

Bunch court: PX.SBR = 1168.640 ms



Bunch long: PX.SBR = 1169.130 ms



NEW CODD

1

Trajectory Measurement

Injection errors
β - tron oscillations
Bunch selection
Aperture measurements
Transfer lines

Average

Higher precision.
Higher sensitivity
Δ/Σ - normalizer

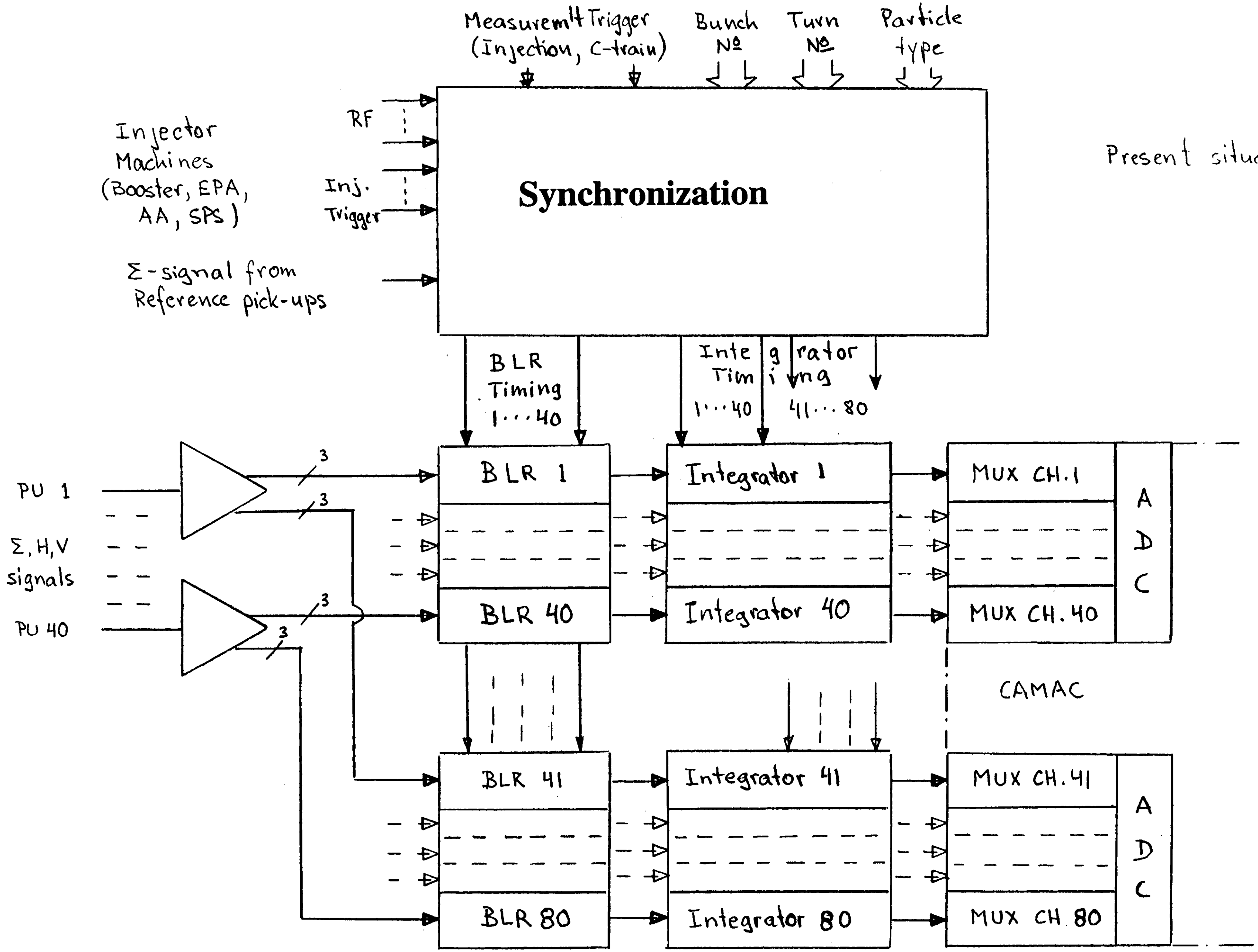
Multiple Trajectories

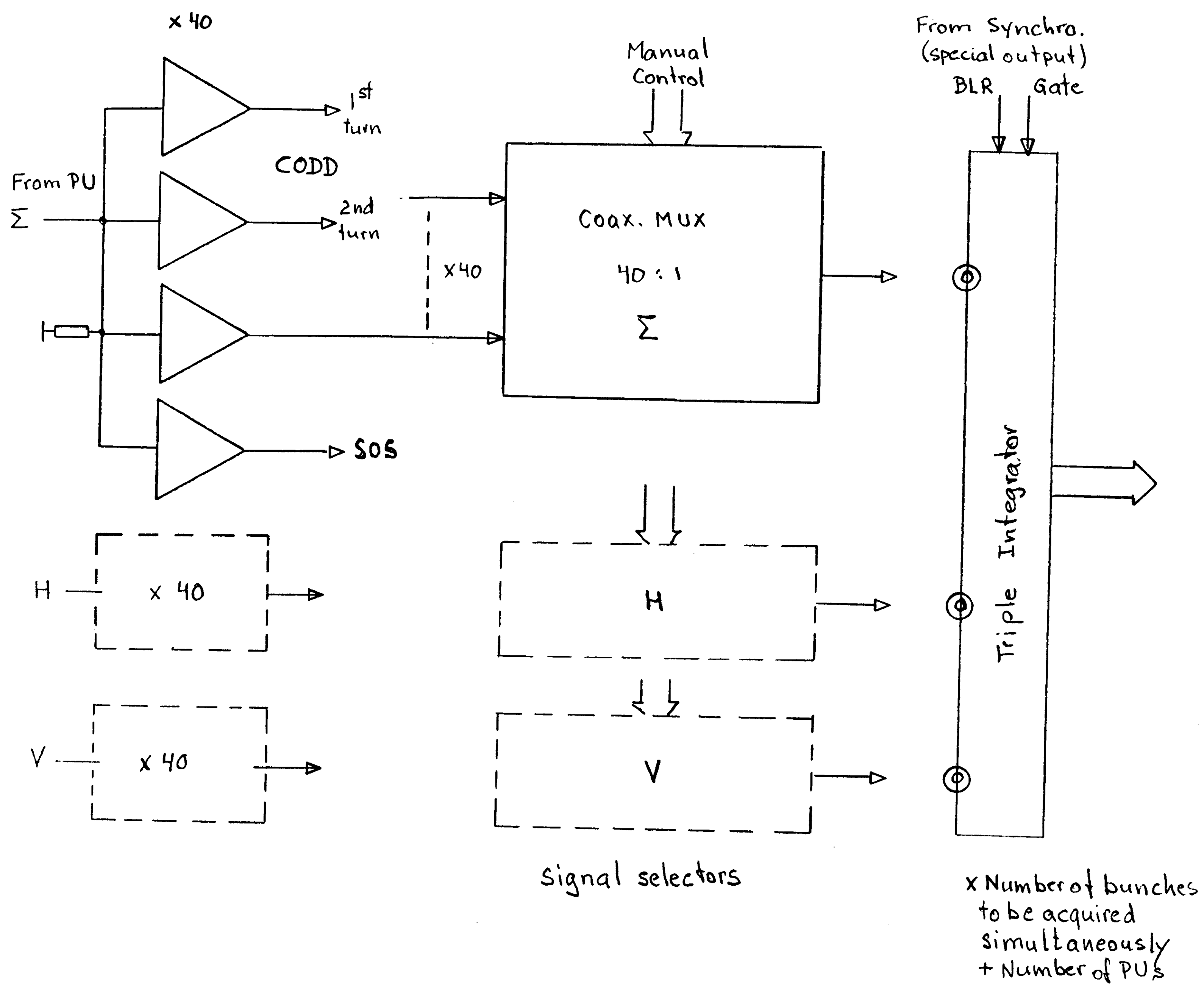
Best of both?

Bunch Integrator:

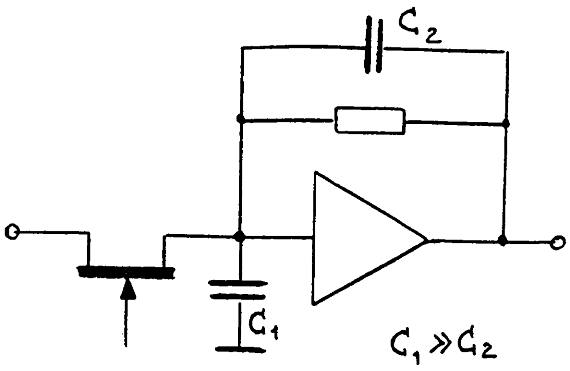
Center of mass measurement
Sensitivity to timing errors
Q - measurement (single bunch intensity dep.)
Feedback systems.

Present situation (CODD)





Layout for multiple measurements (e.g. 100K turns) and simultaneous N bunch measurements on 2 pick-ups.



Principle of present CODD integrator.

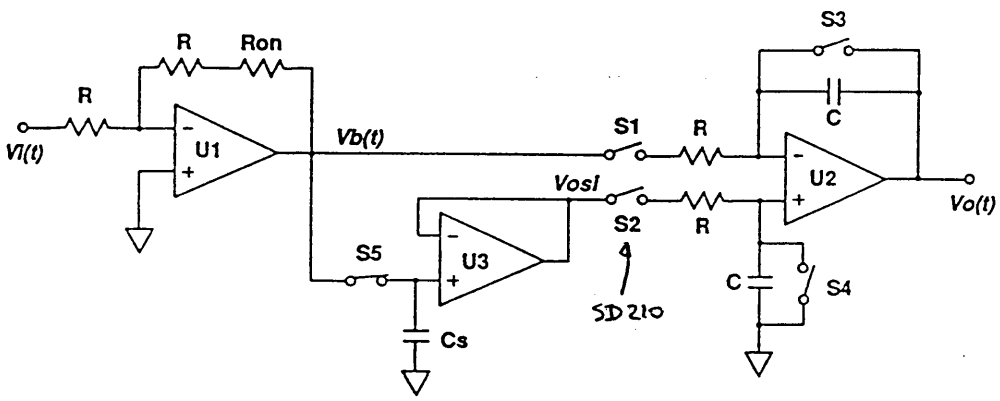
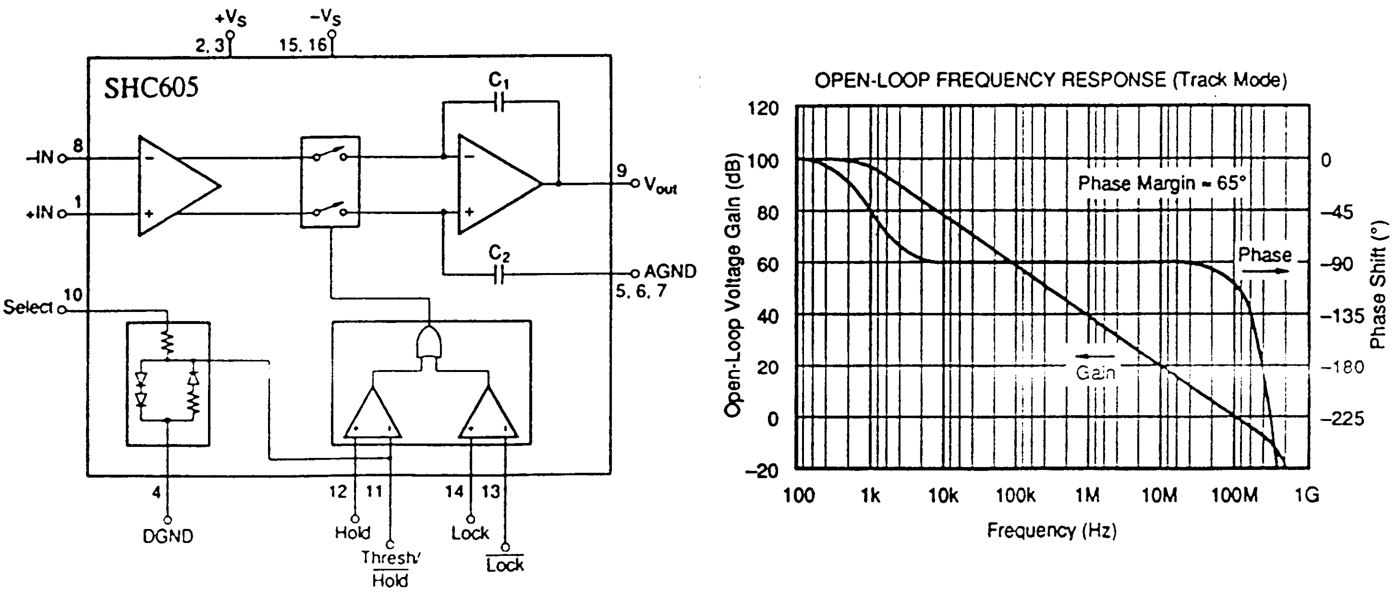


Fig. 3 Schematic of the new gated integrator design (**X. Wang, ANL**)



Commercial T/H Amplifier.

Distribution list

V. Agoritsas	PS
B.W. Allardyce	PS
B. Autin	PS
S. Baird	PS
J. Belleman	PS
J. Boillot	PS
J. Bosser	PS
M. Bouthéon	PS
J. Clendenin	PS
E. Brouzet	SL
H. Braun	PS
R. Cappi	PS
F. Caspers	PS
M. Chanel	PS
V. Chohan	PS
G. Cyvoct	PS
G. Daems	PS
D. Dekkers	PS
J.P. Delahaye	PS
D. Dumollard	PS
L. Durieu	PS
T. Eriksson	PS
J. Evans	PS
B. Frammery	PS
G. Fraser	DSU
R. Garoby	PS
G. Gelato	PS
R. Giannini	PS
M. Giovannozzi	PS
J. Gonzalez	PS
J. Gruber	PS
S. Hancock	PS
H. Haseroth	PS
J.Y. Hémery	PS
Ch. Hill	PS
K. Hübner	DG
E. Jensen	PS
S. Johnston	PS
K.H. Kissler	SL
P. Lefèvre	PS
R. Ley	PS
M. Lindroos	PS
J. Madsen	PS
D. Manglunki	PS
M. Martini	PS
S. Maury	PS
G. Metral	PS
C. Metzger	PS
D. Moehl	PS
H. Mulder	PS
F. Pedersen	PS
F. Perriollat	PS
J.P. Potier	PS
U. Raich	PS
N. Rasmussen	PS
J. Riche	PS
J.P. Riunaud	PS
Cl. Saulnier	PS
K. Schindl	PS
G. Schneider	PS
H. Schönauer	PS
E. Schulte	PS
T.R. Sherwood	PS
D. Simon	PS
C. Steinbach	PS
E. Tanke	PS
G. Tranquille	PS
H. Ullrich	PS
H. Umstatter	PS
B. Vandorpe	PS
F. Varenne	PS
M. Vretenar	PS
D. Warner	PS
E. Wildner-Malandain	PS
D. J. Williams	PS