EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
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CERN - PS DIVISION

PS/ PA/ Note 95-20 (PPC)

Minutes of the PPC Meeting held on September 23rd, 1995 Status of the Lead Ion Beam

D. Manglunki

Geneva, Switzerland
28 September 1995

PS/PA Note 95-20 (PPC)
September 26th, 1995

Minutes of the PPC meeting held on September 23nd, 1995
Status of the lead ion beam

Present :

G.L .Arduini/SL, J. Boillot, E. Brouzet/SL, R. Cappi (Chairman), M. Chanel, G. Cyvoct, D. Dekkers, D. Dumollard, R. Garoby, G. Gelato, H. Haseroth, D. Manglunki (Secretary), M. Martini, S. Maury, N. Rasmussen, J.P. Riunaud, G. Schneider, M. Schneider/AT, D. Simon, E. Tanke, H. Ullrich, M. Vretenar, E. Wildner.

1. Linac 3 (M. Vretenar)

- The culprit for the low-energy tail of the beam spectrum has been identified as the aging stripping foil. Why an old stripper foil gives more straggling still remains to be investigated. (matter deposition, geometrical deformation...). It is reminded that the stripper is a half-micron thick carbon foil..
- The RFQ power is back to its nominal level.
- Six stripper foils have been installed on a "marguerite".
- All diagnostics are now in an operational state.
- The source lead sample has been changed. It will be changed again just before the SPS run.- U.Ratzinger/GSI will come next week to
  a) optimise the field distribution in the IH tanks (in parallel with operation) and
  b) measure the maximum field (needs dedicated time).
- Installation of a new 100MHz amplifier for the RFQ.

2. PSB (E. Wildner)

- The performances are $900/1829*10^7$ charges before/after a sublimation.
- Beam in ring 3 has a shorter lifetime (20ms) as compared to the other rings (30ms); this may be due to a vacuum leak.
- Detailed studies of last year's statistics showed no clear correlation between the high intensity beam for Isolde and the PSB Pb performance. More statistics will be analysed during next run.
- RF group has been working a lot on new beam control components, now installed on C08.
- The Q-setting has been optimised.
- Sublimations will take place very often during the physics run.

3. PS (R. Cappi)

- A lot of work has been done on the proton beam at 13GeV/c, which simulates the fully stripped ions sent to SPS. This showed a transmission (from circulating in PS to circulating in SPS) of about 90%, and no transverse blow-up.
- The lead ion beam has been very low until now, peaking at $7*10^9$ charges/shot extracted from the PS ring, with transverse emittances of ~1.8 and ~1.3 π*mm*mrad, respectively horizontal and vertical.
- Remains to be done : Energy fine tuning, transmission check-up, and optimisation of the stripper thickness (currently 1 mm).

4. SPS (E. Brouzet)

- A new supercycle has been set up, to allow for an intermediate flat-top at 26GeV/c for debunching/rebunching. This should improve the structure of the slow extraction spill.
- All transverse settings (except for extraction, due to lack of time) have been achieved with the proton simulation beam.
- Leptons have been optimised on this new supercycle.
- Ions have been injected from the four PS cycles, and accelerated to the 26GeV/c flat-top, but with poor efficiency due to lack of MD time.

5. Discussion and short-term programme

- The SPS will request ions in parasitic mode (on the "third lepton" cycle) as from this Monday, September 25th. The aim is to finish optimising injection by the end of week 39, to be able to use the remaining MD time for LHC studies which have been delayed.
- The main objective is to inject and accelerate ions in the SPS during the dedicated PS/SPS MD in week 41.
- The stripper thickness optimisation tests will be done during week 43 or 45.
- LEAR will use protons during the next PS MD (week 41)
- A tentative programme is being sketched. (added to these minutes)

STATUS OF LEAD ION BEAM IN LINAC 3

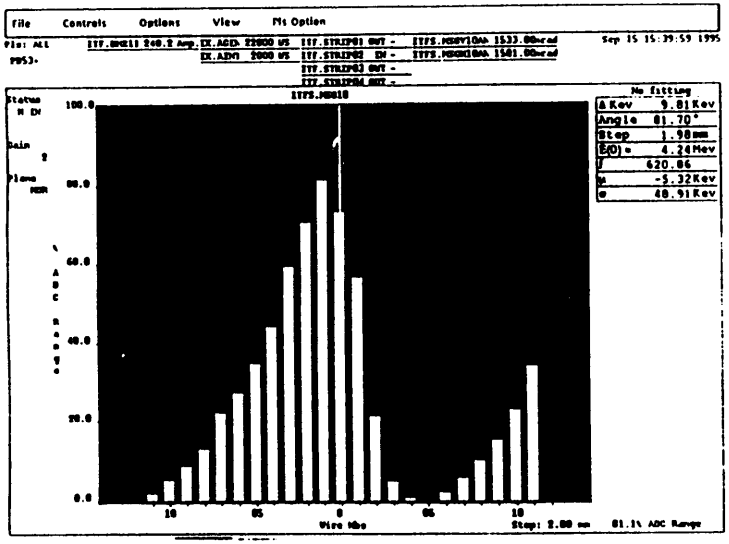
(A) WORK DONE RECENTLY: [some planned, some unplanned]

1. TAIL IN THE ENERGY DISTRIBUTION
   - due to the stripper foil
     [in place ~4 months - previous record 2.5 m. - average 1.5 m.]
2. RFQ LEVEL BACK TO NOMINAL [10 ÷ 20% current increase]
   - RF amplifier (GSI old) close to saturation
3. NEW STRIPPER FOILS IN [intervention yesterday 21.9]
   - 6 foils, prepared with 2 different techniques
4. REPAIRED a DAMAGED SEM GRID
   - all diagnostics ok.
5. SOURCE:
   - high downtime last week due to the frequent water interruptions [→ need hours to reform the source!]
   - oven changed 21.9 morning due to failure [+ new lead sample]
   - very stable since!

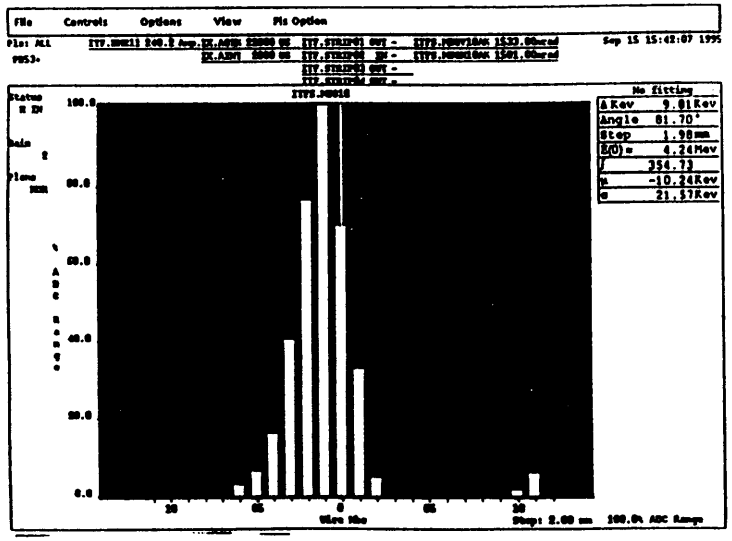
(B) PROGRAMME BEFORE THE PH. RUN

1. WORK ON THE IH-TANKS
   [by U. Ratzinger / GSI, wk. 39 Tu/Th.]
   a. optimise field distribution inside the tanks [acting on the "fixed" tuners] aiming for:
      → { * higher beam transmission
          * smaller emittance growth
   [Note that beam can be delivered to PSB → PS → SPS in parallel with these adjustments]
   b. measure of maximum field reachable in the tanks
   [lower priority - no beam possible]
2. INSTALLATION OF THE 2ND 100 MHz AMPLIFIER [FOR THE RFQ]
   - installation at Linac 3 and tests on a dummy load in week 40 (?)
   - if the tests are positive and the amplifier arrives in time, we will have to decide which amplifier to use for the physics run.

PB53+ ENERGY PROFILE AT LINAC 3 (after TK3)
- ITF line -



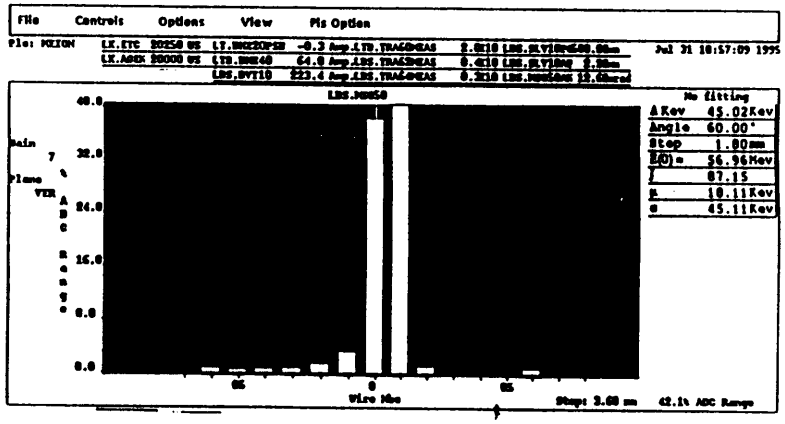
OLD STRIPPER



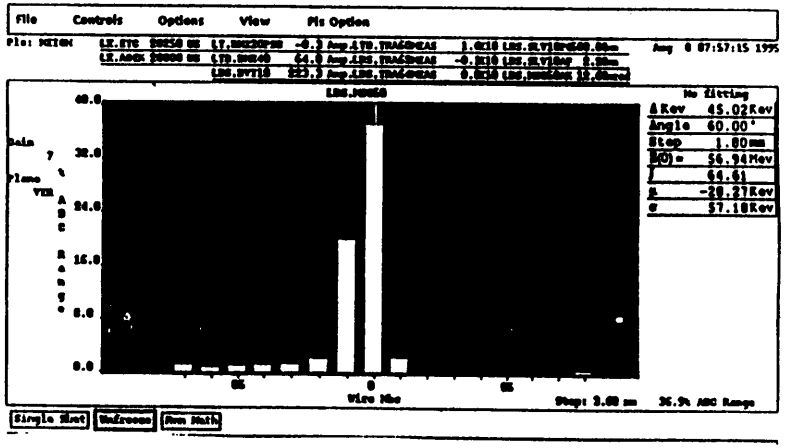
NEW STRIPPER

LEAD BEAM ENERGY PROFILE
AT BOOSTER INPUT (LBS LINE)

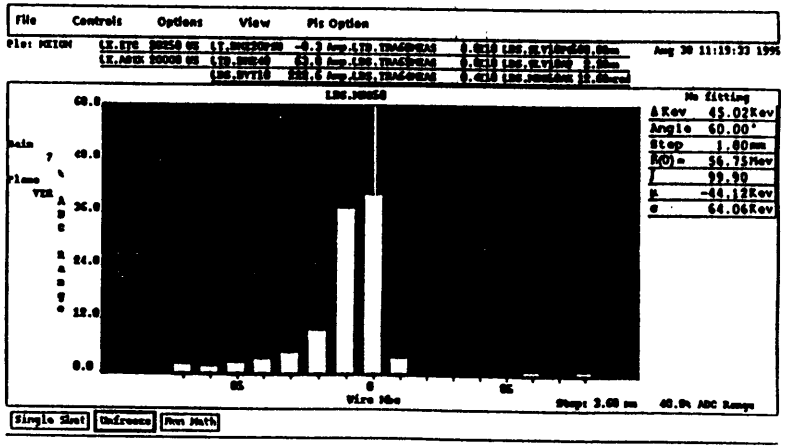
3.8 Kev/u
wire



31.7.95



8.8.95



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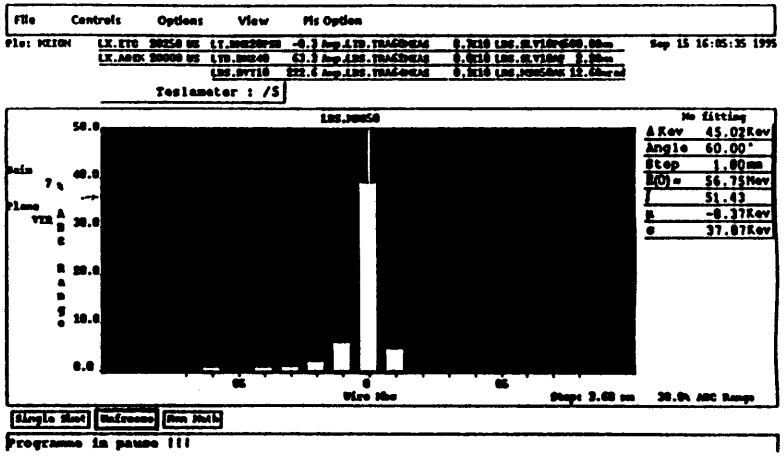
File
Controls
Options
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Plt: MEIGN
Sep 15 16:05:35 1995
Teslameter : /S
LNS.PUMS0
No fitting
ΔKev 45.02Kev
Angle 60.00°
Step 1.00mm
E(0)= 56.75Kev
51.43
μ -0.37Kev
σ 37.07Kev
Main
Plane
VER
Wire Nbr
Single Shot
Reference
Run Multi
Programme in pause !!!

3d
2Le V/u /w

PPC 22/9 1995

Booster

Pb53+

Reported by E.Wildner

The 16/8 we had some kind of record for the ion intensities. Because of the heavy influence of the vacuum, we measure the Booster intensities before and after flashing of the sublimation pumps, to have comparable references. See fig 1.
Unfortunately we do not have a hardcopy of the vacuum situation from this date. Last year's record is still slightly higher.

VACUUM

The vacuum in general is comparable to last year, with the the problematic region 14L1-15L1,1L1.

Sublimation is not done except during MDs (once per 2 hours) to give reasonable intensities to the PS.

Ring 3 has a particular problem, see fig. 2.

For ion intensities around 1E10 charges accelerated, the ISOLDE beam has no measurable influence on the vacuum or the accelerated beam intensity. Tests were made for proton intensities from 1.6 to 2.8E13. Tests to be repeated at 1.5E10 ion charges.

Statistics from last year show similar results. Fig. 3,4,5

Conclusion: for the moment no a priori reduction in the ISOLDE beam is justified to save ion intensity.

OPTIMIZATION

Optimization of Linac helped a lot:
increase in RFQ amplitude gave ~ 40% more beam in the injection channel. Change of stripper foil gave a spectrum without tails.

Linac energy and dispersion variations are difficult for the booster to cope with. These variations cause problems for the booster RF, with difficulties with GFAD programming etc. When the Linac energy changes, the steering in the BI line seems to be "lost", and a lengthy and difficult optimization procedure has to start.

Steering with screens difficult. Nominal positions on screens do not give the best performance. The shape of the beam on one of the screens is different from last year.

Q-setting has been corrected to correspond to the proton bare machine setting (gave a very slight gain). The ring dependent correcting coils normally used at injection for high intensity beams could not be taken away (total intensity went down) because of differences in the four rings.

Around 10% gain in accelerated intensity could be observed when the number of turns was increased. This experiment will be repeated with refined adjustment of the injection conditions (Bdl, capture etc.). The total intensity during the experiment was 1E10, maybe the effect is lesser at higher ion intensities.

Today's situation: se fig. 6,7

fig 1.

beamcurrents

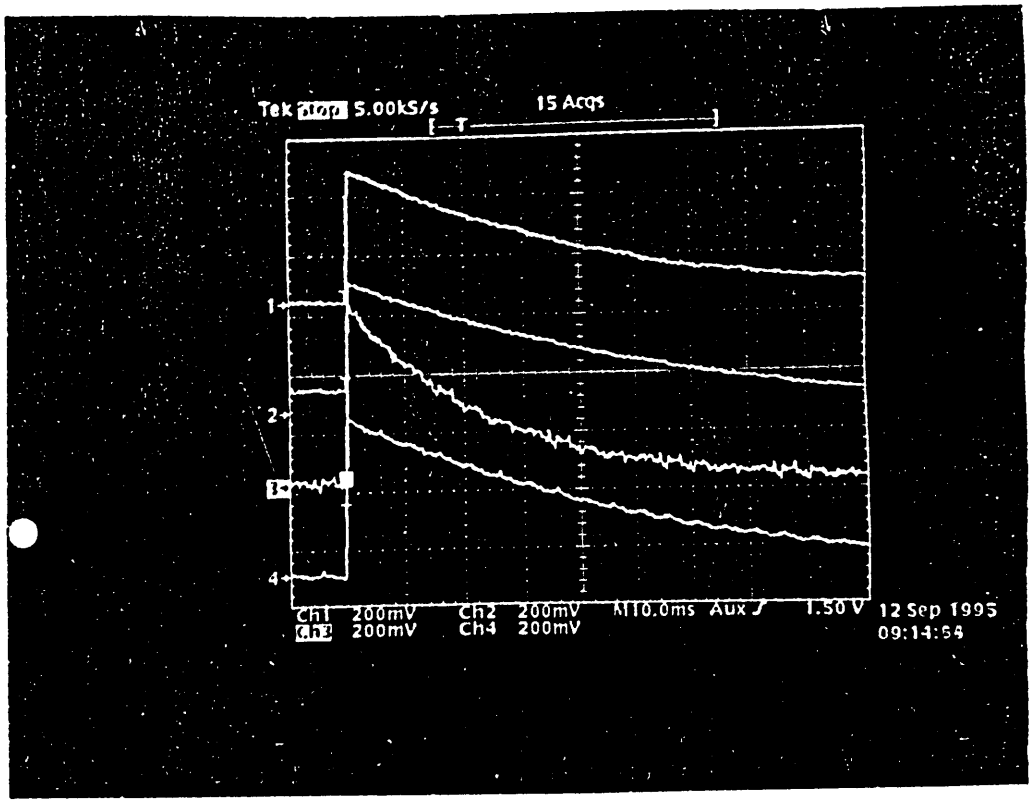
File View Options Control Help

Ions to DUMP (E7) HEION ** Aug 16 15:51:10

Transfo names	RING 1		RING 2		RING 3		RING 4		SUM	
LTB.TRA55	1473	0%	1219	0%	1230	0%	1189	0%	5111	0%
BI.TRA10	1690	115%	1602	131%	1632	133%	1614	136%	6538	128%
BI.TRA20	1190	70%	1059	66%	1052	64%	1345	83%	4646	71%
INJECTION	873	73%	1139	108%	1105	105%	1225	91%	4341	93%
CAPTURE	447	51%	663	58%	431	39%	693	57%	2234	51%
BEF.DEBUN	303	68%	456	69%	271	63%	498	72%	1527	68%
AFT.DEBUN	256	85%	331	73%	168	62%	408	82%	1163	76%
ACCELER	195	76%	287	87%	126	75%	317	78%	925	80%
BT.TRA									532	58%
BTP.TRA									213	40%
BTH.TRA										
BTY.TRA112										
Number of turns:	19.0		19.0		19.0		19.0		Send Ring 3 to all rings	

Update Unfreeze Freeze All Lines Asynchronous

Avant sublimation



beamcurrents

File View Options Control Help

Ions to DUMP (E7) HEION ** Aug 16 17:46:21

Transfo names	RING 1		RING 2		RING 3		RING 4		SUM	
LTB.TRA55	1557	0%	1493	0%	1496	0%	1491	0%	6037	0%
BI.TRA10	1655	106%	1532	103%	1536	103%	1522	102%	6245	103%
BI.TRA20	1181	71%	1383	90%	1299	85%	1588	104%	5451	87%
INJECTION	956	81%	1388	100%	1113	86%	1112	70%	4569	84%
CAPTURE	621	65%	1003	72%	611	55%	834	75%	3069	67%
BEF.DEBUN	503	81%	751	75%	417	68%	770	92%	2441	80%
AFT.DEBUN	453	90%	617	82%	344	82%	692	90%	2105	86%
ACCELER	397	88%	545	88%	283	82%	604	87%	1829	87%
BT.TRA									1713	94%
BTP.TRA									220	13%
BTH.TRA										
BTY.TRA112										
Number of turns	19.0		19.0		19.0		19.0		Send Ring 3 to all rings	

Update Unfreeze Freeze All Lines Asynchronous

Après sublimation

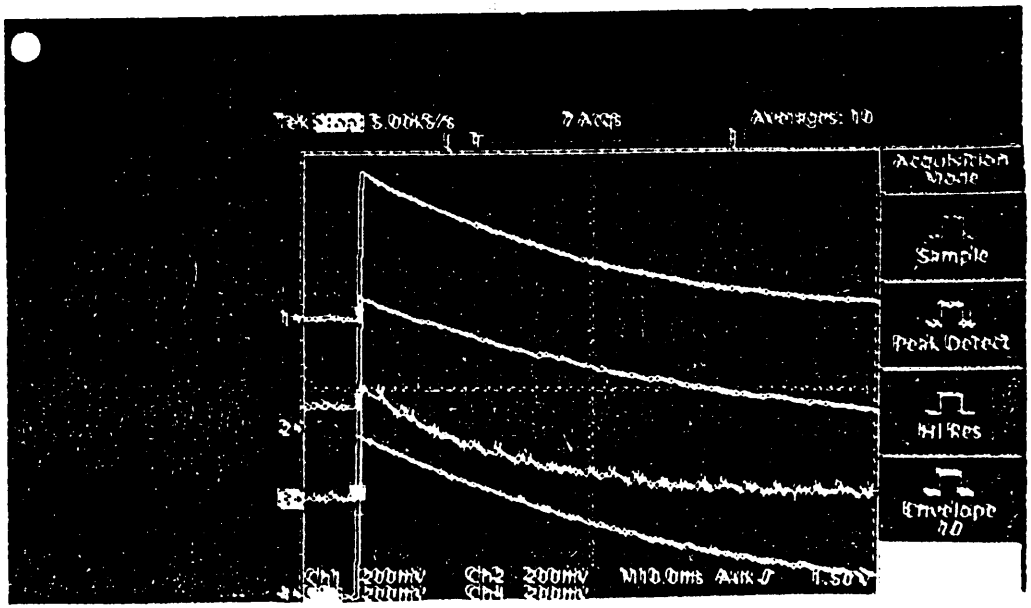


Fig 3

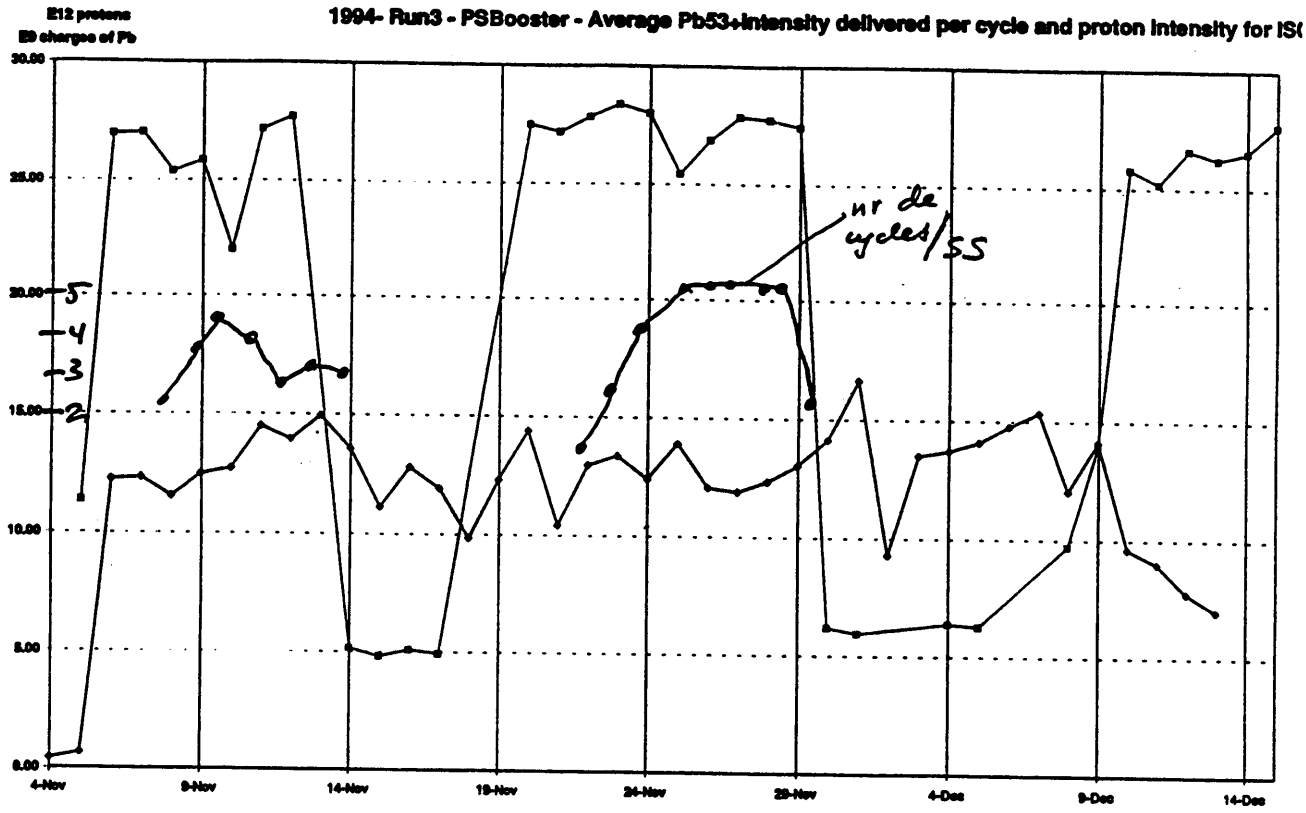
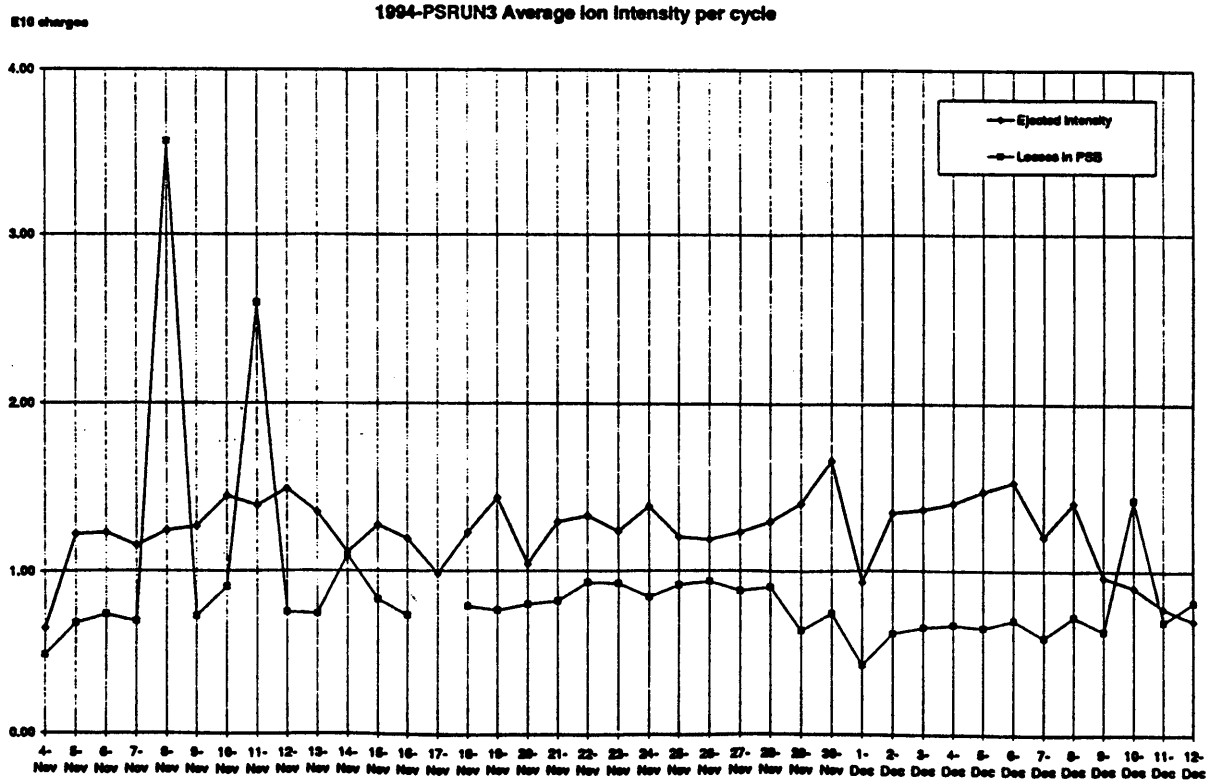


Fig. 8

IONBOM.JS

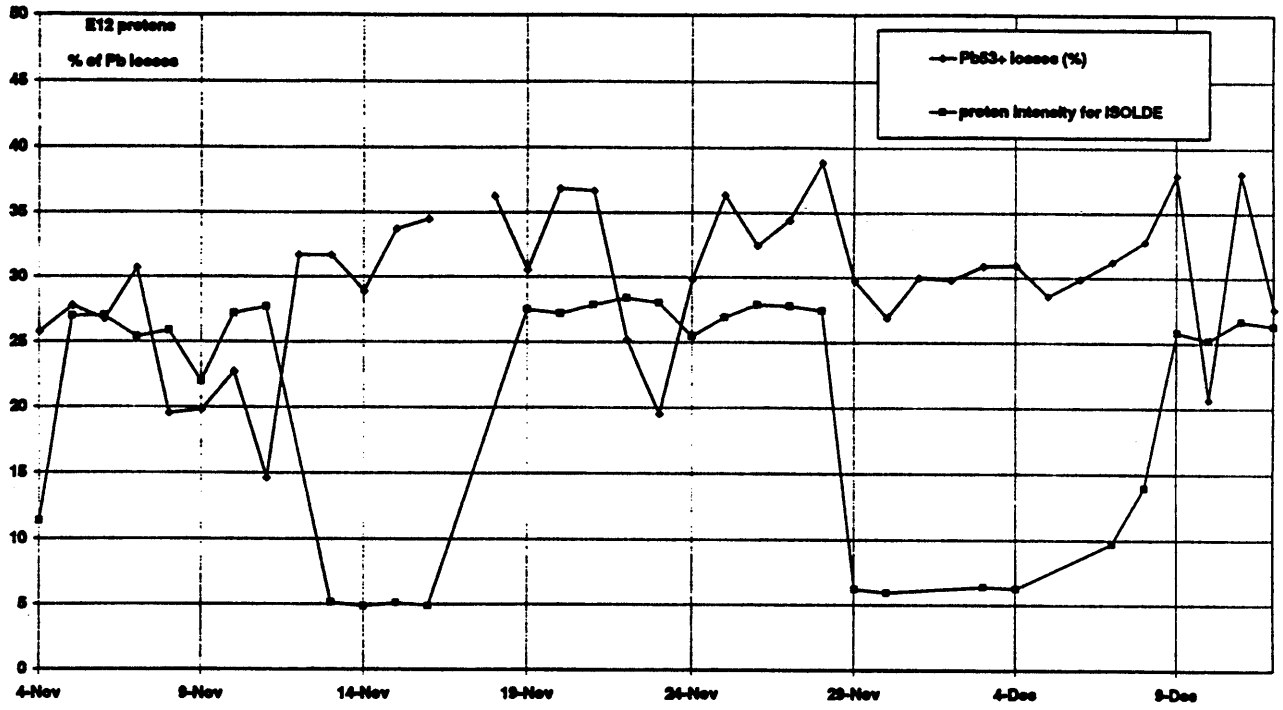
Fig 4



IONBOM4.JLS

Fig 5

1994- Run3 - PSBooster - Percentage of Pb53 losses in PSB and average proton intensity per cycle for ISOLDE



IONBOM.XLS

Fig 6

beamcurrents

File View Options Control Help

Ions to DUMP (E7) MEION ** Sep 20 10:47:20

Transfo names	RING 1		RING 2		RING 3		RING 4		SUM	
LTB.TRA55	1037	0%	-47	0%	-42	0%	9	0%	957	0%
BI.TRA10	2755	266%	1417	*****	1448	*****	1480	*****	7100	742%
BI.TRA20	1800	65%	1558	110%	1478	102%	1407	95%	6243	88%
INJECTION	1200	67%	903	58%	987	67%	713	51%	3804	61%
CAPTURE	648	54%	583	65%	497	50%	450	63%	2179	57%
BEF.DEBUN	448	69%	470	81%	318	64%	358	80%	1595	73%
AFT.DEBUN	378	84%	381	81%	200	63%	307	86%	1266	79%
ACCELER	323	85%	319	84%	156	78%	261	85%	1059	84%
BT.TRA									1043	98%
BTM.TRA									-3975	*****
BTY.TRA112									320	
BTP.TRA									226	
Number of turns	▲▲ ▲ 19.0 ▼▼ ▼		▲▲ ▲ 19.0 ▼▼ ▼		▲▲ ▲ 19.0 ▼▼ ▼		▲▲ ▲ 19.0 ▼▼ ▼		Send Ring 3 to all rings	

Update | Unfreeze | Freeze | All Lines | Asynchronous

User TSOGPS (ot/r.) before ~~MTE~~ Subtracting

Name	Status	Pressu
BI10.VGP1	On	3.90E-
BI10.VGP2	On	6.10E-
BR.VGP14L5	On	2.30E-
BR.VGP1SL1	On	2.30E-
BR.VGP1GL1	On	2.00E-
BR.VGP1GL5	On	1.00E-
BR.VGP1L1	On	1.00E-
BR.VGP1L5	On	7.40E-
BR.VGP2L1	On	6.10E-
BR.VGP3L1	On	7.60E-
BR.VGP5L5	On	4.20E-
BR.VGP7L1	On	8.40E-
BR.VGP9L1	On	2.40E-
BR.VGP11L1	On	1.10E-
BR.VGP12L5	On	4.80E-
BR.VGP13L5	On	1.80E-
BR.VGP14L1	On	7.10E-
BT10.VGP1	On	3.40E-
BT20.VGP1	On	7.00E-
BTP.VGP1	On	8.20E-
BTM.VGP1	On	2.80E-
BTY.VGP117	On	1.20E-
BTY.VGP149	On	1.80E-
BTY.VGP201	On	3.20E-

Fig 7

Final performance

beamcurrents

File View Options Control Help

Ions to DUMP (E7)

MEION ** Sep 20 11:10:21

Transfo names	RING 1		RING 2		RING 3		RING 4		SUM	
LTB.TRA55	935	0%	-121	0%	-115	0%	-100	0%	599	0%
BI.TRA10	2762	295%	1484	*****	1481	*****	1489	*****	7216	*****
BI.TRA20	1689	61%	1439	97%	1455	98%	1415	95%	5998	83%
INJECTION	1192	71%	981	68%	898	62%	788	56%	3860	64%
CAPTURE	785	66%	743	76%	502	56%	577	73%	2606	68%
BEF.DEBUN	579	74%	616	83%	328	65%	509	88%	2032	78%
AFT.DEBUN	514	89%	517	84%	284	86%	451	89%	1765	87%
ACCELER	442	86%	443	86%	234	83%	381	84%	1500	85%
BT.TRA									1458	97%
BTM.TRA									-4475	*****
BTY.TRA112									320	
BTP.TRA									208	
Number of turns	19.0		19.0		19.0		19.0		Send Ring 3 to all rings	

Update | Unfreeze | Freeze | All Lines | Asynchronous

Linac :DSC communication error 15 mn after sublimation

Name	Status	Pres
BI10.VGP1	On	3.9
BI10.VGP2	On	6.1
BR.VGP14L5	On	1.6
BR.VGP15L1	On	1.9
BR.VGP16L1	On	1.5
BR.VGP16L5	On	7.7
BR.VGP1L1	On	8.7
BR.VGP1L5	On	5.3
BR.VGP2L1	On	3.6
BR.VGP3L1	On	6.1
BR.VGP5L5	On	3.3
BR.VGP7L1	On	5.1
BR.VGP9L1	On	2.9
BR.VGP11L1	On	5.5
BR.VGP12L5	On	4.0
BR.VGP13L5	On	1.0
BR.VGP14L1	On	4.9
BT10.VGP1	On	3.3
BT20.VGP1	On	7.0
BTP.VGP1	On	7.9
BTM.VGP1	On	2.7
BTY.VGP117	On	1.2
BTY.VGP149	On	1.8
BTY.VGP201	On	3.2

New prototype Tuning and AVC modules installed for Ring 4.

Since the MD on Monday 11. September, new prototype AVC and Tuning modules (developed by Mauro Paoluzzi) have been installed for the C08 cavity and left in operation to gain operational experience and detect any possible adverse effect on beam stability at high intensity.
It is scheduled to change all 4 rings to this new system during the Jan./Feb./ shutdown in 1996.

Change of start pulse for BA4.GFASC08VRF from BX.WI0 to BX.STBD, new functions.

STATUS OF P_b IONS IN PS

RC 22.9.

* SIMULATION p BEAM @ 13 GeV/c

- Beam characteristics : $I_p \simeq 1 \div 5 \cdot 10^{10}$ p/p

  $\tau_b \simeq 4$ ns ; $\varepsilon_L \simeq 1.5$ meVs ; $dp/p \simeq \pm 2 \cdot 10^{-3}$

- PS–SPS TRANSMISSION MEASUREMENTS

$$\Rightarrow \quad I_{p\,SPS} / I_{p\,PS} \simeq \underline{0.90} \pm 5\%$$

(PS extr. $\eta \simeq 95\%$, SPS inj $\eta \simeq 95\%$)

$\Rightarrow$

	PS(ws)	TT2(SMF)	TT10(SMC)	SPS(ws
ε_x 2σ, π mm mrad	1.2 ±5%	1.19 ±5%	1.15	1.2
ε_y 2σ, π mm mrad	0.27 ±5%	0.27 ±5%	0.4	0.28

NO TRANSV. B.U. !

* P_b^{53+} BEAM

$I_p \simeq 2 \div 7 \cdot 10^9$ ch/pulse extracted

$\varepsilon_x \sim 1.8$ π mm mrad

$\varepsilon_y \sim 1.3$ π

extraction $\eta \simeq 90\%$, stripping $\eta \simeq 90\%$?

TO BE DONE : ① FINE E TUNING
② Check UP OF TRANSMISSION
③ STRIPPER OPTIMIZATION ...

LEAD ION BEAM STATUS IN SPS

Summary after week 37 MD

- **SU of a new supercycle** (as compared to 1994; same length of 19.2 s) :

  . new ion cycle (same length of 14.4 s)
  with intermediate flat-top at 26 GeV/c to improve beam structure

  . followed by 2 lepton cycles (1.2 s) for LEP filling

  . 2 cycles (1.2 s) at the end for possible proton and lepton MD's

- **With the proton beam** :

  . SU and steering of TT10 and injection
  good CPS-SPS transmissions in intensity and transverse emittances

  . Transverse SU of the new ion cycle
  tunes, chromaticities, orbits, but no extraction SU (lack of time)

- **With the lepton beams** :

  . SU of the positon cycle

  . SU of the electron cycle up to the middle of acceleration

- **With the ion beams** : (during the last few hours.....)

  . Injection of the 4 CPS cycles, with very low intensity
  total of ~ $5.\ 10^{9}$ finally obtained

  . Poor transmission on flat-bottom, beam off-center

  . SU of RF capture, transmission even worse

  . Acceleration of very little beam to the 26 GeV/c flat-top

  . not enough intensity to try debunching and recapture

Another MD session is necessary

Short term program (i.e. Week 39, 40 + MD of Week 41)

W39:

Mon 25/9 $p \rightarrow SPS$, $p_b \rightarrow PS$ $I_{PSB} \geq 10^{10}$

Tue 26/9 $p_b \rightarrow SPS$ ≤ 16 bunches

Wed 27/9 "

Thu 28 "

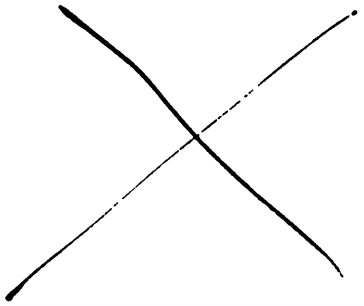
Fri 29 "

W40

Mon 2/10

Tue 3/10

Wed 4/10



W41 BI-SPS MD

We 11/10 $p_b \rightarrow SPS$

Long term program (RUN 3)

STRIPPER OPTIM. ON W43 OR 45

Distribution

B.W. Allardyce	PS	R. Ley	PS
G.L. Arduini	SL	M. Lindroos	PS
B. Autin	PS	J. Madsen	PS
S. Baird	PS	D. Manglunki	PS
J. Boillot	PS	M. Martini	PS
J. Bosser	PS	S. Maury	PS
M. Bouthéon	PS	G. Metral	PS
E. Brouzet	SL	C. Metzger	PS
H. Braun	PS	S. Myers	SL
R. Cappi	PS	D. Moehl	PS
F. Caspers	PS	H. Mulder	PS
M. Chanel	PS	F. Pedersen	PS
V. Chohan	PS	F. Perriollat	PS
J. Clendenin	PS	W. Pirkl	PS
G. Cyvoct	PS	J.P. Potier	PS
G. Daems	PS	N. Rasmussen	PS
D. Dekkers	PS	J. Riche	PS
J.P. Delahaye	PS	J.P. Riunaud	PS
D. Dumollard	PS	K. Schindl	PS
L. Durieu	PS	G. Schneider	PS
T. Eriksson	PS	M. Schneider	AT
B. Frammery	PS	H. Schönauer	PS
R. Garoby	PS	T.R. Sherwood	PS
G. Gelato	PS	D. Simon	PS
R. Giannini	PS	C. Steinbach	PS
M. Giovannozzi	PS	E. Tanke	PS
J. Gruber	PS	G. Tranquille	PS
S. Hancock	PS	H. Ullrich	PS
H. Haseroth	PS	H. Umstatter	PS
J.Y. Hémery	PS	B. Vandorpe	PS
Ch. Hill	PS	M. Vretenar	PS
K. Hübner	DG	D. Warner	PS
E. Jensen	PS	E. Wildner	PS
H. Koziol	PS		
K. Langbein	PS		
P. Lefèvre	PS		