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ISR PERFORMANCE REPORT

Run 1246 - Rings 1 & 2 - 26 GeV - 2 March 1982

Preparation of the double low-β scheme for physics at 26 GeV

Purpose and conclusion

As it was demonstrated[1] that stacking was possible with the double low-β scheme, this run was used to prove stacking efficiency and to check the space charge compensation in ring 1. It was possible to make two 15 A stacks, the space charge compensation procedure was identical to that of the SL machine and worked well.

The double low-β scheme was set up in ring 2, where 3 A were stacked.

1. Ring 1

The set up was made with the currents in the file previously created[1]. Injection was obtained without any problem.

The LB currents were slightly modified according to a new matching, in order to avoid saturation of LBQ1 during acceleration to 31 GeV. Some SL currents had to be adjusted.

The working line was adjusted to be the same as the one used for stacking with the SL machine. A 15 A stack was made with feedback in "ELSA" mode in order to check the space charge compensation with TUCO (i.e. the standard procedure). The measurements of the working line after compensation at 7 A and 15 A are shown in fig. 1: the compensation works well. The coupling compensation was made with this stack. A second stack was lost with the feed back in mode "SL" at 3 A. (Apparently only a part of the feedback system was working.) With the feedback OFF, the beam was lost at 6 A. The beam loss induced a quench in SL7 at 7 h.00. The feedback was then switched to "ELSA".

A 4th stack was made in order to try a luminosity measurement but the monitors in I8 did not work properly and it was only possible to measure h_{eff} in I5. The result was 3.5 mm ± 0.2 mm, which is satisfactory.

For both stacks the density obtained was about 0.7 A/mm, which guarantees stacking conditions for this machine as favourable as those of the SL machine.

The orbit at injection was copied in the file R1DL (see fig. 2) and the currents were kept in the file DL26. For ring 1 they are given in Table 1.

2. Ring 2

The currents used for the set up were:

- the PFW's currents of the file DL26, ring 1[1)]
- the QT's currents necessary for the DL machine in ring 2
- the H's currents of the file FP26, ring 2
- the BT's currents computed for the DL machine[2)]

When injection was possible, the working line was adjusted equal to that of the base machine obtained from the DL machine on the physics line (Q_h = 8.887, Q_v = 8.862, $Q'_{h\ v} \sim 2.5$). The measurement of the line of the base machine is shown on fig. 4 a). The C.O. distortion at injection is shown on fig. 3 a). The collimators around this orbit were set by POCO.

The SL insertion was turned on without cycling and its effect on the injection trajectory was cancelled by the correctors:

CR756	+ 10 %	CR804	- 7 %		
AFC2	+ 5 %	AFC4	- 9 %	H816	- 27 %

(AFC2 and AFC4 were both excited in order to spread the correction).

The LB insertion was turned on and its effect on the injection trajectory was cancelled by the correctors:

CR860	- 4.6 %	CR108	- 2.5 %
H848	- 17.8 %	H116	- 8 %

Then injection of 165 mA was possible, the proton losses in the SL quadrupoles were smaller than 10^{10} proton per injection. The closed orbit measured under these conditions is shown in fig. 3. The working line is shown in fig. 4 b). The value of Q_h is 0.01 below the expected value and

Q'_h is a little too small. However, in the vertical plane the agreement is very good. The discrepancy between measured and expected Q'_hs is larger than in the case of the SL insertion, suggesting that there could be a small excitation error in the F quadrupoles of the insertions although all currents correspond to the computed ones.

The horizontal orbit distorsion increased considerably with momentum. A correction was made by COCO witht the preset magnet option in order to remove the local correctors. However, it was only possible to reduce the horizontal p.t.p. amplitude to 23 mm at + 40 because a further correction at this position would have distorted the injection orbit, whose p.t.p. amplitude was already 23.5 mm. The phases of the distortions at injection and at + 40 were opposite, which confirms that there could be a F gradient error in the insertions. Up to now no error has been found in the current file which was made from the current in the machine at the end of the experiment.

The vertical orbit was corrected very well, the p.t.p. distortion was below 6.5 mm in the whole aperture.

The injection orbit was copies in the file R2DL, PR (see fig. 5). The currents necessary to operate the DL machine are in the file DL26 (see Table 2). 3 A were stacked in order to try a luminosity measurement.

T. Risselada A. Verdier

References

1. ISR Performance Report, Test of stacking possiblity on the prosposed double low-ß scheme, ISR-BOM/AV/rh, 18.12.1981.

2. Memorandum by V. Remondino on "Matching of the ISR beam transfer for the DL and p machines", 16.2.1982.

3. ISR Performance Report, First, second and third tests with the superconducting insertion, ISR-BOM-OP/GG/AV/rh, 12.1.1981.

Table 1

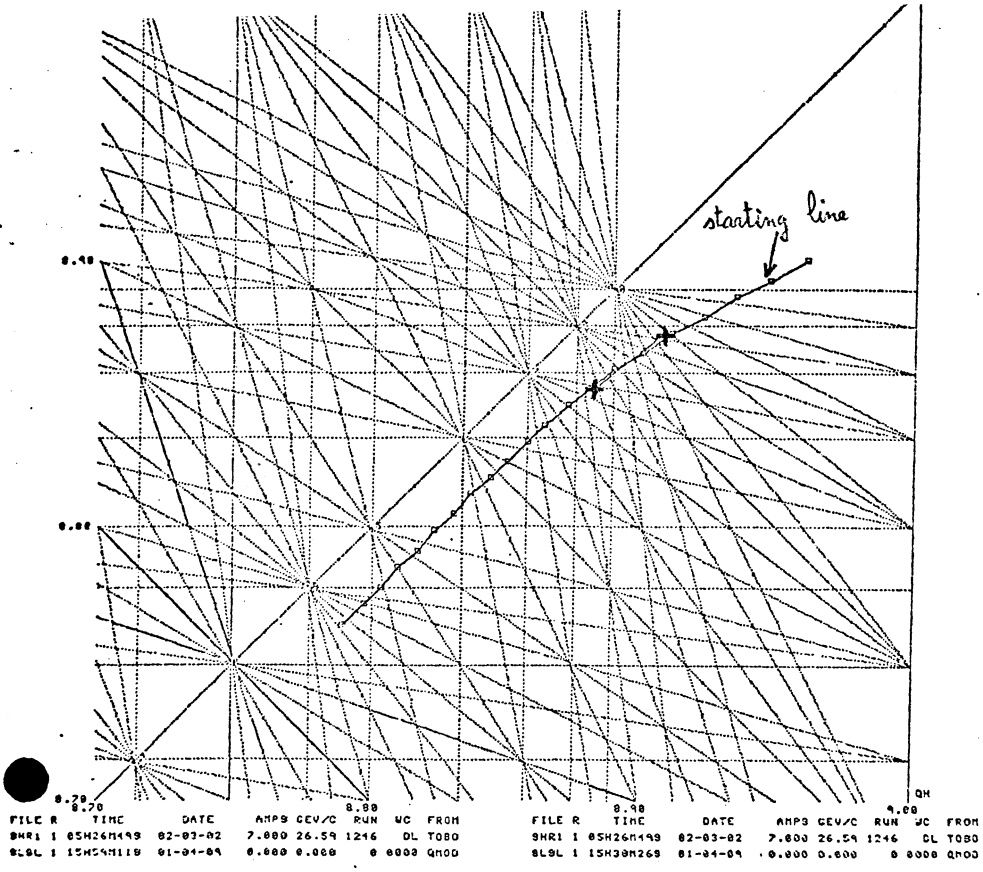
Currents in ring 1 for DL operation file DL 26

```
/XOUT(IF=DL26,R1,ALL)    TIME:09H35M39S     DATE:82-03-11
/LAST-RUN:1246    LAST-TIME:08H18M45S     LAST-DATE:82-03-02
/MA RUN R1/R2:1246/1246
   1GEV     +26.5908     1DVM     +76.539     1WL      DL
   1CP      +47.19
/OT RUN R1/R2:1246/1246
   1QT2     -23.44       1QT1     +13.82      1QT8     +0.44
   1QT3     -19.34       1QT5     +33.96      1QT6     -21.02
   1QT7     +40.94       1SLQ9    +82.93
/PF RUN R1/R2:1246/1246
   1PFF1    -59.91       1PFF2    -61.65      1PFF3    -40.21
   1PFF4    -35.40       1PFF5    -25.22      1PFF6    -18.12
   1PFF7    -12.52       1PFF8     -4.61      1PFF9     +7.67
   1PFF10   +16.11       1PFF11   +23.85      1PFF12   +32.57
   1PFD1    +39.40       1PFD2    -29.64      1PFD3    -33.59
   1PFD4    -31.91       1PFD5    -26.07      1PFD6    -27.17
   1PFD7    -25.44       1PFD8    -23.02      1PFD9    -19.43
   1PFD10    -9.38       1PFD11    -5.27      1PFD12    +0.07
/H RUN R1/R2:1246/1246
   1H117    +20.00       1H253    -27.88      1H349    +14.99
/CR RUN R1/R2:1246/1246
   1CR825    +5.69       1CR145    -4.00      1CR729   -14.09
/SO RUN R1/R2:1246/1246
/QS RUN R1/R2:1246/1246
   1QS1      +0.22       1QS2      -0.68      1QS3      +0.24
   1QS4      -2.59       1QS5     -13.33      1QS6      +2.95
   1QS7      -9.64
/SL RUN R1/R2:1246/1246
   1SLQ1    +74.179      1SLS1    +47.85      1SLD1    +68.77
   1SLQ3    +81.830      1SLS3    +47.85      1SLD3    +36.01
   1SLQ5    +73.502      1SLS5    +47.95      1SLD5    -23.34
   1SLQ7    +74.866      1SLS7    +34.40      1SLD7     +5.74
/LB RUN R1/R2:1246/1246
   1LBQ1    +84.64       1LBQ3    -65.23      1LBQ5    +65.84
   1LBQ7    +53.10       1LBQ9    -68.65
/AFM RUN R1/R2:1246/1246
/T2 RUN R1/R2:1246/1246
   QF337M   +76.982      QD338M   +78.180     VB303M   +75.452
   HB332    +41.477      QD346    +54.741     QF347    +21.295
   QD348    +45.058      QF349    +56.203     VB309    +57.066
   QD350    +55.100      QF351    +82.403     VH301M   +85.183
/T6 RUN R1/R2:1246/1246
/T1U RUN R1/R2:1246/1246
/T1D RUN R1/R2:1246/1246
/EM RUN R1/R2:1246/1246
/SFM RUN R1/R2:1246/1246
   1TRIM    +20.685      SFM      -84.784     SCM1     +62.135
   LCM1     +64.447
/TH RUN R1/R2:1246/1246
   HB333    +12.343      HB334    +52.817     IK717    +54.81
/TV RUN R1/R2:1246/1246
   VB307    +37.132      VB308    +56.916
/ END OF DATA
```

Table 2

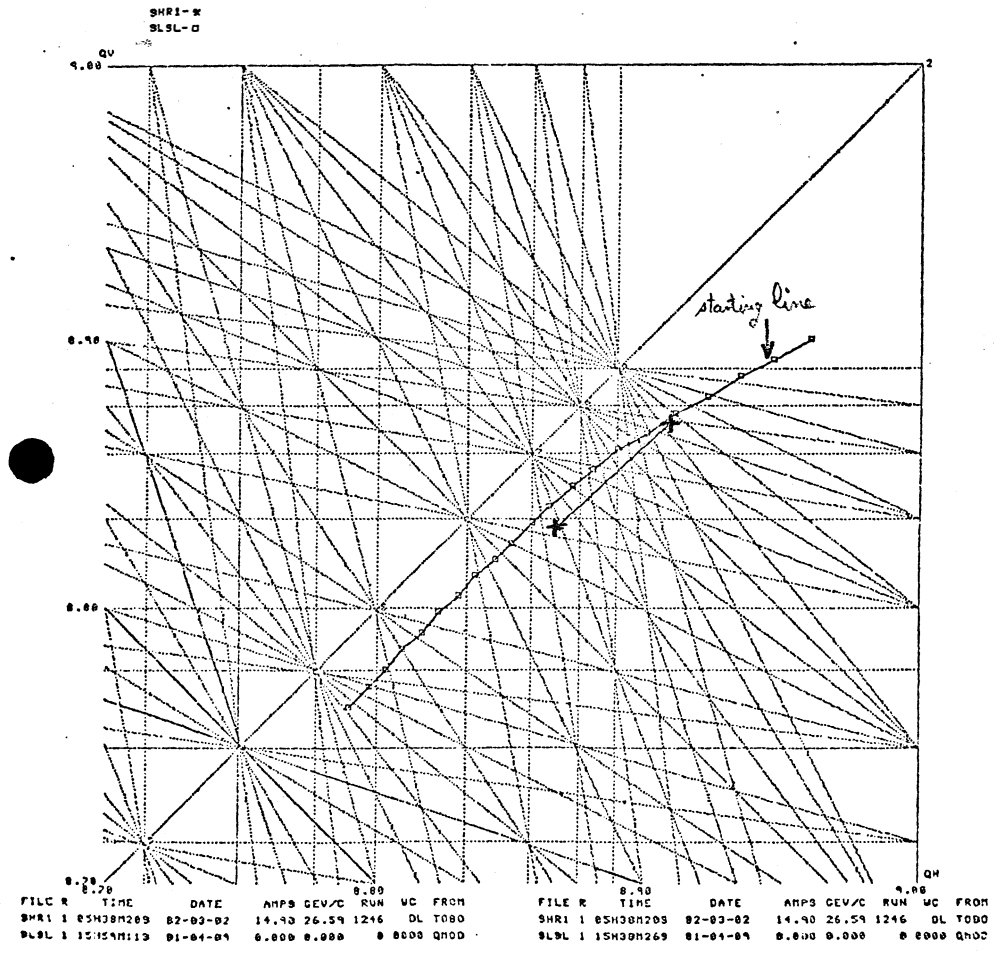
Currents for DL operation in ring 2. File DL26

```
/XOUT(IF=DL26,R2,ALL)     TIME:11H08M53S      DATE:82-03-05
/LAST-RUN:1246    LAST-TIME:08H18M45S      LAST-DATE:82-03-02
/MA RUN R1/R2:1246/1246
   2GEV      +26.5916     2DVM      +76.507      2WL       DL
   2CF       +42.65
/OT RUN R1/R2:1246/1246
   2QT2      -23.44       2QT1      +13.89       2QT8      +0.42
   2QT3      -19.31       2QT5      +39.89       2SF       +0.02
   2QT6      -21.02       2QT7      +40.94       2SLQ10    +83.45
/PF RUN R1/R2:1246/1246
   2PFF1     -24.90       2PFF2     -45.17       2PFF3     -31.59
   2PFF4     -25.66       2PFF5     -15.65       2PFF6     -11.99
   2PFF7      -7.69       2PFF8      +0.10       2PFF9     +10.79
   2PFF10    +17.85       2PFF11    +25.83       2PFF12    +30.00
   2PFD1      -8.33       2PFD2     -26.66       2PFD3     -22.78
   2PFD4     -17.90       2PFD5     -13.67       2PFD6     -19.87
   2PFD7     -18.85       2PFD8     -12.84       2PFD9     -11.23
   2PFD10     -4.71       2PFD11     -0.85       2PFD12     -2.08
/H RUN R1/R2:1246/1246
   2H848      +6.98
/CR RUN R1/R2:1246/1246
   2CR420    +16.80       2CR520    -7.01
/SO RUN R1/R2:1246/1246
/QS RUN R1/R2:q246/1246
/SL RUN R1/R2:1246/1246
   2SLQ2     +75.394      2SLS2     +41.16       2SLD2     +22.02
   2SLQ4     +81.966      2SLS4     +47.88       2SLD4     -17.58
   2SLQ6     +72.794      2SLS6     +47.97       2SLD6     -34.69
   2SLQ8     +74.414      2SLS8     +47.88       2SLD8     +45.14
/LB RUN R1/R2:1246/1246
   2LBQ2     +86.06       2LBQ4     -56.84       2LBQ6     +49.19
   2LBQ8     +58.08       2LBQ10    -67.50
/AFM RUN R1/R2:1246/1246
   2AFC4     -17.38
/T2 RUN R1/R2:1246/1246
/T6 RUN R1/R2:1246/1246
/T1U RUN R1/R2:1246/1246
   QD408     +59.949      HB412     +75.504      QF409     +60.532
   HB404M    +75.630      QD410     +60.687      QF411     +64.580
   QD412     +66.754      QF413     +64.079      HB428M    +68.413
/T1D RUN R1/R2:1246/1246
   HB435C    -60.03       QD414M    +81.046      QF415M    +64.624
   VB403M    +75.591      HB432      +4.062      QD446     +61.922
   QF447     +49.849      QD448     +64.238      QF449      +55.806
   VB409     +57.662      QD450     +51.767      QF451     +61.362
   VH401M    +85.121
/EM RUN R1/R2:1246/1246
/SFM RUN R1/R2:1246/1246
   2TRIM     +21.652      SCM2      +62.169      LCM2      +64.448
   HB433     +19.051      HB434     +15.328      IK248     +60.03
/TV RUN R1/R2:1246/1246
   VB407     +31.647      VB408     +59.331   J/ END OF DATA
```



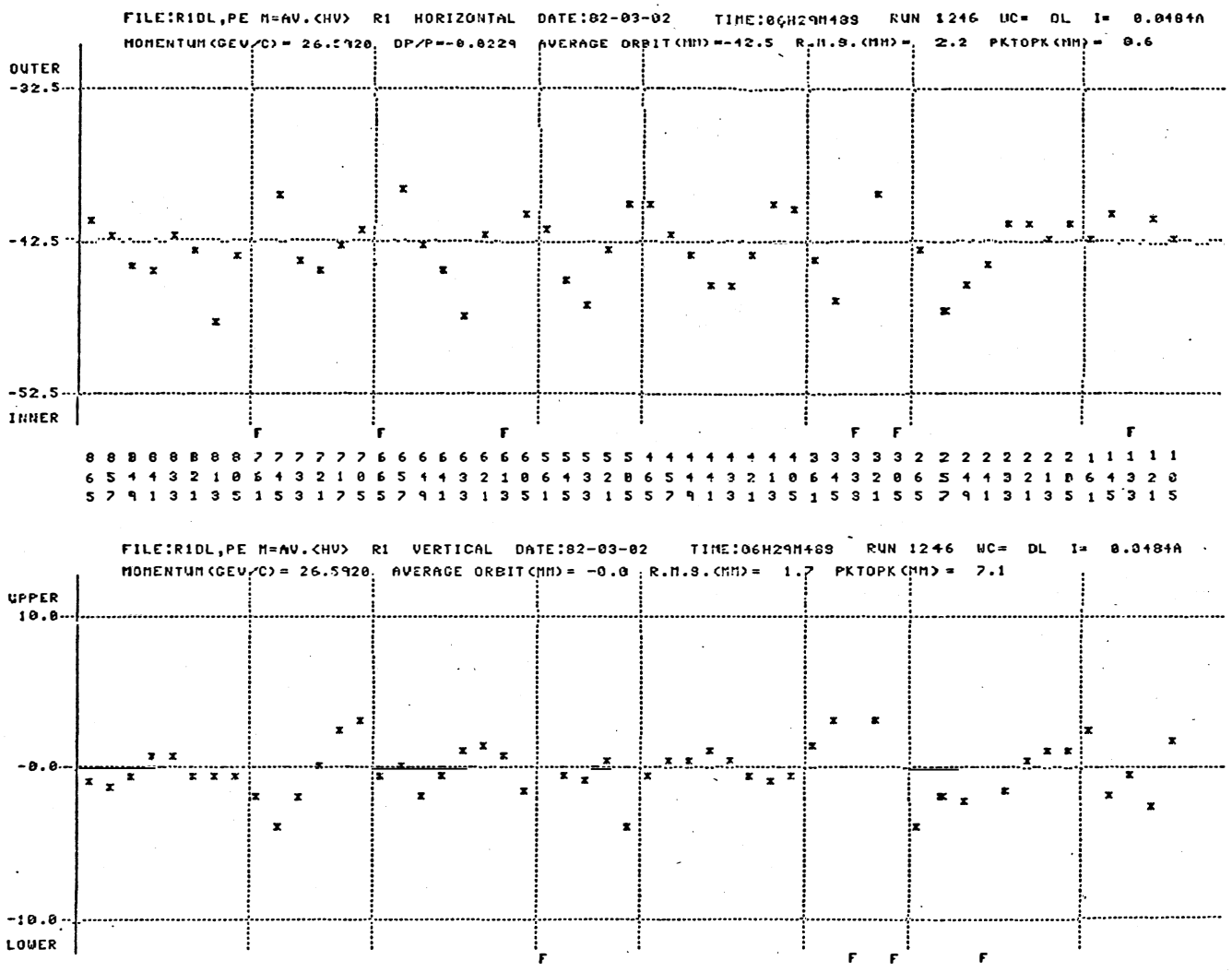
7 A stacked

Measurement of the working lin
after space charge compensatio
by means of the Schottky scans
Only the crosses are measured.



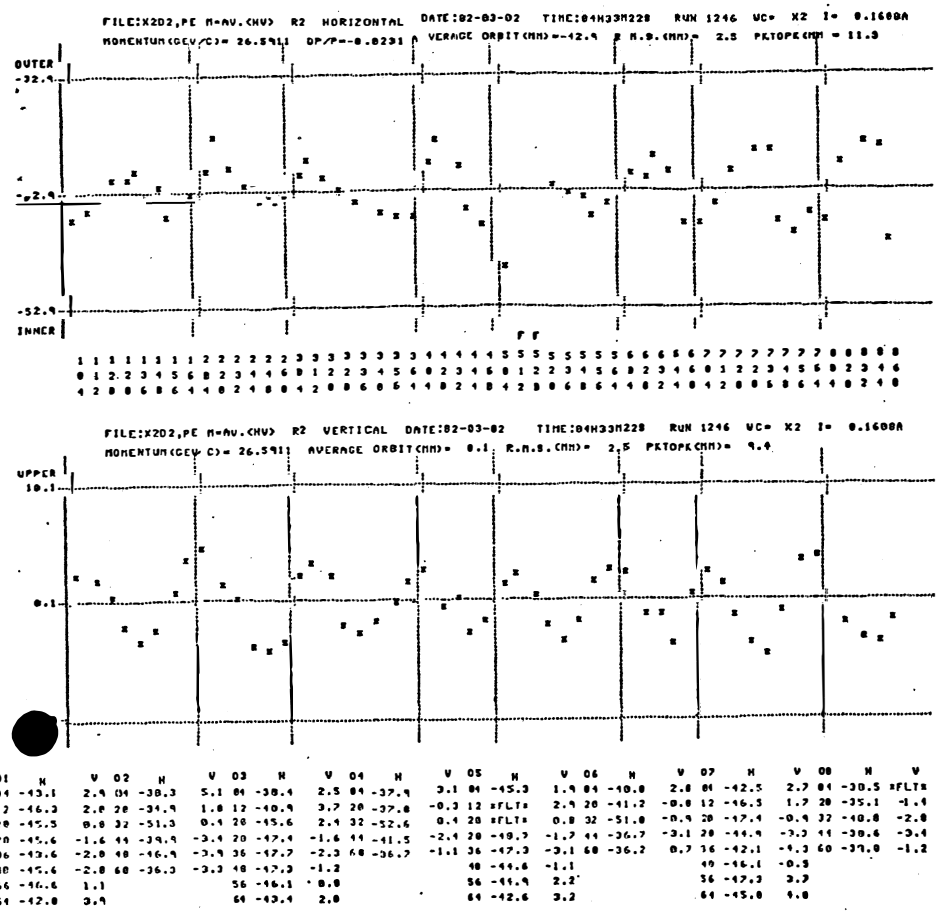
15 A stacked

Fig. 1



08	H	V	07	H	V	06	H	V	05	H	V	04	H	V	03	H	V	02	H	V	01	H	V
65	-35.6	-0.8	61	xFLTx	-1.6	65	xFLTx	-0.2	61	-38.3	xFLTx	65	-35.3	-0.3	61	-41.7	1.5	65	-38.3	-3.7	61	-41.2	2.7
57	-39.9	-1.0	45	-35.6	-3.8	57	-39.0	0.3	45	-42.2	-0.4	57	-42.2	0.6	45	-44.8	3.3	57	-48.2	-1.3	45	-38.7	-1.7
49	-45.3	-0.3	33	-54.4	-1.8	49	-45.5	-1.9	33	-58.2	-0.6	49	-17.2	0.5	33	xFLTx	xFLTx	49	-50.1	-2.1	33	xFLTx	-0.4
41	-48.9	1.0	21	-43.3	0.2	41	-47.7	-0.3	21	-41.3	0.5	41	-49.6	1.3	21	-36.3	3.1	41	-48.2	xFLTx	21	-37.3	-2.5
33	-46.6	1.1	17	-45.9	2.5	33	-49.8	1.2	05	-52.7	-3.7	33	-47.7	0.7	05	xFLTx	xFLTx	33	-42.6	-1.2	05	-32.4	2.1
21	-47.3	-0.3	05	-35.8	3.3	21	-46.1	1.7				21	-46.2	-0.4				21	-43.7	0.7			
13	-48.3	-0.5				13	xFLTx	1.1				13	-41.9	-0.7				13	-44.6	1.1			
05	-41.4	-0.5				05	-40.7	-1.3				05	-40.0	-0.3				05	-43.0	1.3			

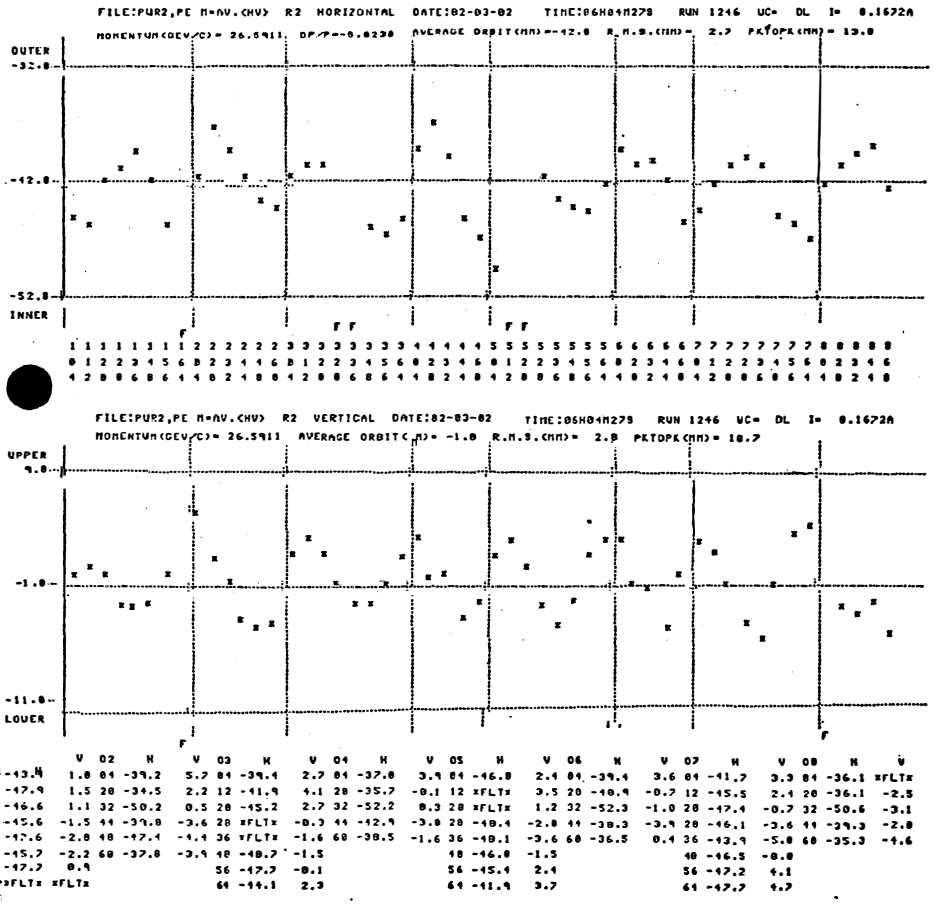
Fig. 2: Injection orbit, for DL set up R1 associated with the currents in Table 1.



01	H	V	02	H	V	03	H	V	04	H	V	05	H	V	06	H	V	07	H	V	08	H	V
04	-43.1	2.4	04	-38.3	5.1	04	-38.4	2.5	04	-37.9	3.1	04	-45.3	1.9	04	-40.8	2.8	04	-42.5	2.7	04	-38.5	#FLT#
12	-46.3	2.8	20	-34.9	1.8	12	-40.9	3.7	20	-37.8	-0.3	12	#FLT#	2.9	20	-41.2	-0.8	12	-46.5	1.7	20	-35.1	-1.4
20	-45.5	0.8	32	-51.3	0.4	20	-45.6	2.4	32	-52.6	0.4	20	#FLT#	0.8	32	-51.0	-0.9	20	-47.4	-0.4	32	-40.8	-2.8
28	-45.6	-1.6	44	-39.9	-3.4	28	-47.4	-1.6	44	-41.5	-2.4	28	-48.3	-1.2	44	-36.7	-3.1	28	-44.9	-3.3	44	-38.6	-3.4
36	-43.6	-2.8	48	-46.9	-3.9	36	-47.7	-2.3	68	-36.2	-1.1	36	-47.3	-3.1	68	-36.2	0.7	36	-42.1	-4.3	68	-39.8	-1.2
48	-45.6	-2.8	68	-36.3	-3.3	48	-47.3	-1.2				48	-44.6	-1.1				48	-46.1	-0.8			
56	-46.6	1.1				56	-46.1	0.8				56	-44.9	2.2				56	-47.3	3.9			
64	-42.8	3.9				64	-43.4	2.8				64	-42.6	3.2				64	-45.8	4.8			

Fig. 3 a):

orbit distortion at injection for the base machine



H	V	02	H	V	03	H	V	04	H	V	05	H	V	06	H	V	07	H	V	08	H	V
-43.4	1.8	04	-39.2	5.2	04	-39.4	2.2	04	-37.8	3.9	04	-46.8	2.4	04	-39.4	3.6	04	-41.2	3.3	04	-36.1	#FLT#
-47.9	1.5	20	-34.5	2.2	12	-41.9	4.1	20	-35.7	-0.1	12	#FLT#	3.5	20	-40.9	-0.7	12	-45.5	2.4	20	-36.1	-2.5
-46.6	1.1	32	-50.2	0.5	20	-45.2	2.7	32	-52.2	0.3	20	#FLT#	1.2	32	-52.3	-1.0	20	-47.4	-0.7	32	-50.6	-3.1
-45.6	-1.5	44	-39.8	-3.6	28	#FLT#	-0.3	44	-42.9	-3.0	28	-48.4	-2.8	44	-38.3	-3.9	28	-46.1	-3.6	44	-39.3	-2.8
-47.6	-2.8	48	-47.4	-4.4	36	#FLT#	-1.6	68	-38.5	-1.6	36	-48.1	-3.6	68	-36.5	0.4	36	-43.9	-5.8	68	-35.3	-4.6
-45.2	-2.2	68	-37.8	-3.9	48	-48.2	-1.5				48	-46.8	-1.5				48	-46.5	-0.8			
-47.2	0.9				56	-47.2	-0.1				56	-45.4	2.4				56	-47.2	4.1			
#FLT#	#FLT#				64	-44.1	2.3				64	-41.9	3.2				64	-47.2	4.2			

Fig. 3 b):

orbit distortion at injection just after the local correction of the insertions.

Fig. 3

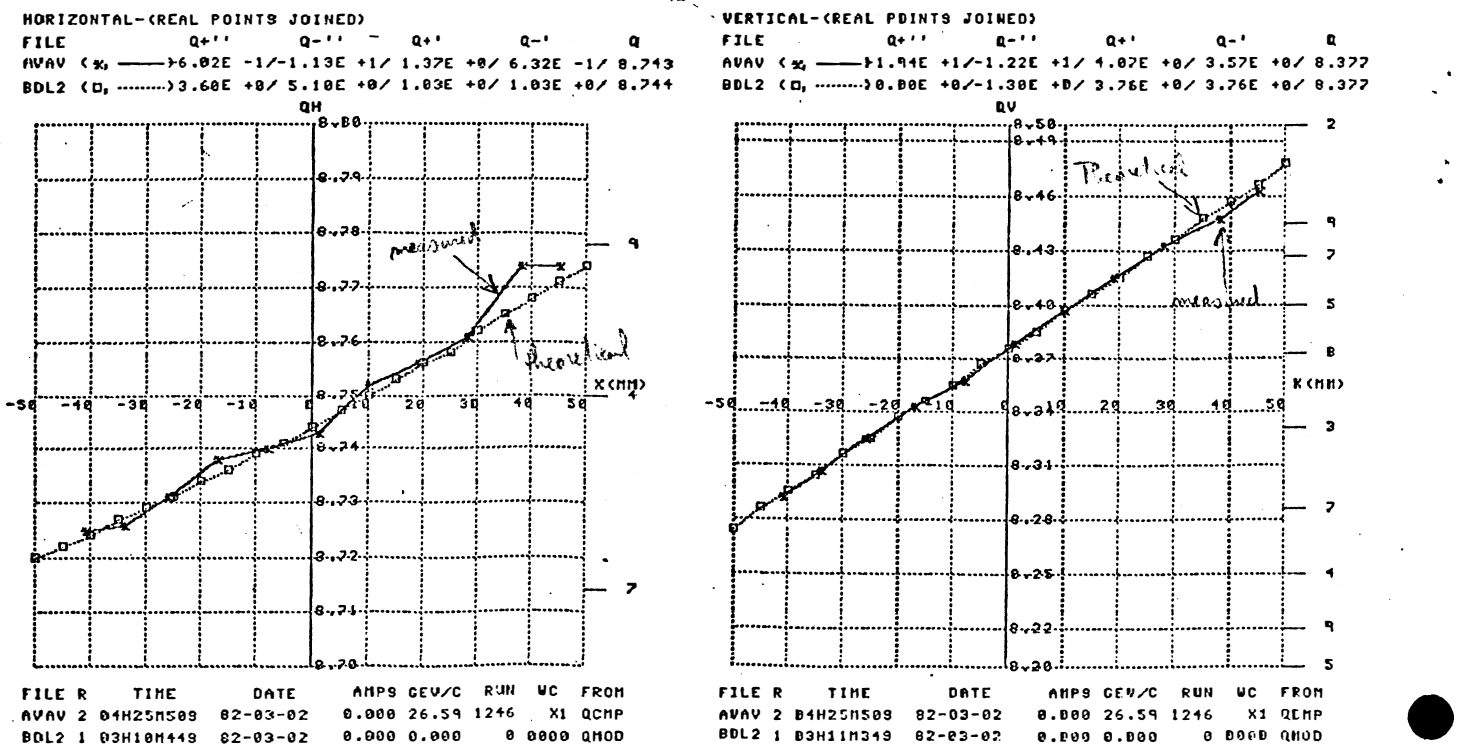


Fig. 4 a): Measurement of the working line of the base machine

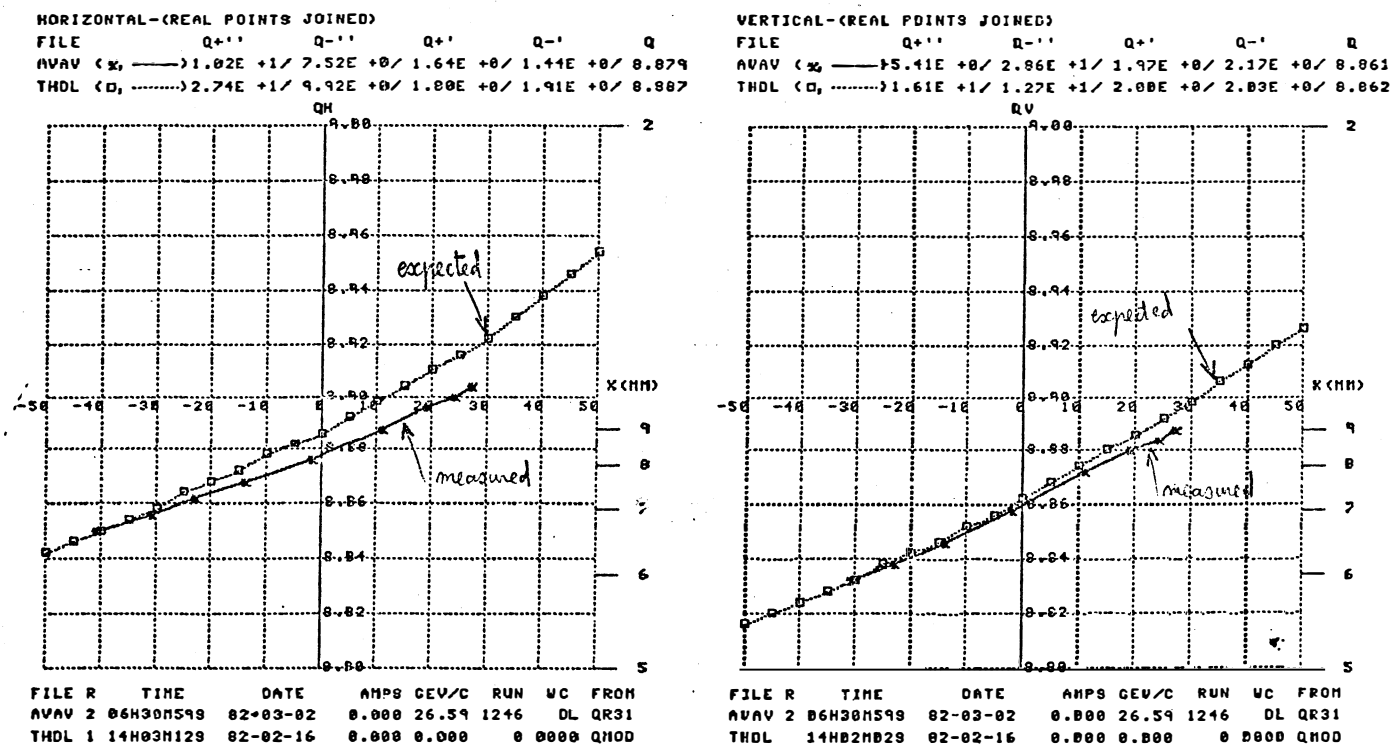
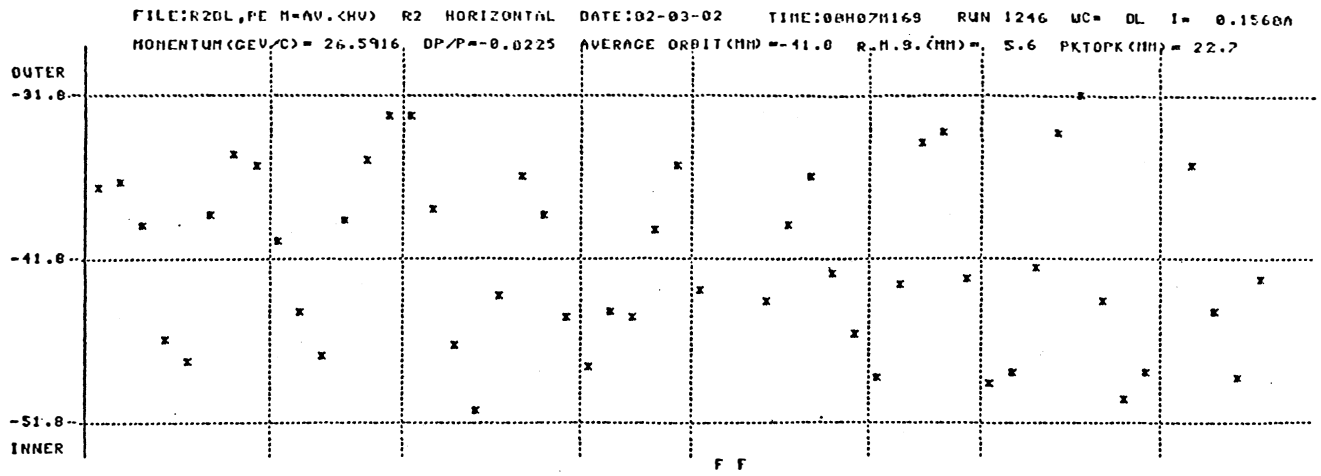
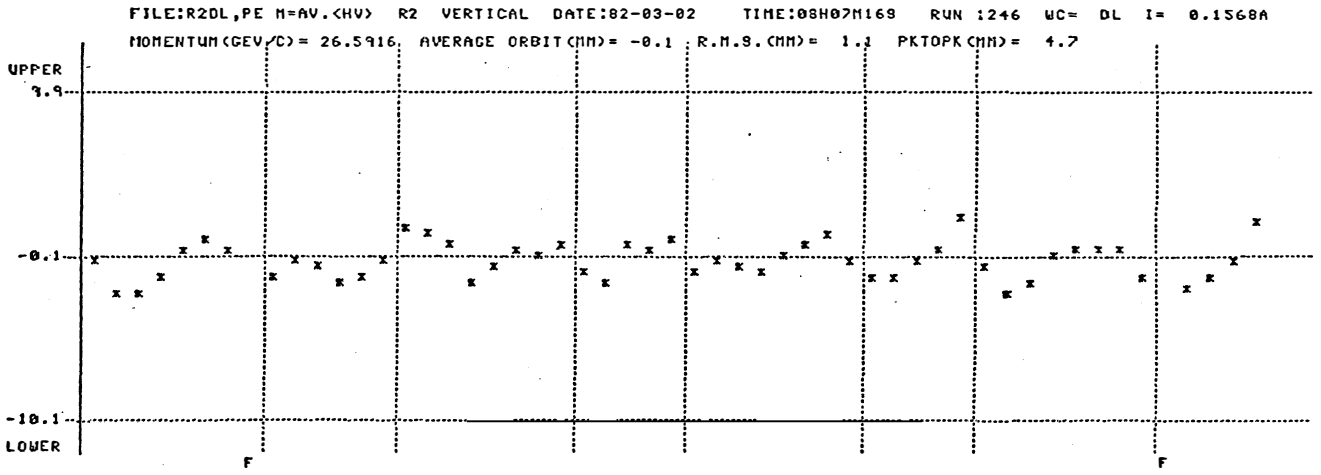


Fig. 4 b): Working line obtained after having turned on the two intersections





01	H	V	02	H	V	03	H	V	04	H	V	05	H	V	06	H	V	07	H	V	08	H	V
04	-35.6	-0.2	04	-37.9	-1.2	04	-30.1	1.8	04	-45.8	-0.6	04	-39.7	-0.6	04	-48.3	-1.1	04	-46.1	-0.5	04	-21.6	xFLTx
12	-38.8	-2.3	20	-42.0	-0.2	12	-39.6	1.5	20	-43.6	-1.4	12	xFLTx	-0.1	20	-42.8	-1.0	12	-51.1	-2.0	20	-31.1	-1.7
20	-43.4	-2.0	32	-57.7	-0.3	20	-51.1	0.9	32	-56.9	0.8	20	xFLTx	-0.4	32	-45.7	-0.2	20	-48.1	-1.3	32	-55.0	-1.2
28	-50.3	-1.0	44	-37.1	-1.3	28	-55.9	-1.6	44	-37.3	0.5	28	-50.4	-0.7	44	-29.5	0.5	28	-39.4	0.0	44	-48.6	0.0
36	-50.9	0.5	48	-39.0	-1.1	36	-47.9	-0.6	60	-27.4	1.3	36	-43.4	0.1	60	-33.9	2.4	36	-34.2	0.4	60	-35.1	2.2
48	-42.0	1.1	60	-26.2	-0.0	48	-39.2	0.5				48	-37.6	0.7				48	-45.2	0.4			
56	-37.3	0.6				56	-39.8	0.3				56	-42.7	1.4				56	-51.2	0.4			
64	-35.2	xFLTx				64	-43.7	0.7				64	-45.3	0.0				64	-48.9	-1.1			

Fig. 5: Injection orbit, for DL set up R2, associated with the currents in Table 2.