VACUUM TESTS IN THE BOOSTER WITH SUBLIMATION PUMPS

1- INTRODUCTION

In view of the probable upgrading of the vacuum in the Booster for heavy ions acceleration , some tests have been performed during the last Shut-down (Jan-88).
We tried the most efficent and economical proposal , as described in Technical Note PS. / Note Tech. 88-8. by installing in Sector 5 four additional Vacuum Sublimation Pumps (VPS) borrowed from SPS , with their power supplies .

Sector 5 was choosen for the following reasons :
-It is a short sector having a relatively heavy gas load due to the Septum Magnet BE/SMH (SS 15 L1) .
- It is possible to estimate the future pressure distribution around the ring from the pressure measurements at the end of Sect. 5, which is similar to 80% of the Booster chamber (gas load only) .

The Pumps were connected to the Vacuum Manifolds in SS L1 and L5 in such way that the titanium sublimates mainly into the manifolds thus increasing the pumping speed . Pump filaments were fired for 30 secondes every 90 minutes . Sublimation and interval times may be adjusted depending pressure conditions, these figures are optimised for the Septum tank in which the final pressure is $7x10^{-9}$ torr.

2 - STARTING SITUATION (before sublimation)

As the pumping speed of ion-pumps (VPI) is well known , thanks to F.L.Hoekmeijer who measured all our new and overhauled pumps for years , one can estimate 300 l/s a conservative figure for partialy saturated VARIAN 400 l/s .

Total pressures were accurately measured by means of 4 added ion-gauges (VGI) close to the vacuum manifolds . Effective pumping speed to be $S_{eff.}$=150 l/s near the beam orbite have been calculated .

With total pressure and effective pumping speed , gas load has been calculated (see Fig. 1).

3- EXPERIMENT WITH SUBLIMATION PUMPS .

VPS were started according to SPS procedure , from $2x10^{-7}$ down to $7x10^{-9}$ torr .

As gas load is unchanged between the two measurements (with and without additional pumps) , VPS pumping speed has been evaluated to be 1600 l/s .

As gas load and vacuum chamber surface are well known , one can calculate specific outgasing to be $4 x 10^{-12}$ torr l/s cm^{-2}.

4- RESULTS .

Experimental measurements were compared with the pressure distribution and mean pressure in a serie of vacuum segments as computed by a simulation program .

As the gauge readings and computed pressures are well in accordance (see Fig. 2), this program has then been run to evaluate by extrapolation pressure distribution and mean pressure , in the case of an extensive use of VPS around the Booster vacuum chamber .

For this simulation , we used the following parameters :

-Pumping speeds.

Existing VPI's	on manifolds	150 l/s
Existing VPI's	on tanks	300 l/s
Added VPS's		1600 l/s

- Gas loads. (Estimated after VPI 's pump current .

BI-SMH (1L1)	1×10^{-5} torr l/s
TARGET TANK (9L1)	4×10^{-6} torr l/s
KFA (14L1)	3×10^{-5} torr l/s
BE- SMH (15L1)	1.5×10^{-5} torr l/s

-Pump distribution (see Fig. 3)

29 VPS connected on existing manifolds .
7VPS connected on manifolds to be built .
3 VPS connected on Tank BI-SMH
1 VPS connected on Target tank
3 VPS connected on Tank BE-KFA
2 VPS connected on Tank BE-SMH

- Specific outgasing : 4×10^{-12} torr l/s cm^2

5- CONCLUSION

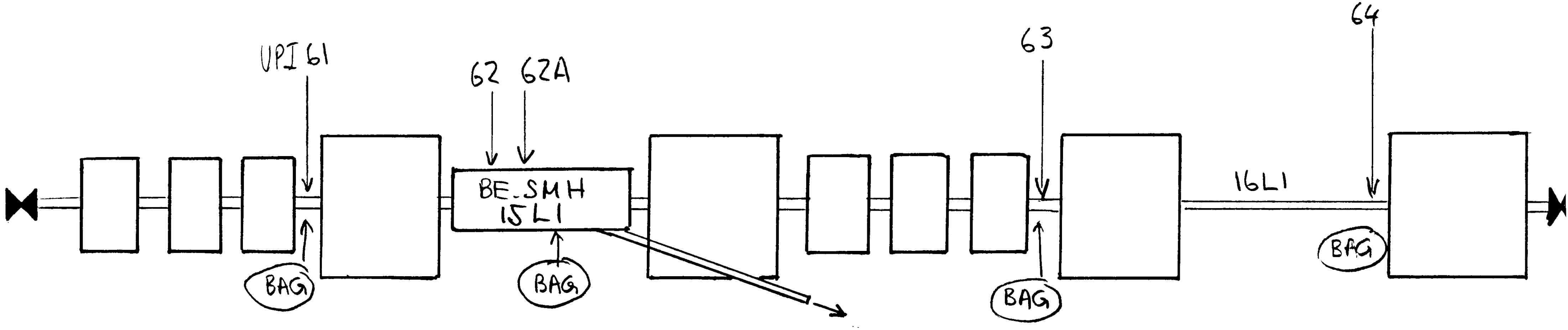
According to the simulation program (see Fig.4 A to E) the mean pressure in tanks BI-SMH , BE-KFA and BE-SMH is 4×10^{-9} torr their total length represents 4 % of the total circumference therefore the equivalent distributed pressure around the ring will be 1.6×10^{-10} torr . For the rest of the machine (96%) the mean pressure is about 5×10^{-10} torr , hence the MEAN PRESSURE in the " BR " ring will be , with the help of 45 sublimation pumps 6.6×10^{-10} torr

At such pressure the gas composition will probably be 80 % Hydrogen and 20 % nitrogen + carbon monoxyde .

THE TRUE MEAN PRESSURE IN THE "BR" VACUUM CHAMBER WILL BE ROUGHLY 1.45×10^{-9} torr (1.9×10^{-9} mbar)

M . BROUET 29 - 03 - 88

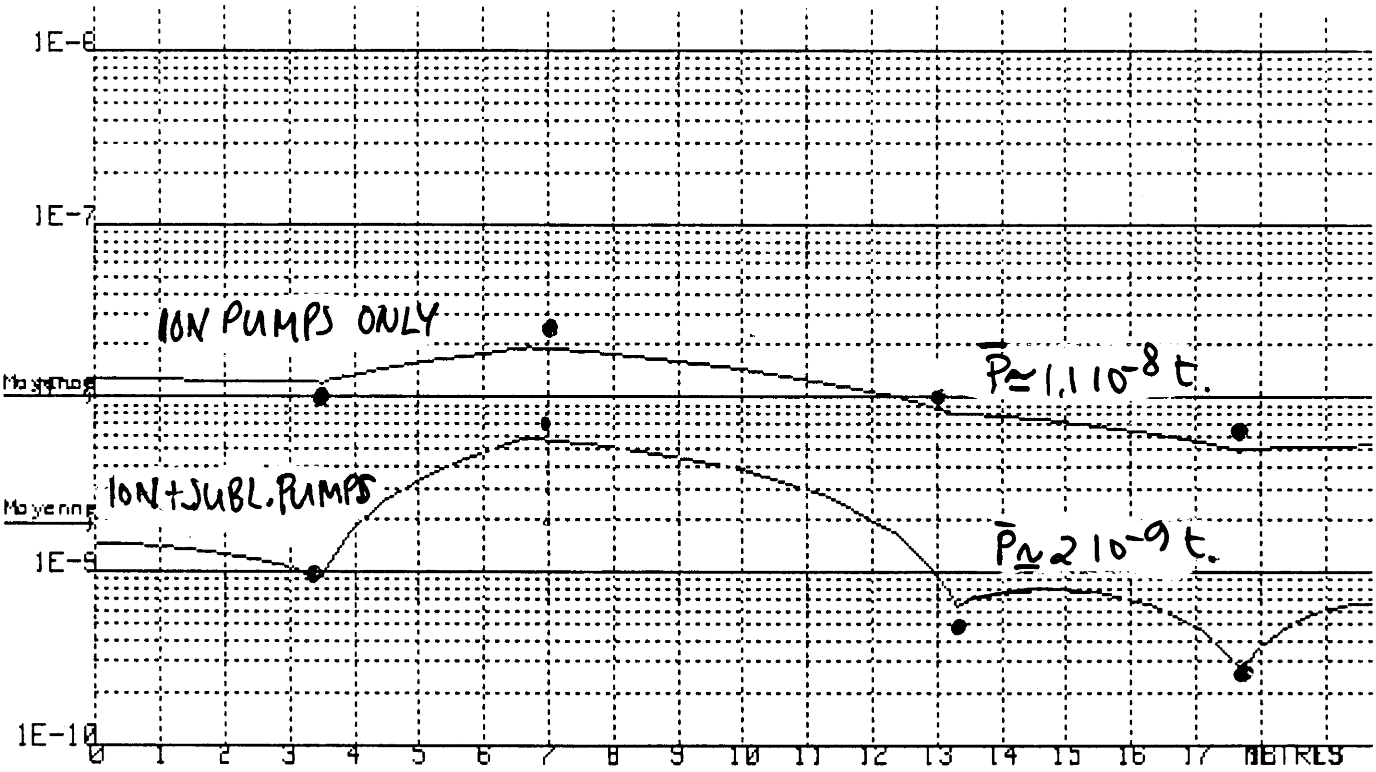
BR. SECTOR 6 . ION PUMPS ONLY



PUMPING SPEED l/s	150	300X2	150	150
PRESSURE (BAG) torr	1×10^{-8}	$2.4\ 10^{-8}$	1×10^{-8}	$6.5\ 10^{-9}$
GAS LOAD Torr l/s	$1.5\ 10^{-6}$	$1.5\ 10^{-5}$	$1.5\ 10^{-6}$	1×10^{-6}

FIG. 1

BAG = BAYARD ALPERT GAUGE

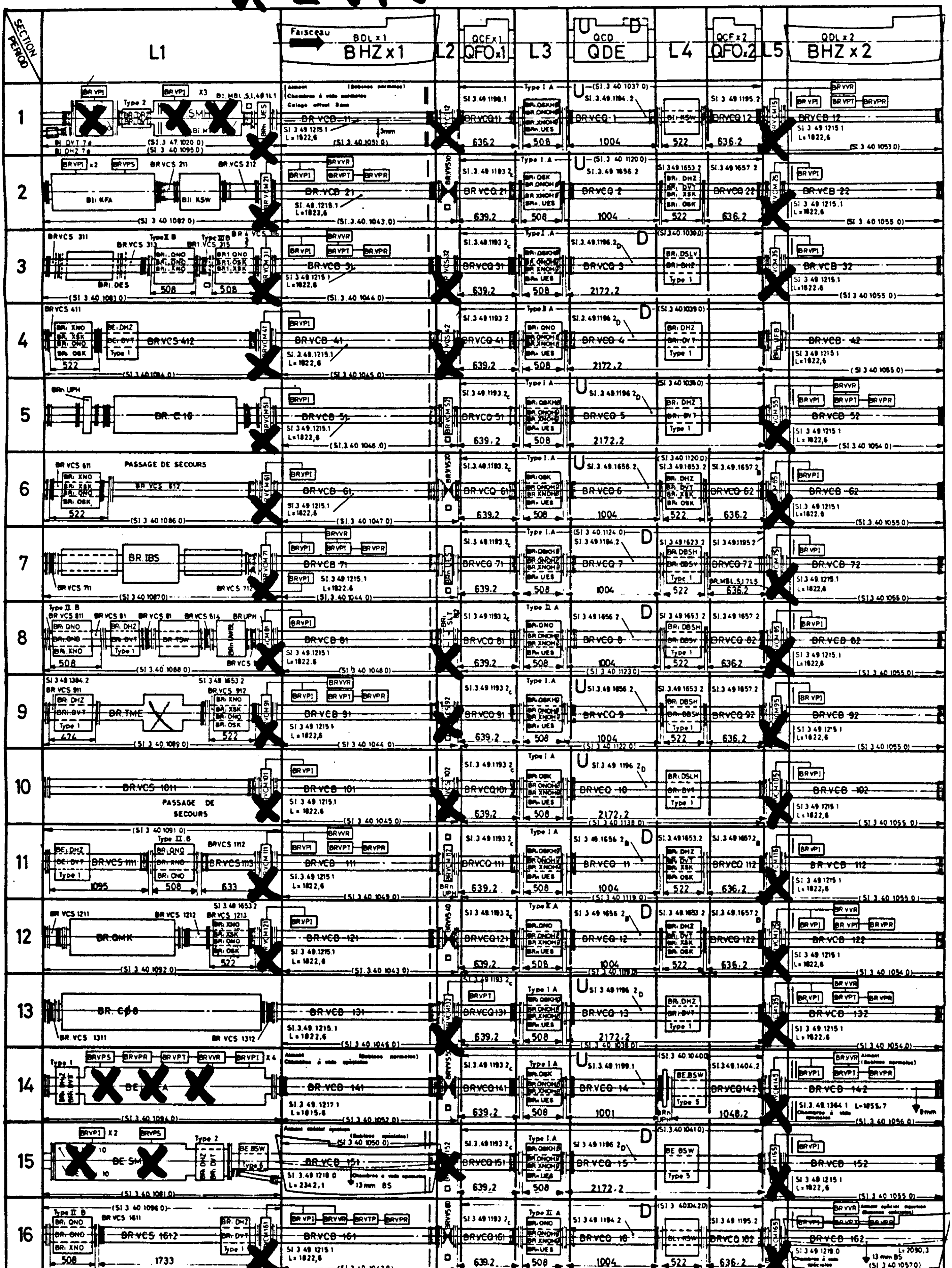


BR. SECT. 5Ø. PRESSURE DISTRIBUTION. (PROGRAM)

• = Gauge readings (EXPERIMENT)

FIG. 2

X = VPS



NOTA:
□ = MBL.S.I
de 1L2 à 16L2

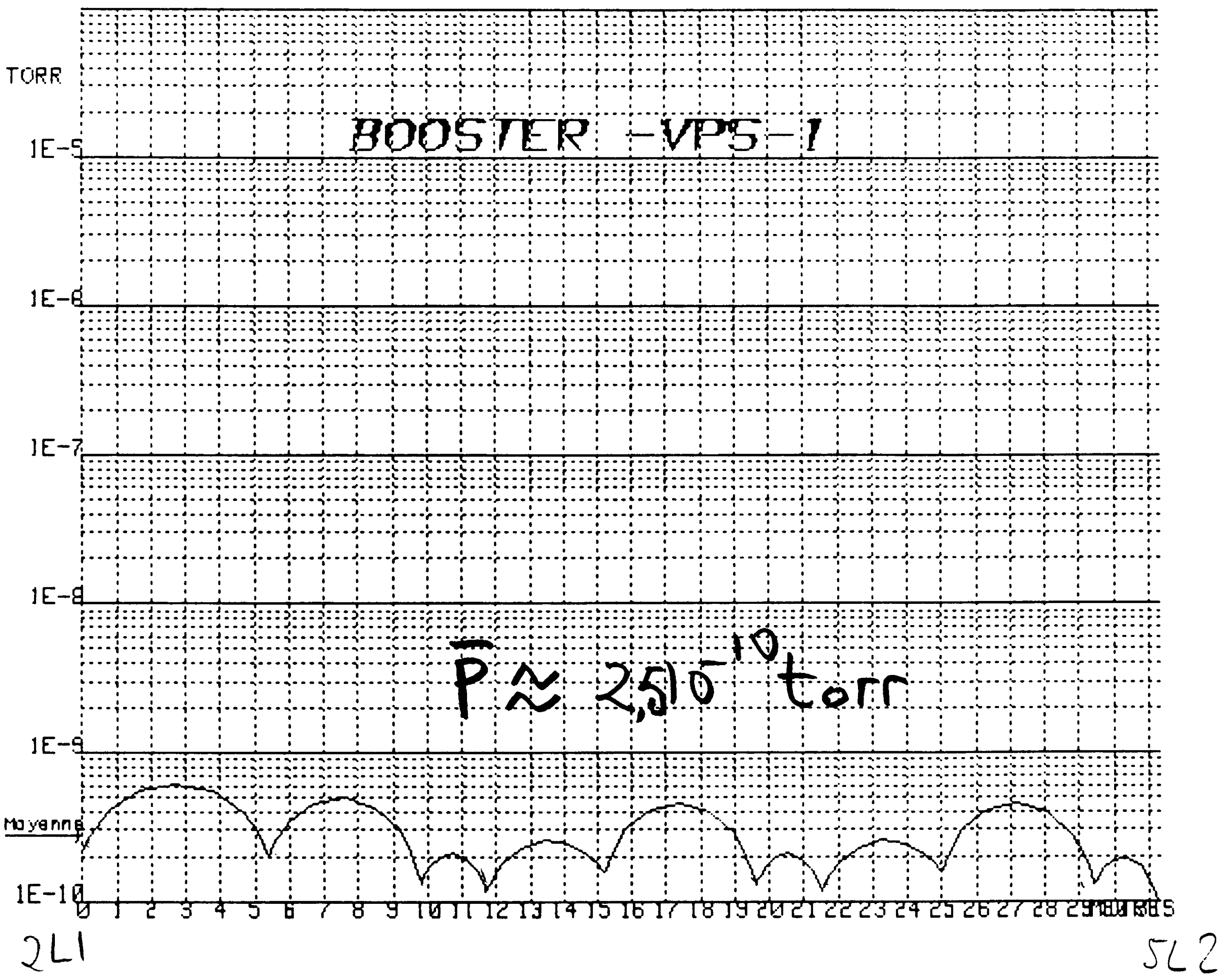
LAYOUT OF VACUUM SYSTEM & BEAM TRANSPORT SYSTEM - PSB

VOIR NOTE PS/OP/BR 79.6 VERSION 2 POUR ABREVIATIONS

PS/BR 1029 5/1

FIG_3

FIG. 4 A


TORR
BOOSTER -VPS-1
1E-5
1E-6
1E-7
1E-8
$\bar{P} \approx 2{,}5\,10^{-10}$ torr
1E-9
Moyenne
1E-10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
2L1
5L2

VITESSE DE POMPAGE : 4.4E+02
CHARGE DE GAZ AMONT ; 0.0E+00

FIG. 4 - B

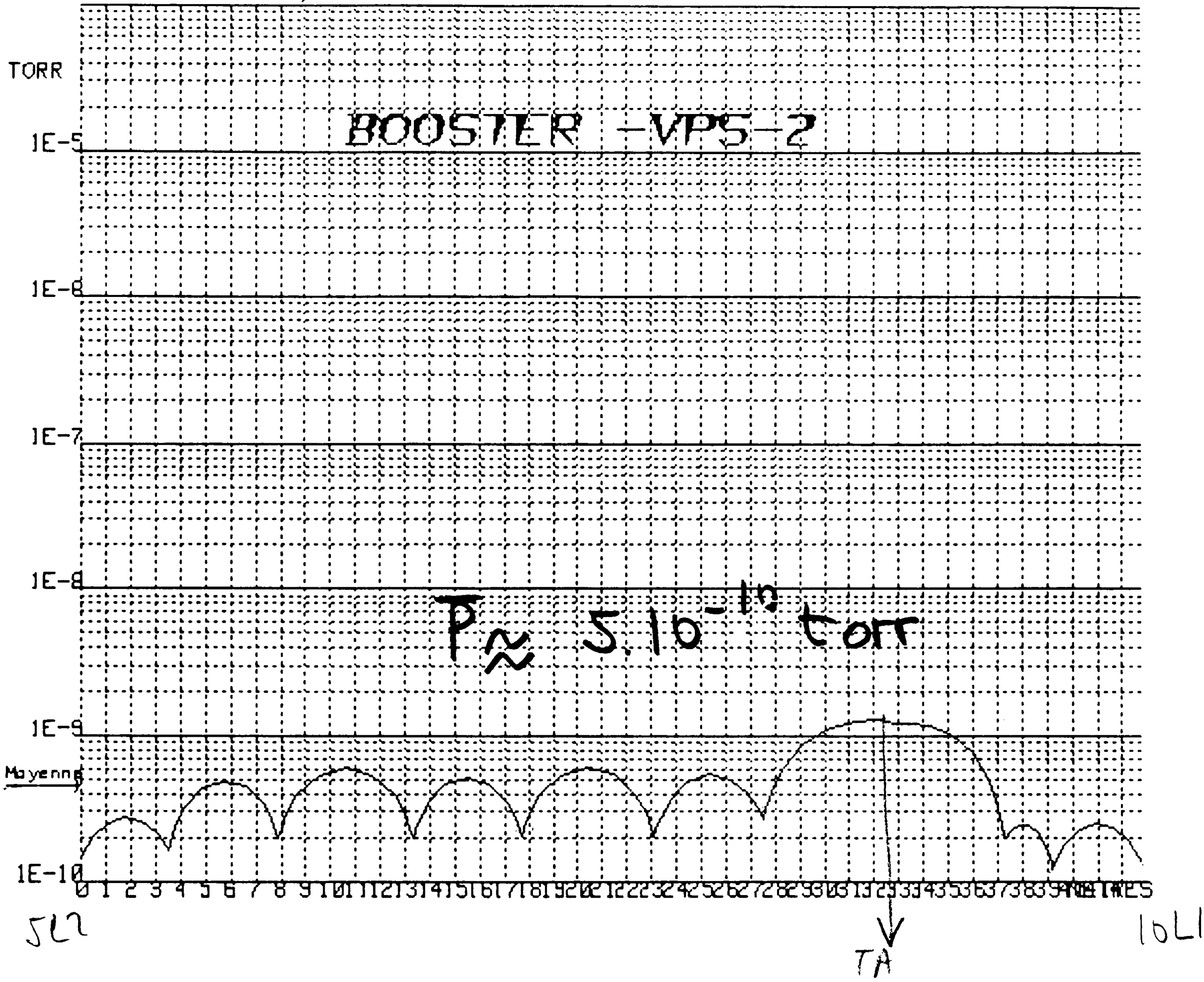
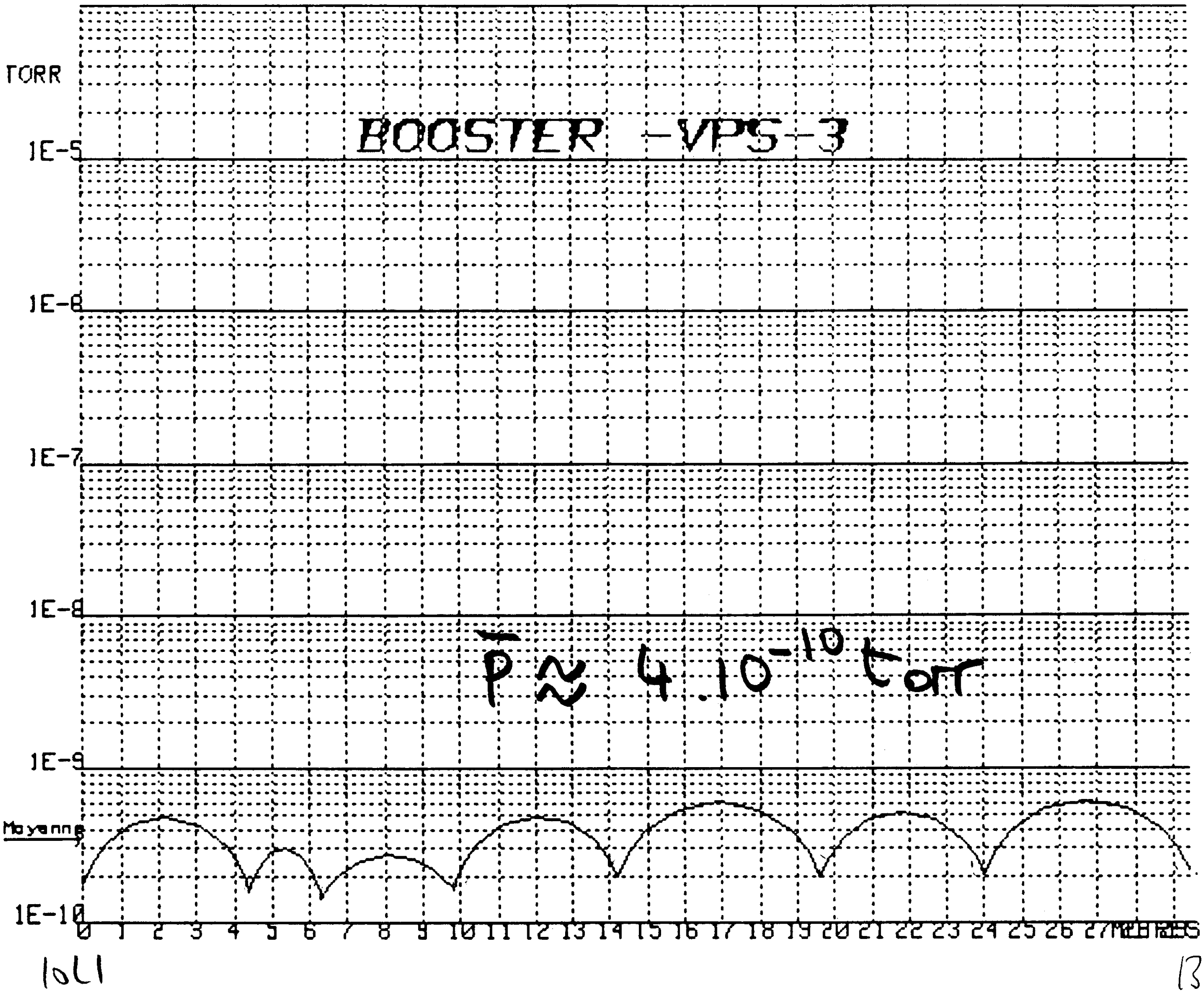
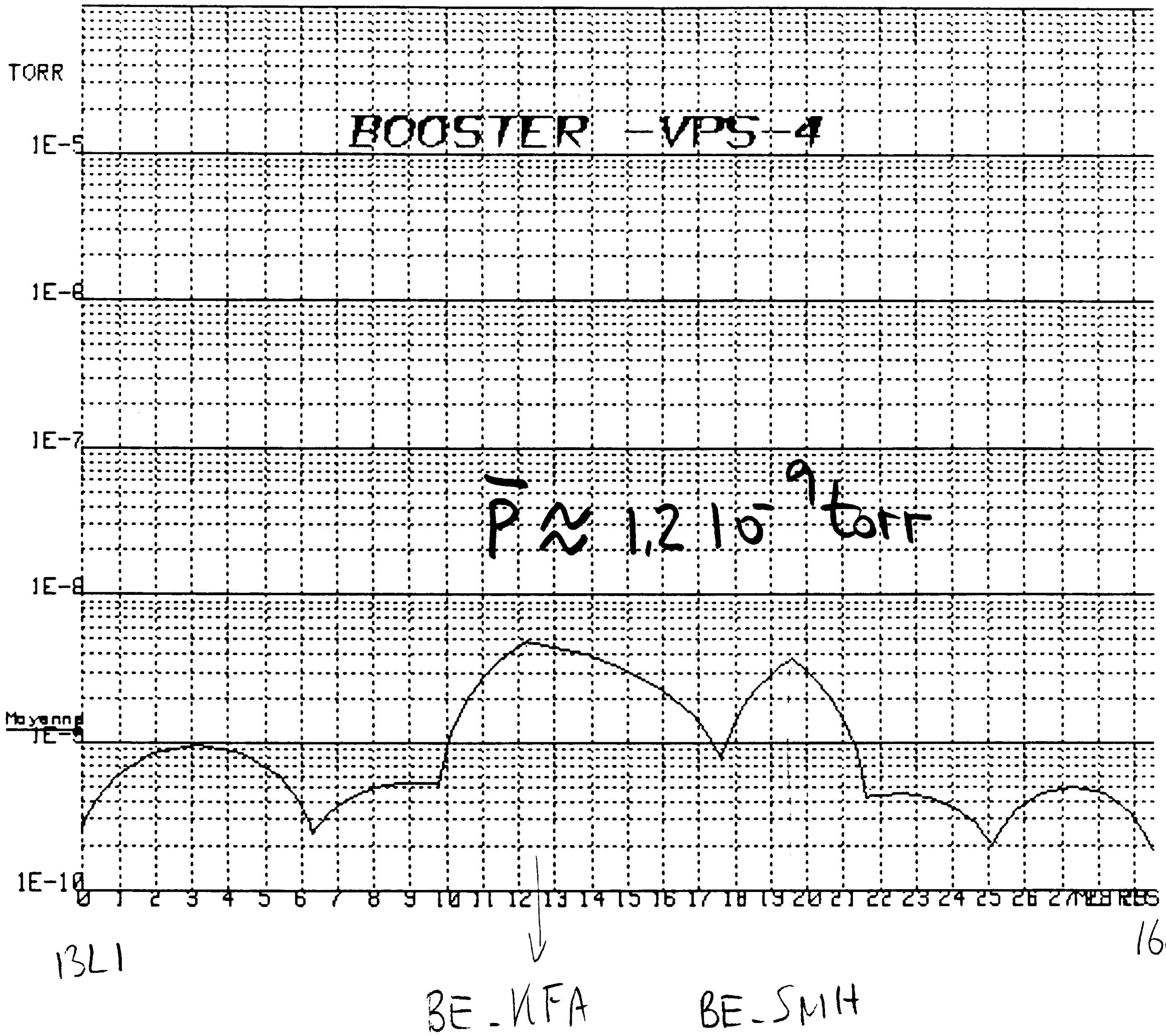


FiG 4. C



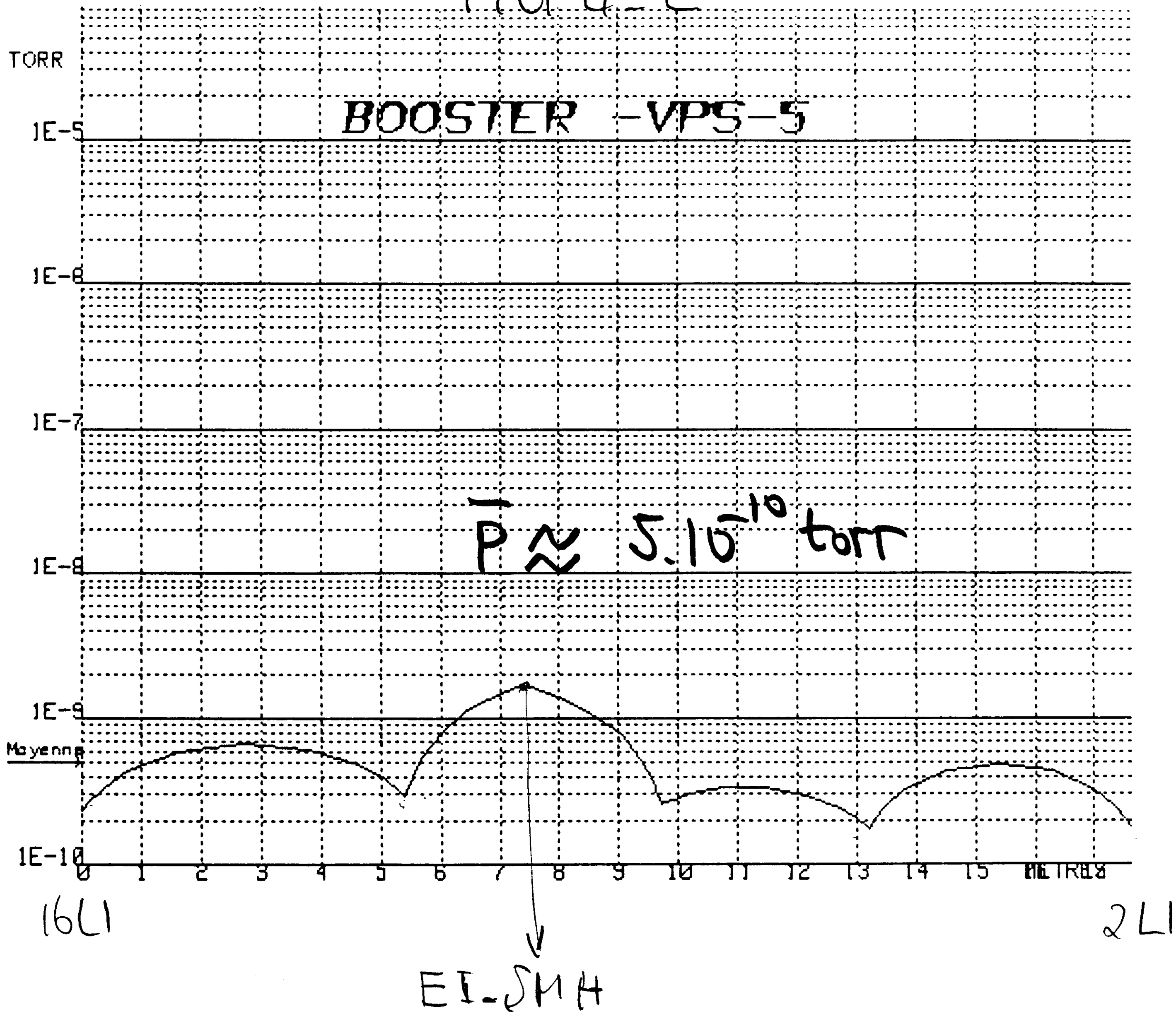
TORR
BOOSTER -VPS-3
1E-5
1E-6
1E-7
1E-8
$\bar{P} \approx 4.10^{-10}$ torr
1E-9
Moyenne
1E-10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
10L1
BL1

Fig 4. D



TORR
BOOSTER -VPS-4
1E-5
1E-6
1E-7
$\bar{P} \approx 1,2\ 10^{-9}$ torr
1E-8
Moyenne
1E-9
1E-10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
13L1
16L1
BE_KFA
BE_SMH

FiG 4_E


TORR
BOOSTER -VPS-5
1E-5
1E-7
1E-8
1E-9
1E-10
Moyenne
P̄ ≈ 5.10⁻¹⁰ torr
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
METRES
16L1
2L1
EI-SMH

Distribution :

M . BOURGEOIS
A . BURLET
B . GAY
M . GIRARDINI
H . HASEROTH
C.E. HILL
P . KHOU
C . LACROIX
H.F. MALTHOUSE
A . PONCET
L . PETTY
P . RIBONI
K . SCHINDL
H . SCHONAUER
M . VAN ROOY